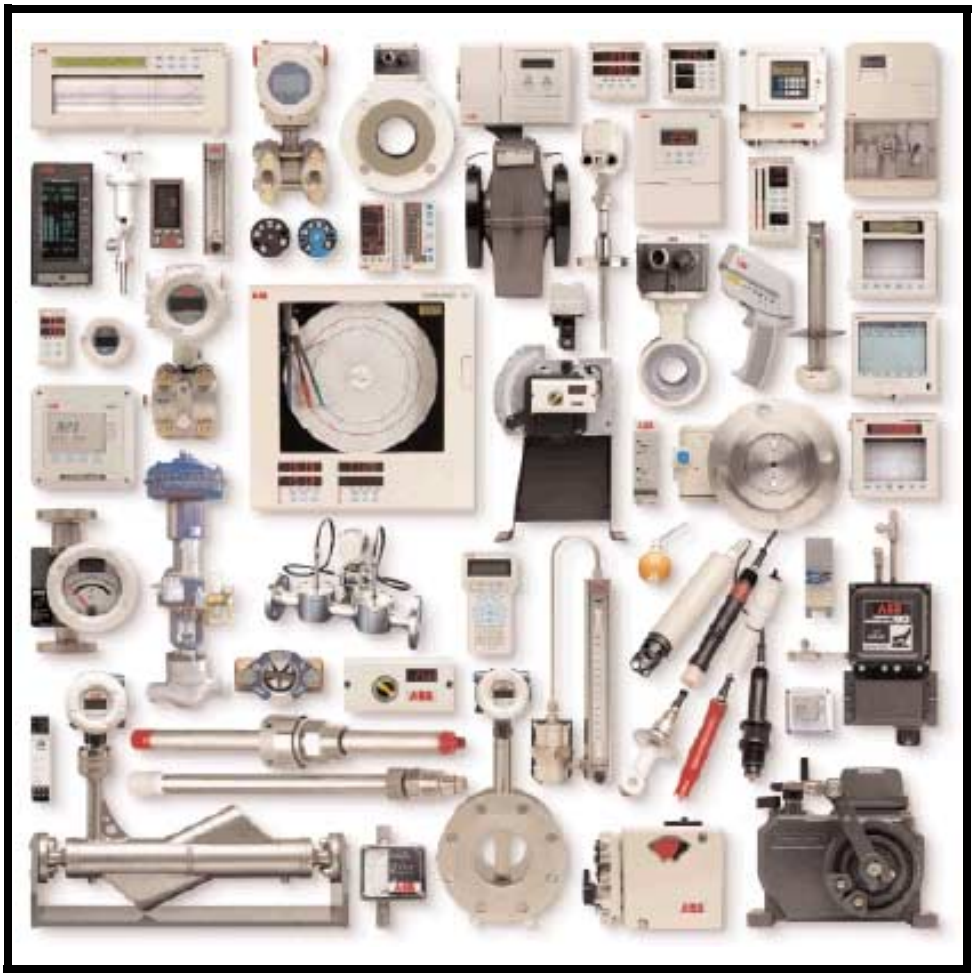
# *INSTRUCTION MANUAL*

## Platinum Standard™ Series HART® Pressure Transmitters

**Type PTHD**



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# Read First

**WARNING**

**INSTRUCTION MANUALS**
**Do not install, maintain or operate this equipment without reading, understanding and following the proper factory-supplied instructions and manuals, otherwise injury or damage may result.**

**RETURN OF EQUIPMENT**
**All equipment being returned to the factory for repair must be free of any hazardous materials (acids, alkalis, solvents, etc.). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact the factory for authorization prior to returning equipment.**

**Read these instructions before starting installation;**
**save these instructions for future reference.**

## Contacting the Factory . . .

Should assistance be required with any of the company's products, contact the following:

**Telephone:**

**24-Hour Call Center**
**1-800-HELP-365**

**E-Mail:**

**ins.techsupport@us.abb.com**

# SECTION 1 - INTRODUCTION

## OVERVIEW

The Type PTHD Platinum Standard HART[1] Pressure Transmitter series (Fig. 1-1) accurately measures absolute, gage or differential pressure, level or flow rate of corrosive and noncorrosive liquids, vapors and gases. The transmitter provides a polled digital (multidrop mode) or a four to 20-milliampere (analog mode) process variable signal.

## INTENDED USER

The information in this instruction is a guide for technical personnel responsible for installing, calibrating, operating, maintaining and repairing the transmitter.

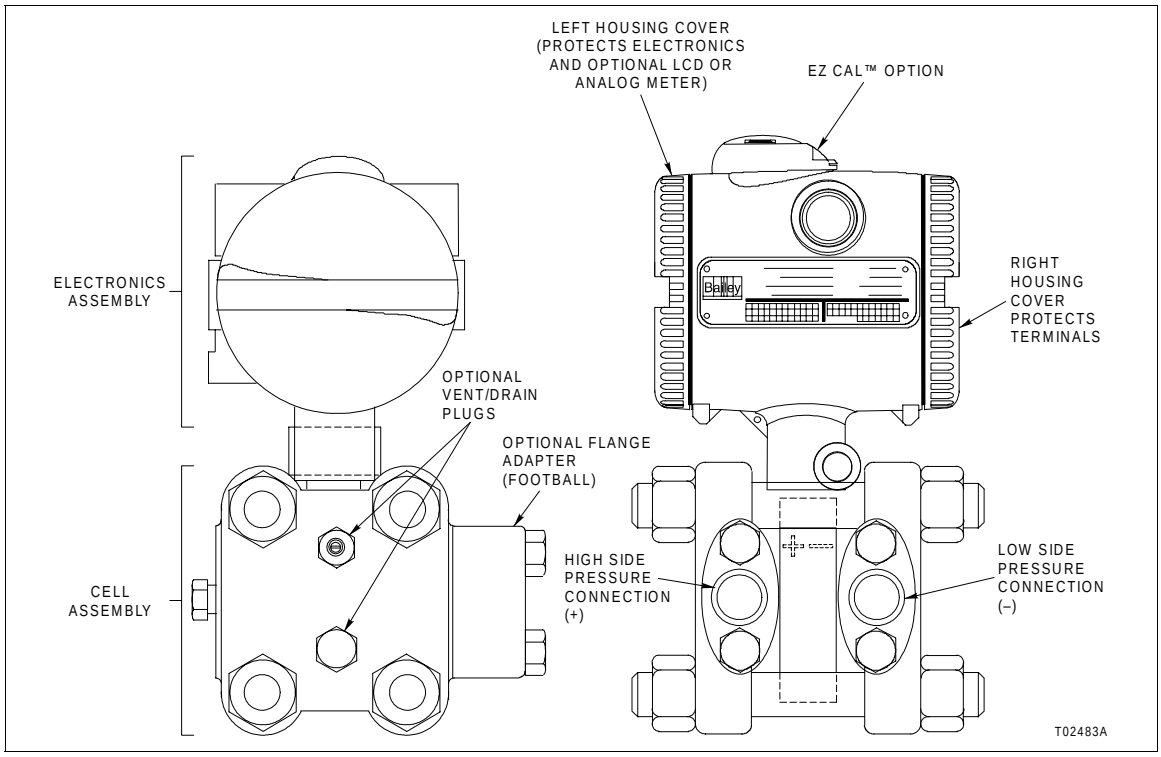



*Figure 1-1. Type PTHD Platinum Standard HART Pressure Transmitter*

1. HART - Highway Addressable Remote Transducer. De facto process control industry standard for field device communications. Controlled by the HART Communication Foundation.

## EQUIPMENT DESCRIPTION

The Type PTHD pressure transmitter consists of a cell with characterization board assembly, and an electronics assembly. The electronics assembly uses the latest microprocessor technology, allowing calibration, operation and troubleshooting from a local or remote location.

Any communication device that supports revision 5.0 or greater of the HART Communication Foundation Specification communicates with the transmitter to program operational parameters, calibrate, check transmitter status and perform other interactions.

The EZ CAL option allows zero and span validation to previously defined pressure values without the use of a communication device.

An optional liquid crystal display (LCD) shows output in percent and user-defined secondary output engineering units, input in primary engineering units, and the cell temperature.

An analog meter is also available. This is recommended if the transmitter will be installed in an environment that takes it beyond the temperature specifications for the LCD (Table 1-3).

## FEATURES

The Type PTHD pressure transmitter has several features and benefits that distinguish it from other pressure transmitters.

***Accurate, Stable and Reproducible Measurements.*** Differential reluctance cell technology provides precise, stable and reproducible pressure measurements.

***Standard Hastelloy® C-276 Wetted Diaphragms.*** Corrosion resistant material reduces stock and minimizes purchase variations.

***Easy Zero and Span Validation.*** Nonintrusive EZ CAL option allows zero and span validation without the use of external communication devices.

***±0.08% Reference Accuracy for Precise Flow Measurements.*** Type PTHDDC pressure transmitter provides optimum performance for the most common flow measurement of 25 kilopascals (100 inches of water).

***Turndown Ratios Ranging from 0.5:1 to 20:1.*** Turndown ratios ranging from 0.5:1, where the calibrated span is actually twice the upper range limit of the transmitter (from minus to plus the upper range limit), to 20:1.

***Remote Communications.*** Communications are possible with any primary or secondary communication device that supports revision 5.0 or greater of the HART Communication Foundation Specification.

***Low Range Differential Pressure Units.*** Increased accuracy at low pressures.

***Optional Two-Line, Seven-Character Liquid Crystal Display.*** Displays user-selected transmitter parameters.

***Advanced Electronics Insures Reliability.*** Amplifier assembly exceeds 50 years mean time between failures (MTBF).

***Dual Cover Housing.*** Shields electronics to insure low susceptibility to radio frequency interference (RFI).

***Reduced Installation and Service Costs.*** Remote communications, modular plug-in electronics, and long-term stability reduce installation and service time.

***Direct Replacement of Existing Analog Two-Wire Transmitters.*** Analog mode transmitters replace most four to 20-milliampere output pressure transmitters that operate over a two-wire system.

***Multidrop Compatibility.*** Overall loop accuracy may be improved by more than three times compared to traditional analog systems.

***Transmitter Diagnostics.*** Performs a series of self-checks, reducing troubleshooting and service time.

***FM and CSA Certifications.*** Explosionproof, nonincendive, dust-ignitionproof, and intrinsically safe (as selected by nomenclature).

## *EQUIPMENT APPLICATION*

Uses for the transmitter include process control applications in the power generation, gas, water, chemical, petroleum, pulp and paper, and food industries.

## *INSTRUCTION CONTENT*

This instruction is organized into eight sections and four appendices.

**Introduction** — Describes this instruction and the transmitter. Includes reference documents, nomenclature, specifications, options and accessories, and the HART command sets.

**Description and Operation** — Describes the functional operation of the transmitter and associated equipment.

**Installation** — Provides procedures for placing the transmitter into service.

**Calibration** — Describes calibration checks and procedures. Also explains the use of the EZ CAL option.

**Troubleshooting** — Lists the general error messages that appear in the event of operating difficulties. There is also a table of output troubleshooting and a troubleshooting flowchart. Additional status codes are located in Appendix C.

**Maintenance** — Provides preventive maintenance schedules and procedures.

**Repair and Replacement Procedures** — Lists procedures for replacing transmitter components.

**Support Services** — Provides spare parts lists and ordering information for replacement parts.

**Quick Reference** — Shows analog mode wiring, multidrop mode wiring, typical calibration setup, lockout jumper position, and an external and mounting dimension diagram.

**HART Commands** — Describes the universal, common practice, and Type PTH transmitter-specific command sets that comply with revision 5.0 or greater of the HART Communication Foundation Specification.

**Additional Status Codes** — Lists the additional status codes that appear if operating difficulties occur.

**Device Description Menu Flow** — Provides a flowchart showing the structure and menu flow of the ABB Type PTH HART Device Description.

> **NOTE:** There are no operating procedures associated with the transmitter itself. Operation is accomplished via the communication device. Refer to Appendix B and the appropriate communication device instruction for detailed information.

## *HOW TO USE THIS INSTRUCTION*

Read this entire instruction through in sequence before attempting to install, calibrate, operate, troubleshoot, service or repair the transmitter. After becoming completely familiar with the transmitter and this instruction, it may be used as a reference.

> **NOTE:** Appendices A, B, C and D are quick reference tools. If desired, remove the appendices and place them in separate notebooks.

Throughout this instruction, the following text conventions generally apply.

*Display Item* — Any item displayed on a screen appears as italic text. Example:

*Running*

**UNIVERSAL COMMAND TEXT** — Indicates commands from the universal command set.

***COMMON PRACTICE COMMAND TEXT*** — Indicates commands from the common practice command set.

*TRANSMITTER -SPECIFIC COMMAND TEXT* — Indicates commands from the Type PTH transmitter-specific command set.

*[Device Description Text]* — Shows the menu flow necessary to perform a specific task. This only applies to users of the Rosemount® Model 275 with the ABB Type PTH HART Device Description loaded.

Example: *[DD: Device setup→Diag/Service→Calibration→Two point calib]*

These menu flows should be used in conjunction with Appendix D.

## *REFERENCE DOCUMENTS*

Table 1-1 lists ABB documents referred to in this instruction.

*Table 1-1. Reference Documents*

| Number | Title |
|---|---|
| B8113038 | Board level wiring diagram |
| C-E21-54-1 | Platinum Standard Series HART Transmitters for Pressure, Flow and Level Measurements, Type PTH Specification |
| D3055060 | Dimension drawing for Type PTHDD differential pressure transmitters |
| D3055061 | Dimension drawing for Types PTHDA (absolute) and PTHDG (gage) pressure transmitters |
| D3055064 | Dimension drawing for optional indicator |
| D3055065 | User field connections |
| I-G18-1 | Instrument Connecting Piping |
| I-G23-1 | Installation of Orifices and Flow Nozzles |
| I-G23-2 | Installation of Holding Ring Type Flow Nozzles |
| I-G23-4 | Installation of Weld-In Type Flow Nozzles |
| P-E21-001 | Installing a 4 to 20 mA Transmitter in a Hazardous Location |
| PN25054 | Type STT04 Smart Transmitter Terminal Instruction |

## *NOMENCLATURE*

The Type PTHD pressure transmitter has 15 nomenclature positions. Positions five through 15 have customer-selectable options. Use Table 1-2 to select or verify transmitter type.

*Table 1-2. Nomenclature*

| Position | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Platinum Standard HART Pressure Transmitter — D Type Cell |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P T H D | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | |

**Measurement application**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Absolute pressure |
| D | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Differential pressure |
| G | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Gage pressure |

**Measurement range**[1]

| | | | | | | | | | | | | Nominal Range | | Minimum Range | | Types |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | kPa | in. $H_2O$/psi | kPa | in. $H_2O$/psi | |
| A | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 0 - 1.5 | 0 - 6 in. $H_2O$ | 0 - 0.1 | 0 - 0.4 in. $H_2O$ | PTHDD |
| B | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 0 - 7.5 | 0 - 30 in. $H_2O$ | 0 - 0.4 | 0 - 1.5 in. $H_2O$ | Not PTHDA |
| C | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 0 - 30 | 0 - 120 in. $H_2O$ | 0 - 1.5 | 0 - 6 in. $H_2O$ | |
| D | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 0 - 90 | 0 - 360 in. $H_2O$ | 0 - 4.5 | 0 - 18 in. $H_2O$ | All |
| F | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 0 - 500 | 0 - 75 psi | 0 - 25 | 0 - 3.8 psi | |
| G | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 0 - 1,800 | 0 - 260 psi | 0 - 90 | 0 - 13 psi | Not PTHDA |
| H | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | 0 - 6,000 | 0 - 900 psi | 0 - 400 | 0 - 60 psi | |

**Diaphragm material and fill fluid**

| | | | | | | | | | | | | Diaphragm Material | Fill Fluid | Types |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Hastelloy C-276 | Silicone oil (ordered most) | All |
| 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Gold plated Hastelloy C-276 | Silicone oil | Not PTHDA or PTHDDA |
| 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Tantalum | | |
| A | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Hastelloy C-276 | Fluorinated oil | All |
| B | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Gold plated Hastelloy C-276 | Fluorinated oil | Not PTHDA or PTHDDA |
| C | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Tantalum | | |
| E | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Hastelloy C-276 | Fluorinated oil - cleaned for oxygen and chlorine service | All |
| F | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Gold plated Hastelloy C-276 | Fluorinated oil - cleaned for oxygen and chlorine service | Not PTHDA or PTHDDA |
| G | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | Tantalum | | |

*Table 1-2. Nomenclature (continued)*

| Position | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Platinum Standard HART Pressure Transmitter — D Type Cell |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | T | H | D | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | |

**High pressure side flange**

| | Material | Purge Valve | Style | Types |
|---|---|---|---|---|
| 2 _ _ _ _ _ _ _ | Stainless steel 316 | Side | North American 7/16 (ordered most) | All |
| 4 _ _ _ _ _ _ _ | Stainless steel 316 | Rear | North American 7/16 (special) | |
| B _ _ _ _ _ _ _ | Hastelloy C-276 | Side | North American 7/16 | |
| D _ _ _ _ _ _ _ | Hastelloy C-276 | Rear | North American 7/16 (special) | |
| N _ _ _ _ _ _ _ | Stainless steel 304 | Remote seal | North American 7/16 | Not PTHDA or PTHDDA |

**Low pressure side flange**

| | Material | Purge Valve | Style | Types |
|---|---|---|---|---|
| 2 _ _ _ _ _ _ | Stainless steel 316 | Side | North American 7/16 (ordered most) | PTHDD |
| 4 _ _ _ _ _ _ | Stainless steel 316 | Rear | North American 7/16 (special) | |
| B _ _ _ _ _ _ | Hastelloy C-276 | Side | North American 7/16 | |
| D _ _ _ _ _ _ | Hastelloy C-276 | Rear | North American 7/16 (special) | |
| N _ _ _ _ _ _ | Stainless steel 304 | Remote seal | North American 7/16 | PTHDD, not PTHDDA |

*Table 1-2. Nomenclature (continued)*

| Position | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P | T | H | D | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |

**Platinum Standard HART Pressure Transmitter — D Type Cell**

**Bolting and O-rings[2]**

| | Bolt Material | Rating[3] kPa | Rating[3] psi | O-Ring Material | Types |
|---|---|---|---|---|---|
| 1 | Carbon steel (ordered most) | 25,000 | 3,625 | Viton® | Note 2 |
| 2 | Stainless steel | 20,000 | 2,900 | | |
| 3 | ASTM A193 B7M: NACE Class 2 | 20,000 | 2,900 | | |
| 4 | Carbon steel | 41,000 | 6,000 | | |
| 5 | Stainless steel | 41,000 | 6,000 | | |
| 6 | ASTM A193 B7M: NACE Class 2 | 41,000 | 6,000 | | |
| A | Carbon steel | 25,000 | 3,625 | Teflon® (PTFE) | Note 2 |
| B | Stainless steel | 20,000 | 2,900 | | |
| C | ASTM A193 B7M: NACE Class 2 | 20,000 | 2,900 | | |
| D | Carbon steel | 41,000 | 6,000 | | |
| E | Stainless steel | 41,000 | 6,000 | | |
| F | ASTM A193 B7M: NACE Class 2 | 41,000 | 6,000 | | |
| M | Carbon steel | 25,000 | 3,625 | Ethylene propylene | Note 2 |
| N | Stainless steel | 20,000 | 2,900 | | |
| P | ASTM A193 B7M: NACE Class 2 | 20,000 | 2,900 | | |
| Q | Carbon steel | 41,000 | 6,000 | | |
| R | Stainless steel | 41,000 | 6,000 | | |
| S | ASTM A193 B7M: NACE Class 2 | 41,000 | 6,000 | | |
| W | Carbon steel | 25,000 | 3,625 | Metal for vacuum service | PTHD___NN[2] |
| X | Stainless steel | 20,000 | 2,900 | | |
| Y | ASTM A193 B7M: NACE Class 2 | 20,000 | 2,900 | | |

*Table 1-2. Nomenclature (continued)*

| Position 5 6 7 8 9 10 11 12 13 14 15 | Platinum Standard HART Pressure Transmitter — D Type Cell |
|---|---|
| P T H D _ _ _ _ _ _ _ _ _ _ _ | |

**Adapters (two for PTHDD) and mounting bracket**

| | Adapters | Mounting Bracket | Types |
|---|---|---|---|
| 0 | None | None | All |
| 1 | None | Zinc plated chromate dipped C steel | |
| 3 | None | Stainless steel 316 | |
| A | ½ NPT stainless steel 316 | None | |
| B | ½ NPT stainless steel 316 | Zinc plated chromate dipped C steel | |
| D | ½ NPT stainless steel 316 | Stainless steel 316 | |
| M | ½ NPT Hast C-276 | None | |
| N | ½ NPT Hast C-276 | Zinc plated chromate dipped C steel | |
| Q | ½ NPT Hast C-276 | Stainless steel 316 | |

**Certifications**

| | |
|---|---|
| 0 | NEMA 4X - ABB standard |
| 1 | NEMA 4X and CENELEC flameproof and intrinsically safe |
| 2 | NEMA 4X and FM and CSA explosionproof and intrinsically safe |

**Housing and electrical connection**

| | Housing | Electrical Connection | Types |
|---|---|---|---|
| 1 | Standard - low Cu light alloy Al | Two ½ NPT with 1 plug | All |
| A | Stainless steel 316 | Two ½ NPT with 1 plug | All[3] |

**Indicator, lightning arrestor and EZ CAL option**

| | Indicator | Lightning Arrestor | EZ CAL Option[3] | Types |
|---|---|---|---|---|
| 0 | Not included | Not included | Not included | All |
| 1 | Not included | Included | Not included | All |
| 3 | Not included | Not included | Included | All[3] |
| 4 | Not included | Included | Included | All[3] |
| A | LCD | Not included | Not included | All |
| B | LCD | Included | Not included | All |
| D | LCD | Not included | Included | All[3] |
| E | LCD | Included | Included | All[3] |
| M | Analog meter | Not included | Not included | All |
| N | Analog meter | Included | Not included | All |
| Q | Analog meter | Not included | Included | All[3] |
| R | Analog meter | Included | Included | All[3] |

*Table 1-2. Nomenclature (continued)*

| Position 5 6 7 8 9 10 11 12 13 14 15<br>P T H D _ _ _ _ _ _ _ _ _ _ _ | Platinum Standard HART Pressure Transmitter — D Type Cell |
|---|---|

**Configuration, tagging and accessories[4]**

| | Configuration | Customer Tagging | Accessories[4] | Types |
|---|---|---|---|---|
| 0 | Standard | Not included | Not included | All |
| 1 | Standard | Riveted stainless steel | Not included | |
| 2 | Standard | Wired stainless steel | Not included | |
| 3 | Standard | Paper | Not included | |
| 4 | Standard | Not included | Included | |
| 5 | Standard | Riveted stainless steel | Included | |
| 6 | Standard | Wired stainless steel | Included | |
| 7 | Standard | Paper | Included | |
| A | Custom | Not included | Not included | All |
| B | Custom | Riveted stainless steel | Not included | |
| C | Custom | Wired stainless steel | Not included | |
| D | Custom | Paper | Not included | |
| E | Custom | Not included | Included | |
| F | Custom | Riveted stainless steel | Included | |
| G | Custom | Wired stainless steel | Included | |
| H | Custom | Paper | Included | |

**NOTES:**

1. Units will be set to the nominal range. Specific customer calibrations are selected in nomenclature position 15. Refer to Table 1-8 for help.
2. Exceptions to the pressure ratings listed are: Type PTHDDA pressure transmitters are 2,000 kPa (300 psi); Types PTHDDH and PTHDGH pressure transmitters are 14,000 kPa (2,000 psi); all transmitters with tantalum diaphragms (3, C or G in nomenclature position 7) are 14,000 kPa (2,000 psi). High static pressure bolting and flanges (4, 5, 6, D, E, F, Q, R or S in nomenclature position 10) are only available for Types PTHDDB/C/D/F/G pressure transmitters, excluding those with tantalum diaphragms.
3. EZ CAL option cannot be used on transmitters with stainless steel housings (A in nomenclature position 13).
4. Typical accessories are mounted remote seals, manifolds, and integral orifice plates.

## SPECIFICATIONS

The specifications are organized into separate tables. First is a list of specifications common to all Type PTHD pressure transmitters. This is followed by specifications unique to each of the three measurement applications (differential, gage and absolute pressure).

### Common Specifications

Tables 1-3 and 1-4 list the specifications common to all Type PTHD pressure transmitters.

*Table 1-3. Common Specifications*

<table>
<tr><th>Property</th><th>Characteristic/Value</th></tr>
<tr><td>Reference conditions<br>Temperature<br>Humidity<br>Barometric pressure</td><td><br>15.0° to 35.5°C (59.0° to 95.9°F)<br>45% to 75%<br>86.0 to 106.0 kPa (12.5 to 15.4 psi)</td></tr>
<tr><td>Temperature limits for electronics, cell and optional liquid crystal display</td><td>
<table>
<tr><th rowspan="2">Parameter</th><th colspan="2">Electronics[1]</th><th colspan="2">Cell[1,2]</th><th colspan="2">LCD[3]</th></tr>
<tr><th>°C</th><th>°F</th><th>°C</th><th>°F</th><th>°C</th><th>°F</th></tr>
<tr><td>Normal op</td><td>-40 to +85</td><td>-40 to +185</td><td>-40 to +85</td><td>-40 to +185</td><td>0 to +50</td><td>+32 to +122</td></tr>
<tr><td>Extreme op</td><td>-50 to +85</td><td>-58 to +185</td><td>-50 to +120</td><td>-58 to +248</td><td>0 to +50</td><td>+32 to +122</td></tr>
<tr><td>Storage/ transport</td><td>-55 to +85</td><td>-67 to +185</td><td>-55 to +85</td><td>-67 to +185</td><td>-20 to +70</td><td>-4 to +158</td></tr>
</table>
</td></tr>
<tr><td>Humidity limits</td><td>5% to 100% noncondensing continuous when the covers are properly installed and the conduit is sealed</td></tr>
<tr><td>Supply voltage[4,5]</td><td>12 to 53 VDC (12 to 42 VDC for CSA certified applications). Installation category III.</td></tr>
<tr><td>Power supply effect</td><td>±0.005% of URL per volt</td></tr>
<tr><td>Output signal<br>Analog<br>Digital</td><td><br>4 to 20 mA<br>HART communications</td></tr>
<tr><td>Output current limiting<br>Maximum<br>Minimum</td><td><br>≥21.6 mA<br>≤3.9 mA</td></tr>
<tr><td>Loop load limits</td><td>Refer to Figure 2-3</td></tr>
<tr><td>Damping/response time (one time constant - approximately 62% of final reading)</td><td>Analog and digital response to a step input change is adjustable from 0.0 to 32.0 secs and is entered during configuration. This value is in addition to:<br>Cell response time: dependent on cell and fill fluid<br>Electronics response time: approximately 0.3 secs</td></tr>
<tr><td>A/D sample rate</td><td>8 times per sec</td></tr>
<tr><td>RFI/EMI effects</td><td>±0.1% of URL in fields from 4 to 1,040 MHz at 10 V/m</td></tr>
<tr><td>Burst</td><td>Complies with IEC 801-4 test criteria</td></tr>
<tr><td>Vibration effect</td><td>±0.1% of URL for 1 g from 1 to 2,000 Hz in any axis of the transmitter</td></tr>
<tr><td>Enclosure rating</td><td>NEMA 4X and IP67</td></tr>
</table>

*Table 1-3. Common Specifications (continued)*

| Property | Characteristic/Value |
|---|---|
| FM and CSA certifications[6,7] | |
| Explosionproof and dust-ignitionproof | Class I, Division 1, Groups B, C and D; Class II, Division 1, Groups E, F and G; Class III |
| Intrinsically safe | Classes I, II and III, Division 1; applicable groups when connected per drawing B222611 |
| Nonincendive | Class I, Division 2, Groups A, B, C and D; Class II, Division 2, Groups E, F and G; Class III |

**NOTES:**
1. The normal operating temperature range is that at which the transmitter meets all specifications. The extreme operating temperature range is that at which the transmitter remains powered without damage.
2. All transmitters with fluorinated oil filled cells can only be operated in temperatures from -10° to +80°C (+14° to +176°F).
3. The normal operating temperature range for the LCD is that at which the LCD remains functional. Exceeding those conditions may cause the LCD to go blank. The transmitter remains functional to its operating limits. When the temperature returns to the acceptable range, the display is restored; however, the life of the display may be reduced.
4. The minimum supply voltage necessary to support communications is 16.6 VDC with a 230-Ω load resistor.
5. Add 0.4 VDC to all minimum supply voltage values if using the lightning arrestor option.
6. Refer to Table 1-4 for the ambient condition limits for certified applications.
7. The transmitters are only certified for those agencies and classes indicated on the certification label. Do not install the transmitters in locations for which they are not suited. Refer to nomenclature position 12.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

*Table 1-4. Ambient Condition Limits for Certified Applications*

| Agency | Category | $T_{max}$ | | $T_{min}$ | | $P_{max}$ | | $P_{min}$ | | $O_{2max}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | °C | °F | °C | °F | kPa | psia | kPa | psia | % |
| FM | Explosionproof | 80 | 176 | -40 | -40 | 108 | 15.7 | 86 | 12.5 | 21 |
| | Dust-ignitionproof | | | | | | | | | |
| | Intrinsic safety | 65 (T4) | 149 (T4) | | | | | | | |
| | Nonincendive | | | | | | | | | |
| CSA | Explosionproof | 60 | 140 | | | | | | | |
| | Dust-ignitionproof | | | | | | | | | |
| | Intrinsic safety | 40 (T3C)<br>60 (T3A) | 104 (T3C)<br>140 (T3A) | | | | | | | |
| | Nonincendive | 60 (T4A) | 140 (T4A) | | | | | | | |

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

### *Type PTHDD Differential Pressure Transmitter Specifications*

Table 1-5 lists the specifications unique to Type PTHDD differential pressure transmitters.

*Table 1-5. Type PTHDD Differential Pressure Transmitter Specifications*

<table>
<tr><th>Property</th><th>Characteristic/Value</th></tr>
<tr><td>Measurement range, turndown ratio, zero suppression and zero elevation</td><td>Lower range value (zero) and upper range value (100%) can be calibrated at any value of pressure, provided that:<br>1. Their algebraic difference (the calibrated span) corresponds to an authorized TDR.<br>2. Both are within the following acceptable limits.<br><br>
<table>
<tr><th rowspan="3">Type</th><th colspan="7">International System Units</th></tr>
<tr><th colspan="2">Range Limits (kPa)</th><th colspan="5">Span and Turndown Ratio (TDR)</th></tr>
<tr><th>Upper</th><th>Lower</th><th colspan="2">Nominal (kPa)</th><th colspan="2">Maximum (kPa)</th><th>Minimum (kPa)</th></tr>
<tr><td>PTHDDA</td><td>1.5</td><td>-1.5</td><td>1.5</td><td>1:1 TDR</td><td>3</td><td>0.5:1 TDR</td><td>0.1 15:1 TDR</td></tr>
<tr><td>PTHDDB</td><td>7.5</td><td>-7.5</td><td>7.5</td><td>1:1 TDR</td><td>15</td><td>0.5:1 TDR</td><td>0.4 20:1 TDR</td></tr>
<tr><td>PTHDDC</td><td>30</td><td>-30</td><td>30</td><td>1:1 TDR</td><td>60</td><td>0.5:1 TDR</td><td>1.5 20:1 TDR</td></tr>
<tr><td>PTHDDD</td><td>90</td><td>-90</td><td>90</td><td>1:1 TDR</td><td>180</td><td>0.5:1 TDR</td><td>4.5 20:1 TDR</td></tr>
<tr><td>PTHDDF</td><td>500</td><td>-500</td><td>500</td><td>1:1 TDR</td><td>1,000</td><td>0.5:1 TDR</td><td>25 20:1 TDR</td></tr>
<tr><td>PTHDDG</td><td>1,800</td><td>-1,800</td><td>1,800</td><td>1:1 TDR</td><td>3,600</td><td>0.5:1 TDR</td><td>90 20:1 TDR</td></tr>
<tr><td>PTHDDH</td><td>6,000</td><td>-6,000</td><td>6,000</td><td>1:1 TDR</td><td>12,000</td><td>0.5:1 TDR</td><td>400 15:1 TDR</td></tr>
</table>
<br>
<table>
<tr><th rowspan="3">Type</th><th colspan="7">American Units</th></tr>
<tr><th colspan="2">Range Limits (in. $H_2O$)</th><th colspan="5">Span and Turndown Ratio (TDR)</th></tr>
<tr><th>Upper</th><th>Lower</th><th colspan="2">Nominal (in. $H_2O$)</th><th colspan="2">Maximum (in. $H_2O$)</th><th>Minimum (in. $H_2O$)</th></tr>
<tr><td>PTHDDA</td><td>6</td><td>-6</td><td>6</td><td>1:1 TDR</td><td>12</td><td>0.5:1 TDR</td><td>0.4 15:1 TDR</td></tr>
<tr><td>PTHDDB</td><td>30</td><td>-30</td><td>30</td><td>1:1 TDR</td><td>60</td><td>0.5:1 TDR</td><td>1.5 20:1 TDR</td></tr>
<tr><td>PTHDDC</td><td>120</td><td>-120</td><td>120</td><td>1:1 TDR</td><td>240</td><td>0.5:1 TDR</td><td>6 20:1 TDR</td></tr>
<tr><td>PTHDDD</td><td>360</td><td>-360</td><td>360</td><td>1:1 TDR</td><td>720</td><td>0.5:1 TDR</td><td>18 20:1 TDR</td></tr>
<tr><td>—</td><td colspan="7">(psi)</td></tr>
<tr><td>PTHDDF</td><td>75</td><td>-75</td><td>75</td><td>1:1 TDR</td><td>150</td><td>0.5:1 TDR</td><td>3.8 20:1 TDR</td></tr>
<tr><td>PTHDDG</td><td>260</td><td>-260</td><td>260</td><td>1:1 TDR</td><td>520</td><td>0.5:1 TDR</td><td>13 20:1 TDR</td></tr>
<tr><td>PTHDDH</td><td>900</td><td>-900</td><td>900</td><td>1:1 TDR</td><td>1,800</td><td>0.5:1 TDR</td><td>60 15:1 TDR</td></tr>
</table>
</td></tr>
</table>

*Table 1-5. Type PTHDD Differential Pressure Transmitter Specifications (continued)*

<table>
<tr><th>Property</th><th>Characteristic/Value</th></tr>
<tr><td>Reference accuracy - per IEC 770 and SAMA PMC 31.1<br><br>All reference accuracy values are for transmitters with zero based spans, silicone oil fill and Hastelloy C-276 isolating diaphragms at a reference temperature of 25°C (77°F).</td><td>The reference accuracy includes the effects of linearity, hysteresis, repeatability and deadband. The value listed may vary depending on the URL and calibrated span of the particular transmitter. To determine the accuracy of a transmitter:<br><br>RA or $\frac{CF \times URL}{Span}$ whichever is greater, where RA = reference accuracy at 1:1 TDR and CF = compensation factor due to TDR.
<table>
<tr><th rowspan="2">Type</th><th colspan="2">URL</th><th>RA</th><th>CF</th></tr>
<tr><th>(kPa)</th><th>(in. $H_2O$)</th><th>(% of Span)</th><th>(% of Span)</th></tr>
<tr><td>PTHDDA</td><td>1.5</td><td>6</td><td>±0.20</td><td>±0.032</td></tr>
<tr><td>PTHDDB</td><td>7.5</td><td>30</td><td>±0.10</td><td>±0.020</td></tr>
<tr><td>PTHDDC</td><td>30</td><td>120</td><td>±0.08</td><td>±0.012</td></tr>
<tr><td>PTHDDD</td><td>90</td><td>360</td><td>±0.10</td><td>±0.012</td></tr>
<tr><td>—</td><td>(kPa)</td><td>(psi)</td><td></td><td></td></tr>
<tr><td>PTHDDF</td><td>500</td><td>75</td><td>±0.10</td><td>±0.016</td></tr>
<tr><td>PTHDDG</td><td>1,800</td><td>260</td><td>±0.10</td><td>±0.016</td></tr>
<tr><td>PTHDDH</td><td>6,000</td><td>900</td><td>±0.20</td><td>±0.020</td></tr>
</table></td></tr>
<tr><td>Stability per 12-month period</td><td>±0.1% of URL (±0.2% of URL for Type PTHDDA pressure transmitter) at reference conditions</td></tr>
<tr><td>Static pressure and overpressure limits<br><br>NOTE: The maximum static pressure and overpressure for transmitters with tantalum diaphragms (3, C or G in nomenclature position 7) is 14,000 kPa (2,000 psi).</td><td>The minimum static pressure for all types is 3.4 kPa absolute (14.0 in. $H_2O$ absolute or 0.5 psia). The maximum static pressure is listed in the following table.
<table>
<tr><th rowspan="3">Type</th><th colspan="2" rowspan="2">URL</th><th colspan="6">Pressure Rating/Bolting</th></tr>
<tr><th colspan="2">Carbon Steel</th><th colspan="2">Stainless Steel and NACE</th><th colspan="2">High Static Pressure</th></tr>
<tr><th>(kPa)</th><th>(in. $H_2O$)</th><th>(kPa)</th><th>(psi)</th><th>(kPa)</th><th>(psi)</th><th>(kPa)</th><th>(psi)</th></tr>
<tr><td>PTHDDA</td><td>1.5</td><td>6</td><td>2,000</td><td>300</td><td>2,000</td><td>300</td><td>N/A</td><td>N/A</td></tr>
<tr><td>PTHDDB</td><td>7.5</td><td>30</td><td>25,000</td><td>3,625</td><td>20,000</td><td>2,900</td><td>41,000</td><td>6,000</td></tr>
<tr><td>PTHDDC</td><td>30</td><td>120</td><td>25,000</td><td>3,625</td><td>20,000</td><td>2,900</td><td>41,000</td><td>6,000</td></tr>
<tr><td>PTHDDD</td><td>90</td><td>360</td><td>25,000</td><td>3,625</td><td>20,000</td><td>2,900</td><td>41,000</td><td>6,000</td></tr>
<tr><td>—</td><td>(kPa)</td><td>(psi)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PTHDDF</td><td>500</td><td>75</td><td>25,000</td><td>3,625</td><td>20,000</td><td>2,900</td><td>41,000</td><td>6,000</td></tr>
<tr><td>PTHDDG</td><td>1,800</td><td>260</td><td>25,000</td><td>3,625</td><td>20,000</td><td>2,900</td><td>41,000</td><td>6,000</td></tr>
<tr><td>PTHDDH</td><td>6,000</td><td>900</td><td>14,000</td><td>2,000</td><td>14,000</td><td>2,000</td><td>N/A</td><td>N/A</td></tr>
</table></td></tr>
<tr><td>Static pressure effect on zero and span<br><br>These values are for transmitters with zero based spans, silicone oil fill and Hastelloy C-276 isolating diaphragms at a reference temperature of 25°C (77°F).<br><br>NOTE: Zero effect can be calibrated out at line pressure.</td><td>The values listed for Type PTHDDA pressure transmitters are for a variation of 1,000 kPa (150 psi) for line pressures between 0 and 2,000 kPa (0 and 300 psi).<br><br>The values listed for all other types are for a variation of 7,000 kPa (1,000 psi) for line pressures between 0 and 14,000 kPa (0 and 2,000 psi).
<table>
<tr><th rowspan="2">Type</th><th colspan="2">URL</th><th>Zero Effect</th><th>Span Effect</th></tr>
<tr><th>(kPa)</th><th>(in. $H_2O$)</th><th>(% of URL)</th><th>(% of Reading)</th></tr>
<tr><td>PTHDDA</td><td>1.5</td><td>6</td><td>±0.20</td><td>±0.10</td></tr>
<tr><td>PTHDDB</td><td>7.5</td><td>30</td><td>±0.30</td><td>±0.25</td></tr>
<tr><td>PTHDDC</td><td>30</td><td>120</td><td>±0.20</td><td>±0.25</td></tr>
<tr><td>PTHDDD</td><td>90</td><td>360</td><td>±0.20</td><td>±0.25</td></tr>
<tr><td>—</td><td>(kPa)</td><td>(psi)</td><td></td><td></td></tr>
<tr><td>PTHDDF</td><td>500</td><td>75</td><td>±0.30</td><td>±0.75</td></tr>
<tr><td>PTHDDG</td><td>1,800</td><td>260</td><td>±0.30</td><td>±0.75</td></tr>
<tr><td>PTHDDH</td><td>6,000</td><td>900</td><td>±0.30</td><td>±0.50</td></tr>
</table></td></tr>
</table>

*Table 1-5. Type PTHDD Differential Pressure Transmitter Specifications (continued)*

<table>
<tr><th>Property</th><th>Characteristic/Value</th></tr>
<tr><td>Ambient temperature effect on zero and span<br><br>These values are for transmitters with zero based spans, silicone oil fill and Hastelloy C-276 isolating diaphragms.</td><td>The effects listed are for a variation of ±25°C (±45°F) from a calibration done at a temperature between -30° and +80°C (-22° and +176°F), as long as the variation does not take the transmitter out of the temperature specifications listed in Table 1-3.
<table>
<tr><th rowspan="2">Type</th><th colspan="2">URL</th><th rowspan="2">Total Effect</th></tr>
<tr><th>(kPa)</th><th>(in. $H_2O$)</th></tr>
<tr><td>PTHDDA</td><td>1.5</td><td>6</td><td>±(0.15% URL + 0.30% span)</td></tr>
<tr><td>PTHDDB</td><td>7.5</td><td>30</td><td>±(0.10% URL + 0.15% span)</td></tr>
<tr><td>PTHDDC</td><td>30</td><td>120</td><td>±(0.06% URL + 0.13% span)</td></tr>
<tr><td>PTHDDD</td><td>90</td><td>360</td><td>±(0.08% URL + 0.13% span)</td></tr>
<tr><td>—</td><td>(kPa)</td><td>(psi)</td><td></td></tr>
<tr><td>PTHDDF</td><td>500</td><td>75</td><td>±(0.10% URL + 0.15% span)</td></tr>
<tr><td>PTHDDG</td><td>1,800</td><td>260</td><td>±(0.10% URL + 0.15% span)</td></tr>
<tr><td>PTHDDH</td><td>6,000</td><td>900</td><td>±(0.15% URL + 0.25% span)</td></tr>
</table></td></tr>
<tr><td>Weight</td><td>4.3 kg (9.5 lbs) without options or accessories.</td></tr>
</table>

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

### *Type PTHDG Gage Pressure Transmitter Specifications*

Table 1-6 lists the specifications unique to Type PTHDG gage pressure transmitters.

*Table 1-6. Type PTHDG Gage Pressure Transmitter Specifications*

<table>
<tr><th>Property</th><th>Characteristic/Value</th></tr>
<tr><td>Measurement range, turndown ratio, zero suppression and zero elevation</td><td>Lower range value (zero) and upper range value (100%) can be calibrated at any value of pressure, provided that:<br>1. Their algebraic difference (the calibrated span) corresponds to an authorized TDR.<br>2. Both are within the following acceptable limits.
<table>
<tr><th rowspan="3">Type</th><th colspan="6">International System Units</th></tr>
<tr><th colspan="2">Range Limits (kPa)</th><th colspan="4">Span and Turndown Ratio (TDR)</th></tr>
<tr><th>Upper</th><th>Lower</th><th colspan="2">Nominal (kPa)</th><th colspan="2">Minimum (kPa)</th></tr>
<tr><td>PTHDGB</td><td>7.5</td><td>-7.5</td><td>7.5</td><td>1:1 TDR</td><td>0.4</td><td>20:1 TDR</td></tr>
<tr><td>PTHDGC</td><td>30</td><td>-30</td><td>30</td><td>1:1 TDR</td><td>1.5</td><td>20:1 TDR</td></tr>
<tr><td>PTHDGD</td><td>90</td><td>-90</td><td>90</td><td>1:1 TDR</td><td>4.5</td><td>20:1 TDR</td></tr>
<tr><td>PTHDGF</td><td>500</td><td>-100</td><td>500</td><td>1:1 TDR</td><td>25</td><td>20:1 TDR</td></tr>
<tr><td>PTHDGG</td><td>1,800</td><td>-100</td><td>1,800</td><td>1:1 TDR</td><td>90</td><td>20:1 TDR</td></tr>
<tr><td>PTHDGH</td><td>6,000</td><td>-100</td><td>6,000</td><td>1:1 TDR</td><td>400</td><td>15:1 TDR</td></tr>
</table>
<table>
<tr><th rowspan="3">Type</th><th colspan="6">American Units</th></tr>
<tr><th colspan="2">Range Limits (in. $H_2O$)</th><th colspan="4">Span and Turndown Ratio (TDR)</th></tr>
<tr><th>Upper</th><th>Lower</th><th colspan="2">Nominal (in. $H_2O$)</th><th colspan="2">Minimum (in. $H_2O$)</th></tr>
<tr><td>PTHDGB</td><td>30</td><td>-30</td><td>30</td><td>1:1 TDR</td><td>1.5</td><td>20:1 TDR</td></tr>
<tr><td>PTHDGC</td><td>120</td><td>-120</td><td>120</td><td>1:1 TDR</td><td>6</td><td>20:1 TDR</td></tr>
<tr><td>PTHDGD</td><td>360</td><td>-360</td><td>360</td><td>1:1 TDR</td><td>18</td><td>20:1 TDR</td></tr>
<tr><td>—</td><td colspan="6">(psi)</td></tr>
<tr><td>PTHDGF</td><td>75</td><td>-14</td><td>75</td><td>1:1 TDR</td><td>3.8</td><td>20:1 TDR</td></tr>
<tr><td>PTHDGG</td><td>260</td><td>-14</td><td>260</td><td>1:1 TDR</td><td>13</td><td>20:1 TDR</td></tr>
<tr><td>PTHDGH</td><td>900</td><td>-14</td><td>900</td><td>1:1 TDR</td><td>60</td><td>15:1 TDR</td></tr>
</table>
</td></tr>
</table>

*Table 1-6. Type PTHDG Gage Pressure Transmitter Specifications (continued)*

<table>
<tr><th>Property</th><th>Characteristic/Value</th></tr>
<tr><td>Reference accuracy - per IEC 770 and SAMA PMC 31.1<br><br>All reference accuracy values are for transmitters with zero based spans, silicone oil fill and Hastelloy C-276 isolating diaphragms at a reference temperature of 25°C (77°F).</td><td>The reference accuracy includes the effects of linearity, hysteresis, repeatability and deadband. The value listed may vary depending on the URL and calibrated span of the particular transmitter. To determine the accuracy of a transmitter:<br><br>RA or $\frac{CF \times URL}{Span}$ whichever is greater, where RA = reference accuracy at 1:1 TDR and CF = compensation factor due to TDR.
<table>
<tr><th rowspan="2">Type</th><th colspan="2">URL</th><th>RA</th><th>CF</th></tr>
<tr><th>(kPa)</th><th>(in. $H_2O$)</th><th>(% of Span)</th><th>(% of Span)</th></tr>
<tr><td>PTHDGB</td><td>7.5</td><td>30</td><td>±0.10</td><td>±0.020</td></tr>
<tr><td>PTHDGC</td><td>30</td><td>120</td><td>±0.10</td><td>±0.012</td></tr>
<tr><td>PTHDGD</td><td>90</td><td>360</td><td>±0.10</td><td>±0.012</td></tr>
<tr><td>—</td><td>(kPa)</td><td>(psi)</td><td></td><td></td></tr>
<tr><td>PTHDGF</td><td>500</td><td>75</td><td>±0.10</td><td>±0.016</td></tr>
<tr><td>PTHDGG</td><td>1,800</td><td>260</td><td>±0.10</td><td>±0.016</td></tr>
<tr><td>PTHDGH</td><td>6,000</td><td>900</td><td>±0.20</td><td>±0.020</td></tr>
</table></td></tr>
<tr><td>Stability per 12-month period</td><td>±0.1% of URL at reference conditions.</td></tr>
<tr><td>Pressure limits<br><br>Carbon steel<br><br>Stainless steel and NACE</td><td>Minimum pressure for all types is 3.4 kPa absolute (14.0 in. $H_2O$ absolute or 0.5 psia). The maximum overpressure depends on the type of bolting used to maintain the transmitter flanges.<br><br>NOTE: Maximum overpressure for transmitters with tantalum diaphragms (3, C or G in nomenclature position 7) is 14,000 kPa (2,000 psi).<br><br>25,000 kPa (3,625 psi) for all but PTHDGH with a limit of 14,000 kPa (2,000 psi).<br><br>20,000 kPa (2,900 psi) for all but PTHDGH with a limit of 14,000 kPa (2,000 psi).</td></tr>
<tr><td>Ambient temperature effect on zero and span<br><br>These values are for transmitters with zero based spans, silicone oil fill and Hastelloy C-276 isolating diaphragms.</td><td>The effects listed are for a variation of ±25°C (±45°F) from a calibration done at a temperature between -30° and +80°C (-22° and +176°F), as long as the variation does not take the transmitter out of the temperature specifications listed in Table 1-3.
<table>
<tr><th rowspan="2">Type</th><th colspan="2">URL</th><th rowspan="2">Total Effect</th></tr>
<tr><th>(kPa)</th><th>(in. $H_2O$)</th></tr>
<tr><td>PTHDGB</td><td>7.5</td><td>30</td><td>±(0.10% URL + 0.15% span)</td></tr>
<tr><td>PTHDGC</td><td>30</td><td>120</td><td>±(0.06% URL + 0.13% span)</td></tr>
<tr><td>PTHDGD</td><td>90</td><td>360</td><td>±(0.08% URL + 0.13% span)</td></tr>
<tr><td>—</td><td>(kPa)</td><td>(psi)</td><td></td></tr>
<tr><td>PTHDGF</td><td>500</td><td>75</td><td>±(0.10% URL + 0.15% span)</td></tr>
<tr><td>PTHDGG</td><td>1,800</td><td>260</td><td>±(0.10% URL + 0.15% span)</td></tr>
<tr><td>PTHDGH</td><td>6,000</td><td>900</td><td>±(0.15% URL + 0.25% span)</td></tr>
</table></td></tr>
<tr><td>Weight</td><td>4.3 kg (9.5 lbs) without options or accessories.</td></tr>
</table>

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

### *Type PTHDA Absolute Pressure Transmitter Specifications*

Table 1-7 lists the specifications unique to Type PTHDA absolute pressure transmitters.

*Table 1-7. Type PTHDA Absolute Pressure Transmitter Specifications*

<table>
<tr><th>Property</th><th>Characteristic/Value</th></tr>
<tr><td>Measurement range, turndown ratio, zero suppression and zero elevation</td><td>Lower range value (zero) and upper range value (100%) can be calibrated at any value of pressure, provided that:<br>1. Their algebraic difference (the calibrated span) corresponds to an authorized TDR.<br>2. Both are within the following acceptable limits.
<table>
<tr><th rowspan="3">Type</th><th colspan="6">International System Units</th></tr>
<tr><th colspan="2">Range Limits (kPa)</th><th colspan="4">Span and Turndown Ratio (TDR)</th></tr>
<tr><th>Upper</th><th>Lower</th><th colspan="2">Nominal (kPa)</th><th colspan="2">Minimum (kPa)</th></tr>
<tr><td>PTHDAD</td><td>90</td><td>0</td><td>90</td><td>1:1 TDR</td><td>4.5</td><td>20:1 TDR</td></tr>
<tr><td>PTHDAF</td><td>500</td><td>0</td><td>500</td><td>1:1 TDR</td><td>25</td><td>20:1 TDR</td></tr>
</table>
<table>
<tr><th rowspan="3">Type</th><th colspan="6">American Units</th></tr>
<tr><th colspan="2">Range Limits (in. $H_2O$)</th><th colspan="4">Span and Turndown Ratio (TDR)</th></tr>
<tr><th>Upper</th><th>Lower</th><th colspan="2">Nominal (in. $H_2O$)</th><th colspan="2">Minimum (in. $H_2O$)</th></tr>
<tr><td>PTHDAD</td><td>360</td><td>0</td><td>360</td><td>1:1 TDR</td><td>18</td><td>20:1 TDR</td></tr>
<tr><td>—</td><td colspan="6">(psia)</td></tr>
<tr><td>PTHDAF</td><td>75</td><td>0</td><td>75</td><td>1:1 TDR</td><td>3.8</td><td>20:1 TDR</td></tr>
</table></td></tr>
<tr><td>Reference accuracy - per IEC 770 and SAMA PMC 31.1</td><td>This value is for transmitters with zero based spans, silicone oil fill and Hastelloy C-276 isolating diaphragms at a reference temperature of 25°C (77°F). The reference accuracy includes the effects of linearity, hysteresis, repeatability and deadband.<br><br>$\pm 0.20\%$ of span or $\pm \frac{0.016 \times URL}{Span}$ (% of span), whichever is greater.</td></tr>
<tr><td>Stability per 12-month period</td><td>±0.2% of URL at reference conditions.</td></tr>
<tr><td>Pressure limits<br><br>Carbon steel<br>Stainless steel and NACE</td><td>The minimum pressure for all types is 3.4 kPa absolute (14.0 in. $H_2O$ absolute or 0.5 psia). The maximum overpressure depends on the type of bolting used to maintain the transmitter flanges.<br><br>25,000 kPa (3,625 psi)<br>20,000 kPa (2,900 psi)</td></tr>
<tr><td>Ambient temperature effect on zero and span</td><td>This value is for transmitters with zero based spans, silicone oil fill and Hastelloy C-276 isolating diaphragms. The effects listed are for a variation of ±25°C (±45°F) from a calibration done at a temperature between -30° and +80°C (-22° and +176°F), as long as the variation does not take the transmitter out of the temperature specifications listed in Table 1-3.<br><br>±(0.10% URL + 0.15% span)</td></tr>
<tr><td>Weight</td><td>4.3 kg (9.5 lbs) without options or accessories</td></tr>
</table>

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

## OPTIONS AND ACCESSORIES

Table 1-8 lists and describes the options and accessories available with the Type PTHD pressure transmitter.

*Table 1-8. Options and Accessories*

| Item | Description |
|---|---|
| EZ CAL option[1] | External nonintrusive device for zero and span validation. Add on kit no. 258562_1. |
| Liquid crystal display option[1] | Two-line seven-character display for local output indication. Displays output in percent and user-defined secondary output engineering units, input in primary engineering units, and the cell temperature. Mounts in four orientations for easy viewing. Refer to Table 1-3 for the temperature limitations. Add on kit no. 258550_1 (aluminum cover) or 258550_5 (stainless steel cover). |
| Analog meter option[1] | Provides local output indication for those applications where the transmitter operates outside the temperature limits of the LCD. Linear 0 to 100 and square root 0 to 10 graduations on same scale. Add on kit no. 258550_2 (aluminum cover) or 258550_6 (stainless steel cover). |
| Flange adapter option[1] | ½ NPT stainless steel 316 or Hastelloy C-276 (football style). Part no. 258558_ _. |
| Mounting bracket option[1] | Universal support for mounting on panel or 1.5 in. to 2.0-in. pipe. Available in zinc-plated, chromate-dipped carbon steel or stainless steel 316. |
| Degreasing option[1] | For use in oxygen or chlorine service. |
| Gold plated Hastelloy C-276 diaphragm option[1] | For use in hydrogen service. |
| Manifolds | Carbon steel or stainless steel 316 manifolds that attach directly to the transmitter in place of flange adapters. Manifolds are shipped assembled or unassembled to transmitter. |
| Tantalum diaphragm option[1] | For use with highly corrosive fluids. |
| Remote diaphragm seals option[1] | For use with high temperature and corrosive fluids or where impulse line clogging may be a problem. |
| Lightning arrestor option[1] | Mounts internally to suppress lightning induced transients. Tested to suppress 10 successive 8 by 20 µsec pulses with a peak value of 20 kA (reference IEEE C62.41). |
| Antistatic kit | Contains static-dissipative work surface (mat), ground cord assembly, wrist bands, and alligator clip for personnel working on devices containing semiconductor components. Kit no. 1948385_1. |
| Available drawings | |
| B8113038 | Board level wiring diagram. |
| D3055060 | Dimension drawing for Type PTHDD differential pressure transmitters. |
| D3055061 | Dimension drawing for Types PTHDA (absolute) and PTHDG (gage) pressure transmitters. |
| D3055064 | Dimension drawing for optional indicator. |
| D3055065 | User field connections. |

*Table 1-8. Options and Accessories (continued)*

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Configuration option[1]</td><td>The transmitters are delivered with a standard configuration. Custom configurations can be ordered by selecting that option in nomenclature position 15. The factory programmed configuration is listed below, as well as a column to aid in ordering custom configurations.
<table>
<tr><th>Parameter</th><th>Standard Configuration</th><th>Custom Configuration</th></tr>
<tr><td>ID tag</td><td>PTH</td><td></td></tr>
<tr><td>Operating mode</td><td>Analog</td><td></td></tr>
<tr><td>Output function</td><td>Linear - normal acting</td><td></td></tr>
<tr><td>Damping</td><td>0.5 sec</td><td></td></tr>
<tr><td>EU</td><td>in. $H_2O$ or psi</td><td></td></tr>
<tr><td>PV lower value</td><td>0.0</td><td></td></tr>
<tr><td>PV upper value</td><td>URL of transmitter</td><td></td></tr>
<tr><td>Initialize output</td><td>Low</td><td></td></tr>
<tr><td>Fail output</td><td>Low</td><td></td></tr>
<tr><td>Secondary output EU</td><td>..MA</td><td></td></tr>
<tr><td>Secondary output LRL</td><td>4.00</td><td></td></tr>
<tr><td>Secondary output URL</td><td>20.00</td><td></td></tr>
<tr><td>Cell temp. low alarm</td><td>-40°C</td><td></td></tr>
<tr><td>Cell temp. high alarm</td><td>85°C</td><td></td></tr>
<tr><td>Message</td><td>(left blank)</td><td></td></tr>
<tr><td>Descriptor</td><td>(left blank)</td><td></td></tr>
<tr><td>Date</td><td>Date of manufacture</td><td></td></tr>
<tr><td>Final assembly number</td><td>0</td><td></td></tr>
<tr><td>No. of response preambles</td><td>5</td><td></td></tr>
</table>
</td></tr>
</table>

**NOTE:**
1. These items are selected via nomenclature in Table 1-2.

## *HART COMMAND SETS*

ABB has confirmed operational compatibility of the Type PTHD pressure transmitter with the communication devices and their respective software revision levels as listed in Table 1-9. All software revisions for the Type STT04 Smart Transmitter Terminal are compatible. The operational compatibility of any other device or any other revision of software with the Type PTHD pressure transmitter is the responsibility of the user.

Table 1-9 is organized in command number order. The universal command set includes commands zero through 19, the common practice command set includes commands 34 through 59, and the Type PTH transmitter-specific command set includes commands 128 through 145. Table 1-9 lists only the commands that are supported by the Type PTHD pressure transmitter. Columns four through seven indicate, by the presence of an X, which communication devices support each command.

*Table 1-9. HART Commands (HART Communication Foundation Specification Revision 5.0 or Greater)*

| Command Set | Command No. | Command | Communication Device | | | |
|---|---|---|---|---|---|---|
| | | | Elsag Baile STT04 | Baile-FP 53MC5000[1] | MTL® 611[2] | Rosemount 275[3] |
| Universal | 0 | Read unique identifier | X | X | X | X |
| | 1 | Read PV | X | X | X | X |
| | 2 | Read PV current and percent of range | X | — | — | X |
| | 3 | Read dynamic variables and PV current | X | X | X | X[4] |
| | 6 | Write polling address | X | — | X | X |
| | 11 | Read unique identifier associated with tag | — | — | — | — |
| | 12 | Read message | X | X | X | X |
| | 13 | Read tag, descriptor, date | X | X | X | X |
| | 14 | Read PV sensor info | X | — | X | X |
| | 15 | Read PV output info | X | X | X | X |
| | 16 | Read final assembly number | X | — | X | X |
| | 17 | Write message | X | X | X | X |
| | 18 | Write tag, descriptor, date | X | X | X | X |
| | 19 | Write final assembly number | X | — | — | X |
| Common Practice | 34 | Write PV damping value | X | X | — | X |
| | 35 | Write PV range values | X | X | X | X |
| | 38 | Reset configuration changed flag | X | X | — | — |
| | 40 | Enter/exit fixed PV current mode | X | — | X | X |
| | 42 | Perform master reset | X | — | X | X[4] |
| | 43 | Set PV zero | X | — | — | X[4] |
| | 44 | Write PV units | X | X | — | X |
| | 45 | Trim PV current DAC zero | X | — | X | X |
| | 46 | Trim PV current DAC gain | X | — | X | X |
| | 47 | Write PV transfer function | — | X | — | — |
| | 48 | Read additional transmitter status | X | — | — | X[4] |
| | 59 | Write number of response preambles | X | — | X | X[4] |

*Table 1-9. HART Commands (HART Communication Foundation Specification Revision 5.0 or Greater) (continued)*

| Command Set | Command No. | Command | Communication Device | | | |
|---|---|---|---|---|---|---|
| | | | Elsag Baile STT04 | Baile-FP 53MC5000[1] | MTL® 611[2] | Rosemount 275[3] |
| Type PTH Transmitter - Specific | 128 | Report secondary output | — | — | — | X[4] |
| | 129 | Report secondary output ranges and EU | X | — | — | X[4] |
| | 130 | Write secondary output ranges and EU | X | — | — | X[4] |
| | 131 | Report user temperature alarm set points | X | — | — | X[4] |
| | 132 | Write user temperature alarm set points | X | — | — | X[4] |
| | 133 | Read output options | X | — | — | X[4] |
| | 134 | Write output options | X | — | — | X[4] |
| | 135 | Read first five values of function generator | X | — | — | X[4] |
| | 136 | Read second five values of function generator | X | — | — | X[4] |
| | 137 | Write first five values of function generator | X | — | — | X[4] |
| | 138 | Write second five values of function generator | X | — | — | X[4] |
| | 139 | Default configuration | X | — | — | X[4] |
| | 140 | Configure local LCD display | X | — | — | X[4] |
| | 141 | Report manufacturing cell data | X | — | — | X[4] |
| | 142 | Report product nomenclature | X | — | — | X[4] |
| | 143 | Report statistical information | — | — | — | X[4] |
| | 144 | Calibrate PV lower value | X | — | — | X[4] |
| | 145 | Calibrate PV upper value | X | — | — | X[4] |

**NOTES:**

1. ABB Model 53MC5000 Process Control Station. Software revision level 3.
2. MTL Model 611 Pocket Terminal. Software Revision Level 4.0. Requires a Type CNF61 interface. This device can perform all commands via user programming.
3. Rosemount Model 275 Hand-Held Terminal. Software Revision Level F1.6.
4. These commands require that the ABB Type PTH HART Device Description be loaded into the Rosemount Model 275.

# SECTION 2 - DESCRIPTION AND OPERATION

## *INTRODUCTION*

This section describes the Type PTHD Platinum Standard HART Pressure Transmitter. It also includes information about special applications such as volume measurements and the function generator.

## *FUNCTIONAL OPERATION*

The Type PTHD pressure transmitter has two major sections: a cell with characterization board assembly, and an electronics assembly. A HART-compatible communication device interacts with the transmitter. The EZ CAL option provides a way to validate the zero and span of the transmitter without the use of a communication device.

### *Cell with Characterization Board Assembly*

Type PTHD pressure transmitters use an electrically isolated differential reluctance cell as the sensing device. The cell has two half-shells clasping a measuring diaphragm, centered and welded at the edges under stress. A core is welded to each side and at the center of the diaphragm. The diaphragm has spiral ridges for pressures less than or equal to 90 kilopascals (360 inches of water) or is flat and trimmed for pressures greater than 90 kilopascals (360 inches of water). These distinctive diaphragms provide symmetry, flexibility and accuracy under static pressure (Fig. 2-1).

Two inductive coils are at each side of the cores in the two half-shells. Two welded walls isolate them from the fill fluid. Two isolating diaphragms, welded to the edges, isolate the measuring diaphragm to protect against corrosion and overloads.

A welded housing protects the cell from the surroundings. The cell used for measuring absolute pressure has a vacuum sealed reference chamber. The pressure, transmitted by the isolating diaphragms and fill fluid (silicone oil or fluorinated oil), moves the measuring diaphragm. An AC voltage excites the two series coils. The midpoint voltage of these coils varies as a function of the movement of the magnetic cores welded to the measuring diaphragm.

The cell and characterization board are a matched set and are permanently attached. For more information on the characterization board, refer to ***Electronics Assembly***.

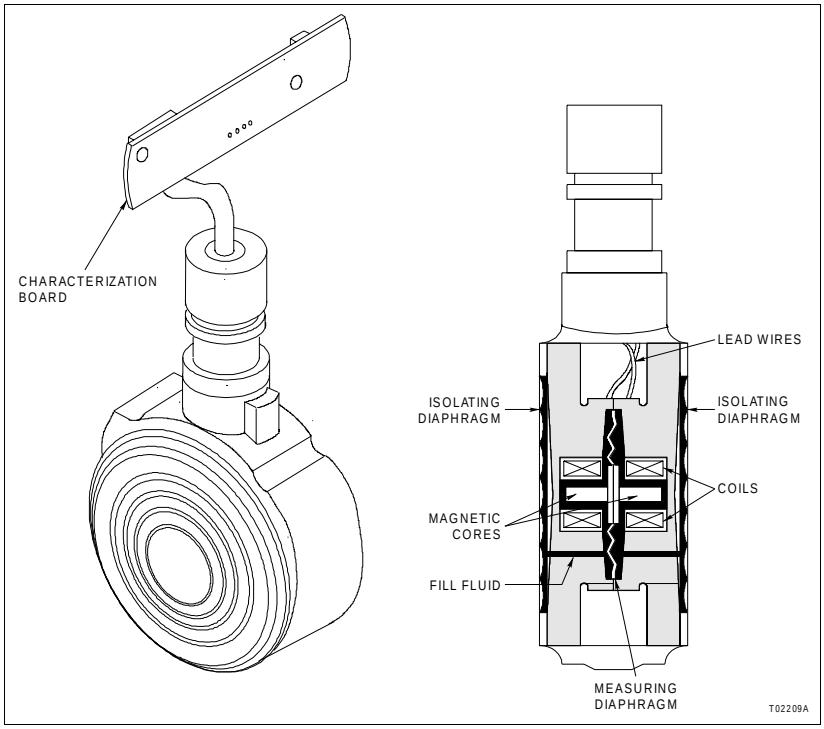



*Figure 2-1. Cell with Characterization Board Assembly*

### *Electronics Assembly*

Refer to Figure 2-2 for a block diagram of the Type PTHD pressure transmitter electronics. All calibration, configuration and compensation data are stored in both the main and characterization boards. The cell output goes into a custom analog to digital converter on the LSI smart chip via the characterization board. The microcontroller requests the digital outputs of the custom analog to digital converter. It uses these digital outputs and the information stored on the characterization board to calculate an output for the transmitter. This output is then available as a four to 20-milliampere output or a polled digital process variable signal.

The transmitter has a lockout jumper that when activated, prevents any alterations to the calibration or configuration. Refer to ***CONFIGURATION LOCKOUT PROCEDURE*** in Section 3.

### *EZ CAL Option*

> **NOTE:** The EZ CAL option is for zero and span validation only. ***Do not*** use it to change the calibrated span of the transmitter. The EZ CAL option provides no means to indicate if an error is made.

After mounting the EZ CAL option, one of two magnetically coupled components responds to the moving of a magnet in the EZ CAL option. When validating the zero, adjust the input pressure to the configured zero value and turn and hold the adjustment screw on the EZ CAL option in the zero direction for at least three seconds. This

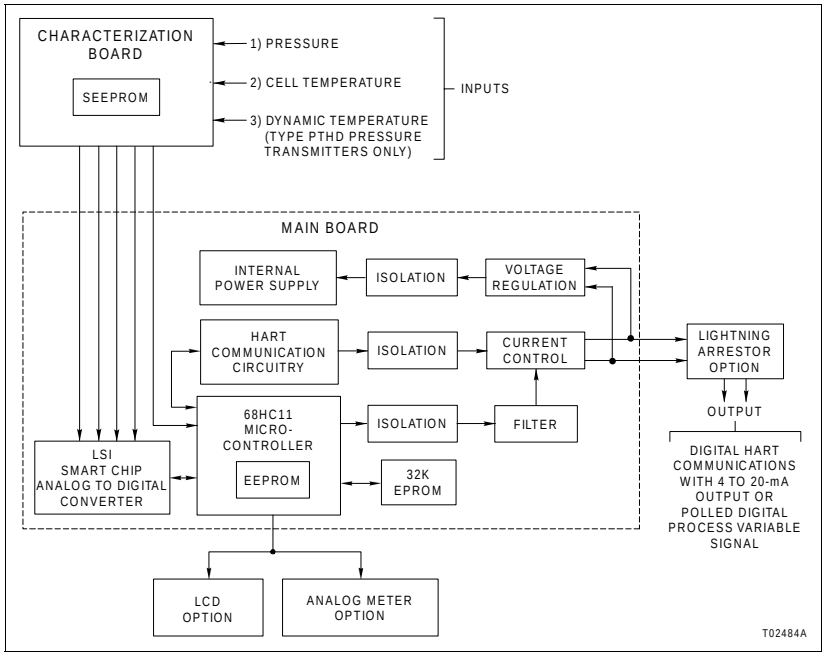



*Figure 2-2. Electronics Block Diagram*

causes the electronics to automatically adjust the output to zero percent. To validate the span, set the input pressure to the configured span value, depress the span lock and turn and hold the adjustment screw on the EZ CAL option in the span direction for at least three seconds. This causes the electronics to automatically adjust the output to 100 percent. Span or zero or both may be adjusted.

> **NOTE:** If the change attempted is more than plus or minus ten percent of the upper range limit of the particular transmitter, the new values will be rejected. However, there is no indication this has occurred.

### *Communications*

An AC voltage imposed on the signal wires allows communications between the transmitter and the primary or secondary communication device. This communication method provides excellent noise immunity. This is true whether the transmitter is configured in the analog (four to 20 milliampere) or multidrop mode. A minimum of 230-ohms loop resistance is required to support communications, although typical installations use 250 ohms.

The secondary communication device connects to the target transmitter anywhere there is access to the signal leads. The clip leads connect across the signal leads independent of signal direction or polarity. Since the communication signal is an AC waveform with a zero DC average, it has no effect on the output. Two different frequency levels transmit a logic zero or a logic one.

Configuring the transmitter in the multidrop mode causes the microcontroller to set the output of the transmitter to less than four milliamperes for low power consumption. The transmitter then provides a digital process variable signal. The transmitter reports its output (in percent) at least one time per second.

Refer to Figures 2-3 and 2-4 for typical wiring arrangements for analog mode and multidrop mode installations. Both operating modes require that the secondary communication device be connected between the loop resistance and the transmitter; it cannot be connected directly across the power supply.

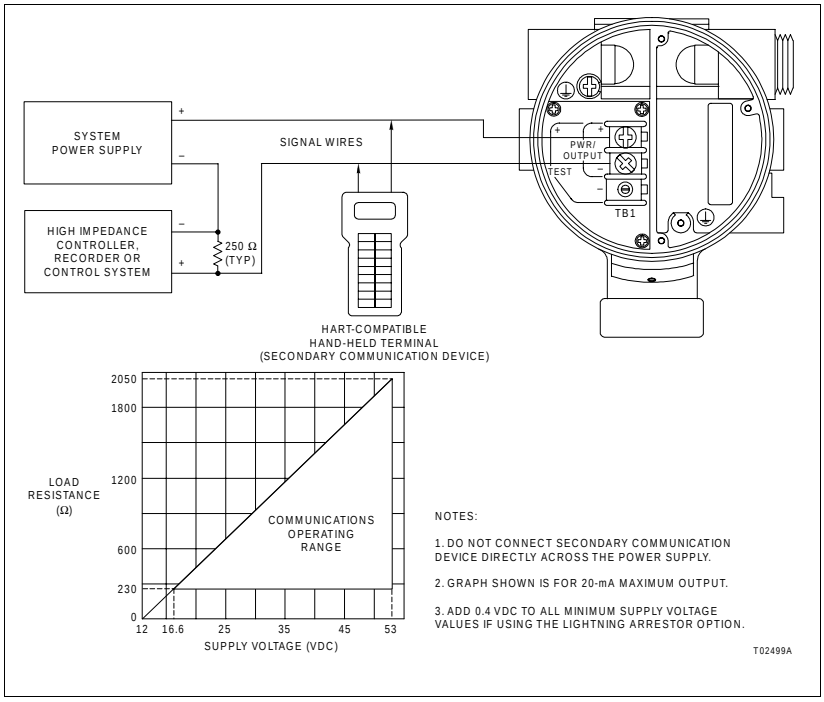



*Figure 2-3. Analog Mode Wiring*

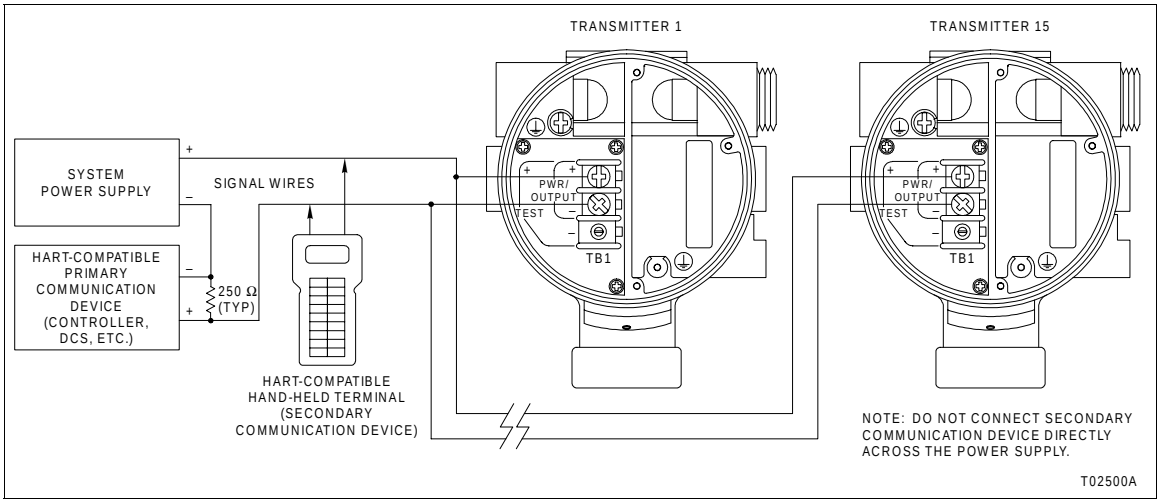



*Figure 2-4. Multidrop Mode Wiring*

### *Temperature Compensatio*

The electronics assembly monitors the temperature of the cell assembly. This is accomplished by monitoring the resistance of the coils within the cell. This technique provides a true cell temperature measurement and the transmitter uses it to calculate an advanced correction for the cell output based on the programmed cell temperature characteristics.

The transmitter monitors and compensates the output for temperature changes within the electronics housing and the dynamic temperature difference between the high and low sides of the cell. The cell temperature can be monitored by a communication device.

### *Diagnostics*

The status of continuous self-diagnostics is accessible through a communication device. Areas monitored include cell, cell temperature, electronics temperature, dynamic temperature, calibration, configured pressure limits, input circuits, analog to digital converter, EPROM, SEEPROM, reference voltages and microcontroller EEPROM. Diagnostics identify the malfunctioning section of the transmitter. The diagnostics indicate if a calibration error occurs.

### *Software Functions*

Configuration and operational commands allow the input of an ID tag for the transmitter configuration, selection of engineering units (primary and secondary output) and definition of the output. The output can be a linear, square root, $^{3}/_{2}$-power, $^{5}/_{2}$-power representation of the input, or a function generator that follows a curve consisting of six straight line segments

$^{3}/_{2}$-power and $^{5}/_{2}$-power apply to open channel measurements to find flow rates through flumes and weirs in processes such as water delivery and treatment. $^{3}/_{2}$-power is used for flumes, while $^{5}/_{2}$-power is used for weirs. Take the measurements in these situations using a bubbler system or a stilling chamber.

Other calculated outputs include the volume of a spherical or horizontal flat end tank. The output can be set for normal or reverse acting and fixed to a specific value for plant startup and troubleshooting purposes. Other commands allow the output to be set to default values upon transmitter initialization and failure. Additionally, a communication device can monitor the transmitter input, output and status. A damping adjustment command is also available.

### *SPHERICAL TANK VOLUME CALCULATION*

**NOTE:** This function is only available through communication devices that support the Type PTH transmitter-specific command set.

Figure 2-5 illustrates a spherical tank setup. This is a common industrial tank. To calculate the values entered into the transmitter via the communication device:

**Command 134**

1. Access *WRITE OUTPUT OPTIONS* and select volumetric (spherical tank). This is done using bits 4 through 6 via *WRITE OUTPUT OPTIONS* (refer to Appendix B).

*[DD: Device setup→Basic setup→Output Options→ Pres xfer fnctn→Spherical Tank Vol]*[1]

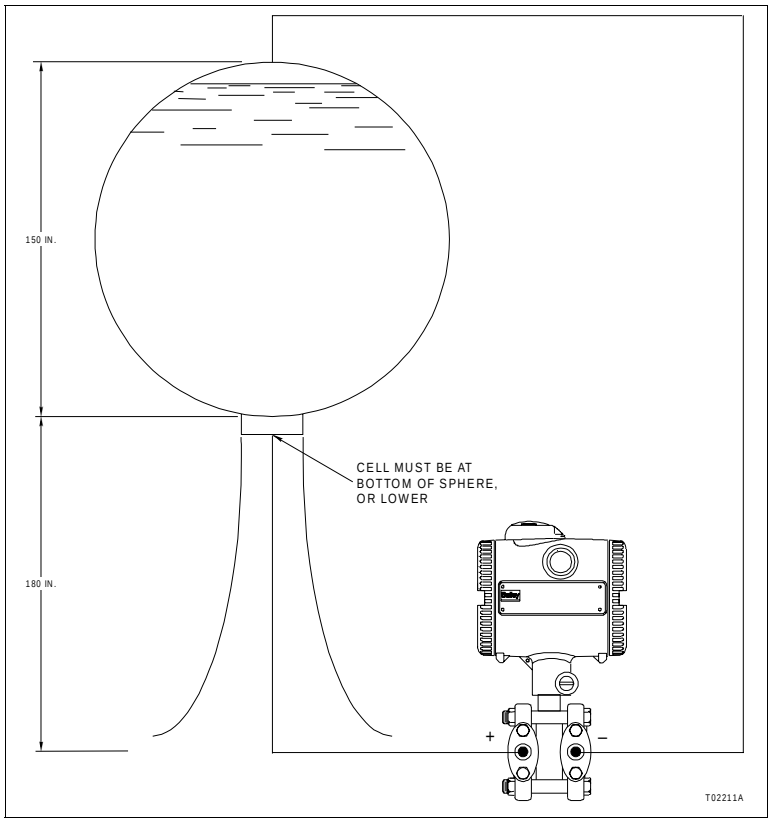



*Figure 2-5. Spherical Tank Volume Measurement (Shown for Pressurized Vessel)*

**Command 144**

2. The empty tank pressure is the primary variable (PV) lower value. If the location of the cell is at the bottom of the sphere, then the PV lower value is 0.00 kilopascals (0.00 inches of water). If the location of the cell is below the bottom of the sphere (Fig. 2-5), then offset the zero via *CALIBRATE PV LOWER VALUE*.

1. Throughout this section, this type of text indicates the menu flow for the Rosemount Model 275 with the ABB Type PTH HART Device Description loaded. Refer to Appendix D for the complete Device Description menu flow.

This zero offset is the product of the specific gravity (SG) of the liquid, and the distance between the cell and the bottom of the sphere.

*[DD: Device setup→Diag/Service→Calibration→Two point calib]*

**Command 145**

3. The full tank pressure is the PV upper value. If the location of the cell is at the bottom of the sphere, then the PV upper value is the product of the height of the tank and the specific gravity of the liquid. If the location of the cell is below the bottom of the sphere (Fig. 2-5), the PV upper value is the product of the specific gravity of the liquid and the height of the sphere, plus the PV lower value. Use *CALIBRATE PV UPPER VALUE* to set the PV upper value.

*[DD: Device setup→Diag/Service→Calibration→Two point calib]*

**NOTE:** From Steps 2 and 3, it can be seen that whether the cell is at or below the bottom of the sphere, the span between the PV lower value and the PV upper value is the same.

4. The secondary output lower range value is the empty volume of the tank (always zero).

*[DD: Device setup→Detailed setup→Secondary Output→ SOut LRV]*

5. The secondary output upper range value is the full volume of the tank which depends on the tank and the process.

*[DD: Device setup→Detailed setup→Secondary Output→ SOut URV]*

*[DD: Device setup→Detailed setup→Secondary Output→ SO Units]*

**NOTE:** The empty and full volumes do not include the tank base. The volume only includes the spherical portion of the tank.

Example:

A Type PTHDDD pressure transmitter is installed as shown in Figure 2-5, and will be configured in the United States. The tank is filled with water (specific gravity = 1.0). The transmitter has an upper range limit of 360 in. $H_2O$. The cell is mounted 180 in. below the bottom of the sphere. The sphere itself is 150 in. in diameter. The empty volume is zero and the full volume is 7,650 gal. The compensating leg is a dry leg.

1. Calculate the empty tank pressure as the PV lower value. Since the cell is below the bottom of the sphere by 180 inches, the PV lower value is equal to 180 inches multiplied by the specific gravity of water (1.0) or 180 inches of water.

2. Calculate the PV upper value. Since the tank is 150 inches in diameter, the full pressure is equal to 150 inches multiplied by the specific gravity of water (1.0) or 150 inches of water. However, since the zero offset of 180 inches of water was calculated as the PV lower value, the PV upper value must be equal to 150 plus 180, or 330 inches of water.

3. The secondary output lower range value is the empty volume of the tank (always zero).

4. The full volume of the tank is calculated to be 7,650 gallons for the secondary output upper range value.

### *FLAT END (CYLINDRICAL) TANK VOLUME CALCULATION*

**NOTE:** This function is only available through communication devices that support the Type PTH transmitter-specific command set.

Figure 2-6 illustrates a flat end (cylindrical) tank setup. This is a general purpose tank. To calculate the values entered into the transmitter via the communication device:

**Command 134**

1. Access *WRITE OUTPUT OPTIONS* and select volumetric (flat end cylindrical tank). This is done using bits 4 through 6 via *WRITE OUTPUT OPTIONS* (refer to Appendix B).

*[DD: Device setup→Basic setup→Output Options→ Pres xfer fnctn→Flat End Tank Vol]*

**Command 144**

2. The empty tank pressure is the PV lower value. If the location of the cell is at the bottom of the tank, then the PV lower value is 0.00 kilopascals (0.00 inches of water). If the location of the cell is below the bottom of the tank (Fig. 2-6), then offset the zero via *CALIBRATE PV LOWER VALUE*. This zero offset is the product of the specific gravity (SG) of the liquid and the distance between the cell and the bottom of the tank.

*[DD: Device setup→Diag/Service→Calibration→Two point calib]*

**Command 145**

3. The full tank pressure is the PV upper value. If the location of the cell is at the bottom of the tank, then the PV upper value is the height of the tank multiplied by the specific gravity of the liquid. If the location of the cell is below the bottom of the tank (Fig. 2-6), the PV upper value is the product of the specific gravity of the liquid and the height of the tank, plus the PV lower value. Use *CALIBRATE PV UPPER VALUE* to set the PV upper value.

*[DD: Device setup→Diag/Service→Calibration→Two point calib]*

**NOTE:** From Steps 2 and 3, it can be seen that whether the cell is at or below the bottom of the tank, the span between the PV lower value and the PV upper value is the same.

4. The secondary output lower range value is the empty volume of the tank (always zero).

5. The secondary output upper range value is the full volume of the tank and depends on the tank and the process.

*[DD: Device setup→Detailed setup→Secondary Output→ SOut URV]*
*[DD: Device setup→Detailed setup→Secondary Output→ SO Units]*

Example: A Type PTHDDC pressure transmitter is installed as shown in Figure 2-6, and will be configured in the United States. The tank is filled with water (specific gravity = 1.0). The transmitter has an upper range limit of 120 in. $H_2O$. The cell is mounted 60 in. below the bottom of the tank. The tank itself is 30 in. in diameter and 100 in. long. The empty volume is zero and the full volume is 306 gal.

1. Calculate the empty tank pressure as the PV lower value. Since the cell is below the bottom of the tank by 60 inches, the PV lower value is equal to 60 inches multiplied by the specific gravity of water (1.0) or 60 inches of water.

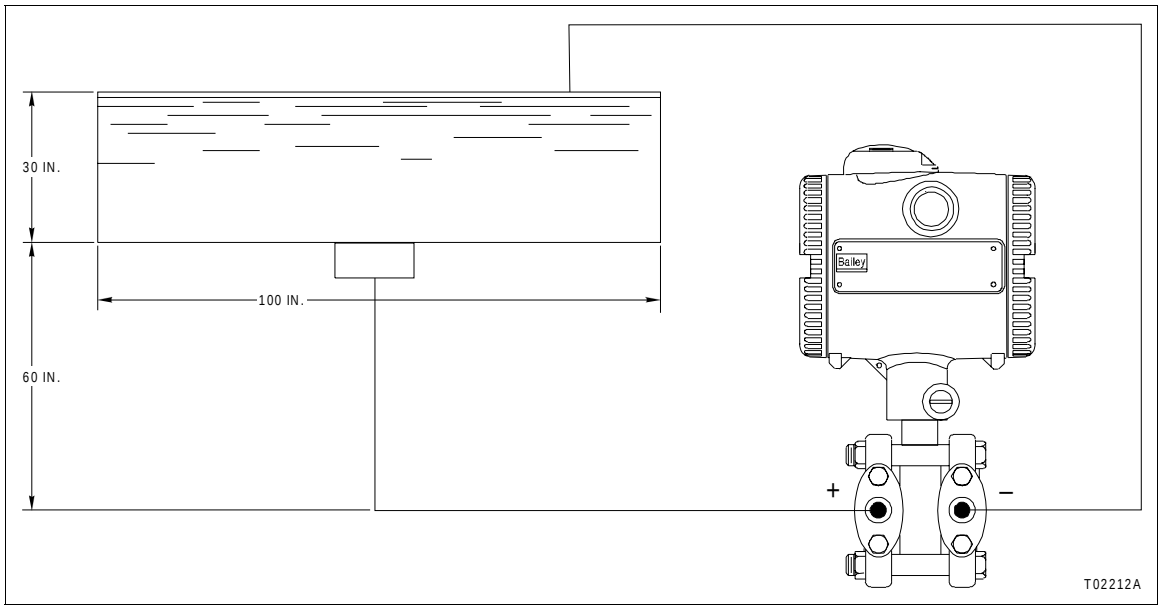



*Figure 2-6. Flat End (Cylindrical) Tank Volume Measurement (Shown for Pressurized Vessel)*

2. Calculate the PV upper value. The full pressure is equal to 30 inches multiplied by the specific gravity of water (1.0) or 30 inches of water. However, since the zero offset of 60 inches of water was entered for the PV lower value, the PV upper value must be 30 plus 60, or 90 inches of water.

3. The secondary output lower range value is the empty volume of the tank (always zero).

4. The full volume of the tank is calculated to be 306 gallons for the secondary output upper range value.

### *FUNCTION GENERATOR*

**NOTE:** This function is only available through communication devices that support the Type PTH transmitter-specific command set.

**Command 134**

The function generator is a curve consisting of six straight line segments programmed into the transmitter via the communication device. This is selected by sending the appropriate bits via *WRITE OUTPUT OPTIONS* (refer to Appendix B). This makes it possible to program an application specific relationship between input pressure and output value.

*[DD: Device setup→Basic setup→Output Options→ Pres xfer fnctn→Function Generator]*

**Commands 137 and 138**

The first and last points of the curve (P0 and P6) are predefined at zero-percent input and output (0.00, 0.00), and 100-percent input and output (1.00, 1.00) respectively.

**NOTE:** The function generator points must be entered as values between 0.00 and 1.00 inclusive. To arrive at these numbers, divide the input and output percentages by 100.

The other five points corresponding to P1 through P5 are entered using commands 137 and 138, *WRITE FIRST FIVE VALUES OF FUNCTION GENERATOR* and *WRITE SECOND FIVE VALUES OF FUNCTION GENERATOR*.

*[DD: Device setup→Basic setup→Function Generator→ X1-X5, Y1-Y5]*

Refer to Figure 2-7 for an illustration of a function generator used to control the output of a Type PTHDDA pressure transmitter. This transmitter has a nominal range of zero to six inches of water. As shown in Figure 2-7, the calibrated range is from -0.50 to +0.50 inches of water (calibrated span of 1.0 inch of water). The function generator is used to provide a full scale output (zero to 100 percent) for a -0.05 to +0.15 furnace pressure draft range. This is a common draft range for paint ovens used in the automobile or appliance industry, slab reheat furnaces in the steel industry, and glass tanks in the glass industry.

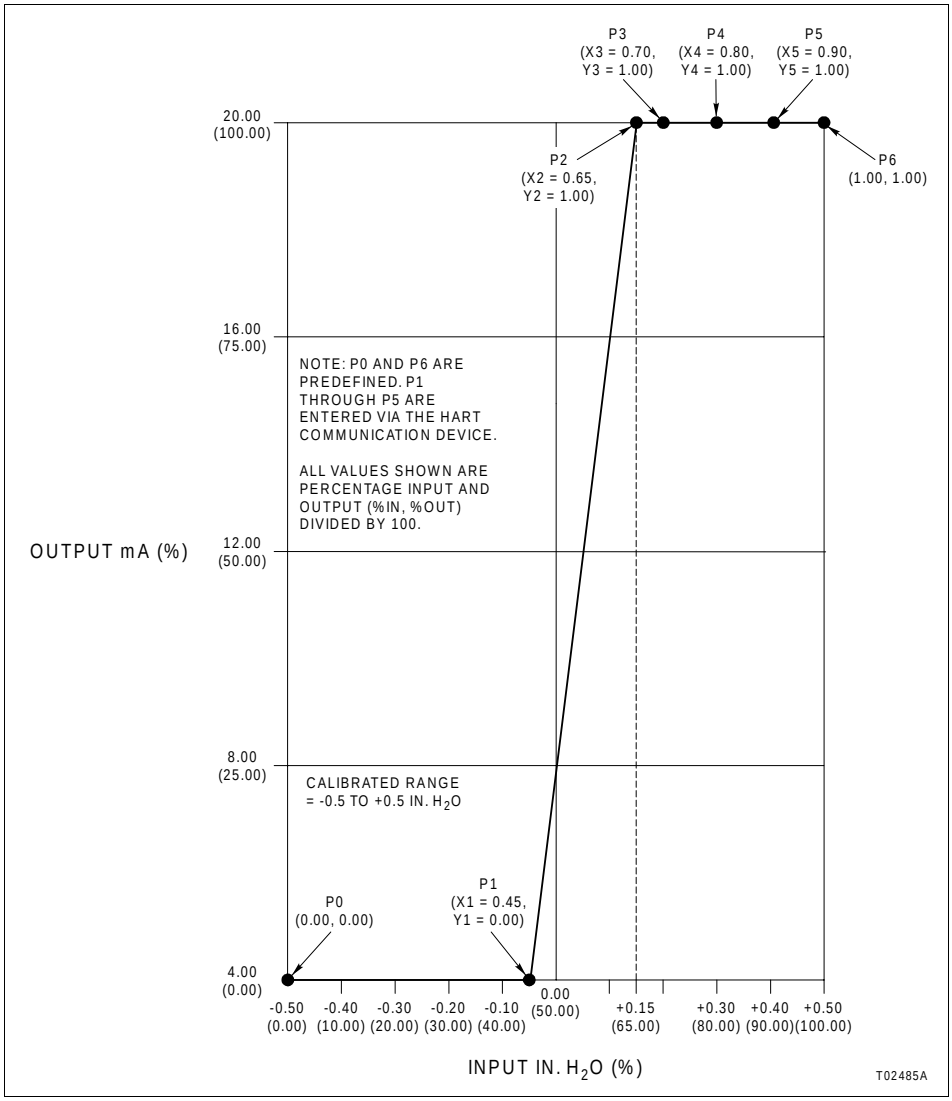



*Figure 2-7. Function Generator Example*

# SECTION 3 - INSTALLATION

## *INTRODUCTION*

This section aids in all levels of the installation process and provides procedures for placing the transmitter into service.

> **NOTE:** Refer to the ***Installing a 4 to 20 mA Transmitter in a Hazardous Location*** application guide and ANSI/ISA RP12.6, ***Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations***, when applicable.

## *SPECIAL HANDLING*

Semiconductors are subject to damage by static electricity. Therefore, observe these techniques during servicing, troubleshooting and repair.

> **NOTE:** An antistatic kit (refer to Table 1-8) is available for personnel working on equipment containing semiconductors. The kit contains a static-dissipative mat, ground cord assembly, wrist bands and alligator clips.

1. Most assemblies with semiconductors come in a special antistatic bag. Keep the assembly in the bag as much as possible whenever the assembly is not installed.

2. Assemblies containing semiconductors should be removed from their antistatic container only under certain conditions:

   a. When at a static-free workstation or when the bag is grounded at a field test site.

   b. Only after neutralizing the conductive area of the container.

   c. Only after firm contact with an antistatic mat and/or firmly gripped by grounded personnel.

3. Personnel handling assemblies with semiconductors should be neutralized to a static-free workstation by a grounding wrist strap connected to the station or to a good ground point at a field site.

4. Do not allow clothing to contact semiconductors. Most clothing generates static electricity.

5. Avoid touching connectors or components.

6. Avoid partial connection of semiconductors. Most devices can be damaged by floating leads, especially the power supply connector. If an assembly must be placed in a live system, it should be done quickly. Do not cut leads or lift circuit paths when troubleshooting.

7. Ground the test equipment.

8. Avoid static charges during removal and replacement. Make sure the assembly is fully clean around its leads, but do not rub or clean with an insulating cloth.

## *UNPACKING AND INSPECTION*

After receiving the transmitter, unpack it and inspect it for in-transit damage.

1. Check for any obvious damage to the carton or its contents. If damage is evident, notify the carrier and a sales representative.

2. Remove any loose packing from the carton.

3. Carefully remove the transmitter from the carton.

4. Inspect the nameplate to verify the unit received matches the desired function.

5. If the transmitter is to be stored prior to installation, pack it in the original container, if possible. Store in an area free from corrosive vapors and extremes in temperature and humidity. Install the covers and seal all wiring inlets.

> **NOTE:** Storage temperatures must not exceed the limits listed in Table 1-3.

## *LOCATION CONSIDERATIONS*

Because of process and economic considerations, pressure transmitters are often installed in harsh environments. Locate the transmitter so that the effects of temperature gradients and fluctuations, and shock and vibration are minimized.

When mounting the transmitter, leave ample clearance to open the cover of the electronics housing (Fig. 3-1). Wire the transmitter with a twisted, shielded pair cable for best results. Avoid sources of radio frequency interference (RFI). Refer to Table 3-1 for the A, B and C dimensions shown in Figure 3-1.

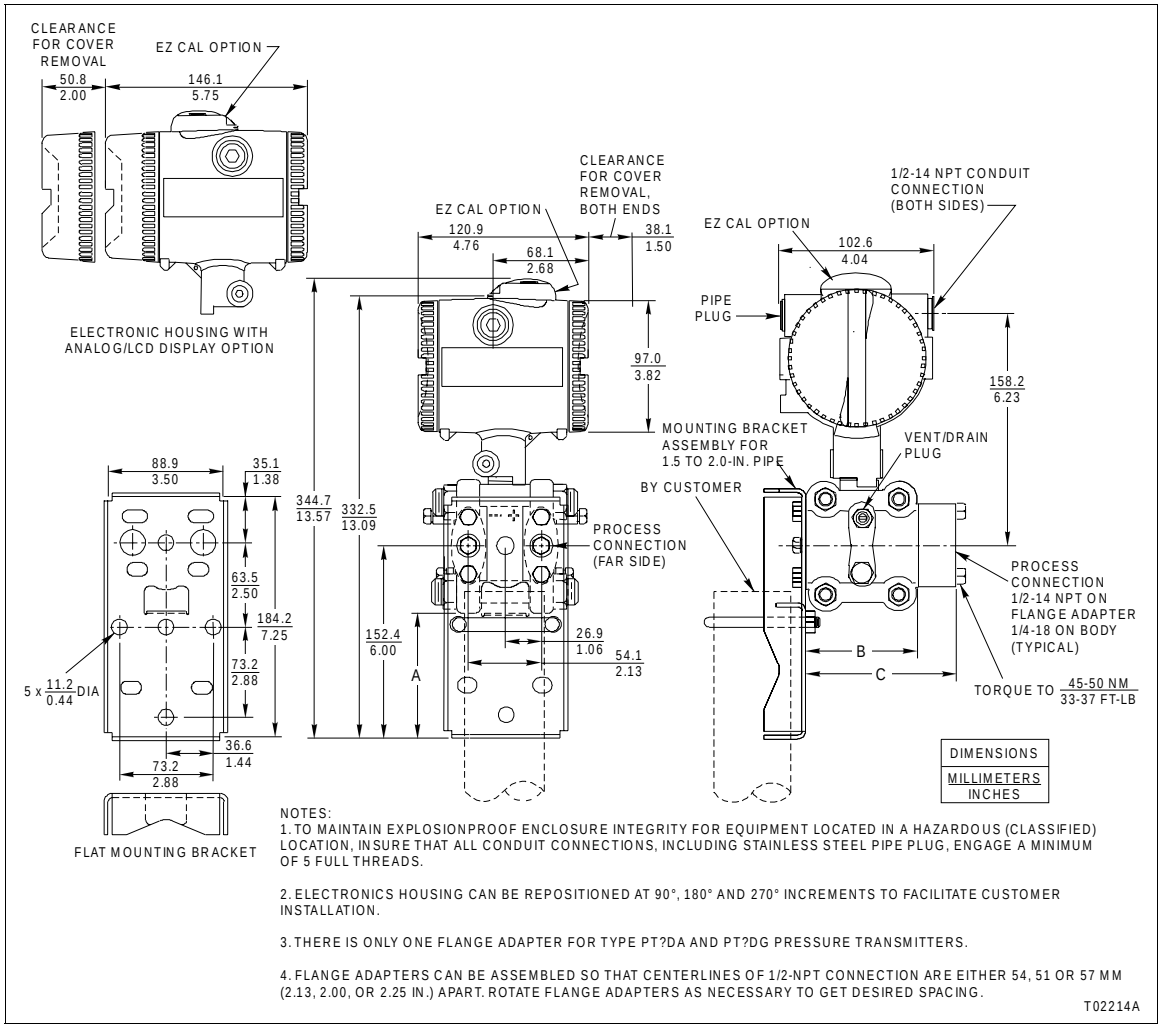



*Figure 3-1. External and Mounting Dimensions*

*Table 3-1. Dimensions for Figure 3-1*

| Dimension | Standard Bolting, mm (in.) | High Static Pressure Bolting, mm (in.) |
|---|---|---|
| A | 105.7 (4.16) | 98.3 (3.87) |
| B | 84.1 (3.31) | 94.0 (3.70) |
| C | 112.5 (4.43) | 122.4 (4.82) |

## *SETUP AND PHYSICAL INSTALLATION*

The quality of the measurement depends on the installation. This includes the orientation, pipe connections, and wiring.

Refer to the ***Instrument Connecting Piping*** instruction and ANSI B31.1, ***ASME/ANSI Code for Pressure Piping***.

For flow measurement, proper installation of the primary measuring element is also critical to the accuracy of the measurement. Refer to the ***Installation of Orifices and Flow Nozzles***, ***Installation of Weld-In Type Flow Nozzles*** and ***Installation of Holding Ring Type Flow Nozzles*** instructions when applicable.

### *Mounting*

Refer to Figure 3-1 and Table 3-1 for the external and mounting dimensions of the transmitter.

#### *FLANGE ADAPTERS*

The process connections of the transmitter process flanges have ¼-18 NPT tapped holes. Optional ¼-14 NPT flange adapters (football flanges) are available.

The flange adapters allow disconnection of the transmitter from the process by removing the flange adapter bolts. If supplied, the flange adapters are shipped in a bag in the shipping carton.

The process connection on each flange adapter is slightly off center, making it possible to install the flange adapters so that the center-to-center distance of the process connections is 54 millimeters (2-⅛ inches), 51 millimeters (2 inches), or 57 millimeters (2-¼ inches). This is accomplished by rotating either one or both of the flange adapters 180 degrees.

When installing the flange adapters, tighten the flange adapter bolts to a torque of 45 to 50 Newton meters (33 to 37 foot-pounds).

> **NOTE:** If the O-rings are PTFE, tighten to the same torque again after ***five days***. This is necessary due to the cold flow properties of PTFE. Tests have shown that a loss of torque of as much as 40 percent occurs over the five days. After a second tightening, no loss of torque is apparent.

#### *MANIFOLDS*

It is possible to mount Type PTHDD differential pressure transmitters by means of a carbon steel or stainless steel manifold. The manifold connects directly to the cell in place of the flange adapter. Refer to Table 1-8 for manifold part numbers.

If mounting the transmitter near the measuring point, the pressure pipes support the manifold and transmitter. If not, use the optional mounting bracket to mount the transmitter to a panel or 1.5 to 2.0-inch pipe.

### *VENT/DRAIN PLUGS*

Refer to Figure 3-1 for identification of the optional vent/drain plugs.

The purpose of the vent/drain feature is to release residual pressure during startup and servicing (as a bleeder valve) and to purge unwanted gas or liquid. This applies to discharging (in gas applications) and venting (in liquid and vapor applications). During installation, make sure each vent/drain plug (if provided) is tight before proceeding with piping installation and calibration.

### *ELECTRONICS HOUSING ORIENTATION*

Rotate the electronics housing as desired to aid in the installation process. There is a stop in the electronics housing to prevent it from being rotated more than 270 degrees. This stop prevents damage to the cell cable. Refer to Figure 3-2 for the location of the cell lock.

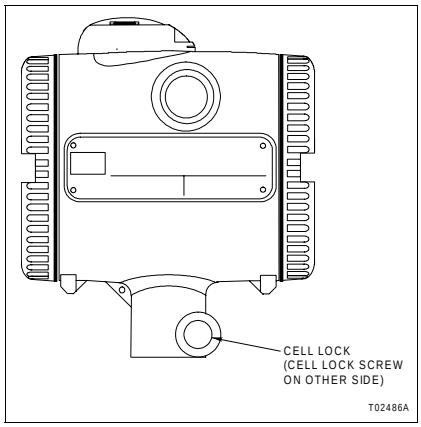



*Figure 3-2. Cell Lock*

To rotate the electronics housing:

1. Use a 4-millimeter or 5/32-inch Allen wrench to loosen the cell lock screw.

2. Back out the cell lock.

3. Rotate the electronics housing to the desired orientation.

4. Push the cell lock back in tight.

5. Tighten the cell lock screw.

### *INDICATOR ORIENTATION*

**NOTES:**
1. The analog meter cannot be rotated.

2. Refer to ***SPECIAL HANDLING*** before performing this procedure.

The transmitter is shipped with the indicator in the upright (zero-degree) position. The LCD can be rotated 360 degrees in 90-degree increments.

To rotate the LCD:

1. Remove power from the transmitter.

2. Remove the housing cover from the indicator side of the electronics housing.

3. Remove the four indicator screws (Fig. 3-3).

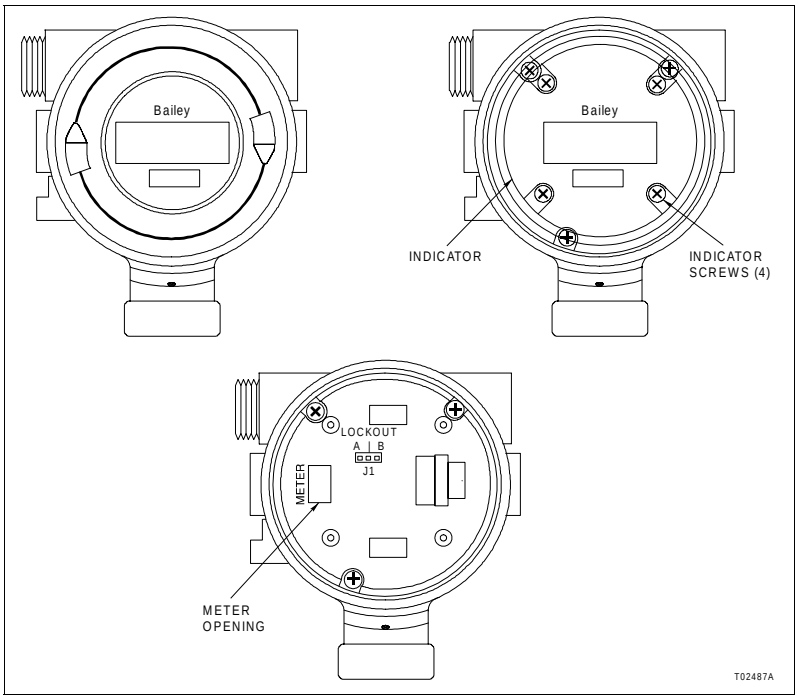



*Figure 3-3. Indicator Orientation*

4. Gently pull on the LCD to unplug it.

5. Align one of the connectors on the back of the LCD with the meter opening in the amplifier assembly to get the desired viewing orientation (Fig. 3-3).

6. Gently press down on the LCD to seat the mating connectors.

7. Install the four indicator screws.

8. Coat the threads of the housing cover and the housing with a light coating of NEVER-SEEZ® lubricant.

9. Replace the left housing cover.

10. Apply power to the transmitter.

***EZ CAL OPTION***

The transmitter is shipped with a logo nameplate in place of the EZ CAL option. To install the EZ CAL option:

**NOTE:** The EZ CAL option cannot be used on transmitters with stainless steel housings.

1. Lift up on the logo nameplate to snap its tab out of the EZ CAL option mounting hole.

2. Position the EZ CAL option on top of the transmitter (Fig. 3-1).

3. Tighten the mounting screw.

***Piping***

| | |
|---|---|
| **WARNING** | **Consider the corrosive properties of the measured substance when selecting piping materials. Degradation of the piping can upset the process. Some process upsets can injure personnel and damage equipment.** |

Piping should be in accordance with ANSI Code B31.1 for pressure piping.

| | |
|---|---|
| **WARNING** | **When pressurizing, avoid overloading and pressure hammer. Refer to the introduction section for the pressure limits of the cell. Exceeding this pressure could result in damage to the cell and cause serious injury to personnel.** |

The nameplate indicates the maximum allowable pressure. Do not exceed this value when pressurizing the cell.

The piping arrangements shown in this section are typical piping arrangements only. They are intended as generalized guides, and may not reflect the exact configuration required for the particular service. As general rules:

- Mount the transmitter with the flanges vertical. Mounting with the flanges other than vertical causes a zero offset due to the weight of the fill oil in the cell. Refer to Section 4 to reset the zero if the transmitter must be mounted with the flanges other than vertical.

- Avoid splashes if using in corrosive processes.
- Prevent obstruction of the pressure connections by solid matter or products coming from the piping.
- Be sure the wet legs in the pressure piping are full.
- Avoid sudden temperature variations.
- Wet legs (and possibly the transmitter) should be heated to prevent freezing.
- Make the impulse lines as short as possible.
- Locate the pressure inputs in accordance with standard practice for gas, liquid and vapor flows.
- For liquid flow measurements, be sure there is no trapped air or gas in the pipes.
- For liquid flow measurements, mount the transmitter below the primary element. Avoid high points and slope all horizontal lines at least 83 millimeters per meter (one inch per foot) downward toward the transmitter.
- For liquid flow measurements, if the primary element is in a vertical pipe, provide drip pots at the low points.
- For gas flow measurements, mount the transmitter above the primary element to evacuate the condensates in the connecting pipes. Slope all horizontal lines at least 83 millimeters per meter (one inch per foot) upward toward the transmitter.
- For wet gas flow measurements, be sure the pipes are filled. Install drip pots at the low points.
- For flow measurements of condensable vapor, use condensate pots. Mount these pots on the pipe connections or on the flanges of the pressure connections so that the longitudinal axis of the pot is horizontal and its output toward the valve is directed vertically downward. Be sure the pots are at the same level.
- Provide drip (condensation) pots along the entire course of the connecting pipes when impurities are present in the vapor or liquid in the pipes.

The piping between the primary element and the transmitter must transfer the process pressure at the pipe or flange taps to the transmitter. Possible sources of error in this pressure transfer are: leaks; friction loss, if continuous purging is used; trapped gas in a liquid line; and trapped condensates in a gas line.

### *FLOW MEASUREMENTS*

Refer to Figures 3-4, 3-5 and 3-6 for installation examples of transmitters used to measure liquid, vapor and gas flow.

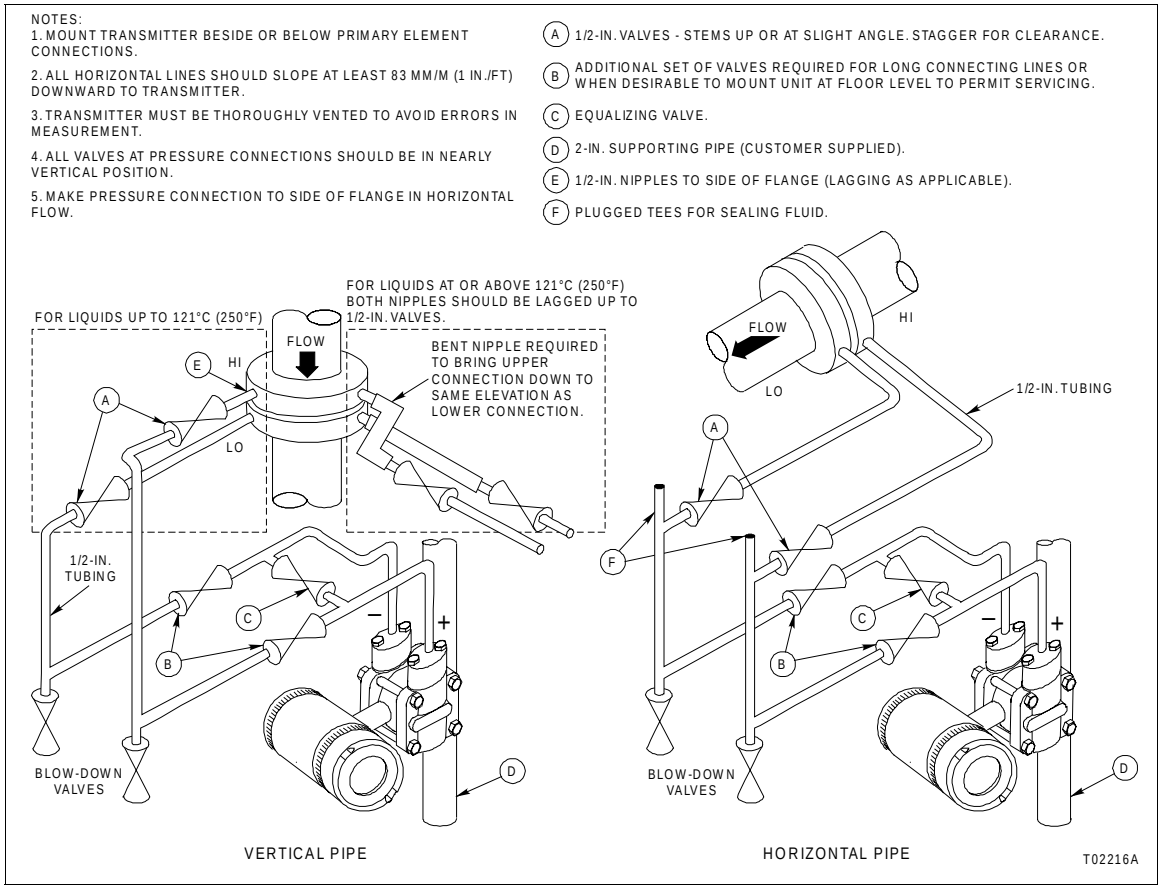



*Figure 3-4. Liquid Flow Measurements*

NOTES:
1. MOUNT TRANSMITTER BELOW PRIMARY ELEMENT CONNECTIONS.

2. ALL HORIZONTAL LINES SHOULD SLOPE AT LEAST 83 MM/M (1 IN./FT) DOWNWARD TO TRANSMITTER.

3. TRANSMITTER SHOULD BE THOROUGHLY VENTED TO AVOID MEASUREMENT ERRORS.

4. ALL VALVES AT PRESSURE CONNECTIONS SHOULD BE IN NEARLY VERTICAL POSITION.

5. DO NOT BLOW DOWN IMPULSE PIPING THROUGH TRANSMITTER. FLUSH LINES WITH VALVES "A" CLOSED. REFILL LINES WITH WATER BEFORE RESUMING MEASUREMENT.

(A) 1/2-IN. VALVES - STEMS UP OR AT SLIGHT ANGLE. STAGGER FOR CLEARANCE.

(B) ADDITIONAL SET OF VALVES REQUIRED FOR LONG CONNECTING LINES OR WHEN DESIRABLE TO MOUNT UNIT AT FLOOR LEVEL TO PERMIT SERVICING.

(C) EQUALIZING VALVE.

(D) 2-IN. SUPPORTING PIPE (CUSTOMER SUPPLIED).

(E) PLUGS OR VENT VALVES.

(F) 1/2-IN. NIPPLES TO SIDE OF FLANGE OR PIPE. LAG TO VALVES.

(G) 1/2-IN. NIPPLES AT LEAST 102 MM (4 IN.) LONG.

(H) 1/2-IN. TEES BOTH AT SAME ELEVATION.

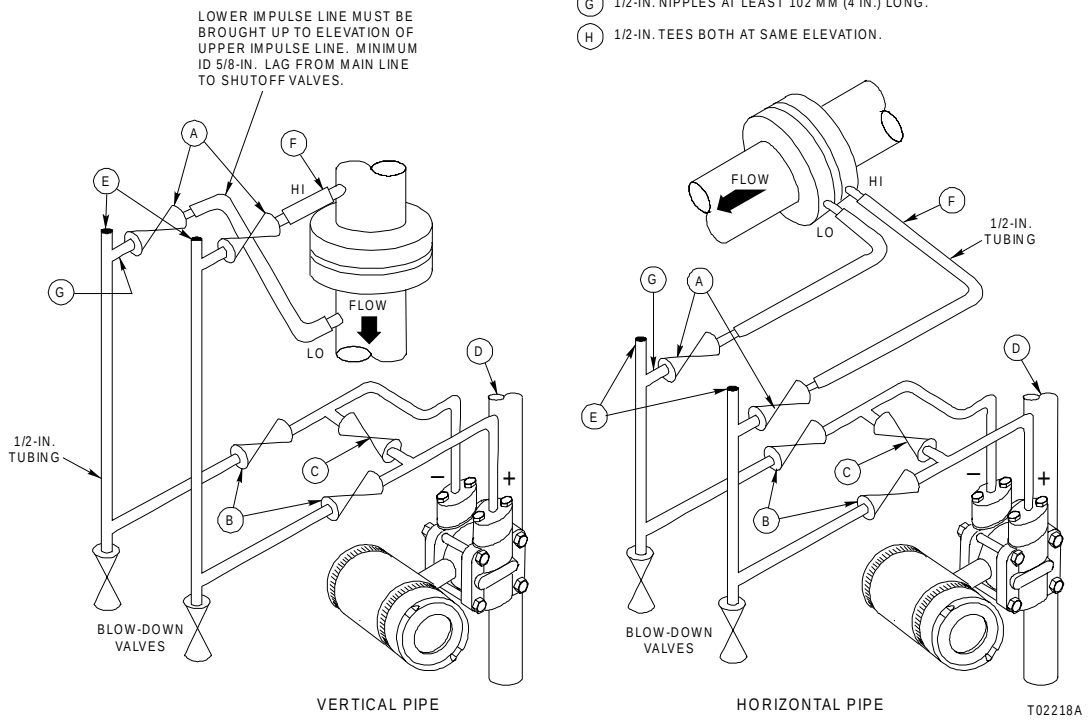



*Figure 3-5. Vapor Flow Measurements*

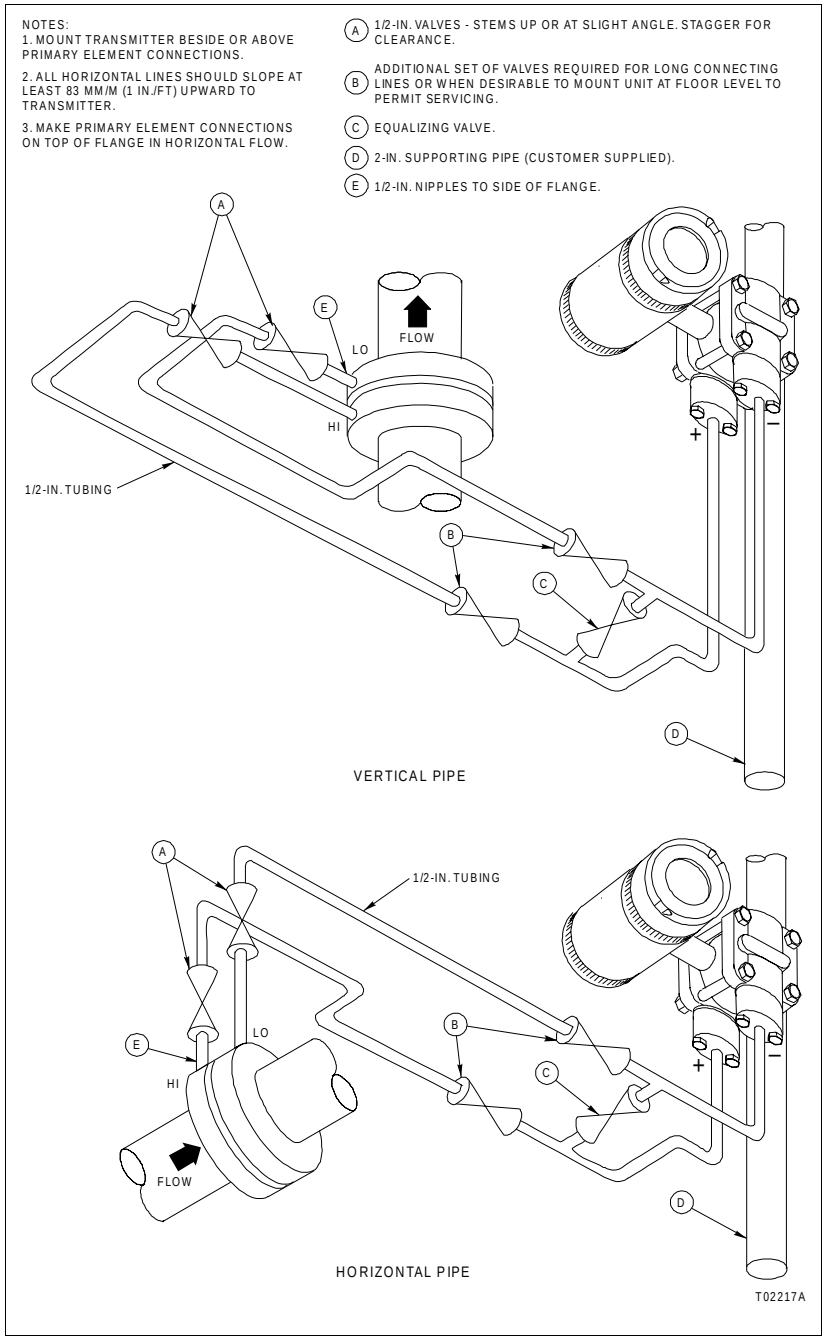



*Figure 3-6. Gas Flow Measurements*

### *LEVEL MEASUREMENTS*

There are three types of level measurements discussed in this section: open tank, closed tank in noncondensing atmospheres and closed tank in condensing atmospheres.

### *Open Tank*

In an open vessel, level can be measured by making a pressure measurement (P) at the bottom of the vessel (Figs. 3-7 and 3-8).

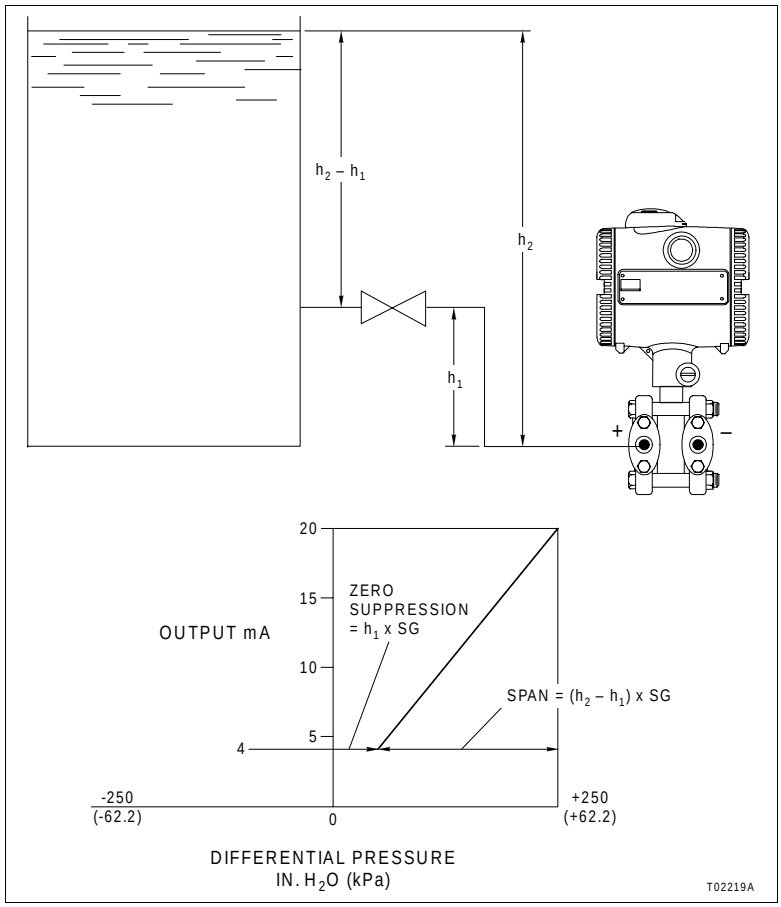



*Figure 3-7. Open Tank Level Measurement*

The pressure at the transmitter high pressure (+) connection is equal to the product of the height ($h_2$) and the specific gravity (SG) of the liquid. Since SG is known, and P is the measured pressure, then:

$$h_2 = \frac{P}{SG}$$

1. Figure 3-8 shows a typical piping arrangement for open tank level measurements.

2. Make the pressure connection to the high pressure (+) connection.

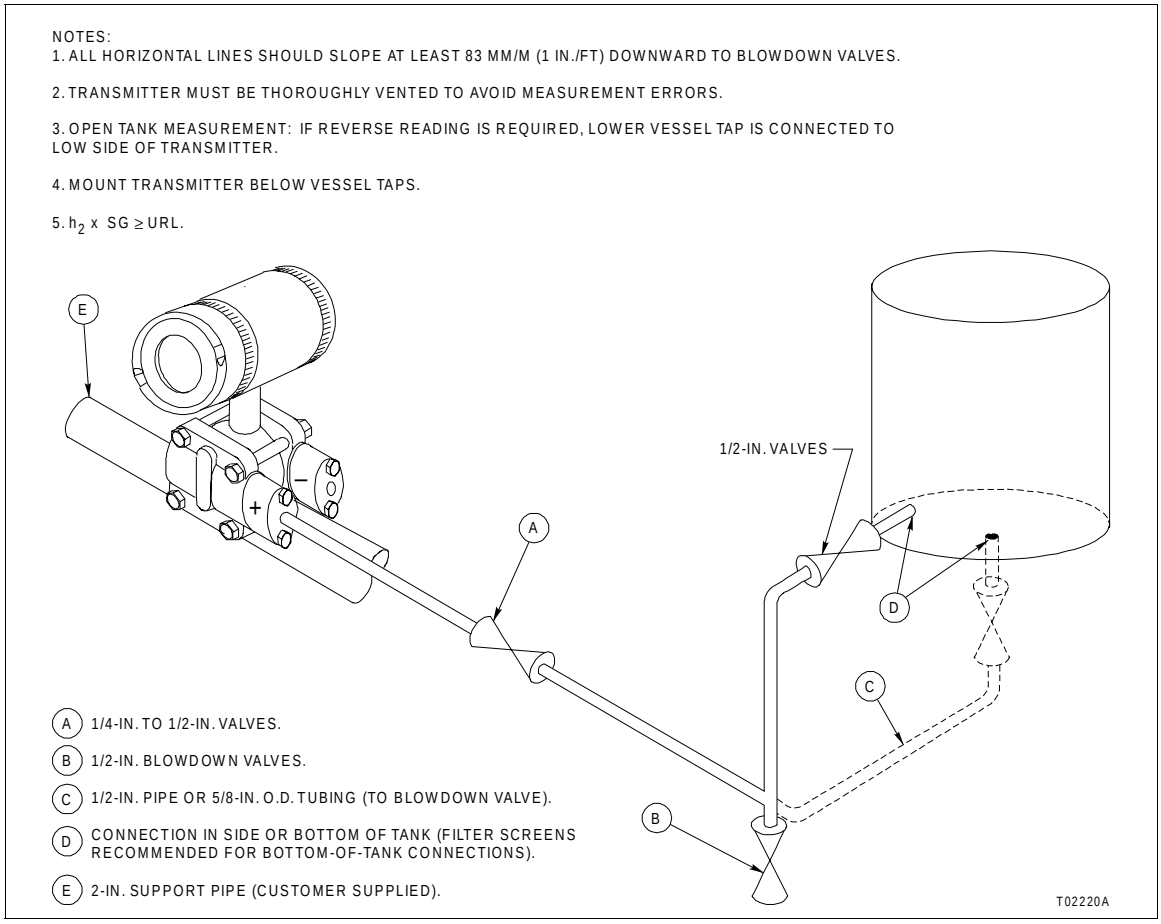



*Figure 3-8. Open Tank Level Measurement Piping*

3. Leave the low pressure (–) connection open to the atmosphere.

   **NOTE:** It is not unheard of for bees, wasps, spiders and other unwanted pests to make a home of the open low pressure process connection. To prevent this, cover this connection with a fine screen or cheese cloth.

4. Observe the conventions as shown in Figure 3-8.

5. The output of the transmitter is proportional to the level of the liquid above the cell multiplied by the specific gravity of the liquid. If the zero point of the desired level range is above the cell, the lower range value must be changed to reflect this. Refer to Section 4 and Appendix B for more information. Refer to Figure 3-7 for a graphical representation of this application.

### *Closed Tank*

In a closed vessel, pressure above the liquid affects the pressure measured at the bottom of the vessel. It is then necessary to subtract the pressure above the liquid from the pressure at the bottom of the vessel. Instead of leaving the low pressure (–) connection open to the

atmosphere, connect a pressure tap from the tank above the maximum level to be measured to the low pressure (–) connection.

If the atmosphere above the liquid is noncondensing, the pressure line from the top of the tank to the low pressure (–) connection is a dry leg. The transmitter responds only to the pressure of the fluid measured at the lower tap of the tank that connects to the high pressure (+) connection (Fig. 3-9). The calculations are the same as those for an open tank level measurement.

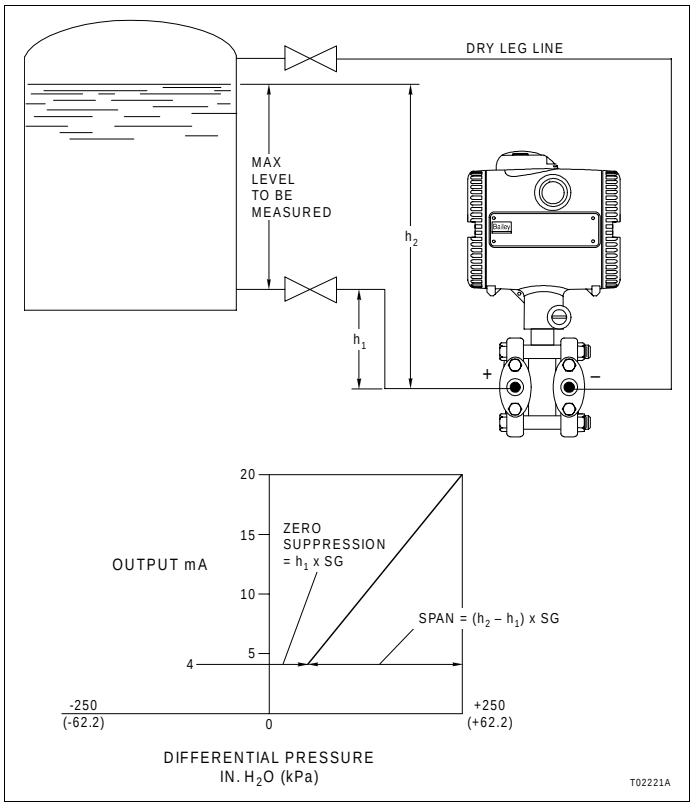



*Figure 3-9. Closed Tank (Noncondensing Atmosphere) Level Measurement*

1. Figure 3-10 shows a typical piping arrangement for closed tank level measurements in noncondensing atmospheres.

2. Make the connection from the lower tap of the tank to the high pressure (+) connection.

3. Make the connection from the upper tap of the tank to the low pressure (–) connection.

4. Observe the conventions as shown in Figure 3-10.

5. The output of the transmitter is proportional to the level of the liquid above the cell multiplied by the specific gravity of the liquid. If the zero point of the desired level range is above the cell, the lower range value must be changed to reflect this. Refer to Section 4 and

Appendix B for more information. Refer to Figure 3-9 for a graphical representation of this application. .

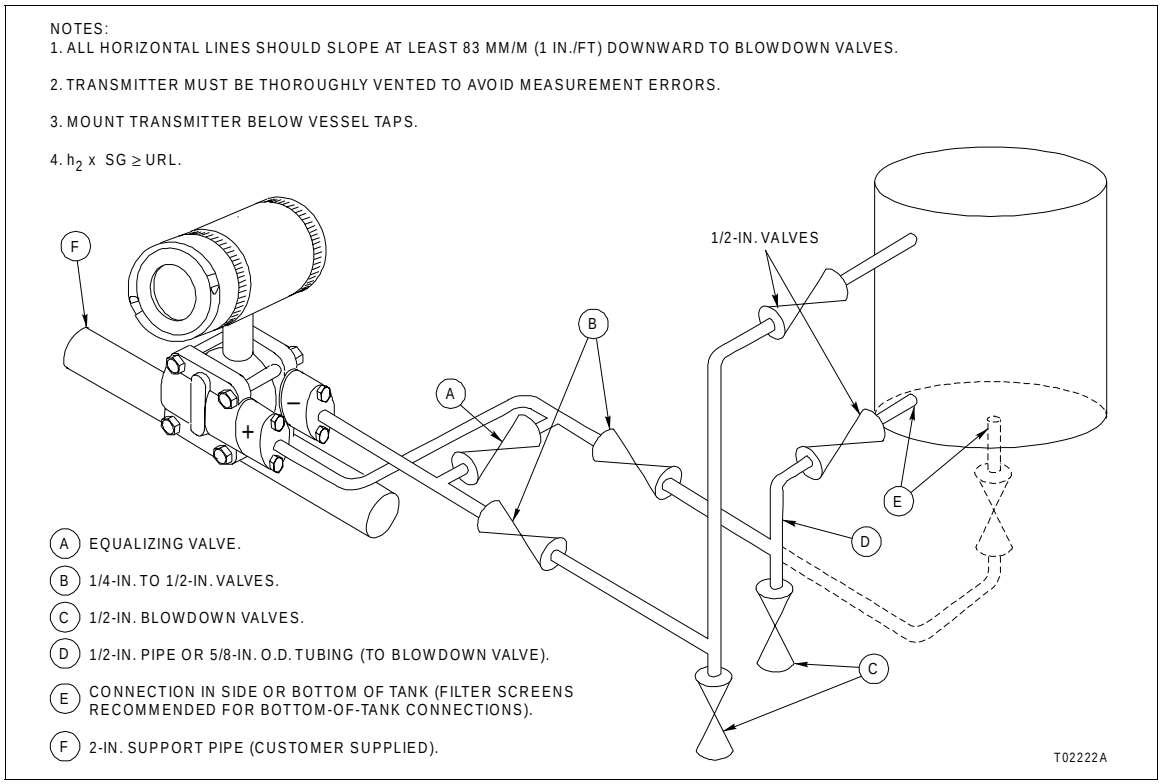



*Figure 3-10. Closed Tank (Noncondensing Atmosphere) Level Measurement Piping*

If the atmosphere (vapor state of the liquid) above the liquid is condensable (such as steam above boiler water), the pressure line from the upper tap of the tank to the low pressure (–) connection fills with condensate. This creates a wet leg or reference leg that exerts a pressure at the low pressure (–) connection that is greater than that exerted by the variable level on the high pressure (+) connection.

As shown in Figure 3-11, if $h_3$ is the level of the liquid at any point between minimum and maximum level range values, the transmitter senses the difference in pressure between the fixed head at $h_2$ and the variable head at $h_3$. As the level of $h_3$ increases, the difference between $h_2$ and $h_3$ decreases. The transmitter output decreases with increasing level and decreasing differential pressure. The effect is that of a negative differential pressure that decreases in numerical value as the level rises. This negative differential is simulated for calibration purposes by a positive pressure, increasing in value, imposed on the low pressure (–) connection.

1. Figure 3-12 shows a typical piping arrangement for closed tank level measurements in condensing atmospheres.

2. Make the connection from the lower tap of the tank to the high pressure (+) connection.

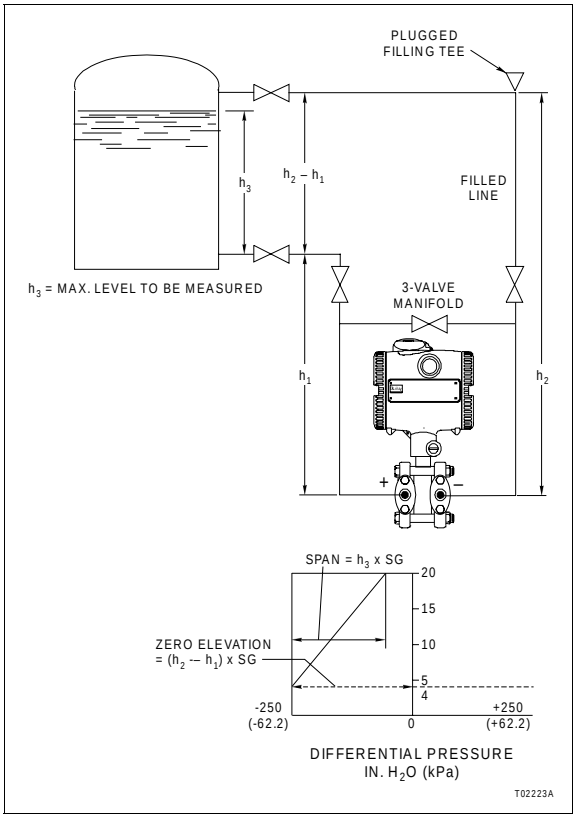



*Figure 3-11. Closed Tank (Condensing Atmosphere) Level Measurement*

3. Make the connection from the upper tap of the tank to the low pressure (–) connection.

4. Observe the conventions outlined in Figure 3-12.

5. The output of the transmitter is proportional to the level of the liquid above the cell multiplied by the specific gravity of the liquid. If the zero point of the desired level range is above the cell, the lower range value must be changed to reflect this. Refer to Section 4 and Appendix B for more information, and to Figure 3-11 for a graphical representation.

## *Wiring*

Signal wiring should not be run in conduit or open trays with wiring used to power high current devices and should not be run near high power electrical equipment. A twisted shielded pair cable is recommended for best results. Reverse polarity protection is built into the transmitter to protect it against accidental reversal of field wiring connections.

**NOTES:**

1. Never connect the loop wiring to the TEST terminals.

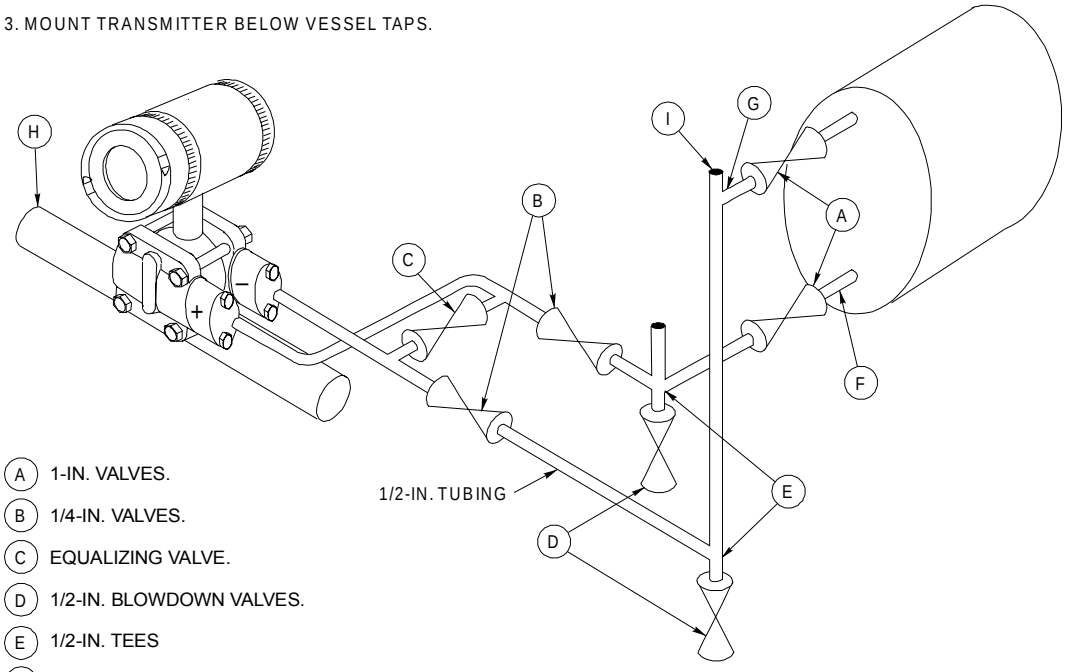



*Figure 3-12. Closed Tank (Condensing Atmosphere) Level Measurement Piping*

2. Do not connect permanent receiving devices (meters, recorders, etc.) to the TEST terminals.

There are two possible signal wiring configurations for the Type PTHD pressure transmitter: analog mode signal wiring and multidrop mode signal wiring.

### *ANALOG MODE SIGNAL WIRING*

As shown in Figure 2-3, the electrical connections in the analog mode of operation are made in the typical two-wire, four to 20-milliampere configuration. Both positive (+) and negative (–) PWR/OUTPUT terminals are provided at the transmitter to identify the signal leads.

**NOTE:** Insure that the temperature rating of the wire is suitable for the environment.

The signal terminals located in the electronics housing accept wire sizes up to 14 AWG. The signal wiring supplies all power to the trans-

mitter. The power supply limits are 12 to 53 VDC (12 to 42 VDC for CSA certified applications) across the transmitter inputs. Refer to Figure 2-3 for the load resistance limits, or use the equation:

$$R_{max} = \frac{V - 12.00}{0.02}$$

**NOTES:**

1. The equation for load resistance is based on a maximum output of 20 milliamperes with the negative (-) TEST terminal jumper screw tightened. In some cases (initialize high, fail high, overpressure conditions, etc.), the output may be higher. If this value is known, it can be used in the denominator of the equation instead of 0.02.

2. If the jumper is loosened from the negative (-) TEST terminal, the minimum supply voltage is 12.7 VDC.

3. If using the optional lightning arrestor, add 0.4 VDC to all minimum supply voltage values.

The power supply and load resistance are variable over the entire operating region as shown in Figure 2-3.

The TEST terminals have the same four to 20-milliampere signal as the PWR/OUTPUT terminals. Loosen the negative (-) test terminal jumper screw ½-turn for calibration or testing (Fig. 2-3).

**NOTE:** Do not connect permanent receiving devices (meters, recorders, etc.) to the TEST terminals.

Signal wiring should be shielded. Use twisted pairs for best results. Connect the shield at the ground terminal inside the electronics housing (Fig. 2-3) or at the receiver.

**NOTE:** Connect the shield at one end only. Connecting the shield at both ends may result in a ground loop condition.

### *MULTIDROP MODE SIGNAL WIRING*

Refer to Figure 2-4 for a typical wiring configuration for multidrop installations. In the multidrop mode of operation, there is no four to 20-milliampere signal. The transmitter draws less than four milliamperes to maintain operation.

In the multidrop mode, the process variable signal of each transmitter is a digitally polled variable. The primary communication device sequentially polls each transmitter output on the bus. Each transmitter has its own unique address that is assigned during configuration. The address allows the primary communication device to distinguish between transmitters on the loop.

Each transmitter present on the bus is wired from the control system to the positive (+) and negative (–) PWR/OUTPUT terminals of the transmitter. Connect all transmitters on the bus in parallel.

The minimum power supply voltage required for the loop is determined by:

$$V_{min} = 0.004A \times T \times R$$

where:

| | |
|---|---|
| $V_{min}$ | Minimum supply voltage (VDC). |
| T | Number of transmitters on the bus. |
| R | Load resistance. |

The load resistance must include the system input resistance and the resistance of the wire. No analog meters or measuring devices are to be included in the loop since the transmitters are not delivering an analog process variable. Power supply regulation is not critical as long as the voltage remains above the minimum calculated value.

The secondary communication device can be connected anywhere there is access to the signal leads, as long as it is not connected directly across the power supply.

**NOTE:** Only one secondary communication device can be connected to the bus at any one time, and that device can monitor any transmitter on the bus.

### *GROUNDING THE SIGNAL WIRING*

Signal wiring may be either ungrounded (floating) or grounded at any one point in the signal loop. If more than one transmitter is connected to a single power supply, grounding should be at the supply. The electronics housing must also be grounded. A ground terminal is provided inside the electronics housing (Fig. 2-3 or 2-4).

## *CONFIGURATION LOCKOUT PROCEDURE*

The Type PTHD pressure transmitter has a lockout feature. When engaged, configuration and calibration information is unalterable. This has no effect on the monitoring of transmitter functions. Refer to Figure 3-13 for the location of the jumper on the amplifier assembly.

To change the lockout jumper position:

**NOTE:** Refer to ***SPECIAL HANDLING*** before performing this procedure.

1. Remove power from the transmitter.

2. Remove the left housing cover.

3. If there is an optional indicator, go to Step 4. If there is no optional indicator, go to Step 6.

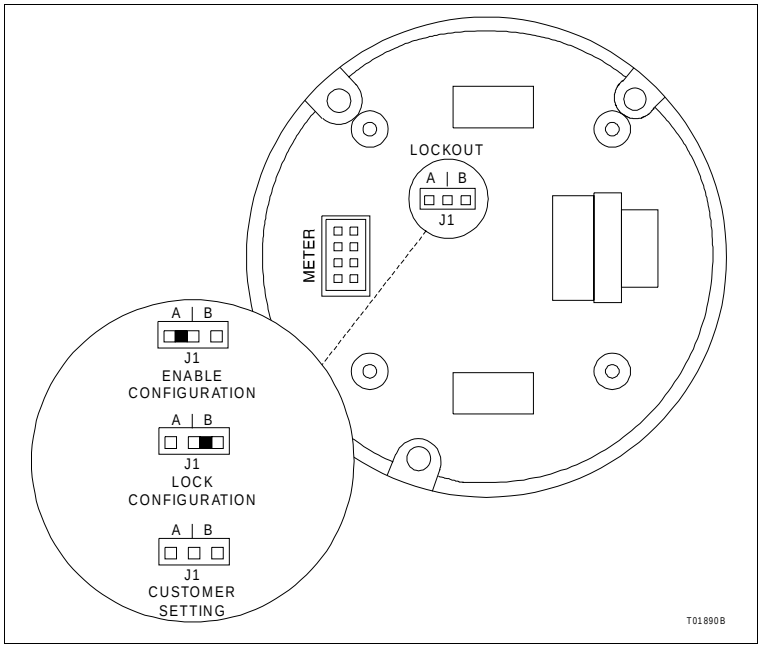



*Figure 3-13. Lockout Jumper*

4. Remove the four indicator screws (Fig. 3-3).

5. Gently pull on the indicator to unplug it.

6. Use needle nose pliers to change the jumper position. LOCKOUT B locks the configuration and LOCKOUT A enables configuration (Fig. 3-13).

7. Reverse this procedure to put the transmitter back into service.

## *SELECTING DEFAULTS*

The configuration of process control equipment within a particular system dictates the response to the controlled process of that system. Configuration may include such items as cross-limits, interlocks, alarms dealing with bad quality and safety control equipment.

Modern electronic process control equipment based on semiconductor technology is highly reliable and can be expected to provide years of trouble-free service. However, component failures that disrupt process control are still possible. In addition, power line induced failures, static discharge, conducted and radiated electromagnetic interference (EMI), acts of nature such as lightning strikes, failures caused by human error and accidents can cause disruption of process control.

Refer to Appendix B to select defaults for failure conditions.

## *HAZARDOUS LOCATION INSTALLATIONS (FLAMMABLE ATMOSPHERES)*

The Type PTHD Platinum Standard HART Pressure Transmitter must not be located in a hazardous (classified) location unless factory marked as suitable for that location. This equipment must be installed and operated according to the ***Installing a 4 to 20 mA Transmitter in a Hazardous Location*** application guide.

# SECTION 4 - CALIBRATION

## *INTRODUCTION*

| | |
|---|---|
| **WARNING** | **Explosionproof/dust-ignitionproof installations and intrinsically safe installations in Class II or Class III hazardous locations require that the assembly be kept tight while circuits are live unless the location is known to be nonhazardous at the time. Failure to follow this warning can lead to unsafe conditions that can injure personnel and damage equipment.** |

This section identifies the calibration status of the transmitter and provides the calibration check procedures. Calibration and validation procedures using both the communication device and the EZ CAL option appear here.

**NOTES:**

1. The calibration functions are only available through communication devices that support the HART common practice and Type PTH transmitter-specific command sets.

2. This section does not provide step-by-step procedures for the communication device. Refer to the appropriate communication device instruction for detailed procedures.

## *CALIBRATION PROCEDURES*

If the standard configuration is ordered, the transmitter will be set close to a zero based full scale span. A custom calibration can be factory supplied or implemented in the field.

The transmitter operates in the analog or multidrop mode.

The analog mode of operation allows both a complete bench pressure calibration and a digital to analog converter (DAC) trim. The DAC trim compensates for slight inaccuracies in the four to 20-milliampere current loop (or in receiving devices such as recorders). Use this procedure only when the system has first been installed or if something in the four to 20-milliampere current loop has changed. The multidrop mode of operation allows only a bench pressure calibration.

### *Equipment Required for Calibration*

Use the following equipment to properly calibrate the transmitter.

- DC power supply, 24 VDC (±1 VDC) recommended.

- Digital multimeter (DMM), 4-½ digit display minimum with an accuracy at least four times greater than that of the transmitter (Tables 1-5, 1-6 and 1-7).
- 250-ohm (±0.01-percent) resistor, ½-watt minimum.
- Pressure source with an accuracy at least four times greater than that of the transmitter (Tables 1-5, 1-6 and 1-7).
- Flat-blade screwdriver.
- NEVER-SEEZ lubricant.
- Nonmetallic tool for removing O-rings.
- O-ring, cover spare parts kit. Consists of ten Buna-N O-rings. Refer to Section 8 for kit number.
- Dow Corning® 4 electrical insulating compound.
- HART-compatible communication device.

### *Bench Pressure Calibration*

Use this procedure for validation of transmitter calibration before installation, after an inadvertent overpressure condition, or after the replacement of components. If the checkout indicates an incorrect calibration, continue with the procedure to calibrate the transmitter.

To check the calibration, and if necessary perform a bench pressure calibration on a Type PTHD pressure transmitter:

1. Remove the housing cover from the field terminal side of the housing.

2. Unscrew the negative (-) TEST terminal jumper screw ½-turn.

3. Mount and connect the transmitter in a calibration setup (Fig. 4-1).

4. Orient the transmitter in the same position as the final installation.

5. Allow the transmitter one minute to stabilize after power up.

6. Connect the pressure source to the high pressure (+) connection of the cell.

7. Apply a pressure to the cell equal to the configured or desired primary variable (PV) lower value.

8. The digital multimeter (set to mA) should read:

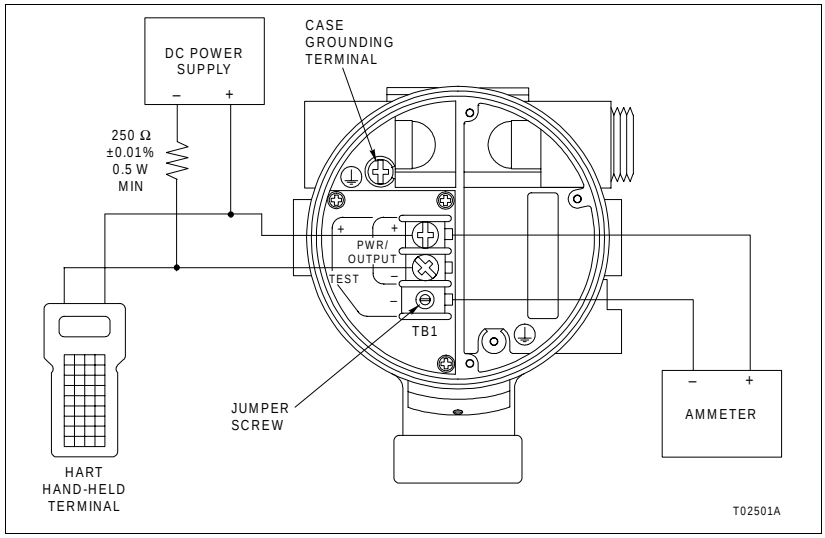



*Figure 4-1. Calibration Setup (Typical)*

**Analog mode** 4.000 mA, plus or minus the tolerance for the particular transmitter listed in Table 4-1. Go to Step 10.

**Multidrop mode** Less than 4.000 mA (since the transmitter is set for digital operation). Go to Step 9.

*Table 4-1. Calibration Tolerances*

| Type | Tolerance | |
|---|---|---|
| | Analog Mode | Multidrop Mode |
| PTHDDC | 0.013 mA (0.003 VDC) | 0.08% |
| PTHDDB<br>PTHDDD<br>PTHDDF<br>PTHDDG | 0.016 mA (0.004 VDC) | 0.10% |
| PTHDGB<br>PTHDGC<br>PTHDGD<br>PTHDGF<br>PTHDGG | | |
| PTHDAC<br>PTHDAF | 0.032 mA (0.008 VDC) | 0.20% |
| PTHDDA<br>PTHDDH | | |
| PTHDGH | | |

9. Use the communication device to monitor the output. It should display 0.00%, plus or minus the tolerance for the particular transmitter listed in Table 4-1. Go to Step 10.

*[DD: Device setup→Process variables→Pres % rnge]*[1]

10. Apply a pressure to the high pressure (+) connection of the cell equal to the configured or desired PV upper value.

11. The digital multimeter (set to mA) should read:

**Analog mode** 20.000 mA, plus or minus the tolerance for the particular transmitter listed in Table 4-1. Go to Step 13.

**Multidrop mode** Less than 4.000 mA (since the transmitter is set for digital operation). Go to Step 12.

> **NOTE:** If the four to 20-milliampere output changes with respect to pressure, then the transmitter is not in the multidrop mode. To enter this mode, refer to Appendix B and the communication device instruction.

12. Use the communication device to monitor the output. It should display 100.00%, plus or minus the tolerance for the particular transmitter listed in Table 4-1.

*[DD: Device setup→Process variables→Pres % rnge]*

13. If the output is not within the limits specified in Steps 8 and 11 (analog mode) or Steps 9 and 12 (multidrop mode), go to Step 14 to calibrate the transmitter. If it is within these limits, go to Step 15.

**Commands 144 and 145**

14. Use *CALIBRATE PV LOWER VALUE* (command 144) and *CALIBRATE PV UPPER VALUE* (command 145) to electronically set the transmitter at any two points within the range of the transmitter. Each command tells the transmitter that the measured input value should equal the calibration point set.

*[DD: Device setup→Diag/Service→Calibration→Two point calib]*

It is not required to calibrate the transmitter at the PV lower and upper values, although doing so provides the best overall accuracy.

> **NOTE:** If the applied pressure is not within the allowable tolerance of the calibration point specified, the transmitter will not perform the requested calibration and will return response code 9 or 10:

*APPLIED PROCESS TOO HIGH*

*APPLIED PROCESS TOO LOW*

1. Throughout this section, this type of text indicates the menu flow for the Rosemount Model 275 with the ABB Type PTH HART Device Description loaded. Refer to Appendix D for the complete Device Description menu flow.

15. When completed, tighten the negative (-) TEST terminal jumper screw.

16. If this calibration procedure was performed after initially placing the transmitter into service, replace the cover O-ring before installing the cover.

a. Remove the old O-ring.

b. Coat the new O-ring with a film of Dow Corning 4 compound and install.

c. Coat the threads of the housing cover and the electronics housing with a light coating of NEVER-SEEZ lubricant.

17. Install the housing cover.

### *DAC Trim (Fine Tuning the Analog Loop)*

**NOTE:** This procedure applies only to analog mode transmitters.

**Commands 45 and 46**

This procedure does not require removal of the covers from the electronics housing. Compensation for slight inaccuracies in the four to 20-milliampere current loop (or in receiving devices such as recorders) is accomplished by accessing ***TRIM PV CURRENT DAC ZERO*** (command 45) and ***TRIM PV CURRENT DAC GAIN*** (command 46) on the communication device while it is connected to the target transmitter. This procedure does not adjust the zero or span of the transmitter and only applies when first installing the system or if something in the four to 20-milliampere current loop has changed. To adjust the process pressure zero, refer to ***REZERO PROCEDURE*** and the appropriate communication device instruction.

Either connect the digital multimeter, set to measure DC milliamperes, in series with the four to 20-milliampere current loop, or make a parallel connection across the precision 250-ohm resistor as shown in Figure 2-3, with the digital multimeter set to measure VDC. With the latter setup, the four to 20-milliampere output corresponds to one to five VDC.

**NOTES:** These notes only apply when measuring VDC across the 250-ohm resistor as shown in Figure 2-3.

1. The loop resistor must have a tolerance of 0.01 percent or better in order for this procedure to be valid.

2. If a resistor value other than 250 ohms is used, the voltage output will be different according to Ohm's Law:

$(V = I \times R)$.

3. Throughout this procedure, the voltage values, based on a 250-ohm resistor, will be shown in parentheses following the milliampere values.

4. When entering the DMM reading in Steps 4 and 8, they must be converted back to milliamperes using Ohm's Law:

$\left(I = \frac{V}{R}\right)$.

This is a general procedure for performing the DAC trim function. Refer to the appropriate communication device instruction for specific procedures.

*[DD: Device setup→Diag/Service→Calibration→D/A trim]*

***or***

*[DD: Device setup→Diag/Service→Calibration→ Scaled D/A trim]*

**Command 40**

1. Set the transmitter to the fixed PV current mode via ***ENTER/EXIT FIXED PV CURRENT MODE***.

2. Fix the current at 4.000 mA (1.000 VDC).

**Command 45**

3. To trim the zero or lower endpoint of the PV analog output so that the current at this output is set exactly to its minimum (typically 4.000 mA (1.000 VDC)), access ***TRIM PV CURRENT DAC ZERO***.

**NOTE:** If the fixed PV current mode has not been entered, or if the current has not been set to the exact minimum value for the DAC zero trim (or exact maximum value for the DAC gain trim), response code 9 will be returned:

*NOT IN PROPER CURRENT MODE*

4. Enter the mA reading from the digital multimeter.

5. Repeat Steps 3 and 4 until the output is 4.000 mA (1.000 VDC), plus or minus the tolerance for the particular transmitter listed in Table 4-1 (as indicated on the digital multimeter). If using a receiving device (e.g. recorder), adjust for a 0% indication.

6. Use command 40 to fix the current at 20.000 mA (5.000 VDC).

**Command 46**

7. To trim the gain for the upper endpoint of the PV output so that the current at this output is set exactly to its maximum (typically 20.000 mA (5.000 VDC)), access ***TRIM PV CURRENT DAC GAIN***.

**NOTE:** If the fixed PV current mode has not been entered, or if the current has not been set to the exact minimum value for the DAC zero trim (or exact maximum value for the DAC gain trim), Response Code 9 will be returned:

*NOT IN PROPER CURRENT MODE*

8. Enter the mA reading from the digital multimeter.

9. Repeat Steps 7 and 8 until the output is 20.000 mA (5.000 VDC), plus or minus the tolerance for the particular transmitter listed in Table 4-1 (as indicated on the digital multimeter). If using a receiving device (e.g. recorder), adjust for a 100% indication.

## *REZERO PROCEDURE*

This procedure zeros the transmitter only and does not compensate for slight inaccuracies in the four to 20 milliampere current loop. To adjust for these inaccuracies, refer to ***DAC Trim (Fine Tuning the Analog Loop)***.

**Command 43**

By accessing ***SET PV ZERO*** on the communication device, the transmitter can calibrate the PV lower value (zero-percent value) without performing a complete bench pressure calibration. There is no effect on the span of the transmitter. This command sets the existing process pressure value applied to the transmitter equal to the programmed PV lower value. The resulting offset must be within the limits defined for the particular transmitter.

*[DD: Device setup→Diag/Service→Calibration→Zero trim]*

## *VALIDATING CALIBRATION WITH THE EZ CAL OPTION*

Before using the EZ CAL option to validate calibration, consider the following:

- The EZ CAL option is for zero and span validation only. Do not use it to make large adjustments to the zero and span of the transmitter. The EZ CAL option provides no means to indicate if an error is made.
- If the change attempted is more than plus or minus ten percent of the upper range limit of the particular transmitter, the new values will be rejected. However, there is no indication that this has occurred.

To validate calibration using the EZ CAL option:

1. If not installed, refer to ***EZ CAL OPTION*** in Section 3 for the installation procedure.

2. Open the dust cover on the EZ CAL option.

3. Connect the pressure source to the high pressure (+) connection of the cell.

4. Apply a pressure to the cell equal to the configured PV lower value.

5. Turn and hold the adjustment screw on the EZ CAL option in the zero direction (indicated on the EZ CAL option) for at least three seconds. The transmitter automatically adjusts the output to 0%.

6. Apply a pressure to the cell equal to the configured PV upper value.

7. Depress the span lock and turn and hold the adjustment screw on the EZ CAL option in the span direction (indicated on the EZ CAL option) for at least three seconds. The transmitter automatically adjusts the output to 100%.

# SECTION 5 - TROUBLESHOOTING

## INTRODUCTION

The status of the transmitter is reported every time communications are established. Any errors returned at this time are general errors.

**Command 48**

If a general error indicates there is additional status information, use ***READ ADDITIONAL TRANSMITTER STATUS*** to access the additional error or errors identified in status groups one through three.

*[DD: Device setup→Diag/Service→Status→Status group 1-3]*[1]

Both general and additional errors are returned to the communication device as status bits. The general errors appear in text format (Table 5-1). The display of the additional status bits is a function of the communication device. They could be displayed in text, binary or hexadecimal format (refer to Appendix C).

Table 5-2 is dedicated to potential output signal irregularities that may or may not return a status code. Figure 5-1 is a troubleshooting flowchart. Figures 5-2 and 5-3 are continuations of the flowchart, depending on the path taken.

## GENERAL ERRORS

Table 5-1 lists the general error messages pertaining to the transmitter that can display on the communication device. Table 5-1 has five columns.

1. The ***Fail Mode*** column indicates if the error causes the transmitter to enter the fail mode. Refer to ***WRITE OUTPUT OPTIONS*** in Appendix B for more information.

2. The ***General Error Message*** column lists the errors as they appear on the display of the communication device.

3. The ***Specific Device Description Error Message*** column lists the specific error message text for users of the Rosemount Model 275 Hand-Held Terminal with the ABB Type PTH HART Device Description loaded.

4. The ***Probable Cause*** column provides a brief explanation of the cause of the error.

5. The ***Corrective Action*** column lists corrective actions to take for each error.

1. Throughout this section, this type of text indicates the menu flow for the Rosemount Model 275 with the ABB Type PTH HART Device Description loaded. Refer to Appendix D for the complete Device Description menu flow.

*Table 5-1. General Error Messages*

| Fail Mode | General Error Message | Specific Device Description Error Message | Probable Cause | Corrective Action |
|---|---|---|---|---|
| Yes | Field device malfunction | Field device has malfunctioned due to a hardware error or failure | Transmitter entered fail mode. | Access ***READ ADDITIONAL TRANSMITTER STATUS*** and refer to Table C-2. |
| No | Configuration changed | A modification has been made to the configuration of the field device | Configuration-changed flag is set in EEPROM. | Verify that configuration should have been changed. If so, use ***RESET CONFIGURATION CHANGED FLAG***. If not, configure transmitter to original values. |
| No | Cold start | A reset or self-test of the field device has occurred, or power has been removed and applied | Set on power up and cleared on the first response to a communication device. | None. Notification only. |
| No | More status available | Field device has more status available | Additional status bits are set. | Access ***READ ADDITIONAL TRANSMITTER STATUS*** and refer to Table C-2. |
| No | PV analog output fixed | Analog output and its digital representation are in fixed mode, and not responsive to input changes | Transmitter is in the fixed output mode. | Use ***ENTER/EXIT FIXED PV CURRENT MODE*** to enter a value of 0 mA to cancel fixed output. |
| No | PV analog output saturated | Analog output and its digital representation are outside the operating range limits, and not responding to input | PV is greater than +111% or less than -3.75% of its range and the analog output cannot show changes in its process input. | Check for proper pressure connection to the transmitter. |
| | | | | Check that transmitter range is appropriate for application. |
| | | | | Perform the DAC trim adjustment (refer to Section 4). |
| No | Non-PV out of limits | Process applied to the nonprimary variable is outside the operating limits of the field device | Temperature alarm has been violated. | Access ***READ ADDITIONAL TRANSMITTER STATUS*** and refer to Table C-2 to find out which temperature alarm has been violated. |
| No | PV out of limits | Process applied to the primary variable is outside the operating limits of the field device | Input pressure is over or underrange. | Correct process input. |

## *OUTPUT TROUBLESHOOTING*

Table 5-2 lists possible output irregularities, their probable causes, and the recommended corrective action.

*Table 5-2. Output Troubleshooting*

| Fault | Probable Cause | Corrective Action |
|---|---|---|
| High output | Primary element. | Check for restrictions at primary element. |
| | Pressure piping. | Check for leaks or blockage. |
| | | Check that blocking valves are fully open. |
| | | Check for entrapped gas in liquid lines and for liquid in dry lines. |
| | | Check that the density of the fluid in the pressure lines is unchanged. |
| | | Check for sediment in the transmitter process flanges. |
| | Transmitter electronics connections. | Make sure all pins and receptacles are clean. |
| | | Check cell connections. |
| | Transmitter electronics failure. | Refer to Figure 5-1 and Appendix C. |
| Erratic output | Cell. | Refer to Figure 5-1 and Appendix C. |
| | Loop wiring. | Check for intermittent shorts, open circuits and multiple grounds. |
| | Process fluid pulsation. | Increase software damping. |
| | | Install dampers in pressure piping. |
| | Pressure piping. | Check for entrapped gas in liquid lines and for liquid in dry lines. |
| | Transmitter electronics connections. | Make sure all pins and receptacles are clean. |
| | | Check cell connections. |
| | Transmitter electronics failure. | Refer to Figure 5-1 and Appendix C. |
| Low output or no output | Power supply. | Check output of power supply. |
| | Loop wiring. | Check for shorts, open circuits and multiple grounds. |
| | | Check polarity of connections. |
| | | Check loop impedance. |
| | Process connection. | Check installation and condition of process connections. |
| | | Note any changes in process properties that may affect output. |
| | Pressure piping. | Check that the pressure connection is correct. |
| | | Check for leaks or blockage. |
| | | Check that blocking valves are fully open and that bypass valves are tightly closed. |
| | | Check for entrapped gas in liquid lines and for liquid in dry lines. |
| | | Check that the density of the fluid in the pressure piping is unchanged. |
| | | Check for sediment at transmitter process connections. |
| | Transmitter electronics connections. | Check for shorts in cell leads. |
| | | Make sure pins and receptacles are clean. |
| | | Check cell connections. |
| | Transmitter electronics failure. | Refer to Figure 5-1 and Appendix C. |
| | Cell | |

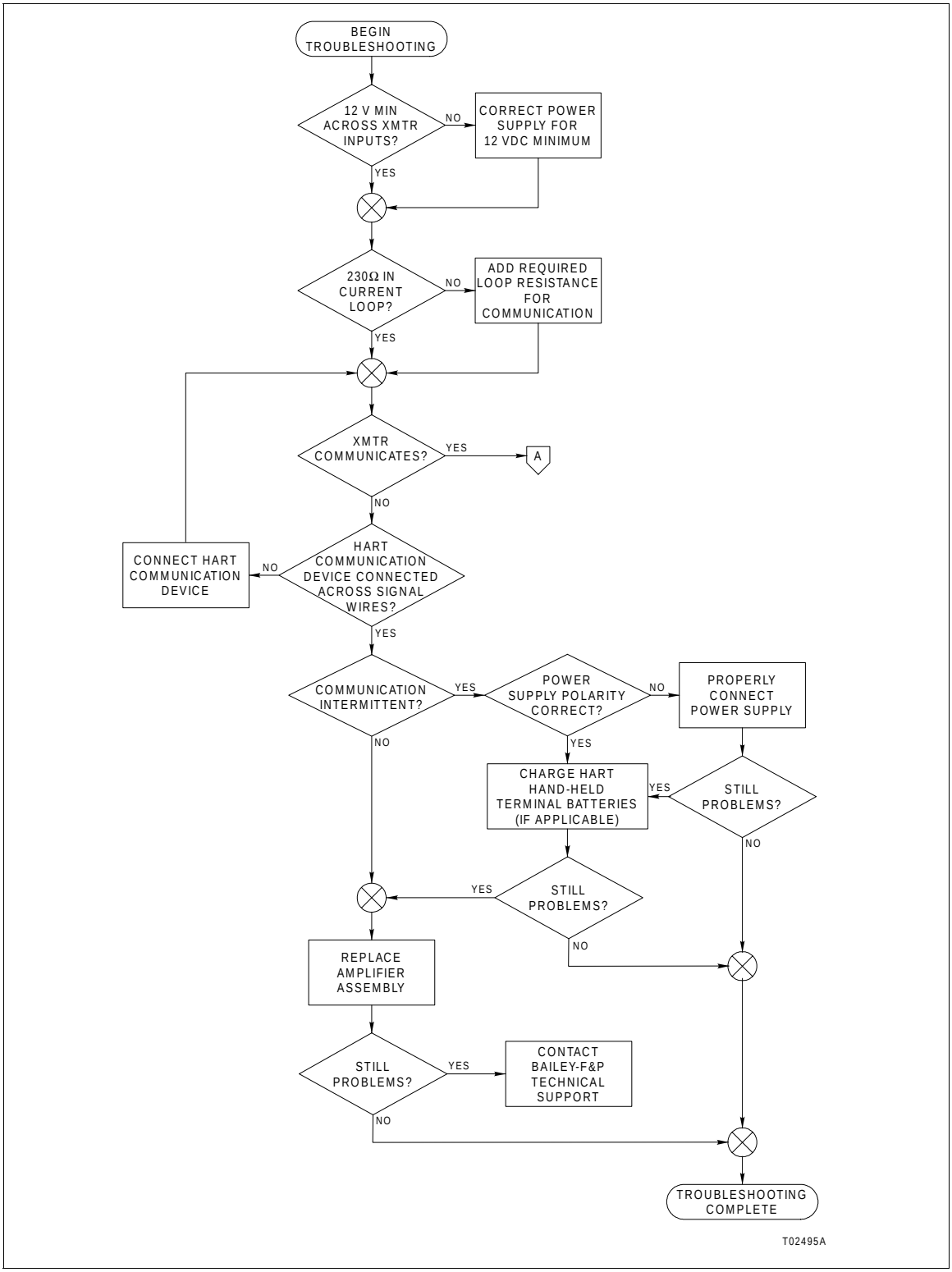



*Figure 5-1. Troubleshooting Flowchart (Sheet 1 of 3)*

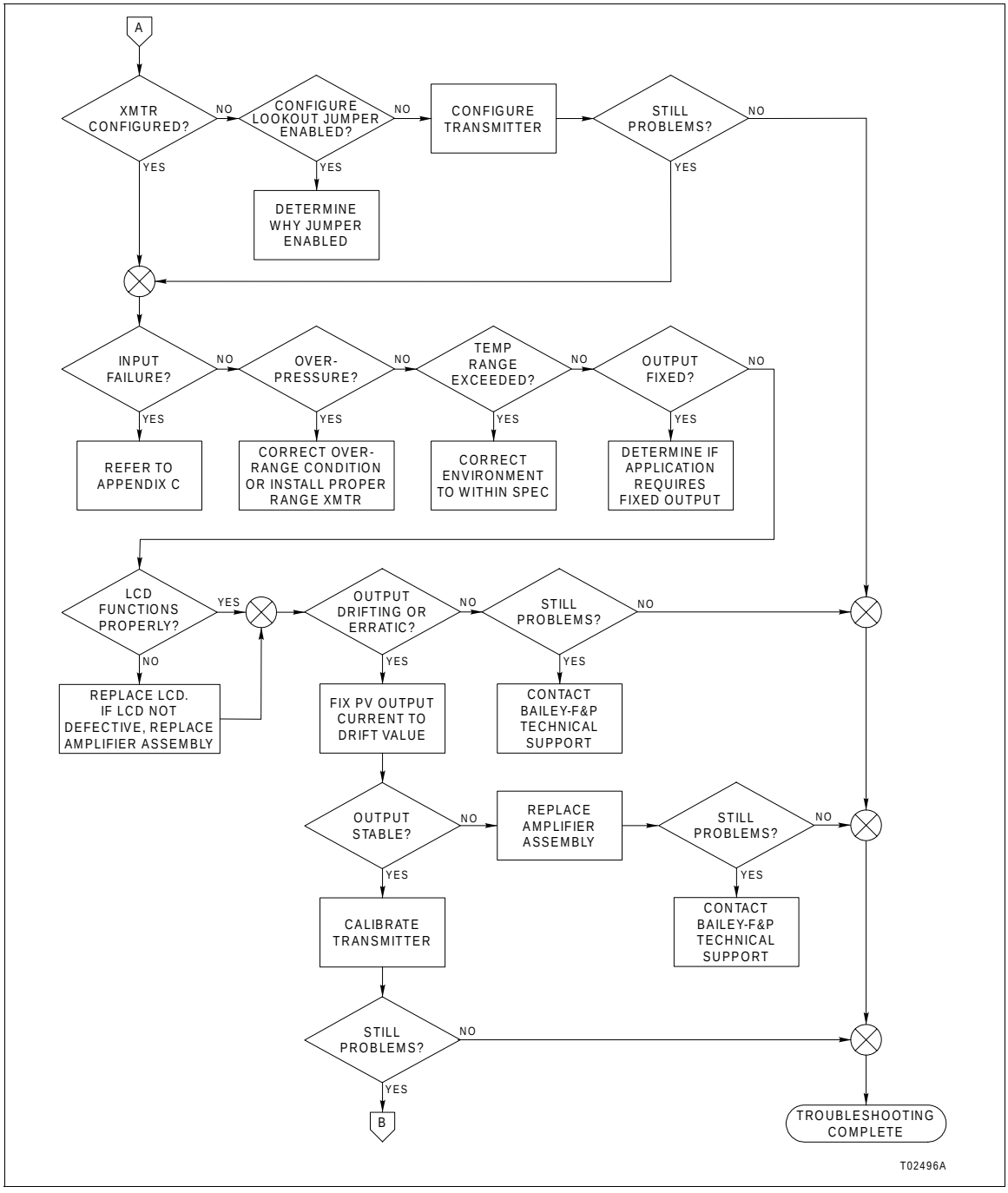



*Figure 5-2. Troubleshooting Flowchart (Sheet 2 of 3)*

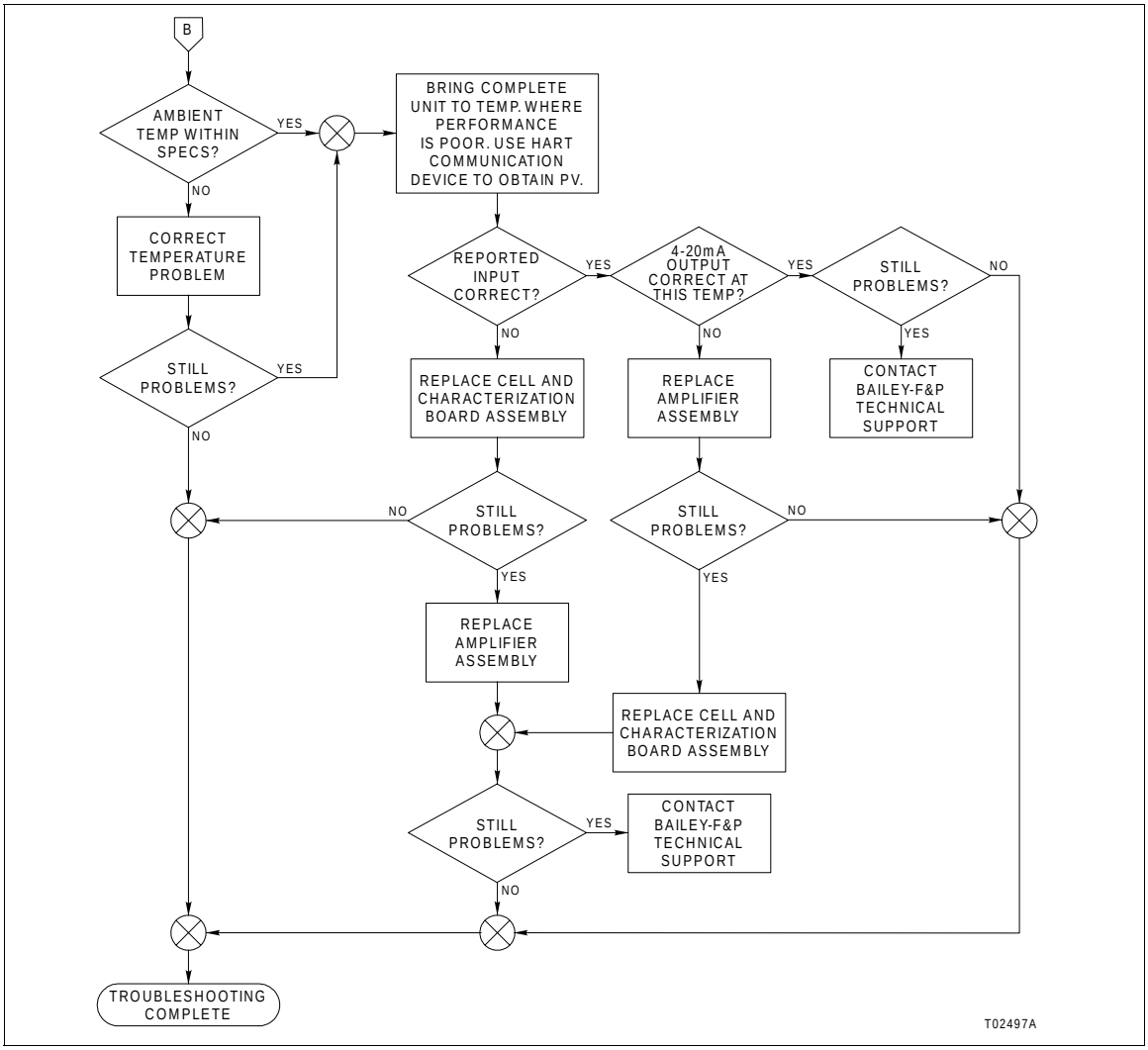



*Figure 5-3. Troubleshooting Flowchart (Sheet 3 of 3)*

# SECTION 6 - MAINTENANCE

## *INTRODUCTION*

**WARNING**

**System maintenance must be performed only by qualified personnel and only after securing the equipment controlled by the circuit. Altering or removing components from an active circuit may upset the controlled process leading to personnel injury and equipment damage.**

**Explosionproof/dust-ignitionproof installations and intrinsically safe installations in Class II or Class III hazardous locations require that the assembly be kept tight while circuits are live unless the location is known to be nonhazardous at the time. Failure to follow this warning can lead to unsafe conditions that can injure personnel and damage equipment.**

The reliability of any stand-alone product or control system is affected by the maintenance of the equipment. ABB recommends that all equipment users practice a preventive maintenance program that will keep the equipment operating at an optimum level.

**NOTE:** Refer to the ***Installing a 4 to 20 mA Transmitter in a Hazardous Location*** application guide when applicable.

Personnel performing preventive maintenance should meet the following qualifications.

- Should be qualified electrical technicians or engineers that know the proper use of test equipment.
- Should be familiar with the Type PTHD Platinum Standard HART Pressure Transmitter and associated equipment and have experience working with process control systems.

## *PREVENTIVE MAINTENANCE SCHEDULE*

The Type PTHD Platinum Standard HART Pressure Transmitter has no moving parts and requires limited maintenance when operated under normal conditions.

Table 6-1 is the preventive maintenance schedule for the Type PTHD pressure transmitter. The table lists the tasks in groups according to their specified maintenance interval. Some tasks in Table 6-1 are self-explanatory. Instructions for tasks that require further explanation are covered under ***PREVENTIVE MAINTENANCE PROCEDURES***.

If the transmitter is inoperative, or if operation is faulty, refer to Section 5.

*Table 6-1. Preventive Maintenance Schedule*[1]

| Task | Frequency |
|---|---|
| Clean indicator window (if supplied). See procedure. | 3 months |
| Clean transmitter exterior. See procedure. | |
| Check and tighten all wiring connections, including power and ground connections. See procedure. | |
| Clean sediment and deposits from connecting piping (procedure depends on the installation and the process). | |
| Check and tighten piping connections (procedure depends on the installation and the process). | |
| Check and tighten all conduit connections (procedure depends on the installation and the process). | 6 months |
| Calibrate the unit. Refer to Section 4. | 12 months |
| Change O-rings. Refer to Section 7. | |
| Complete all applicable tasks in this table. | Shutdown[2] |

**NOTES:**
1. Environmental conditions might warrant more frequent attention.
2. Shutdown is usually defined as an occurrence that happens on a frequency level of greater than one year.

## *PREVENTIVE MAINTENANCE PROCEDURES*

This section covers tasks from Table 6-1 that require specific instructions or further explanation.

- Checking and tightening all wiring connections.
- Cleaning the indicator window (if supplied).
- Cleaning the exterior of the transmitter.

### *Checking Connections*

The equipment needed to perform this procedure is a flat-blade screwdriver.

Check all signal wiring, power and ground connections within the transmitter to verify their integrity. When checking connections, always turn the screw in the direction to tighten only. If the connection is loose, it will be tightened. If the connection is tight, the tightening action will verify that it is secure. There must not be any motion done to loosen the connection.

### *Indicator Window Cleaning*

The equipment required to perform this procedure is:

- Window cleaning solution.
- Soft, lint-free cloth.

1. Spray the window cleaning solution on the soft, lint-free cloth. Do not spray directly on the indicator window.

2. Wipe the indicator window with the soft, lint-free cloth until all deposits are removed and the indicator can be easily viewed.

### *Transmitter Exterior Cleaning*

The equipment needed to perform this procedure is dependent upon the standard cleaning procedures employed by the customer.

**CAUTION**

**If the cell with characterization board assembly has been cleaned for oxygen and chlorine service, do not compromise the integrity of this cleaning during these procedures. Impurities will react with oxygen and chlorine and damage the transmitter and the process.**

**Clean the diaphragms with a soft rag and appropriate solvent. The use of metal brushes, blades, or other tools will damage the diaphragms.**

When cleaning the exterior of the transmitter, it is common to hose the unit down to free it of dust and process deposits. When this is done, the temperature of the medium (water, steam or air) should not exceed the specifications of the transmitter and associated components. Refer to Table 1-3 for temperature specifications.

In some processes, it is necessary to clean out the deposits of solid matter, crystals and viscous condensates from the measuring chambers of the cell.

If possible, do not remove the process flanges from the cell after removing the transmitter from the process.

If it is absolutely necessary to remove the process flanges to clean the transmitter, refer to ***Process Flange Removal*** and ***Process Flange Installation*** in Section 7.

# SECTION 7 - REPAIR AND REPLACEMENT PROCEDURES

## *INTRODUCTION*

| | |
|---|---|
| **WARNING** | **Repairs must be performed only by qualified personnel and only after securing the equipment controlled by the circuit. Altering or removing components from an active circuit may upset the controlled process leading to personnel injury and equipment damage.**<br><br>**Explosionproof/dust-ignitionproof installations and intrinsically safe installations in Class II or Class III hazardous locations require that the assembly be kept tight while circuits are live unless the location is known to be nonhazardous at the time. Failure to follow this warning can lead to unsafe conditions that can injure personnel and damage equipment.** |

The design of the Type PTHD pressure transmitter allows replacement of components in as little as five minutes. All calibration and configuration data are stored on both the amplifier assembly and characterization board.

Replacement of the amplifier assembly requires no configuration, as the characterization board automatically downloads this information into the amplifier assembly. Replacement cell with characterization board assemblies come with the standard factory configuration (Table 1-8) and that data transfers to the original amplifier assembly. If a configuration other than the standard one is required, the transmitter must go through the step-by-step configuration. The transmitter must also be calibrated according to the procedures in Section 4.

## *COMPONENT REMOVAL AND INSTALLATION PROCEDURES*

| | |
|---|---|
| **CAUTION** | **If the cell with characterization board assembly has been cleaned for oxygen and chlorine service, do not compromise the integrity of this cleaning during these procedures. Impurities will react with oxygen and chlorine and damage the transmitter and the process.** |

All procedures assume replacement of O-rings whenever a component sealed by the O-ring is removed.

The items needed to perform these procedures are:

- Spare parts kit identified in Section 8 for the particular component to be replaced.
- O-ring kit identified in Section 8 for the particular application.

- Four-millimeter or 5/32-inch Allen wrench.
- Phillips screwdriver.
- Flat-blade screwdriver.
- Zero to one-inch adjustable crescent wrench.
- Torque wrench or wrenches ranging from at least 45 to 191 Newton meters (33 to 141 foot-pounds).
- NEVER-SEEZ lubricant.
- Dow Corning 4 compound.
- Tape-Seal® Teflon tape.
- Nonmetallic tool to remove O-rings.

**NOTE:** Refer to ***SPECIAL HANDLING*** in Section 3 when performing these procedures.

### *Cell with Characterization Board Assembly Removal*

**NOTE:** The cell and characterization board are a matched set. If performing this procedure to remove and install the same cell (for instance, to change the O-rings or clean the cell), the characterization board does not need replacing. If performing this procedure to replace the cell with a new cell, replace the entire cell with characterization board assembly.

1. Remove the transmitter from the process and disconnect power.

2. Remove the left housing cover (Fig. 7-1).

3. Use the Phillips screwdriver to remove the three amplifier assembly screws (Fig. 7-2).

4. Gently pull the amplifier assembly out of the electronics housing to unplug it from the characterization board connector (Fig. 7-2).Remove the two characterization board screws (Fig. 7-2).

5. Use the 4-millimeter or 5/32-inch Allen wrench to remove the cell lock screw (Fig. 7-1).

6. Remove the cell lock (Fig. 7-1).

7. Carefully remove the cell and process flange assembly, feeding the cell cable and characterization board through the opening left in the electronics housing by the cell.

8. Use the crescent wrench to remove all four of the process flange nuts on either side of the process flange (Fig. 7-3).

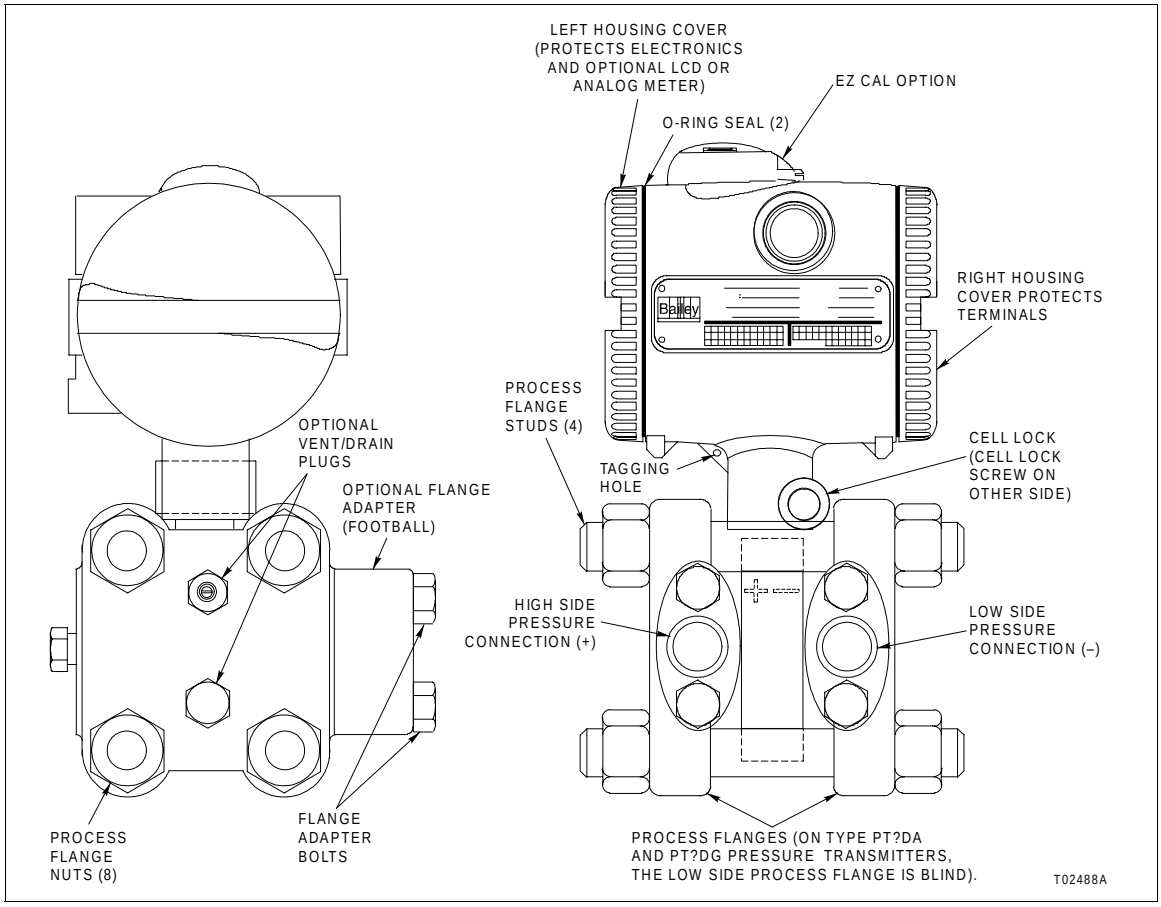



*Figure 7-1. External Components*

9. Separate the process flanges from the cell, taking care not to damage the isolating diaphragms (Fig. 7-3).

10. Remove the cell, process and cover O-rings (Figs. 7-1 and 7-3).

### *Cell with Characterization Board Assembly Installation*

1. Determine the proper replacement cell, process and cover O-rings for the application (refer to Section 8).

2. Coat the O-rings with a film of Dow Corning 4 compound and install.

3. Mount the process flanges in the proper position and insert the process flange studs until the process flange nuts already installed come in contact with the process flange.

4. Starting with one of the four process flange nuts, finger tighten it only until it comes in contact with the process flange.

5. Proceed in the same manner with the remainder of the process flange nuts, operating diagonally two-by-two.

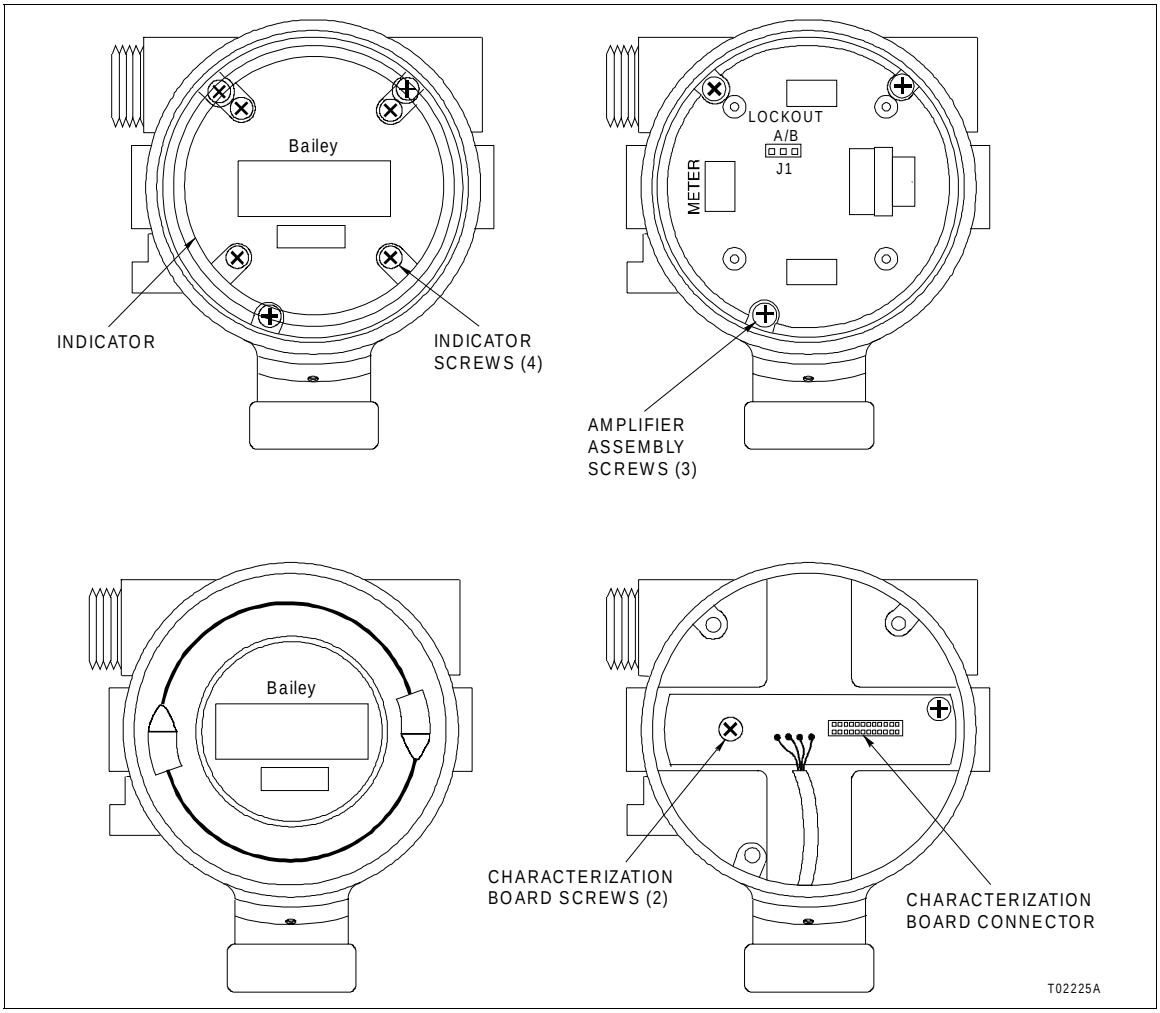



*Figure 7-2. Internal Components*

6. Working diagonally two-by-two, tighten the process flange nuts in 25% increments until reaching a value of 65 to 69 Newton meters (48 to 52 ft-lbs) for stainless steel and NACE nuts, 78 to 82 Newton meters (57 to 61 ft-lbs) for carbon steel nuts, or 179 to 191 Newton meters (131 to 141 ft-lbs) for high static pressure nuts.

> **NOTE:** If the O-rings are made of PTFE, tighten the process flange nuts and flange adapter bolts to the same torque again after ***five days***. This is necessary due to the cold flow properties of PTFE. Tests have shown that a loss of torque of as much as 40% occurs over the five days. After a second tightening, no loss of torque is apparent.

7. Coat the cylindrical part of the cell with a light coating of NEVER-SEEZ lubricant (Fig. 7-3).

8. Feed the characterization board and cell cable through the opening in the bottom of the electronics housing, being careful not to damage the cell cable.

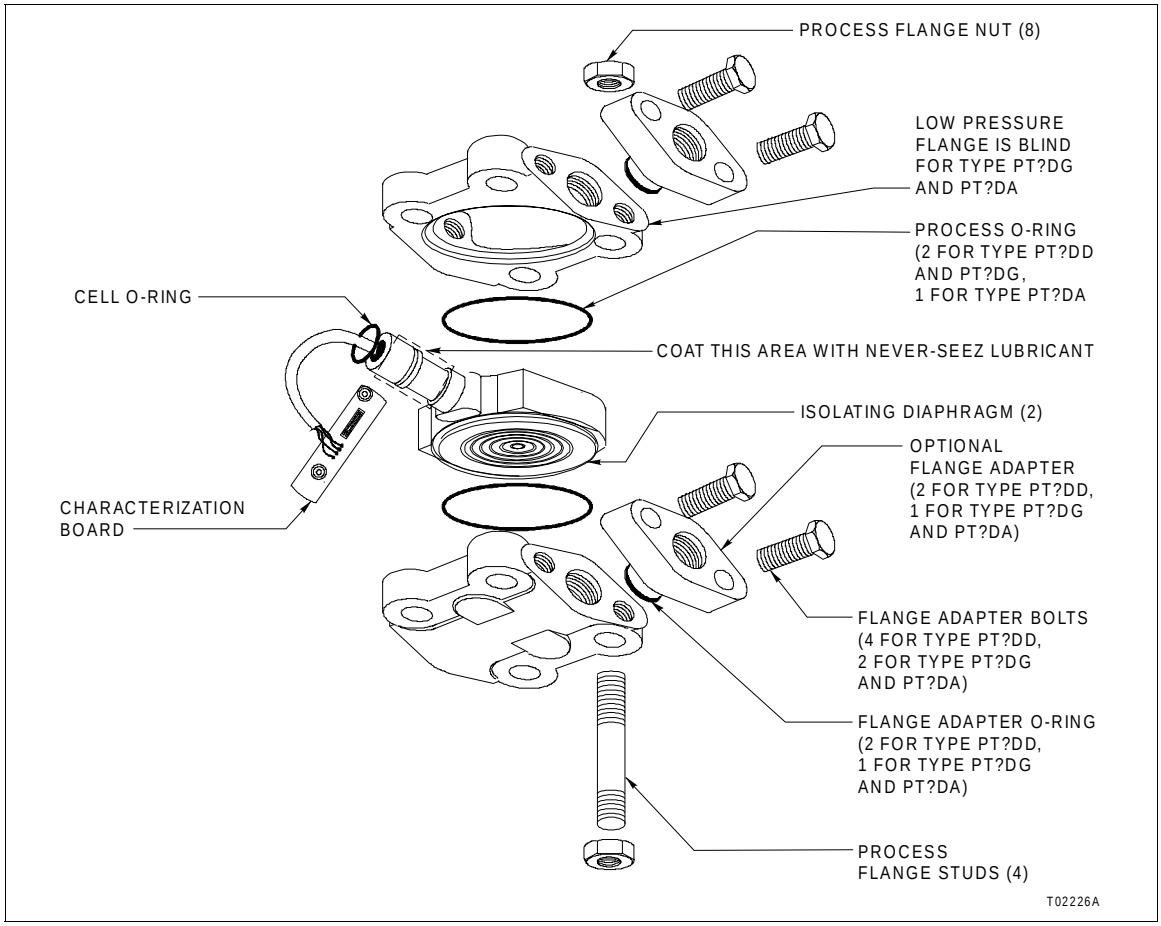



*Figure 7-3. Cell with Characterization Board Assembly*

9. Mount the cell into the electronics housing in the desired orientation.

10. Install the cell lock and tighten the cell lock screw (Fig. 7-1).

11. Mount the characterization board to the electronics housing and install the two characterization board screws (Fig. 7-2).

12. Align the rectangular opening on the bottom of the amplifier assembly with the characterization board connector (Fig. 7-2) and install the amplifier assembly into the electronics housing. Gently press it down to seat the mating connectors.

13. Install the three amplifier assembly screws (Fig. 7-2).

14. Grease the threads of the housing cover and the electronics housing with a light film of NEVER-SEEZ lubricant.

15. Install the housing cover.

**NOTE:** There will be a delay (less than 45 seconds) after initial power up when a new cell with characterization board assembly and amplifier assembly are mated.

16. If this is a new cell with characterization board assembly, and a configuration other than the standard factory configuration is desired (Table 1-8), refer to Appendix B and the appropriate communication device instruction.

17. Perform the calibration procedures in Section 4.

18. Install the transmitter on the process.

### *Amplifier Assembly Removal*

Perform Steps 1 through 4 under ***Cell with Characterization Board Assembly Removal***.

### *Amplifier Assembly Installation*

1. Determine the proper replacement cover O-rings (refer to Section 8).

2. Coat the O-rings with a film of Dow Corning 4 compound and install.

3. Perform Steps 12 through 15 under ***Cell with Characterization Board Assembly Installation***.

4. Perform the calibration procedures outlined in Section 4.

**NOTE:** This procedure assumes replacement of the amplifier assembly only. This means that the original configuration is still present in the characterization board memory and will be automatically downloaded to the amplifier assembly.

5. Install the transmitter on the process.

### *Electronics Housing and Cover Replacement*

If the electronics housing sustains damage, but the internal components and cell are unaffected:

1. Remove the transmitter from the process and disconnect power.

2. Remove the housing covers from the electronics housing (Fig. 7-1). If the housing covers ***do not*** require replacing, go to Step 3. If the housing covers ***do*** require replacing, go to Step 6.

3. Remove the cover O-rings (Fig. 7-1).

4. Determine the proper cover O-rings (refer to Section 8).

5. Coat the cover O-rings with a film of Dow Corning 4 compound and install.

6. Perform Steps 3 through 8 under ***Cell with Characterization Board Assembly Removal***.

7. Discard the old electronics housing covers (if required).

8. Determine the proper cell O-ring (Fig. 7-3). Refer to Section 8.

9. Coat the cell O-ring with a film of Dow Corning 4 compound and install.

10. Perform Steps 7 through 15 under ***Cell with Characterization Board Assembly Installation***.

11. Perform the calibration checks in Section 4 to verify the calibration has not changed.

12. Install the transmitter on the process.

### *Bolting Removal*

1. Remove the transmitter from the process and disconnect power.

2. Using the crescent wrench, remove four of the process flange nuts from either side of the process flange (Figs. 7-1 and 7-3).

3. Remove the process flange studs (Fig. 7-3).

4. Remove the process O-rings.

### *Bolting Installation*

1. Determine the proper process O-rings for the application (Fig. 7-3). Refer to Section 8.

2. Coat the process O-rings with a film of Dow Corning 4 compound and install.

3. Using the new process flange studs and process flange nuts, finger tighten four of the process flange nuts on the sides of each of the four process flange studs with the least threads until the process flange nuts are at the bottom of the threads.

4. Insert the process flange studs into the flange and cell assembly until the process flange nuts already installed come in contact with the process flange.

5. Starting with one of the other four process flange nuts, finger tighten it only until it comes in contact with the process flange.

6. Proceed in the same manner with the remainder of the process flange nuts, operating diagonally two-by-two.

7. Working diagonally two-by-two, tighten the process flange nuts in 25% increments until reaching a value of 65 to 69 Newton meters (48 to 52 ft-lbs) for stainless steel and NACE nuts, 78 to 82 Newton meters (57 to 61 ft-lbs) for carbon steel nuts, or 179 to 191 Newton meters (131 to 141 ft-lbs) for high static pressure nuts.

> **NOTE:** If the O-rings are made of PTFE, tighten the process flange nuts and flange adapter bolts to the same torque again after ***five days***. This is necessary due to the cold flow properties of PTFE. Tests have shown that a loss of torque of as much as 40% occurs over the five days. After a second tightening, no loss of torque is apparent.

8. Perform the procedures in Section 4 to verify that the calibration of the transmitter has not changed.

9. Install the transmitter on the process.

### *Process Flange Removal*

1. Remove the transmitter from the process and disconnect power.

2. Using the crescent wrench, remove the flange adapters and vent/drain plugs from the process flanges (if supplied, Figs. 7-1 and 7-3).

3. Using the crescent wrench, remove four of the process flange nuts from either side of the process flange (Fig. 7-3).

4. Remove the process flange studs (Fig. 7-3).

5. Separate the flanges from the cell, being careful not to damage the isolating diaphragms (Fig. 7-3).

6. Remove the process and flange adapter O-rings (if supplied).

### *Process Flange Installation*

1. Determine the proper process and flange adapter O-rings for the application (if supplied, Fig. 7-3). Refer to Section 8.

2. Coat the O-rings with a film of Dow Corning 4 compound and install.

3. Perform Steps 4 through 7 under ***Bolting Installation***.

4. If supplied, install the flange adapters. Orient them in the same position as when they were removed to maintain the proper center-to-center distance for the application.

5. Torque the flange adapter bolts to 45 to 50 Newton meters (33 to 37 ft-lbs).

> **NOTE:** If the O-rings are made of PTFE, tighten the process flange nuts and flange adapter bolts to the same torque again after ***five days***. This is necessary due to the cold flow properties of PTFE. Tests have shown that a loss of torque of as much as 40% occurs over the five days. After a second tightening, no loss of torque is apparent.

6. If supplied and removed, wrap the threads of the vent/drain plugs with one layer of Tape-Seal using a small overlap.

7. Press the tape into the threads slightly to hold it in place.

8. Install the vent/drain plugs and tighten them with the crescent wrench.

9. Perform the procedures in Section 4 to verify that the calibration of the transmitter has not changed.

10. Install the transmitter on the process.

### *O-Ring Replacement*

All O-ring replacement procedures are incorporated in the steps for the replacement of various transmitter components.

## *OPTIONAL EQUIPMENT REMOVAL AND INSTALLATION PROCEDURES*

> **NOTE:** Refer to ***SPECIAL HANDLING*** in Section 3 before performing these procedures.

### *Indicator Removal*

1. Remove the transmitter from the process and disconnect power.

2. Remove the left housing cover from the electronics housing (Fig. 7-1).

3. Remove the four indicator screws (Fig. 7-2).

4. Gently pull on the indicator to unplug it from the amplifier assembly.

5. Remove the cover O-ring.

### *Indicator Installation*

1. Align one of the connectors on the back of the indicator with the meter opening in the amplifier assembly (Fig. 7-2) to obtain the

desired viewing orientation. Gently press the indicator down to seat the mating connectors.

**NOTE:** The analog meter must be installed in the upright (zero degree) position. It cannot be rotated.

2. Install the four indicator screws (Fig. 7-2).

3. Identify the cover O-rings (refer to Section 8).

4. Coat the O-rings with a film of Dow Corning 4 compound and install.

5. Coat the threads of the housing cover and the housing with a light coating of NEVER-SEEZ lubricant.

6. Install the housing cover.

7. Install the transmitter on the process.

### *EZ CAL Option Removal*

1. Use the flat-blade screwdriver to loosen the mounting screw that secures the EZ CAL option to the electronics housing (Fig. 7-1).

2. Remove the EZ CAL option.

### *EZ CAL Option Installation*

1. Position the EZ CAL option on the electronics housing.

2. Use the flat-blade screwdriver to tighten the mounting screw.

### *Flange Adapter Removal*

1. Remove the transmitter from the process and disconnect power.

2. Using the crescent wrench, remove the flange adapter bolts (Figs. 7-1 and 7-3).

3. Remove the flange adapter O-rings (Fig. 7-3).

### *Flange Adapter Installation*

1. Determine the proper flange adapter O-rings for the application (refer to Section 8).

2. Coat the flange adapter O-rings with a film of Dow Corning 4 compound and install.

3. Install the flange adapters. Orient them in the same position as when they were removed to maintain the proper center-to-center distance for the application.

4. Torque the flange adapter bolts to 45 to 50 Newton meters (33 to 37 ft-lbs).

> **NOTE:** If the flange adapter O-rings are made of PTFE, tighten the flange adapter bolts to the same torque again after ***five days***. This is necessary due to the cold flow properties of PTFE. Tests have shown that a loss of torque of as much as 40% occurs over the five days. After a second tightening, no loss of torque is apparent.

5. Install the transmitter on the process.

### *Vent/Drain Plug Removal*

1. Remove the transmitter from the process and disconnect power.

2. Using the crescent wrench, remove the vent/drain plugs.

### *Vent/Drain Plug Installation*

1. Wrap the threads of the vent/drain plugs with one layer of Tape-Seal Teflon tape using a small overlap.

2. Press the tape into the thread slightly to hold it in place.

3. Install the vent/drain plugs and tighten them with the crescent wrench.

4. Install the transmitter on the process.

# SECTION 8 - SUPPORT SERVICES

## *INTRODUCTION*

ABB can help in the use, application and repair of its products. Contact the nearest sales office to make requests for sales, applications, installation, repair, overhaul and maintenance contract services.

## *REPLACEMENT PARTS*

When making repairs, order replacement parts from an authorized ABB sales representative. Provide the following information:

1. Part description, part number and quantity.

2. Nomenclature and serial numbers (if applicable).

3. ABB instruction number, page number and reference figure that identifies the part.

When ordering standard parts from ABB, use the part numbers and descriptions from the spare parts lists. Order nonstandard parts from the nearest ABB sales office.

## *SPARE PARTS LISTS*

Tables 8-1 through 8-14 list spare parts and kits. All kits are delivered with a copy of the kit drawing. This drawing lists the individual parts contained in the kit and their part numbers. To order compensated spare or replacement cell with characterization board assemblies, refer to ***Cell with Characterization Board Assembly Replacements***.

The ***Applicable Types*** column is included to indicate the nomenclature of the transmitter as originally supplied. Dashes in any of the 15 nomenclature positions indicate that any possible selection for that position can apply.

### *O-Ring Kits*

*Table 8-1. O-Rings, Cell and Cover[1]*

| O-Ring | Kit Number | Material | Applicable Types |
|---|---|---|---|
| Cell | 258556_7 | Buna-N | All |
| Cover | 258556_8 | | |

**NOTE:**
1. Each kit contains 10 O-rings.

*Table 8-2. O-Ring, Process Flange[1]*

| Kit Number | Material | Applicable Types | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Position | | | | | | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258556_1 | Viton | P | T | H | D | - | - | - | - | - | **1** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **2** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **3** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **4** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **5** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **6** | - | - | - | - | - |
| 258556_2 | Teflon | P | T | H | D | - | - | - | - | - | **A** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **B** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **C** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **D** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **E** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **F** | - | - | - | - | - |
| 258556_3 | Ethylene propylene | P | T | H | D | - | - | - | - | - | **M** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **N** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **P** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **Q** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **R** | - | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **S** | - | - | - | - | - |

**NOTE:**
1. Each kit contains 10 O-rings.

*Table 8-3. O-Ring, Flange Adapter[1]*

| Kit Number | Material | Applicable Types | Applicable Types |
|---|---|---|---|
| | | Position | Position |
| | | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 |
| 258556_4 | Viton | P T H D - - - - - **1** **A** - - - - | P T H D - - - - - **4** **A** - - - - |
| | | P T H D - - - - - **1** **B** - - - - | P T H D - - - - - **4** **B** - - - - |
| | | P T H D - - - - - **1** **D** - - - - | P T H D - - - - - **4** **D** - - - - |
| | | P T H D - - - - - **1** **M** - - - - | P T H D - - - - - **4** **M** - - - - |
| | | P T H D - - - - - **1** **N** - - - - | P T H D - - - - - **4** **N** - - - - |
| | | P T H D - - - - - **1** **Q** - - - - | P T H D - - - - - **4** **Q** - - - - |
| | | P T H D - - - - - **2** **A** - - - - | P T H D - - - - - **5** **A** - - - - |
| | | P T H D - - - - - **2** **B** - - - - | P T H D - - - - - **5** **B** - - - - |
| | | P T H D - - - - - **2** **D** - - - - | P T H D - - - - - **5** **D** - - - - |
| | | P T H D - - - - - **2** **M** - - - - | P T H D - - - - - **5** **M** - - - - |
| | | P T H D - - - - - **2** **N** - - - - | P T H D - - - - - **5** **N** - - - - |
| | | P T H D - - - - - **2** **Q** - - - - | P T H D - - - - - **5** **Q** - - - - |
| | | P T H D - - - - - **3** **A** - - - - | P T H D - - - - - **6** **A** - - - - |
| | | P T H D - - - - - **3** **B** - - - - | P T H D - - - - - **6** **B** - - - - |
| | | P T H D - - - - - **3** **D** - - - - | P T H D - - - - - **6** **D** - - - - |
| | | P T H D - - - - - **3** **M** - - - - | P T H D - - - - - **6** **M** - - - - |
| | | P T H D - - - - - **3** **N** - - - - | P T H D - - - - - **6** **N** - - - - |
| | | P T H D - - - - - **3** **Q** - - - - | P T H D - - - - - **6** **Q** - - - - |
| 258556_5 | Teflon | P T H D - - - - - **A** **A** - - - - | P T H D - - - - - **D** **A** - - - - |
| | | P T H D - - - - - **A** **B** - - - - | P T H D - - - - - **D** **B** - - - - |
| | | P T H D - - - - - **A** **D** - - - - | P T H D - - - - - **D** **D** - - - - |
| | | P T H D - - - - - **A** **M** - - - - | P T H D - - - - - **D** **M** - - - - |
| | | P T H D - - - - - **A** **N** - - - - | P T H D - - - - - **D** **N** - - - - |
| | | P T H D - - - - - **A** **Q** - - - - | P T H D - - - - - **D** **Q** - - - - |
| | | P T H D - - - - - **B** **A** - - - - | P T H D - - - - - **E** **A** - - - - |
| | | P T H D - - - - - **B** **B** - - - - | P T H D - - - - - **E** **B** - - - - |
| | | P T H D - - - - - **B** **D** - - - - | P T H D - - - - - **E** **D** - - - - |
| | | P T H D - - - - - **B** **M** - - - - | P T H D - - - - - **E** **M** - - - - |
| | | P T H D - - - - - **B** **N** - - - - | P T H D - - - - - **E** **N** - - - - |
| | | P T H D - - - - - **B** **Q** - - - - | P T H D - - - - - **E** **Q** - - - - |
| | | P T H D - - - - - **C** **A** - - - - | P T H D - - - - - **F** **A** - - - - |
| | | P T H D - - - - - **C** **B** - - - - | P T H D - - - - - **F** **B** - - - - |
| | | P T H D - - - - - **C** **D** - - - - | P T H D - - - - - **F** **D** - - - - |
| | | P T H D - - - - - **C** **M** - - - - | P T H D - - - - - **F** **M** - - - - |
| | | P T H D - - - - - **C** **N** - - - - | P T H D - - - - - **F** **N** - - - - |
| | | P T H D - - - - - **C** **Q** - - - - | P T H D - - - - - **F** **Q** - - - - |

*Table 8-3. O-Ring, Flange Adapter[1] (continued)*

| Kit Number | Material | Applicable Types | | | | | | | | | | | | | | Applicable Types | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Position | | | | | | | | | | | | | | Position | | | | | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258556_6 | Ethylene propylene | P | T | H | D | - | - | - | - | - | **M** | **A** | - | - | - | - | P | T | H | D | - | - | - | - | - | **Q** | **A** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **M** | **B** | - | - | - | - | P | T | H | D | - | - | - | - | - | **Q** | **B** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **M** | **D** | - | - | - | - | P | T | H | D | - | - | - | - | - | **Q** | **D** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **M** | **M** | - | - | - | - | P | T | H | D | - | - | - | - | - | **Q** | **M** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **M** | **N** | - | - | - | - | P | T | H | D | - | - | - | - | - | **Q** | **N** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **M** | **Q** | - | - | - | - | P | T | H | D | - | - | - | - | - | **Q** | **Q** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **N** | **A** | - | - | - | - | P | T | H | D | - | - | - | - | - | **R** | **A** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **N** | **B** | - | - | - | - | P | T | H | D | - | - | - | - | - | **R** | **B** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **N** | **D** | - | - | - | - | P | T | H | D | - | - | - | - | - | **R** | **D** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **N** | **M** | - | - | - | - | P | T | H | D | - | - | - | - | - | **R** | **M** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **N** | **N** | - | - | - | - | P | T | H | D | - | - | - | - | - | **R** | **N** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **N** | **Q** | - | - | - | - | P | T | H | D | - | - | - | - | - | **R** | **Q** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **P** | **A** | - | - | - | - | P | T | H | D | - | - | - | - | - | **S** | **A** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **P** | **B** | - | - | - | - | P | T | H | D | - | - | - | - | - | **S** | **B** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **P** | **D** | - | - | - | - | P | T | H | D | - | - | - | - | - | **S** | **D** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **P** | **M** | - | - | - | - | P | T | H | D | - | - | - | - | - | **S** | **M** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **P** | **N** | - | - | - | - | P | T | H | D | - | - | - | - | - | **S** | **N** | - | - | - | - |
| | | P | T | H | D | - | - | - | - | - | **P** | **Q** | - | - | - | - | P | T | H | D | - | - | - | - | - | **S** | **Q** | - | - | - | - |

**NOTE:**
1. Each kit contains 10 O-rings.

### *Flange and Bolting Kits*

*Table 8-4. Bolting*[1]

| Kit Number | Application | Material | Stud Size | Pressure Rating[2] | | Applicable Types | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | kPa | psi | Position | | | | | | | | | | | | | | |
| | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258551_1 | General purpose | Carbon steel | M12 | 25,000 | 3,625 | P | T | H | D | - | - | - | - | - | **1** | - | - | - | - | - |
| | | | | | | P | T | H | D | - | - | - | - | - | **A** | - | - | - | - | - |
| | | | | | | P | T | H | D | - | - | - | - | - | **M** | - | - | - | - | - |
| | | | | | | P | T | H | D | - | - | - | - | - | **W** | - | - | - | - | - |
| 258551_2 | General purpose | Stainless steel | M12 | 20,000 | 2,900 | P | T | H | D | - | - | - | - | - | **2** | - | - | - | - | - |
| | | | | | | P | T | H | D | - | - | - | - | - | **B** | - | - | - | - | - |
| | | | | | | P | T | H | D | - | - | - | - | - | **N** | - | - | - | - | - |
| | | | | | | P | T | H | D | - | - | - | - | - | **X** | - | - | - | - | - |
| 258551_3 | NACE Class 2 | 4140 carbon steel | M12 | 20,000 | 2,900 | P | T | H | D | - | - | - | - | - | **3** | - | - | - | - | - |
| | | | | | | P | T | H | D | - | - | - | - | - | **C** | - | - | - | - | - |
| | | | | | | P | T | H | D | - | - | - | - | - | **P** | - | - | - | - | - |
| | | | | | | P | T | H | D | - | - | - | - | - | **Y** | - | - | - | - | - |
| 258551_4 | General purpose high static pressure | Carbon steel | M18 | 41,000 | 6,000 | P | T | H | D | **D** | - | - | - | - | **4** | - | - | - | - | - |
| | | | | | | P | T | H | D | **D** | - | - | - | - | **D** | - | - | - | - | - |
| | | | | | | P | T | H | D | **D** | - | - | - | - | **Q** | - | - | - | - | - |
| 258551_5 | General purpose high static pressure | Stainless steel | M18 | 41,000 | 6,000 | P | T | H | D | **D** | - | - | - | - | **5** | - | - | - | - | - |
| | | | | | | P | T | H | D | **D** | - | - | - | - | **E** | - | - | - | - | - |
| | | | | | | P | T | H | D | **D** | - | - | - | - | **R** | - | - | - | - | - |
| 258551_6 | NACE Class 2 high static pressure | 4140 carbon steel | M18 | 41,000 | 6,000 | P | T | H | D | **D** | - | - | - | - | **6** | - | - | - | - | - |
| | | | | | | P | T | H | D | **D** | - | - | - | - | **F** | - | - | - | - | - |
| | | | | | | P | T | H | D | **D** | - | - | - | - | **S** | - | - | - | - | - |

**NOTES:**
1. Each kit contains four studs and eight nuts.
2. Exceptions to the pressure ratings listed are:
   The pressure rating for Type PTHDDA pressure transmitters is 2,000 kPa (300 psi).
   The pressure rating for Types PTHDDH and PTHDGH pressure transmitters is 14,000 kPa (2,000 psi).
   The pressure rating for all transmitters with tantalum diaphragms (3, C or G in nomenclature position 7) is 14,000 kPa (2,000 psi).
   High static pressure bolting and flanges are only available for Types PTHDDB, PTHDDC, PTHDDD, PTHDDF and PTHDDG pressure transmitters, excluding those with tantalum diaphragms.

*Table 8-5. Process Flange, High Pressure Side*[1]

| Kit Number | Process Flange | | Application | Vent/Drain Plug | | Pipe Plug Qty | Applicable Types | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Qty | | Mounting | Qty | | Position | | | | | | | | | | | | | |
| | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258553_1 | Stainless steel 316 | 1 | Basic flange | Side | 1 | 2 | P | T | H | D | - | - | - | **2** | - | **1** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **2** | - | **2** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **2** | - | **3** | - | - | - | - | - |

*Table 8-5. Process Flange, High Pressure Side[1] (continued)*

| Kit Number | Process Flange | | Application | Vent/Drain Plug | | Pipe Plug Qty | Applicable Types | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Qty | | Mounting | Qty | | Position | | | | | | | | | | | |
| | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258553_1 *(cont)* | Stainless steel 316 | 1 | Basic flange | Side | 1 | 2 | P | T | H | D | - | - | - | **2** | - | **A** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **2** | - | **B** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **2** | - | **C** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **2** | - | **M** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **2** | - | **N** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **2** | - | **P** | - | - | - | - | - |
| 258553_2 | Stainless steel 316 | 1 | Basic flange | Rear | 1 | 0 | P | T | H | D | - | - | - | **4** | - | **1** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **4** | - | **2** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **4** | - | **3** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **4** | - | **A** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **4** | - | **B** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **4** | - | **C** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **4** | - | **M** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **4** | - | **N** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **4** | - | **P** | - | - | - | - | - |
| 258553_3 | Hastelloy C-276 | 1 | Basic flange | Side | 1 | 2 | P | T | H | D | - | - | - | **B** | - | **1** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **B** | - | **2** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **B** | - | **3** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **B** | - | **A** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **B** | - | **B** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **B** | - | **C** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **B** | - | **M** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **B** | - | **N** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **B** | - | **P** | - | - | - | - | - |
| 258553_4 | Hastelloy C-276 | 1 | Basic flange | Rear | 1 | 0 | P | T | H | D | - | - | - | **D** | - | **1** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **D** | - | **2** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **D** | - | **3** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **D** | - | **A** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **D** | - | **B** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **D** | - | **C** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **D** | - | **M** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **D** | - | **N** | - | - | - | - | - |
| | | | | | | | P | T | H | D | - | - | - | **D** | - | **P** | - | - | - | - | - |

*Table 8-5. Process Flange, High Pressure Side[1] (continued)*

| Kit Number | Process Flange | | Application | Vent/Drain Plug | | Pipe Plug Qty | Applicable Types | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Qty | | Mounting | Qty | | Position | | | | | | | | | | |
| | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258553_5 | Stainless steel 316 | 1 | High static pressure flange[2] | Side | 1 | 2 | P | T | H | D | D | - | - | 2 | - | 4 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 2 | - | 5 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 2 | - | 6 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 2 | - | D | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 2 | - | E | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 2 | - | F | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 2 | - | Q | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 2 | - | R | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 2 | - | S | - | - | - | - | - |
| 258553_6 | Stainless steel 316 | 1 | High static pressure flange[2] | Rear | 1 | 0 | P | T | H | D | D | - | - | 4 | - | 4 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 4 | - | 5 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 4 | - | 6 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 4 | - | D | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 4 | - | E | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 4 | - | F | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 4 | - | Q | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 4 | - | R | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | 4 | - | S | - | - | - | - | - |
| 258553_7 | Hastelloy C-276 | 1 | High static pressure flange[2] | Side | 1 | 2 | P | T | H | D | D | - | - | B | - | 4 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | B | - | 5 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | B | - | 6 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | B | - | D | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | B | - | E | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | B | - | F | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | B | - | Q | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | B | - | R | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | B | - | S | - | - | - | - | - |

*Table 8-5. Process Flange, High Pressure Side[1] (continued)*

| Kit Number | Process Flange | | Application | Vent/Drain Plug | | Pipe Plug Qty | Applicable Types | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Qty | | Mounting | Qty | | Position | | | | | | | | | | | |
| | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258553_8 | Hastel-loy C-276 | 1 | High static pressure flange[2] | Rear | 1 | 0 | P | T | H | D | D | - | - | D | - | 4 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | D | - | 5 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | D | - | 6 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | D | - | D | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | D | - | E | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | D | - | F | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | D | - | Q | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | D | - | R | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | D | - | S | - | - | - | - | - |

**NOTES:**
1. Each kit contains one process flange with vent/drain plugs and pipe plugs installed as indicated in this table.
2. High static pressure bolting and flanges are only available for Types PTHDDB, PTHDDC, PTHDDD, PTHDDF and PTHDDG pressure transmitters, excluding those with tantalum diaphragms.

*Table 8-6. Process Flange, Low Pressure Side[1,2]*

| Kit Number | Process Flange | | Application | Vent/Drain Plug | | Pipe Plug Qty | Applicable Types | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Qty | | Mounting | Qty | | Position | | | | | | | | | | | |
| | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258553_1 | Stain-less steel 316 | 1 | Basic flange | Side | 1 | 2 | P | T | H | D | D | - | - | - | 2 | 1 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 2 | 2 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 2 | 3 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 2 | A | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 2 | B | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 2 | C | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 2 | M | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 2 | N | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 2 | P | - | - | - | - | - |
| 258553_2 | Stain-less steel 316 | 1 | Basic flange | Rear | 1 | 0 | P | T | H | D | D | - | - | - | 4 | 1 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 4 | 2 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 4 | 3 | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 4 | A | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 4 | B | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 4 | C | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 4 | M | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 4 | N | - | - | - | - | - |
| | | | | | | | P | T | H | D | D | - | - | - | 4 | P | - | - | - | - | - |

*Table 8-6. Process Flange, Low Pressure Side[1,2] (continued)*

| Kit Number | Process Flange | | Application | Vent/Drain Plug | | Pipe Plug Qty | Applicable Types | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | | | | | | | | | | |
| | Material | Qty | | Mounting | Qty | | 1 2 3 4 5 6 7 8 9 10 | 11 | 12 | 13 | 14 | 15 | | | | | |
| 258553_3 | Hastel-loy C-276 | 1 | Basic flange | Side | 1 | 2 | PTHDD- - - **B 1** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **B 2** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **B 3** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **B A** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **B B** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **B C** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **B M** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **B N** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **B P** | - | - | - | - | - | | | | | |
| 258553_4 | Hastel-loy C-276 | 1 | Basic flange | Rear | 1 | 0 | PTHDD- - - **D 1** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **D 2** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **D 3** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **D A** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **D B** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **D C** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **D M** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **D N** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **D P** | - | - | - | - | - | | | | | |
| 258553_5 | Stain-less steel 316 | 1 | High static pressure flange[3] | Side | 1 | 2 | PTHDD- - - **2 4** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **2 5** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **2 6** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **2 D** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **2 E** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **2 F** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **2 Q** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **2 R** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **2 S** | - | - | - | - | - | | | | | |
| 258553_6 | Stain-less steel 316 | 1 | High static pressure flange[3] | Rear | 1 | 0 | PTHDD- - - **4 4** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **4 5** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **4 6** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **4 D** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **4 E** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **4 F** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **4 Q** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **4 R** | - | - | - | - | - | | | | | |
| | | | | | | | PTHDD- - - **4 S** | - | - | - | - | - | | | | | |

*Table 8-6. Process Flange, Low Pressure Side[1,2] (continued)*

| Kit Number | Process Flange | | Application | Vent/Drain Plug | | Pipe Plug Qty | Applicable Types |
|---|---|---|---|---|---|---|---|
| | Material | Qty | | Mounting | Qty | | Position<br>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 |
| 258553_7 | Hastel-loy C-276 | 1 | High static pressure flange[3] | Side | 1 | 2 | PTHD**D**- - - **B 4** - - - - - |
| | | | | | | | PTHD**D**- - - **B 5** - - - - - |
| | | | | | | | PTHD**D**- - - **B 6** - - - - - |
| | | | | | | | PTHD**D**- - - **B D** - - - - - |
| | | | | | | | PTHD**D**- - - **B E** - - - - - |
| | | | | | | | PTHD**D**- - - **B F** - - - - - |
| | | | | | | | PTHD**D**- - - **B Q** - - - - - |
| | | | | | | | PTHD**D**- - - **B R** - - - - - |
| | | | | | | | PTHD**D**- - - **B S** - - - - - |
| 258553_8 | Hastel-loy C-276 | 1 | High static pressure flange[3] | Rear | 1 | 0 | PTHD**D**- - - **D 4** - - - - - |
| | | | | | | | PTHD**D**- - - **D 5** - - - - - |
| | | | | | | | PTHD**D**- - - **D 6** - - - - - |
| | | | | | | | PTHD**D**- - - **D D** - - - - - |
| | | | | | | | PTHD**D**- - - **D E** - - - - - |
| | | | | | | | PTHD**D**- - - **D F** - - - - - |
| | | | | | | | PTHD**D**- - - **D Q** - - - - - |
| | | | | | | | PTHD**D**- - - **D R** - - - - - |
| | | | | | | | PTHD**D**- - - **D S** - - - - - |

**NOTES:**
1. Each kit contains one process flange with vent/drain plugs and pipe plugs installed as indicated in this table.
2. To order replacement low pressure side process flanges for Types PTHDA and PTHDG pressure transmitters, use part no. 6640211_10.
3. High static pressure bolting and flanges are only available for Types PTHDDB, PTHDDC, PTHDDD, PTHDDF and PTHDDG pressure transmitters, excluding those with tantalum diaphragms.

*Table 8-7. Flange Adapter[1]*

| Kit Number | Adapter (1 pc) | Bolting (2 pcs) | Applicable Types |
|---|---|---|---|
| | | | Position<br>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 |
| 258558_1 | Stainless steel 316 | General purpose carbon steel | PTHD- - - - - **1 A** - - - - |
| | | | PTHD- - - - - **4 A** - - - - |
| | | | PTHD- - - - - **A A** - - - - |
| | | | PTHD- - - - - **D A** - - - - |
| | | | PTHD- - - - - **M A** - - - - |
| | | | PTHD- - - - - **Q A** - - - - |
| | | | PTHD- - - - - **W A** - - - - |

*Table 8-7. Flange Adapter[1] (continued)*

| Kit Number | Adapter (1 pc) | Bolting (2 pcs) | Applicable Types | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Position | | | | | | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258558_1 *(cont)* | Stainless steel 316 | General purpose carbon steel | P | T | H | D | - | - | - | - | - | **1** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **4** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **A** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **D** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **M** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Q** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **W** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **1** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **4** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **A** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **D** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **M** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Q** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **W** | **D** | - | - | - | - |
| 258558_2 | Stainless steel 316 | General purpose carbon steel | P | T | H | D | - | - | - | - | - | **2** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **5** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **B** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **E** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **N** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **R** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **X** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **2** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **5** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **B** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **E** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **N** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **R** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **X** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **2** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **5** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **B** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **E** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **N** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **R** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **X** | **D** | - | - | - | - |

*Table 8-7. Flange Adapter[1] (continued)*

| Kit Number | Adapter (1 pc) | Bolting (2 pcs) | Applicable Types | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Position | | | | | | | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258558_3 | Stainless steel 316 | Carbon steel 4140 for NACE Class 2 | P | T | H | D | - | - | - | - | - | **3** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **6** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **C** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **F** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **P** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **S** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Y** | **A** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **3** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **6** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **C** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **F** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **P** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **S** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Y** | **B** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **3** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **6** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **C** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **F** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **P** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **S** | **D** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Y** | **D** | - | - | - | - |
| 258558_4 | Hastelloy C-276 | General purpose carbon steel | P | T | H | D | - | - | - | - | - | **1** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **4** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **A** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **D** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **M** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Q** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **W** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **1** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **4** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **A** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **D** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **M** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Q** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **W** | **N** | - | - | - | - |

*Table 8-7. Flange Adapter[1] (continued)*

| Kit Number | Adapter (1 pc) | Bolting (2 pcs) | Applicable Types | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Position | | | | | | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258558_4 *(cont)* | Hastelloy C-276 | General purpose carbon steel | P | T | H | D | - | - | - | - | - | **1** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **4** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **A** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **D** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **M** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Q** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **W** | **Q** | - | - | - | - |
| 258558_5 | Hastelloy C-276 | General purpose carbon steel | P | T | H | D | - | - | - | - | - | **2** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **5** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **B** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **E** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **N** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **R** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **X** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **2** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **5** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **B** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **E** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **N** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **R** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **X** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **2** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **5** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **B** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **E** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **N** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **R** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **X** | **Q** | - | - | - | - |

*Table 8-7. Flange Adapter[1] (continued)*

| Kit Number | Adapter (1 pc) | Bolting (2 pcs) | Applicable Types | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Position | | | | | | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258558_6 | Hastelloy C-276 | Carbon steel 4140 for NACE Class 2 | P | T | H | D | - | - | - | - | - | **3** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **6** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **C** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **F** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **P** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **S** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Y** | **M** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **3** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **6** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **C** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **F** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **P** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **S** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Y** | **N** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **3** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **6** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **C** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **F** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **P** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **S** | **Q** | - | - | - | - |
| | | | P | T | H | D | - | - | - | - | - | **Y** | **Q** | - | - | - | - |

**NOTE:**
1. Each kit contains one flange adapter, two adapter bolts and one of each type of O-ring (Viton, Teflon and ethylene propylene). The O-rings are packaged in individual plastic bags and are identified by part number. Refer to the kit drawing for the part numbers.

## *Electronics Kits*

*Table 8-8. Amplifier Assembly (Compensated)[1]*

| Kit Number | Applicable Types |
|---|---|
| 258581_1 | All |

**NOTE:**
1. Each kit contains one amplifier assembly.

*Table 8-9. Indicator, Add-On*[1]

| Kit Number | Indicator Type | Cover Material | Applicable Types | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Position | | | | | | | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258550_1 | LCD | Aluminum | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **0** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **1** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **3** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **4** | - |
| 258550_2 | Analog meter | Aluminum | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **0** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **1** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **3** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **4** | - |
| 258550_5 | LCD | Stainless steel | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **0** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **1** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **3** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **4** | - |
| 258550_6 | Analog meter | Stainless steel | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **0** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **1** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **3** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **4** | - |

**NOTE:**
1. Each kit contains one indicator, one cover with window and 0.25 oz. NEVER-SEEZ lubricant.

*Table 8-10. Indicator, Spare*[1]

| Kit Number | Indicator Type | Applicable Types | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Position | | | | | | | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | |
| 258550_3 | LCD | P | T | H | D | - | - | - | - | - | - | - | - | - | **A** | - | |
| | | P | T | H | D | - | - | - | - | - | - | - | - | - | **B** | - | |
| | | P | T | H | D | - | - | - | - | - | - | - | - | - | **D** | - | |
| | | P | T | H | D | - | - | - | - | - | - | - | - | - | **E** | - | |
| 258550_4 | Analog meter | P | T | H | D | - | - | - | - | - | - | - | - | - | **M** | - | |
| | | P | T | H | D | - | - | - | - | - | - | - | - | - | **N** | - | |
| | | P | T | H | D | - | - | - | - | - | - | - | - | - | **Q** | - | |
| | | P | T | H | D | - | - | - | - | - | - | - | - | - | **R** | - | |

**NOTE:**
1. Each kit contains one indicator; one O-ring, cover; and 0.25 oz. of NEVER-SEEZ lubricant.

*Table 8-11. EZ CAL Option[1]*

| Kit Number | Applicable Types | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Position | | | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258562_1 | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **3** | - |
| | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **4** | - |
| | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **D** | - |
| | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **E** | - |
| | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **Q** | - |
| | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **R** | - |

**NOTE:**
1. Each kit contains one complete EZ CAL module.

## *Hardware Kits*

*Table 8-12. Tag, Stainless Steel, Wired[1]*

| Kit Number | Applicable Types | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Position | | | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258557_1 | P | T | H | D | - | - | - | - | - | - | - | - | - | - | **2** |
| | P | T | H | D | - | - | - | - | - | - | - | - | - | - | **6** |
| | P | T | H | D | - | - | - | - | - | - | - | - | - | - | **C** |
| | P | T | H | D | - | - | - | - | - | - | - | - | - | - | **G** |

**NOTE:**
1. Each kit contains 10 stainless steel tags with 6-in. wires attached.

*Table 8-13. Cover, Housing[1]*

| Kit Number | Cover Type | Cover Material | Applicable Types | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Position | | | | | | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258555_1 | Standard | Aluminum | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **0** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **1** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **3** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **4** | - |
| 258555_2 | Cover with window | Aluminum | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **A** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **B** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **D** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **E** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **M** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **N** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **Q** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **R** | - |

*Table 8-13. Cover, Housing[1] (continued)*

| Kit Number | Cover Type | Cover Material | Applicable Types | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Position | | | | | | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258555_3 | Standard | Stainless steel | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **0** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **1** | - |
| 258555_4 | Cover with window | Stainless steel | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **A** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **B** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **M** | - |
| | | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **N** | - |

**NOTE:**
1. Each kit contains one housing cover with O-ring installed and 0.25 oz. NEVER-SEEZ lubricant.

*Table 8-14. Electronics Housing[1]*

| Kit Number | Cover Type | Applicable Types | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Position | | | | | | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 258554_1 | Aluminum housing with standard terminal block | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **0** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **3** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **A** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **D** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **M** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **Q** | - |
| 258554_2 | Stainless steel housing with standard terminal block | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **0** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **A** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **M** | - |
| 258554_3 | Aluminum housing with terminal block/ lightning arrestor assembly | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **1** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **4** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **B** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **E** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **N** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **1** | **R** | - |
| 258554_4 | Stainless steel housing with terminal block/ lightning arrestor assembly | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **1** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **B** | - |
| | | P | T | H | D | - | - | - | - | - | - | - | - | **A** | **N** | - |

**NOTE:**
1. Each kit contains one electronics housing; two O-rings, cover; one O-ring, cell; and 0.25 oz. of NEVER-SEEZ lubricant. The electronics housing is supplied with all components installed, except cell with characterization board assembly, amplifier assembly and housing covers.

### *Cell with Characterization Board Assembly Replacements*

To order compensated spare or replacement cell with characterization board assemblies:

1. Obtain the first seven characters of the transmitter nomenclature from the nameplate.

2. Replace the H in position 3 with an S.

3. If position 5 contains a D or G, replace it with a 5. If position 5 contains an A, replace it with a 6.

4. Add an A1 to the end to complete the nine-position nomenclature of the compensated cell with characterization board assembly.

Example 1: A replacement cell with characterization board assembly is required for a Type PTHDDC1221AB1A2 pressure transmitter.

1. The first seven characters of the transmitter nomenclature are ***PTHDDC1***.

2. Replacing the H in position 3 with an S yields ***PTSDDC1***.

3. Since position 5 contains a D, it is replaced with a 5, yielding ***PTSD5C1***.

4. Adding an A1 to the end results in the nine-position nomenclature for the compensated spare or replacement cell with characterization board assembly ***PTSD5C1A1***.

Example 2: A replacement cell with characterization board assembly is required for a Type PTHDAFABB1B01RG pressure transmitter.

1. The first seven characters of the transmitter nomenclature are ***PTHDAFA***.

2. Replacing the H in position 3 with an S yields ***PTSDAFA***.

3. Since position 5 contains an A, it is replaced with a 6, yielding ***PTSD6FA***.

4. Adding an A1 to the end results in the nine-position nomenclature for the compensated spare or replacement cell with characterization board assembly ***PTSD6FAA1***.

## *TRAINING*

ABB has a modern training facility available for training your personnel. On-site training is also available. Contact a ABB sales office for specific information and scheduling.

## *TECHNICAL DOCUMENTATION*

Additional copies of this product instruction, or other ABB instructions, can be obtained from the nearest ABB sales office at a reasonable charge.

# APPENDIX A - QUICK REFERENCE

## *QUICK REFERENCE*

This appendix contains the analog mode wiring (Fig. A-1), multidrop mode wiring (Fig. A-2), typical calibration setup (Fig. A-3), lockout jumper position (Fig. A-4), and external and mounting dimension (Fig. A-5) diagram. Refer to Table A-1 for the A, B and C dimensions shown in Figure A-5.

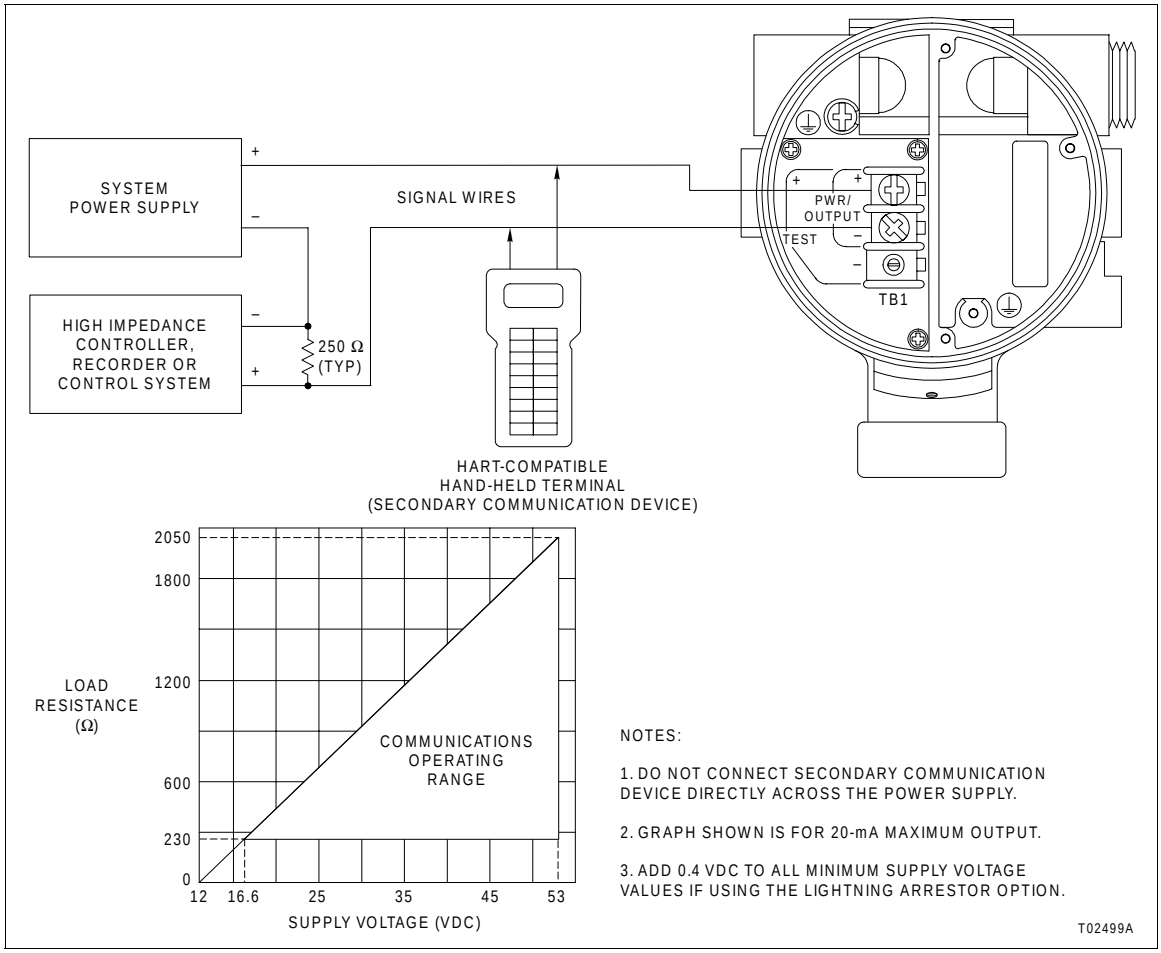



*Figure A-1. Analog Mode Wiring*

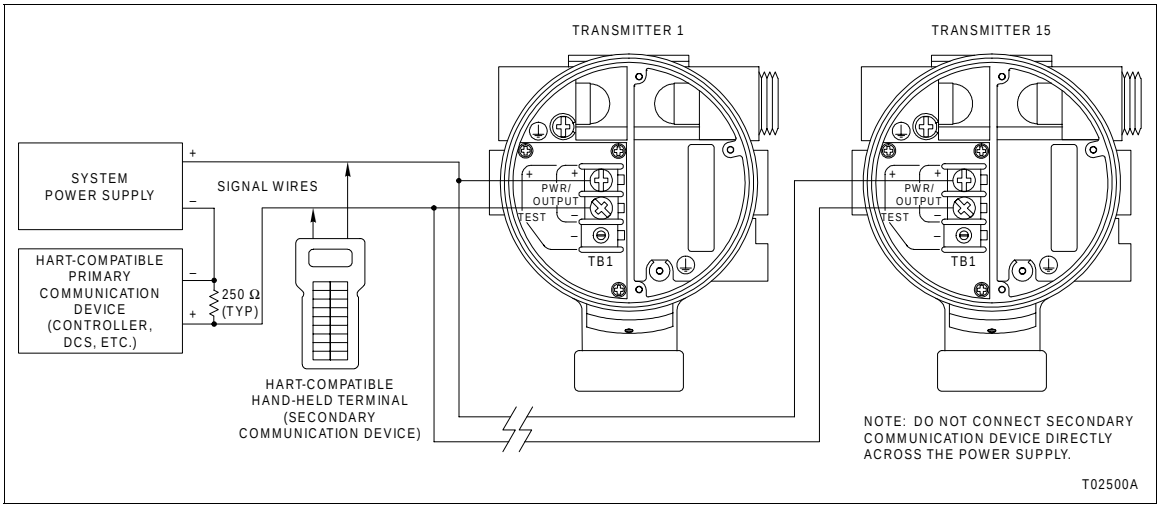



*Figure A-2. Multidrop Wiring*

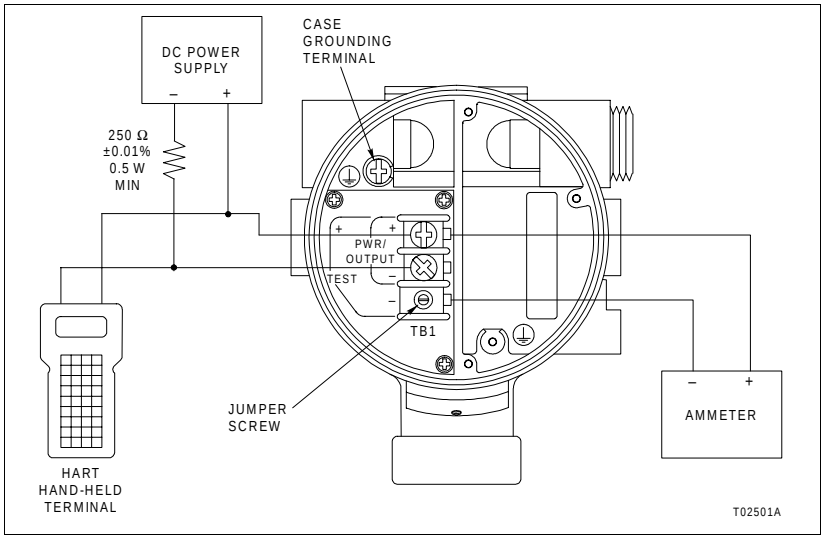



*Figure A-3. Calibration Setup (Typical)*

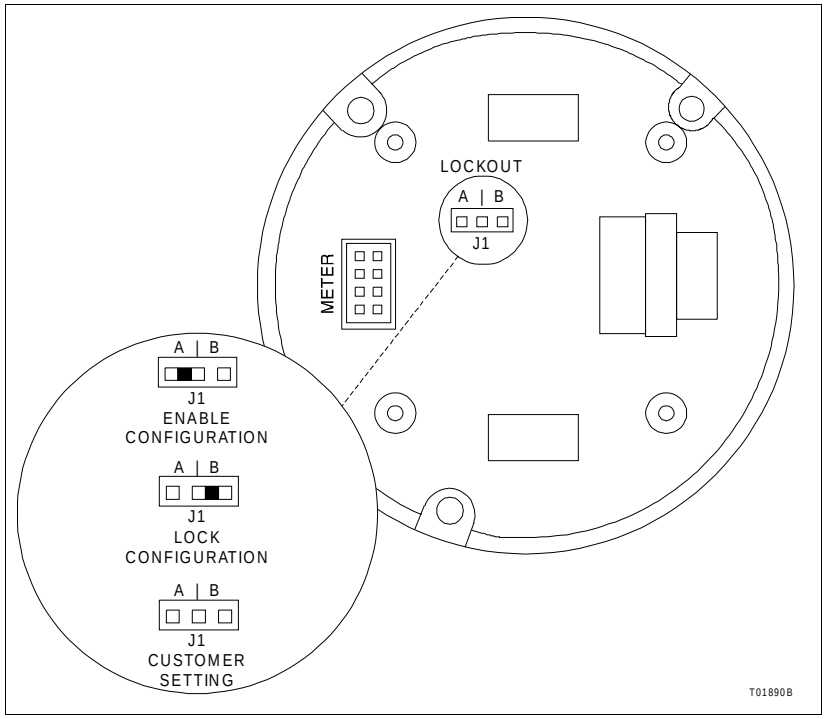



*Figure A-4. Lockout Jumper*

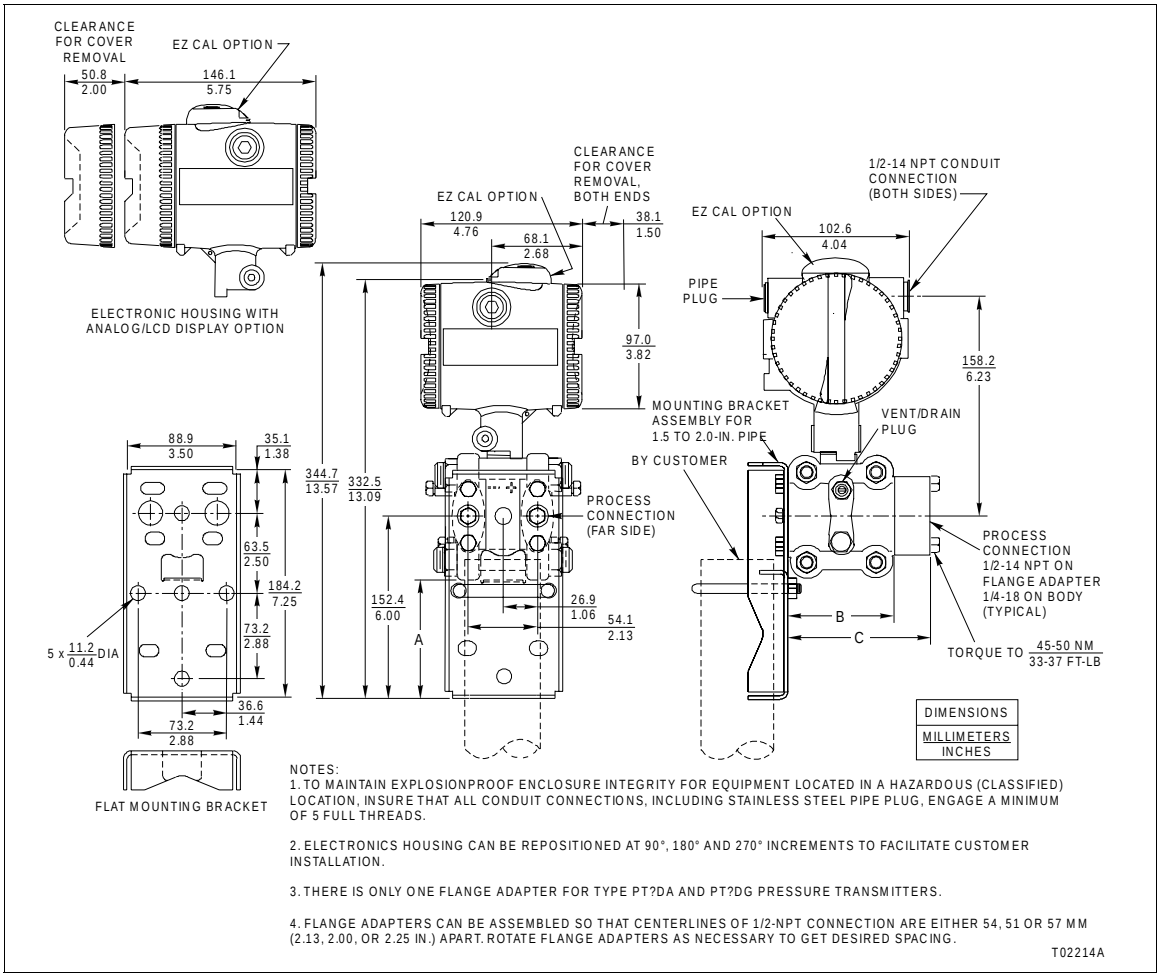



*Figure A-5. External and Mounting Dimensions*

*Table A-1. Dimensions for Figure A-5*

| Dimension | Standard Bolting, mm (in.) | High Static Pressure Bolting, mm (in.) |
|---|---|---|
| A | 105.7 (4.16) | 98.3 (3.87) |
| B | 84.1 (3.31) | 94.0 (3.70) |
| C | 112.5 (4.43) | 122.4 (4.82) |

# APPENDIX B - HART COMMANDS

## *INTRODUCTION*

This appendix contains descriptions of the various HART commands available through the HART universal, common practice, and Type PTH transmitter-specific command sets. It does not provide procedures for the communication device. Refer to the appropriate instruction for detailed procedures.

This appendix is intended as a reference to complement the communication device instruction. Table B-1 summarizes the commands available from each of the three command sets.

ABB has confirmed operational compatibility of the transmitter with the communication devices and their respective software revision levels as listed in Table B-1. All software revisions for the Type STT04 Smart Transmitter Terminal are compatible. The operational compatibility of any other device or any other revision of software with the transmitter is the responsibility of the user.

Table B-1 lists all of the commands available from each command set. This includes the command number, and the command itself. There are four communication devices listed. All four of these communication devices support revision 5.0 or greater of the HART Communication Foundation Specification.

*Table B-1. HART Commands (HART Communication Foundation Specification Revision 5.0 or Greater)*

| Command Set | Command No. | Command | Communication Device | | | |
|---|---|---|---|---|---|---|
| | | | Elsag Baile STT04 | Baile-FP 53MC5000[1] | MTL® 611[2] | Rosemount 275[3] |
| Universal | 0 | Read unique identifier | X | X | X | X |
| | 1 | Read PV | X | X | X | X |
| | 2 | Read PV current and percent of range | X | — | — | X |
| | 3 | Read dynamic variables and PV current | X | X | X | X[4] |
| | 6 | Write polling address | X | — | X | X |
| | 11 | Read unique identifier associated with tag | — | — | — | — |
| | 12 | Read message | X | X | X | X |
| | 13 | Read tag, descriptor, date | X | X | X | X |
| | 14 | Read PV sensor info | X | — | X | X |
| | 15 | Read PV output info | X | X | X | X |

*Table B-1. HART Commands (HART Communication Foundation Specification Revision 5.0 or Greater) (continued)*

| Command Set | Command No. | Command | Communication Device | | | |
|---|---|---|---|---|---|---|
| | | | Elsag Baile STT04 | Baile-FP 53MC5000[1] | MTL® 611[2] | Rosemount 275[3] |
| Universal *(continued)* | 16 | Read final assembly number | X | — | X | X |
| | 17 | Write message | X | X | X | X |
| | 18 | Write tag, descriptor, date | X | X | X | X |
| | 19 | Write final assembly number | X | — | — | X |
| Common Practice | 34 | Write PV damping value | X | X | — | X |
| | 35 | Write PV range values | X | X | X | X |
| | 38 | Reset configuration changed flag | X | X | — | — |
| | 40 | Enter/exit fixed PV current mode | X | — | X | X |
| | 42 | Perform master reset | X | — | X | X[4] |
| | 43 | Set PV zero | X | — | — | X[4] |
| | 44 | Write PV units | X | X | — | X |
| | 45 | Trim PV current DAC zero | X | — | X | X |
| | 46 | Trim PV current DAC gain | X | — | X | X |
| | 47 | Write PV transfer function | — | X | — | — |
| | 48 | Read additional transmitter status | X | — | — | X[4] |
| | 59 | Write number of response preambles | X | — | X | X[4] |
| Type PTH Transmitter - Specific | 128 | Report secondary output | — | — | — | X[4] |
| | 129 | Report secondary output ranges and EU | X | — | — | X[4] |
| | 130 | Write secondary output ranges and EU | X | — | — | X[4] |
| | 131 | Report user temperature alarm set points | X | — | — | X[4] |
| | 132 | Write user temperature alarm set points | X | — | — | X[4] |
| | 133 | Read output options | X | — | — | X[4] |
| | 134 | Write output options | X | — | — | X[4] |
| | 135 | Read first five values of function generator | X | — | — | X[4] |

*Table B-1. HART Commands (HART Communication Foundation Specification Revision 5.0 or Greater) (continued)*

| Command Set | Command No. | Command | Communication Device | | | |
|---|---|---|---|---|---|---|
| | | | Elsag Baile STT04 | Baile-FP 53MC5000[1] | MTL® 611[2] | Rosemount 275[3] |
| Type PTH Transmitter - Specific *(continued)* | 136 | Read second five values of function generator | X | — | — | X[4] |
| | 137 | Write first five values of function generator | X | — | — | X[4] |
| | 138 | Write second five values of function generator | X | — | — | X[4] |
| | 139 | Default configuration | X | — | — | X[4] |
| | 140 | Configure local LCD display | X | — | — | X[4] |
| | 141 | Report manufacturing cell data | X | — | — | X[4] |
| | 142 | Report product nomenclature | X | — | — | X[4] |
| | 143 | Report statistical information | — | — | — | X[4] |
| | 144 | Calibrate PV lower value | X | — | — | X[4] |
| | 145 | Calibrate PV upper value | X | — | — | X[4] |

**NOTES:**
1. Baile-Fischer Porter Model 53MC5000 Process Control Station. Software revision level 3.
2. MTL Model 611 Pocket Terminal. Software Revision Level 4.0. Requires a Type CNF61 interface. This device can perform all commands via user programming.
3. Rosemount Model 275 Hand-Held Terminal. Software Revision Level F1.6.
4. These commands require that the ABB Type PTH HART Device Description be loaded into the Rosemount Model 275.

## *OPERATOR INTERFACE*

Communication devices initiate communications and can be either primary or secondary.

> **NOTE:** The HART Communication Foundation Specification refers to communication devices as masters and to transmitters as slaves.

A ***primary communication device*** is typically a permanently connected panel mount controller or DCS. A ***secondary communication device*** is usually a temporarily connected hand-held terminal or computer.

All communication devices that support revision 5.0 or greater of the HART Communication Foundation Specification support the HART universal command set. This command set enables the communication device to read the transmitter characteristics:

- Primary variable (PV).
- PV current.
- PV percent of range.
- PV sensor information.
- PV output information.
- Unique identifier.
- Dynamic (secondary) variable.
- Message.
- Tag.
- Descriptor.
- Date.
- Final assembly number.

Additionally, the HART universal command set allows programming of:

- Device tag.
- Descriptor.
- Date.
- Final assembly number.
- Message.
- Polling address.

For more in-depth access to the transmitter configuration and data, the communication device must also support the HART common practice and Type PTH transmitter-specific command sets used with the transmitter. The Type STT04 Smart Transmitter Terminal supports most of these commands. Another communication device that supports most of these commands is the Rosemount Model 275 Hand-Held Terminal (software revision level F1.6) with the ABB Type PTH HART Device Description loaded.

## *HART COMMAND SETS*

The remainder of this appendix describes the individual commands from the HART command sets.

### *Universal Command Set*

This section describes commands available for use with the transmitter through the HART universal command set.

#### *READ UNIQUE IDENTIFIER*

**Command 0**

Use **READ UNIQUE IDENTIFIER** to view:

- Expanded device type code.
- Manufacturer identification code.
- Manufacturer device type code.

- Number of preambles required for the request message from the communication device to the transmitter.
- HART universal command set specification revision level implemented by the transmitter.
- Type PTH transmitter-specific command set specification revision level implemented by the transmitter.
- Transmitter software revision level.
- Electronics hardware revision level.
- Flags.
- Device identification number.

*[DD: Device setup→Detailed setup→HART Parameters→ HART Comm Params]*[1]

*[DD: Device setup→Detailed setup→HART Parameters→ Revision #'s]*

*[DD: Device setup→Detailed setup→Field device info→Model]*

*[DD: Device setup→Detailed setup→Field device info→ Mfg Data→Distributor]*

***READ PV***

**Command 1** Monitors the input of the transmitter. The input displays in engineering units and updates at least once per second.

*[DD: Device setup→Process variables→Pres]*

***READ PV CURRENT AND PERCENT OF RANGE***

**Command 2** Monitors the output of the transmitter. The output is returned as a percent and in milliamperes.

*[DD: Device setup→Process variables→AO1 Out]*

*[DD: Device setup→Process variables→Pres % rnge]*

1. Throughout this section, this type of text indicates the menu flow for the Rosemount Model 275 with the ABB Type PTH HART Device Description loaded. Refer to Appendix D for the complete Device Description menu flow.

### *READ DYNAMIC VARIABLES AND PV CURRENT*

**Command 3** Displays the PV (in user-defined units), loop current (in milliamperes) and cell temperature (in degrees Celsius).

*[DD: Device setup→Process variables→Pres]*

*[DD: Device setup→Process variables→Snsr temp]*

*[DD: Device setup→Process variables→AO1 Out]*

### *WRITE POLLING ADDRESS (SELECT OUTPUT MODE)*

**Command 6** Controls the PV analog output and identifies transmitters in multidrop installations.

The analog mode is selected by using **WRITE POLLING ADDRESS** to set the polling address to zero. In this mode, the transmitter provides a four to 20-milliampere output signal.

The multidrop mode is selected by using **WRITE POLLING ADDRESS** to set the polling address to a whole number value between one and 15. In this mode, the transmitter does not provide a four to 20-milliampere signal in proportion to the input, as the transmitter PV value is transmitted digitally. The analog output remains locked below four milliamperes.

The factory default for the polling address is zero, which puts the transmitter in the analog mode.

*[DD: Device setup→Detailed setup→HART Parameters→ HART Comm Params→Poll addr]*

### *READ UNIQUE IDENTIFIER ASSOCIATED WITH TAG*

**Command 11** Views the expanded device type code, revision levels and device identification number of a transmitter containing the tag sent with this command.

### *READ MESSAGE*

**Command 12** Makes it possible to read the user-defined message entered into the transmitter via **WRITE MESSAGE**.

*[DD: Device setup→Detailed setup→HART Parameters→ HART Misc Params→Message]*

### *READ TAG, DESCRIPTOR, DATE*

**Command 13** Views the user-defined information entered into the transmitter via **WRITE TAG, DESCRIPTOR, DATE**.

*[DD: Device setup→Detailed setup→HART Parameters→Tag]*

*[DD: Device setup→Detailed setup→HART Parameters→ HART Misc Params→Descriptor]*

*[DD: Device setup→Detailed setup→HART Parameters→ HART Misc Params→Date]*

### *READ PV SENSOR INFORMATION*

**Command 14** Views the cell serial number, range limits and span engineering units, lower and upper range limits, and minimum span of the cell.

*[DD: Device setup→Detailed setup→Field device info→ Sensor information]*

*[DD: Device setup→Basic setup→PV Range Setup]*

### *READ PV OUTPUT INFORMATION*

**Command 15** Views the PV alarm selection code, PV transfer function code, PV range values units code, PV lower and upper values, PV damping value, write protect code and private label distributor code associated with the transmitter or the PV.

*[DD: Device setup→Basic setup→Output Options]*

*[DD: Device setup→Basic setup→PV Range Setup]*

*[DD: Device setup→Basic setup→Pres damp]*

*[DD: Device setup→Detailed setup→HART Parameters→ HART Comm Params→Write protect]*

*[DD: Device setup→Detailed setup→Field device info→ Mfg Data→Distributor]*

### *READ FINAL ASSEMBLY NUMBER*

**Command 16** Allows the user-defined final assembly number entered via **WRITE FINAL ASSEMBLY NUMBER** to be reviewed.

*[DD: Device setup→Detailed setup→HART Parameters→ HART Misc Params→Final asmbly num]*

***WRITE MESSAGE***

**Command 17** Can be used by one operator to leave a message of up to 32 characters to another operator, store calibration and maintenance schedules, or virtually any other user-defined purpose beneficial to the operation. The transmitter is delivered with this parameter left blank.

*[DD: Device setup→Detailed setup→HART Parameters→ HART Misc Params→Message]*

***WRITE TAG, DESCRIPTOR, DATE***

**Command 18** The transmitter ID tag is a user-defined, eight-character alphanumeric tag that is programmed into the transmitter via **WRITE TAG, DESCRIPTOR, DATE**. The factory default is PTH.

Other functions available with this command are the user-defined descriptor and date. The descriptor allows up to 16 characters of descriptive data about the transmitter to be entered. The transmitter is delivered with this parameter left blank.

The factory default for the date is the date of manufacture. This can also be used for the installation date, configuration date, calibration date, etc.

*[DD: Device setup→Detailed setup→HART Parameters→Tag]*

*[DD: Device setup→Detailed setup→HART Parameters→ HART Misc Params→Descriptor]*

*[DD: Device setup→Detailed setup→HART Parameters→ HART Misc Params→Date]*

***WRITE FINAL ASSEMBLY NUMBER***

**Command 19** Enters a user-defined number as a reference for this transmitter or group of devices. This can be used for inventory or maintenance purposes. The factory default is zero.

*[DD: Device setup→Detailed setup→HART Parameters→ HART Misc Params→Final asmbly num]*

***Common Practice Command Set***

This section describes commands available for use with the transmitter through the HART common practice command set.

***WRITE PV DAMPING VALUE***

**Command 34** Adjusts the damping of the transmitter output. Damping adjustments have no effect on the calibration or accuracy of the transmitter; how-

ever, damping can be used to smooth out a fluctuating process signal. Damping provides single (1τ) time constant values from 0.00 to 32.00 seconds. A damping adjustment of 32.00 seconds would be used for a very noisy signal; 0.00 seconds would be used for an extremely quiet signal. The default value is 0.5 second.

*[DD: Device setup→Basic setup→Pres damp]*

### *WRITE PV RANGE VALUES*

**Command 35** Reranges the current (four to 20 milliampere) output to represent a different portion (turndown) of the input span.

*[DD: Device setup→Basic setup→PV Range Setup→Pres LRV]*

*[DD: Device setup→Basic setup→PV Range Setup→Pres URV]*

**NOTES:**

1. The transmitter output is based on the values entered via this command. The communication device and the transmitter will not reject invalid ranges; therefore, it is imperative to know the range limits specified for the transmitter. Refer to Table 1-2 for the proper ranges.

2. The PV lower and upper values must always be configured with the PV lower value being lower than the PV upper value. *WRITE OUTPUT OPTIONS* allows the reverse acting mode to be set independent of the PV lower and upper values.

### *RESET CONFIGURATION CHANGED FLAG*

**Command 38** The configuration changed status flag appears whenever the configuration of the transmitter has been altered. The configuration changed status flag can be reset via ***RESET CONFIGURATION CHANGED FLAG***.

### *ENTER/EXIT FIXED PV CURRENT MODE*

**Command 40** For system troubleshooting purposes, the transmitter output can be set to a constant, specified as a current in the four to 20 milliampere range via ***ENTER/EXIT FIXED PV CURRENT MODE***. Enter the value of current desired to fix the output at that level. Entering a value of zero milliamperes cancels the fixed output.

*[DD: Device setup→Diag/Service→Loop test]*

### *PERFORM MASTER RESET*

**Command 42** Sends a message to the microprocessor in the transmitter that causes it to reset. The execution of this command may take a relatively long time to complete. The transmitter may not respond to another command until the reset is complete.

*[DD: Device setup→Diag/Service→Reset Transmitter]*

### *SET PV ZERO*

**Command 43**

Sets the zero percent value (PV lower value) of the transmitter without performing a complete bench pressure calibration. Trims the PV so that it reads zero percent with the existing process pressure applied. The resulting offset must be within the limits defined for the transmitter. This command has no effect on the span of the transmitter, nor does it compensate for slight inaccuracies in the four to 20-milliampere current loop. To adjust for these inaccuracies, refer to ***DAC Trim (Fine Tuning the Analog Loop)*** in Section 4.

*[DD: Device setup→Diag/Service→Calibration→Zero trim]*

### *WRITE PV UNITS*

**Command 44**

Selects the primary engineering units for the PV, PV range, PV sensor limits and PV minimum span.

*[DD: Device setup→Basic setup→PV Range Setup→ Pressure unit]*

The primary engineering units codes selectable via this command are listed in Table B-2.

**NOTE:** When the PV units are sent, the transmitter scales all of the associated range values to the new primary engineering units. Therefore, it is necessary to send the desired primary engineering units (via ***WRITE PV UNITS***) before sending new range values.

*Table B-2. Primary Engineering Units Codes*

| Code | Units |
|---|---|
| 1 | $inH_2O$ |
| 4 | $mmH_2O$ |
| 5 | mmHg |
| 6 | PSI |
| 7 | bar |
| 8 | mbar |
| 10 | $kg/cm^2$ |
| 12 | kPascal |

### *TRIM PV CURRENT DAC ZERO*

**Command 45**

**NOTE:** This command only applies to analog mode transmitters.

This command is used in conjunction with ***TRIM PV CURRENT DAC GAIN*** to compensate for slight inaccuracies in the four to 20 milliampere current loop. Refer to Section 4 for information on ***TRIM PV CURRENT DAC ZERO***.

*[DD: Device setup→Diag/Service→Calibration→D/A trim]*

***or***

*[DD: Device setup→Diag/Service→Calibration→ Scaled D/A trim]*

### *TRIM PV CURRENT DAC GAIN*

**Command 46**

**NOTE:** This command only applies to analog mode transmitters.

This command is used in conjunction with ***TRIM PV CURRENT DAC ZERO*** to compensate for slight inaccuracies in the four to 20 milliampere current loop. Refer to Section 4 for information on ***TRIM PV CURRENT DAC GAIN***.

*[DD: Device setup→Diag/Service→Calibration→D/A trim]*

***or***

*[DD: Device setup→Diag/Service→Calibration→ Scaled D/A trim]*

### *WRITE PV TRANSFER FUNCTION*

**Command 47**

Makes it possible to specify the output of the transmitter as linear with respect to the input; as a square root, $^{3}/_{2}$-power, or $^{5}/_{2}$-power representation of the input; as the volume of a spherical tank or cylindrical (flat end) tank; or as a function generator that follows a six-segment linear function (refer to ***FUNCTION GENERATOR***). Table B-3 lists the transfer function code for each output type. The factory default is transfer function code zero for an output that is linear with respect to the input.

*[DD: Device setup→Basic setup→Output Options→ Pres xfer fnctn]*

**NOTE:** Both ***WRITE PV TRANSFER FUNCTION*** (command 47) and **WRITE OUTPUT OPTIONS** (command 134) can be used to change the transfer function.

*Table B-3. Transfer Function Codes*

| Transfer Function Code | Output Type |
|---|---|
| 0 | Linear (factory default) |
| 1 | Square root |
| 2 | $^{3}/_{2}$-power flow mode |
| 3 | $^{5}/_{2}$-power flow mode |
| 4 | Function generator mode |
| 5 | Volumetric (spherical tank) |
| 6 | Volumetric (flat end cylindrical tank) |

### *READ ADDITIONAL TRANSMITTER STATUS*

**Command 48**

The status of the transmitter, determined from results of the continuous self-diagnostics, is reported every time communications with the transmitter are established. If the transmitter indicates there is additional status information, it can be obtained via ***READ ADDITIONAL TRANSMITTER STATUS***. Refer to Appendix C for status bit definitions and troubleshooting tables.

*[DD: Device setup→Diag/Service→Status→Status group 1-3]*

### *WRITE NUMBER OF RESPONSE PREAMBLES*

**Command 59**

Defines the number of preambles to be sent by a transmitter before the start of the response. This value includes the five preambles minimum contained in the start of message signal. The factory default is five preambles. Refer to the communication device instruction to determine the number of preambles required for its proper operation.

*[DD: Device setup→Detailed setup→HART Parameters→ HART Comm Params→Num resp preams]*

## *Type PTH Transmitter-Specific Command Set*

This section describes commands available for use with the transmitter through the Type PTH transmitter-specific command set.

The Type PTH transmitter-specific command set allows configuration of features unique to the transmitter. Table B-4 is a summary of the Type PTH transmitter-specific command set, including the response data bytes, data type and a description of the function of each command.

In Table B-4, data bytes represented by only the pound sign (#) indicate data sent from the transmitter to the communication device. Data bytes represented by the word input followed by the pound sign (#) indicate data sent from the communication device to the transmitter.

*Table B-4. Type PTH Transmitter-Specific Command Data Bytes*

| Command Number | Command | Data Type | Data Bytes | Data Name |
|---|---|---|---|---|
| 128 | Report secondary output | IEEE floating point | #0-#3 | Secondary output value |
| | | ASCII string | #4-#9 | Secondary output engineering units |
| 129 | Report secondary output ranges and EU | IEEE floating point | #0-#3 | Secondary output lower range value |
| | | | #4-#7 | Secondary output upper range value |
| | | ASCII string | #8-#13 | Secondary output engineering units |
| 130 | Write secondary output ranges and EU | IEEE floating point | Input #0-#3 | Secondary output lower range value |
| | | | Input #4-#7 | Secondary output upper range value |
| | | ASCII string | Input #8-#13 | Secondary output engineering units |
| | | IEEE floating point | #0-#3 | Secondary output lower range value |
| | | | #4-#7 | Secondary output upper range value |
| | | ASCII string | #8-#13 | Secondary output engineering units |
| 131 | Report user temperature alarm set points | IEEE floating point | #0-#3 | Low temperature alarm set point |
| | | | #4-#7 | High temperature alarm set point |
| 132 | Write user temperature alarm set points | IEEE floating point | Input #0-#3 | Low temperature alarm set point |
| | | | Input #4-#7 | High temperature alarm set point |
| | | | #0-#3 | Low temperature alarm set point |
| | | | #4-#7 | High temperature alarm set point |
| 133 | Read output options | Single byte | #0 | Output transfer function, output action, fail mode, initialize mode |
| 134 | Write output options | Single byte | Input #0 | Output transfer function, output action, fail mode, initialize mode |
| | | | #0 | Output transfer function, output action, fail mode, initialize mode |
| 135 | Read first five values of function generator | IEEE floating point | #0-#3 | X1 of function generator |
| | | | #4-#7 | Y1 of function generator |
| | | | #8-#11 | X2 of function generator |
| | | | #12-#15 | Y2 of function generator |
| | | | #16-#19 | X3 of function generator |
| 136 | Read second five values of function generator | IEEE floating point | #0-#3 | Y3 of function generator |
| | | | #4-#7 | X4 of function generator |
| | | | #8-#11 | Y4 of function generator |
| | | | #12-#15 | X5 of function generator |
| | | | #16-#19 | Y5 of function generator |

*Table B-4. Type PTH Transmitter-Specific Command Data Bytes (continued)*

| Command Number | Command | Data Type | Data Bytes | Data Name |
|---|---|---|---|---|
| 137 | Write first five values of function generator | IEEE floating point | Input #0-#3 | X1 of function generator |
| | | | Input #4-#7 | Y1 of function generator |
| | | | Input #8-#11 | X2 of function generator |
| | | | Input #12-#15 | Y2 of function generator |
| | | | Input #16-#19 | X3 of function generator |
| | | | #0-#3 | X1 of function generator |
| | | | #4-#7 | Y1 of function generator |
| | | | #8-#11 | X2 of function generator |
| | | | #12-#15 | Y2 of function generator |
| | | | #16-#19 | X3 of function generator |
| 138 | Write second five values of function generator | IEEE floating point | Input #0-#3 | Y3 of function generator |
| | | | Input #4-#7 | X4 of function generator |
| | | | Input #8-#11 | Y4 of function generator |
| | | | Input #12-#15 | X5 of function generator |
| | | | Input #16-#19 | Y5 of function generator |
| | | | #0-#3 | Y3 of function generator |
| | | | #4-#7 | X4 of function generator |
| | | | #8-#11 | Y4 of function generator |
| | | | #12-#15 | X5 of function generator |
| | | | #16-#19 | Y5 of function generator |
| 139 | Default configuration | N/A | No data | Default configuration values |
| 140 | Configure local LCD display | Single byte | Input #0 | LCD display parameter selection |
| | | | #0 | |
| 141 | Report manufacturing cell data | ASCII string | #0-#9 | Cell serial number |
| | | | #10-#17 | Date of manufacture |
| | | | #18-#19 | Two-letter manufacturing location code |
| 142 | Report product nomenclature | ASCII string | #0-#17 | Full nomenclature |
| 143 | Report statistical information | IEEE floating point | #0-#3 | Max. cell temperature in °C |
| | | | #4-#7 | Max. electronics temperature in °C |
| 144 | Calibrate PV lower value | IEEE floating point | Input #0-#3 | PV lower calibration point |
| | | | #0-#3 | PV lower calibration point used |
| 145 | Calibrate PV upper value | IEEE floating point | Input #0-#3 | PV upper calibration point |
| | | | #0-#3 | PV upper calibration point used |

### *SECONDARY OUTPUT ENGINEERING UNITS*

There are three Type PTH transmitter-specific commands associated with the secondary output engineering units.

### *REPORT SECONDARY OUTPUT*

**Command 128** Monitors the secondary output variable. The secondary output is user-scaled and tracks the output of the transmitter. It displays in user-defined secondary output engineering units as a percentage of the secondary output lower and upper range values.

*[DD: Device setup→Process variables→SOut]*

Example: If the secondary output lower range value is 10.0 gal, the secondary output upper range value is 100.0 gal, and the output of the transmitter is 75%, the display reads 75% range, or:

$$[0.75 \times (100.0 - 10.0)] + 10.0$$
$$= (0.75 \times 90.0) + 10.0 = 77.5 \text{ gal.}$$

### *REPORT SECONDARY OUTPUT RANGES AND EU*

**Command 129** Views the configured secondary output lower and upper range values and secondary output engineering units.

*[DD: Device setup→Detailed setup→Secondary Output→ SOut LRV]*

*[DD: Device setup→Detailed setup→Secondary Output→ SOut URV]*

*[DD: Device setup→Detailed setup→Secondary Output→ SO Units]*

### *WRITE SECONDARY OUTPUT RANGES AND EU*

**Command 130** Configures the secondary output lower and upper range values. The secondary output lower and upper range values can be set to any range within ±99999. The ranges are a function of the output of the device. The output can be polled from the device via *REPORT SECONDARY OUTPUT RANGES AND EU* or displayed on the optional LCD. These ranges have no effect on the calibration of the transmitter and are used to report the output of the transmitter in user-defined units.

Secondary output engineering units are programmable via *WRITE SECONDARY OUTPUT RANGES AND EU*. These units are in a free form format of six characters. Program any six characters into the transmitter such as MA or GAL. These units are used in conjunction with the secondary output lower and upper range numeric values.

*[DD: Device setup→Detailed setup→Secondary Output→ SOut LRV]*

*[DD: Device setup→Detailed setup→Secondary Output→ SOut URV]*

*[DD: Device setup→Detailed setup→Secondary Output→ SO Units]*

**NOTE:** The secondary output engineering units are left justified when displayed on the optional LCD. If desired, enter dummy characters to center or right justify the display.

### *REPORT USER TEMPERATURE ALARM SETPOINTS*

**Command 131** Views the configured alarm limits for the cell temperature.

*[DD: Device setup→Detailed setup→Cell Temp Alarms→ Lo Temp Alarm SP]*

*[DD: Device setup→Detailed setup→Cell Temp Alarms→ Hi Temp Alarm SP]*

### *WRITE USER TEMPERATURE ALARM SETPOINTS*

**Command 132** Sets the alarm limits for the cell temperature. The factory defaults are -40.00 and +85.00 degrees Celsius. Configure the alarm limits anywhere between these two values.

*[DD: Device setup→Detailed setup→Cell Temp Alarms→ Lo Temp Alarm SP]*

*[DD: Device setup→Detailed setup→Cell Temp Alarms→ Hi Temp Alarm SP]*

### *READ OUTPUT OPTIONS*

**Command 133** Views the status of the output options entered during configuration. Tables B-5 and B-6 list the output option definitions.

*[DD: Device setup→Basic setup→Output Options]*

*Table B-5. Output Transfer Function Codes*

| Bit | | | Transfer Function |
|---|---|---|---|
| 6 | 5 | 4 | |
| 0 | 0 | 0 | Linear (factory default) |
| 0 | 0 | 1 | Square root |
| 0 | 1 | 0 | $^{3}/_{2}$-power flow mode |
| 0 | 1 | 1 | $^{5}/_{2}$-power flow mode |
| 1 | 0 | 0 | Function generator mode |
| 1 | 0 | 1 | Volumetric (spherical tank) |
| 1 | 1 | 0 | Volumetric (flat end cylindrical tank) |

*Table B-6. Output Option Definitions*

| Bit | | | | Definitions | | |
|---|---|---|---|---|---|---|
| 3 | 2 | 1 | 0 | Fail Mode | Action | Initialize Mode |
| 0 | 0 | 0 | 0 | Low (factory default) | Normal (factory default) | Low (factory default) |
| 0 | 0 | 0 | 1 | Low | Normal | High |
| 0 | 0 | 1 | 0 | Low | Reverse | Low |
| 0 | 0 | 1 | 1 | Low | Reverse | High |
| 0 | 1 | 0 | 0 | High | Normal | Low |
| 0 | 1 | 0 | 1 | High | Normal | High |
| 0 | 1 | 1 | 0 | High | Reverse | Low |
| 0 | 1 | 1 | 1 | High | Reverse | High |
| 1 | 0 | 0 | 0 | Spare | Normal | Low |
| 1 | 0 | 0 | 1 | Spare | Normal | High |
| 1 | 0 | 1 | 0 | Spare | Reverse | Low |
| 1 | 0 | 1 | 1 | Spare | Reverse | High |
| 1 | 1 | 0 | 0 | Same | Normal | Low |
| 1 | 1 | 0 | 1 | Same | Normal | High |
| 1 | 1 | 1 | 0 | Same | Reverse | Low |
| 1 | 1 | 1 | 1 | Same | Reverse | High |

### *WRITE OUTPUT OPTIONS*

**WARNING** **The outputs of smart devices change to fixed values during initialization and detected failure conditions. These values must be selected by the user to insure safe operation.**

**Command 134**

Sets output transfer function, output action (normal or reverse) and initialization and fail modes for the transmitter. Tables B-5 and B-6 list the output option definitions. In Table B-5, bits six through four define the output transfer function. In Table B-6, bits two and three define the fail mode, bit one defines the output action, and bit zero defines the initialization mode. The factory defaults are linear, fail low, normal acting and initialize low.

*[DD: Device setup→Basic setup→Output Options]*

*[DD: Device setup→Basic setup→Output Options→ Pres xfer fnctn]*

**NOTES:**

1. Bit seven is reserved for future use and should be set to zero.

2. Both ***WRITE PV TRANSFER FUNCTION*** (command 47) and *WRITE OUTPUT OPTIONS* (command 134) can be used to change the transfer function.

### *Output Action*

A transmitter in the normal acting mode has an output that increases with increasing pressure. The output of a transmitter in the reverse acting mode decreases with increasing pressure.

*[DD: Device setup→Basic setup→Output Options→Action]*

**NOTE:** The PV lower and upper values must always be configured with the PV lower value being lower than the PV upper value. *WRITE OUTPUT OPTIONS* allows the reverse acting mode to be set independent of the PV lower and upper values.

### *Initialize Mode*

On power up, there is a four-second initialization period during which the output of the transmitter is in transition from nonpowered (no current output) and an output of either above 100 percent or below zero percent as defined via *WRITE OUTPUT OPTIONS*.

*[DD: Device setup→Basic setup→Output Options→Init Mode]*

In the analog mode, initialize low sets the output below zero percent (approximately 3.9 milliamperes). Initialize high sets the output above 100 percent (approximately 22 milliamperes).

In the multidrop mode, initialize low sets the output to below zero percent (approximately 3.9 milliamperes). Initialize high sets the output above 100 percent, but the current output stays at approximately 3.9 milliamperes. After initialization, the output ramps up or down to the proper value.

### *Fail Mode*

If during its continual diagnostics, the microprocessor detects an error that is fatal to the transmitter or system, the transmitter output goes to a predetermined fail level. This level must be selected via *WRITE OUTPUT OPTIONS*. Tables 5-1 and C-2 show what types of errors cause the transmitter to enter the fail mode.

*[DD: Device setup→Basic setup→Output Options→Fail Mode]*

**NOTE:** For a transmitter in the normal acting mode, output corresponding to zero-percent input would be four milliamperes and output corresponding to 100-percent input would be 20 milliamperes. For a transmitter in the reverse acting mode, output corresponding to zero-percent input would be 20 milliamperes and output corresponding to 100-percent input would be four milliamperes.

### *FUNCTION GENERATOR*

**Commands 135 through 138**

There are four Type PTH transmitter-specific commands associated with the function generator. *WRITE FIRST FIVE VALUES OF FUNCTION GENERATOR* (command 137) and *WRITE SECOND FIVE VALUES OF FUNCTION GENERATOR* (command 138) are used to program the X and Y coordinates of the function generator curve. *READ FIRST FIVE VALUES OF FUNCTION GENERATOR* (command 135) and *READ SECOND FIVE VALUES OF FUNCTION GENERATOR* (command 136) allow viewing of the configured X and Y coordinates. Refer to Section 2 for details and a function generator application example.

*[DD: Device setup→Basic setup→Output Options→ Function Generator→X1-X5, Y1-Y5]*

### *DEFAULT CONFIGURATION*

**Command 139**

Changes the configuration of the transmitter back to the standard configuration that was entered at the factory as shown in Table 1-8, except the date, which will be set to Jan 1, 1995. This command causes the transmitter to perform a reset, which in turn causes the output to go to its initialize mode value (high or low) while the reset is taking place.

*[DD: Device setup→Diag/Service→Load Std Config]*

### *CONFIGURE LOCAL LCD DISPLAY*

**Command 140**

The optional LCD can be programmed via *CONFIGURE LOCAL LCD DISPLAY* to display output in percent and user-defined secondary output engineering units, input in primary engineering units, and the cell temperature. Table B-7 lists the LCD configuration codes.

**NOTE:** The analog meter always displays PV percent output. Configuration codes do not apply to the analog meter.

*[DD: Device setup→Detailed setup→LCD Configuration]*

*Table B-7. LCD Configuration Codes*

| Code | Display |
|---|---|
| 0 | Secondary input |
| 1 | Primary input |
| 2 | Percent output |
| 3 | Cell temperature |

### *REPORT MANUFACTURING CELL DATA*

**Command 141**

Views the serial number, manufacturing date and manufacturing location of the cell.

*[DD: Device setup→Detailed setup→Field device info→Mfg Data→Mfg S/N]*

*[DD: Device setup→Detailed setup→Field device info→Mfg Data→Mfg Date]*

*[DD: Device setup→Detailed setup→Field device info→Mfg Data→Mfg Location]*

### *REPORT PRODUCT NOMENCLATURE*

**Command 142**

Views the full nomenclature for the particular transmitter as presented in Table 1-2.

*[DD: Device setup→Detailed setup→Field device info→Mfg Data→Nomenclature]*

### *REPORT STATISTICAL INFORMATION*

**Command 143**

Views the maximum temperatures (in degrees Celsius) to which the cell and electronics assemblies have been exposed.

*[DD: Device setup→Diag/Service→Status→Max Cell Temp]*

*[DD: Device setup→Diag/Service→Status→Max Elec Temp]*

### *PV LOWER AND UPPER VALUES*

**Commands 144 and 145**

*CALIBRATE PV LOWER VALUE* (command 144) and *CALIBRATE PV UPPER VALUE* (command 145) electronically set the transmitter at any two points within the range of the transmitter. Each command tells the transmitter that the measured input value should equal the calibration point set.

*[DD: Device setup→Diag/Service→Calibration→Two point calib]*

It is not required to calibrate the transmitter at the PV lower and upper values, although doing so provides the best overall accuracy. Refer to Section 4 for the use of these commands.

**NOTE:** If the applied pressure is not within the allowable tolerance of the calibration point specified, the transmitter will not perform the requested calibration and will return response code 9 or 10:

*APPLIED PROCESS TOO HIGH*

*APPLIED PROCESS TOO LOW*

# APPENDIX C - ADDITIONAL STATUS CODES

## *INTRODUCTION*

The additional error status bits form four bytes (a 32-bit word) of information. How these status bits are displayed is a function of the communication device. They could be displayed in text format, as a binary status code or as a hexadecimal status code. Hexadecimal status codes must be converted to their binary equivalents. Refer to ***Hexadecimal Format*** and Table C-1 to convert from hexadecimal to binary format.

Table C-2 presents the status bits, their associated messages, probable causes and recommended corrective actions required to solve the problem.

### *Text Format*

These messages are dependent on the particular communication device. If the message displays in text format, it may or may not be an exact match to the text in Table C-2. Although the phrasing may differ, the general meaning of the message is the same. Each error message associated with a particular status bit would have the same probable cause and corrective action.

*[DD: Device setup→Diag/Service→Status→Status group 1-3]*

### *Binary Format*

If the error code is returned in binary format, refer to Table C-2 to determine the error message, probable cause and corrective action for each binary status bit that is set (displayed as a one).

### *Hexadecimal Format*

If the error code is returned in hexadecimal format:

1. Convert the hexadecimal number to its binary equivalent.

Each byte consists of two sets of four bits. Each set of four bits is represented as one hexadecimal digit. Use Table C-1 to convert each hexadecimal digit to its four-bit binary equivalent.

2. Refer to Table C-2 to determine the error message, probable cause and recommended corrective action for each binary status bit that is set (displayed as a one).

Example: The general error message indicates there is additional status.

*Table C-1. Hexadecimal to Binary Conversion*

| Hexadecimal Digit | Binary Value | Decimal Value |
|---|---|---|
| 0 | 0000 | 0 |
| 1 | 0001 | 1 |
| 2 | 0010 | 2 |
| 3 | 0011 | 3 |
| 4 | 0100 | 4 |
| 5 | 0101 | 5 |
| 6 | 0110 | 6 |
| 7 | 0111 | 7 |
| 8 | 1000 | 8 |
| 9 | 1001 | 9 |
| A | 1010 | 10 |
| B | 1011 | 11 |
| C | 1100 | 12 |
| D | 1101 | 13 |
| E | 1110 | 14 |
| F | 1111 | 15 |

**Command 48**

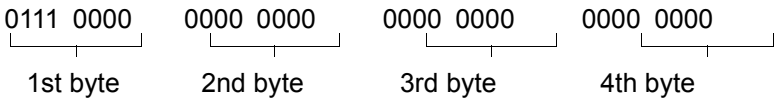
Accessing ***READ ADDITIONAL TRANSMITTER STATUS*** yields the additional status information in hexadecimal format. The hexadecimal status code returned is $70000000_{16}$. Using Table C-1 yields:

$7_{16} = 0111_2$

*and*

$0_{16} = 0000_2$

So the full additional status code in binary format is:




Bits four, five and six of the first byte are set. Using Table C-2 indicates all of the transmitter memory has failed. Table C-2 explains the probable cause and corrective action for each error.

*Table C-2. Additional Status Bits*

| Status Group | Bit | Fail Mode | Message | Probable Cause | Corrective Action |
|---|---|---|---|---|---|
| 1 | 7 | N/A | Reserved | N/A | N/A |
| | 6 | Yes | RAM failure | Memory problem. | Replace transmitter amplifier assembly (refer to Section 7). |
| | 5 | Yes | Cell EEPROM failure | Damage to characterization board assembly. | Remove power from the transmitter and reapply. If error still exists after reset, replace cell with characterization board assembly (refer to Section 7). |
| | 4 | Yes | Main electronics EEPROM failure | Memory problem. | Remove power from the transmitter and reapply. If error still exists, replace amplifier assembly (refer to Section 7). |
| | 3 | Yes | High reference failure | 1. Cell or characterization board disconnected.<br>2. Cell or characterization board damaged. | 1. Make sure cell, characterization board and amplifier assembly are properly mounted.<br>2. Replace cell with characterization board assembly (refer to Section 7). |
| | 2 | Yes | Low reference failure | | |
| | 1 | Yes | Cell temperature sensor damage | | |
| | 0 | Yes | Main channel damage | | |
| 2 | 7 | No | Input applied incorrectly, last calibration attempt failed | Calibrated input outside of factory allowable limits. | Correct input and calibrate (refer to Section 4). |
| | 6 | No | Dynamic temperature measurement failure | Dynamic temperature exceeds limit set at factory. | Output may no longer be accurate. Remove source of temperature extreme. |
| | 5 | No | Electronics temperature measurement failure | Hardware failure of on-board temperature sensor. | Replace amplifier assembly (refer to Section 7). |
| | 4 | No | Pressure overrange | Input exceeds the cell specification. | Correct process input. |
| | 3 | No | Pressure underrange | | |
| | 2 | No | Cell temperature over limit | Cell temperature outside limits set at the factory. | Remove the source of the temperature extreme. |
| | 1 | No | Cell temperature under limit | | |
| | 0 | N/A | Reserved | N/A | N/A |

*Table C-2. Additional Status Bits (continued)*

| Status Group | Bit | Fail Mode | Message | Probable Cause | Corrective Action |
|---|---|---|---|---|---|
| 3 | 7 | No | Cell temperature high alarm | Cell temperature over/ under alarm limit. | 1. Correct temperature problem.<br>2. Change alarm set point values. |
| | 6 | No | Cell temperature low alarm | | |
| | 5 | No | Electronics temperature overrange | Temperature inside electronics housing outside limits set at factory. | Remove the source of the temperature extreme. |
| | 4 | No | Electronics temperature underrange | | |
| | 3 | No | Fixed output mode | Transmitter cannot execute command because of fixed output. | Use ***ENTER/EXIT FIXED PV CURRENT MODE*** to enter a value of 0 mA to cancel fixed output. |
| | 2 | No | Calibration required | Cell has not been calibrated with this amplifier assembly. | Calibrate transmitter (refer to Section 4). |
| | 1 | No | EZ CAL switch failure | 1. Misoperation of EZ CAL option.<br>2. Damaged EZ CAL option.<br>3. Damaged amplifier assembly. | 1. Try again.<br>2. Replace EZ CAL option (refer to Section 7).<br>3. Replace amplifier assembly (refer to Section 7). |
| | 0 | N/A | Reserved | N/A | N/A |
| 4 | 7-0 | N/A | Reserved | N/A | N/A |

# APPENDIX D - DEVICE DESCRIPTION MENU FLOW

## INTRODUCTION

Figure D-1 shows the menu flow for the transmitter when used with a Rosemount Model 275 Hand-Held Terminal with the ABB Type PTH HART Device Description loaded.

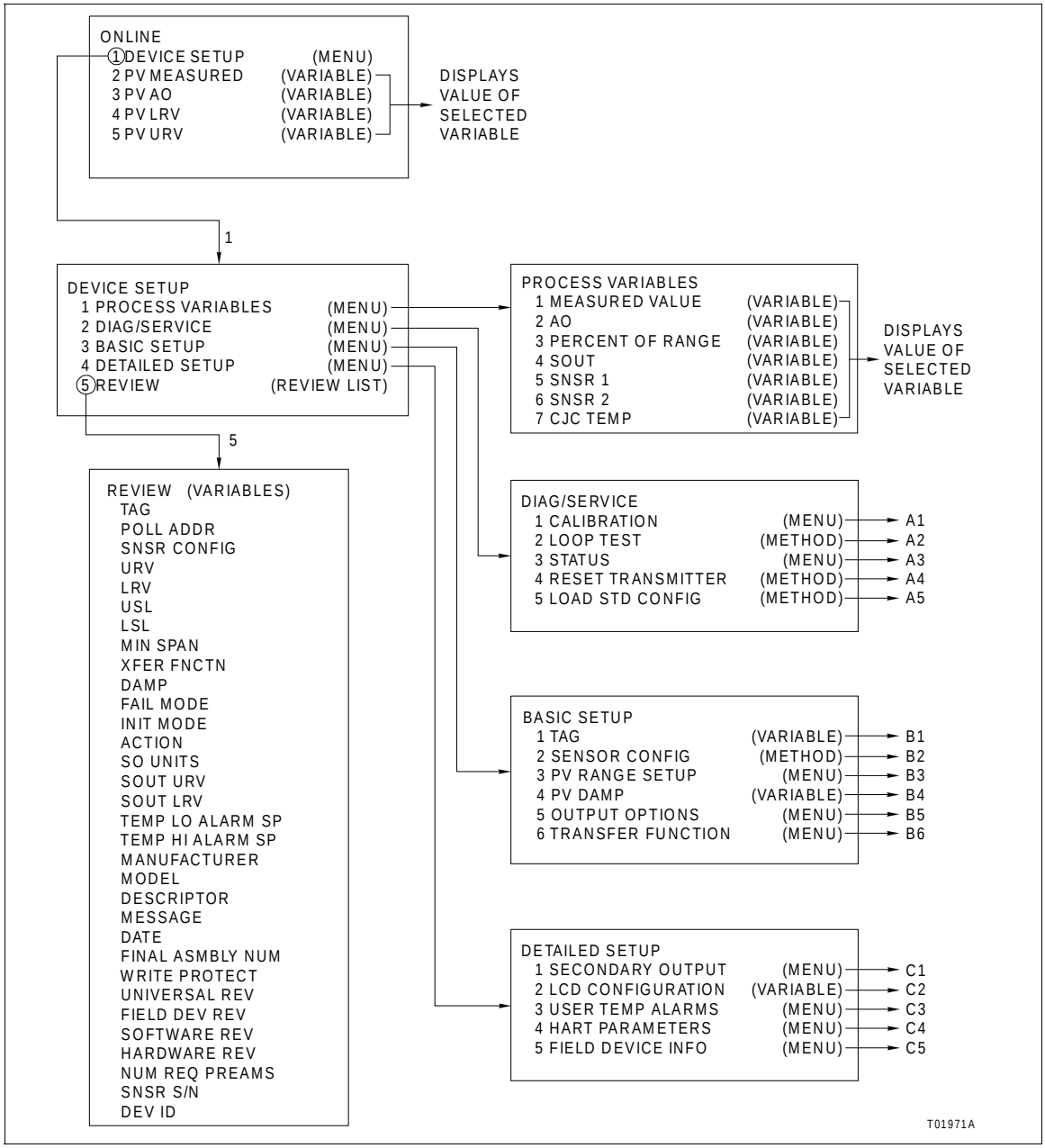



*Figure D-1. Device Description Menu Flow (Sheet 1 of 3)*

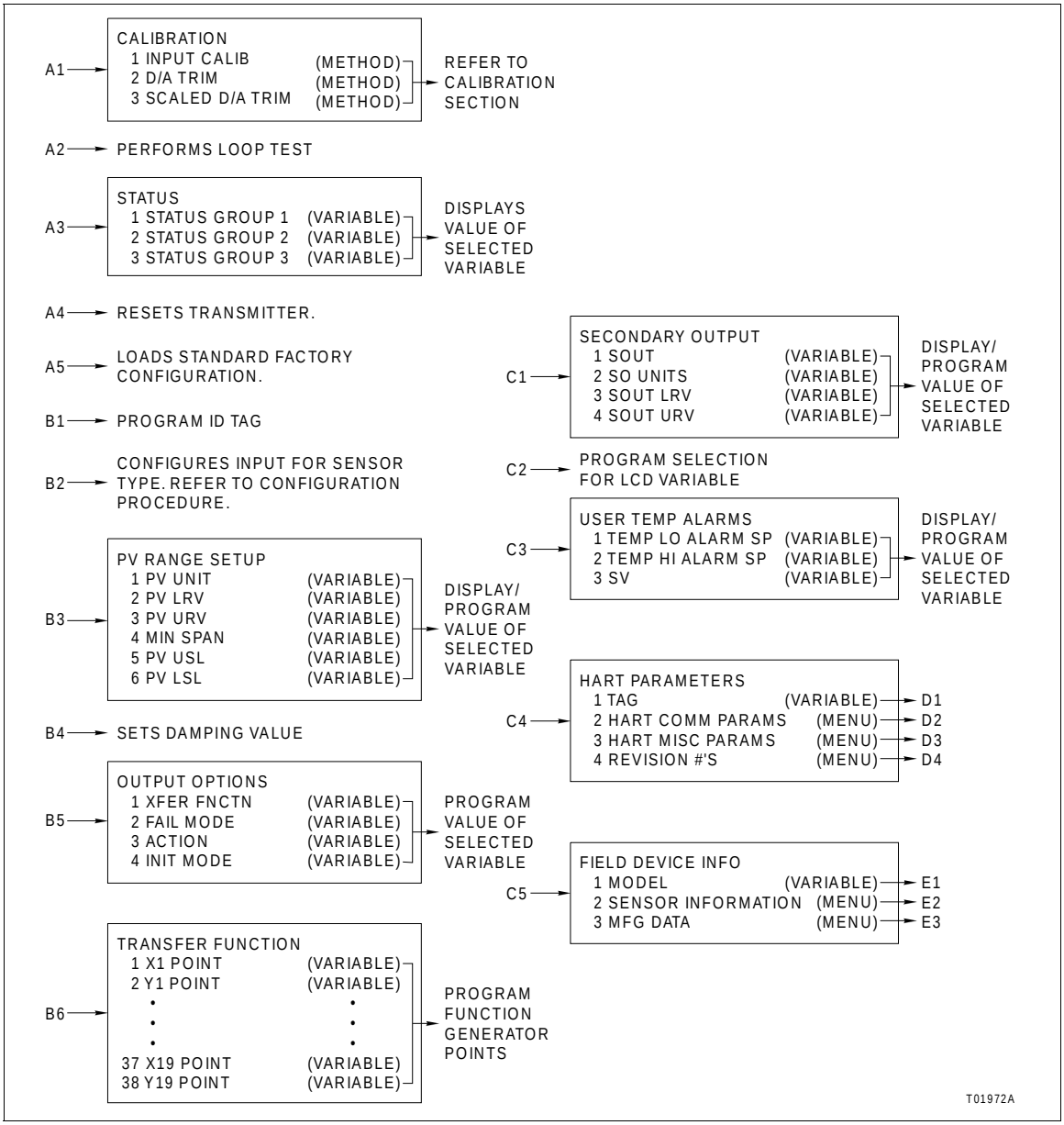



*Figure D-2. Device Description Menu Flow (Sheet 2 of 3)*

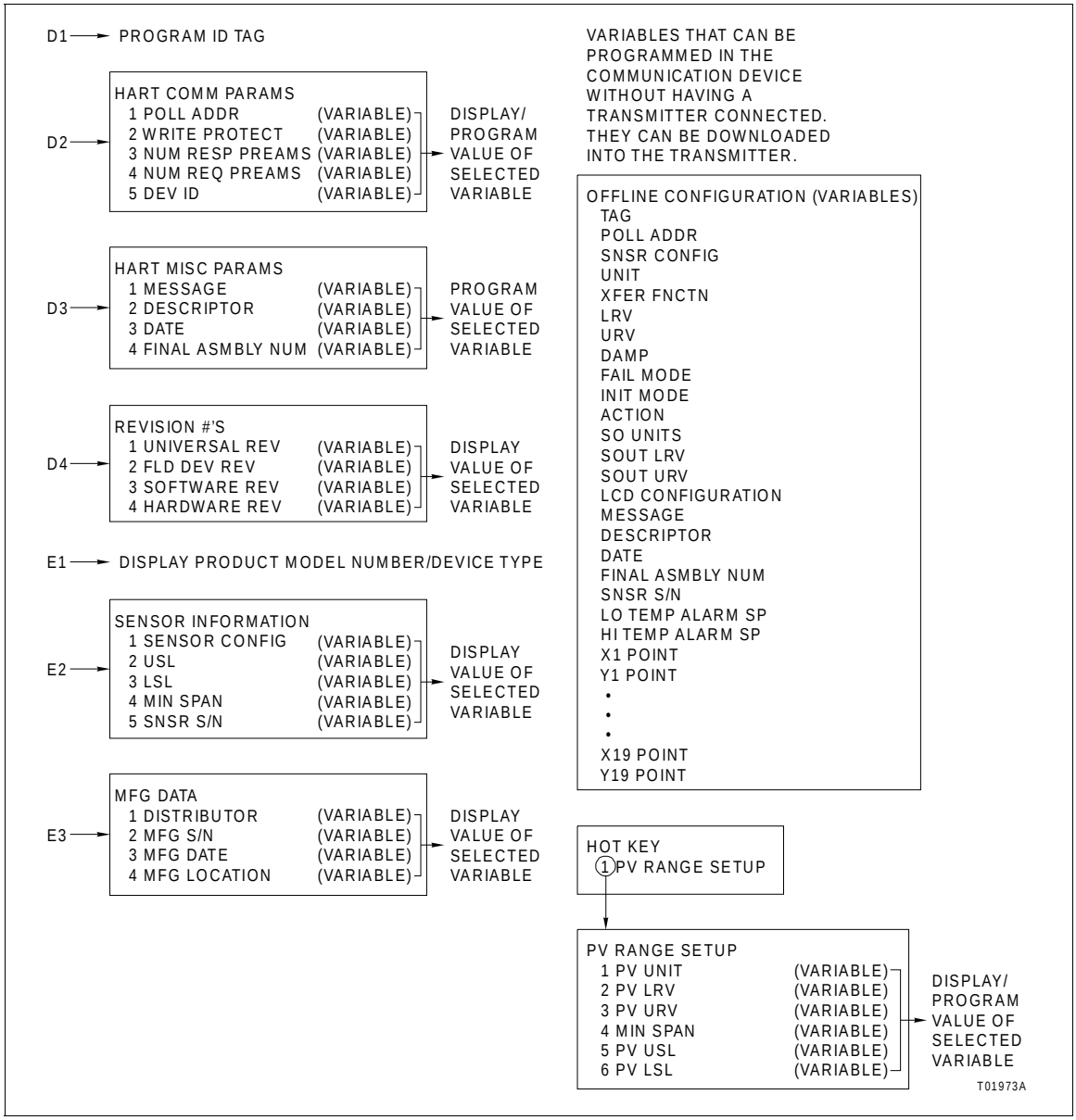



*Figure D-3. Device Description Menu Flow (Sheet 3 of 3)*

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