PRESSURE TRANSMITTERS
IRI- IE-16-EMD
EQUIPMENT MAINTENANCE DESCRIPTION
I&E SECTION

INDUSTRIAL RESOURCES, INC.
A TRAINING SERVICES COMPANY

August 15, 2005

PREFACE

This Training Equipment Maintenance Description (EMD) has been designed to assist you in meeting the requirements of the I&E Section Training Program. It contains information about the I&E Section, Pressure Transmitters. This includes function, quantity of parts, location of parts, description of the physical construction of the part, and description of the operation of the part, equipment preventive and corrective maintenance, and references.

You should review each chapter objective. In doing so you will be better prepared to learn the required information. You should also inspect the equipment, identifying its components and controls. Should you have additional question about the equipment, ask your supervisor.

A separate document, Pressure Transmitters Equipment Maintenance Procedure IRI-IE-16-EMP, covers detailed maintenance of the Pressure Transmitters Equipment.

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Fisher Rosemont Model 1151 Smart Pressure Transmitter Manual 0809-0100-4593
Fisher Rosemont Model 3051 Pressure Transmitter with HART Protocol Manual 00809-0100-4001
Fisher Rosemont Model 3051 Series Pressure Transmitter Family Manual 00809-0100-4801

1.0 Introduction

Chapter Objectives:

1. Describe the functions of the Pressure Transmitters.
2. State, from memory, the functions of the Pressure Transmitters equipment.
3. Describe how the Pressure Transmitters is operated and maintained.
4. List the normal Pressure Transmitters operating parameters.

Figure 1 - Pressure Transmitter

1.1 Equipment Function

The function of a Pressure Transmitter, shown in **Figure 1**, is to interface with a process, sense the pressure of the process variable, and transmit that signal to a remote instrument for display or recording of the actual pressure of the process fluid.

1.2 Equipment Description

The Model 1151 Smart Pressure Transmitters are manufactured by Rosemount. They are a part of the Rosemount SMART FAMILY® of instruments, all of which communicate through HART (Highway Addressable Remote Transducer) protocol. The Model 1151 ALPHALINE Pressure Transmitters have a variable capacitance sensing element. **Figure 2** shows a Rosemont 1151 Pressure Transmitter and **Figure 3** shows a HART Communicator.

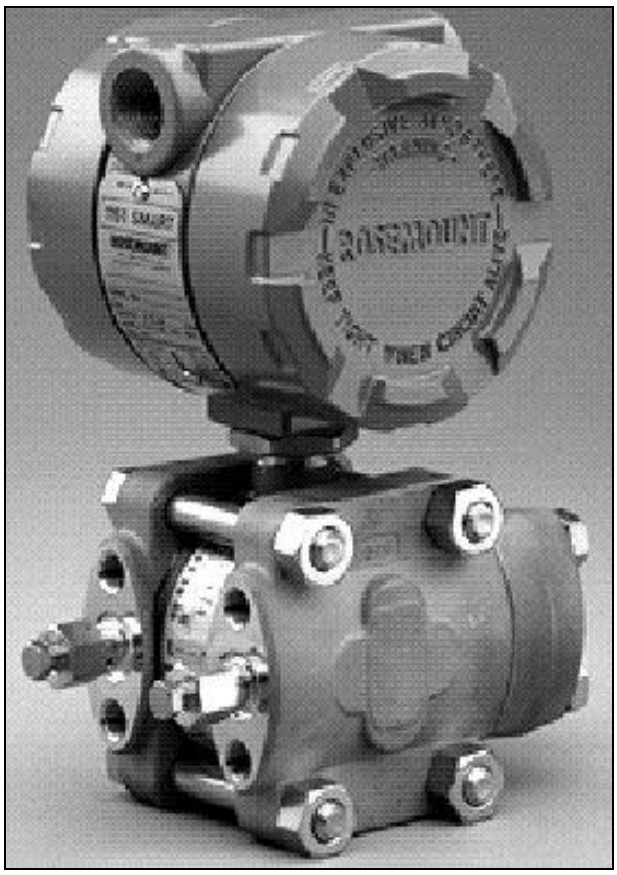


Figure 2 – 1151 Smart Pressure Transmitter

Figure 3 - Hart Communicator

Pressure is defined as a force applied to a unit area. The unit of measure for pressure determination in the US is pounds per square inch (PSI). Atmospheric pressure is the weight of a column of air acting on a square inch of area at any point on the earth. From this statement, it is easy to understand why atmospheric pressure varies as the altitude changes. At higher altitudes, the column of air is smaller and therefore the atmospheric pressure is lower than at a lower altitude.

A pressure sensing instrument when not connected to a process pressure will read zero (0), but actually it is reading atmospheric pressure. The pressure indicated by the instrument is called the gage (gauge) pressure. The true pressure is the absolute pressure, which is actually the gage pressure plus the atmospheric pressure. Atmospheric pressure changes, even if the elevation does not. This is due to changes in weather conditions. As the air becomes denser, the column of air becomes heavier, and therefore the atmospheric pressure increases. The reverse is true if the density of the air decreases. Where precise absolute pressure measurement is necessary, absolute pressure transmitters are used.

The Rosemount Model 1151 Series ALPHALINE Pressure Transmitters have a variable capacitance sensing element, the δ-CELL, shown in **Figure 4**. Differential capacitance between the sensing diaphragm and the capacitor plates is converted electronically to a 2-wire 4-20 mADC, or 10-50 mADC signal.

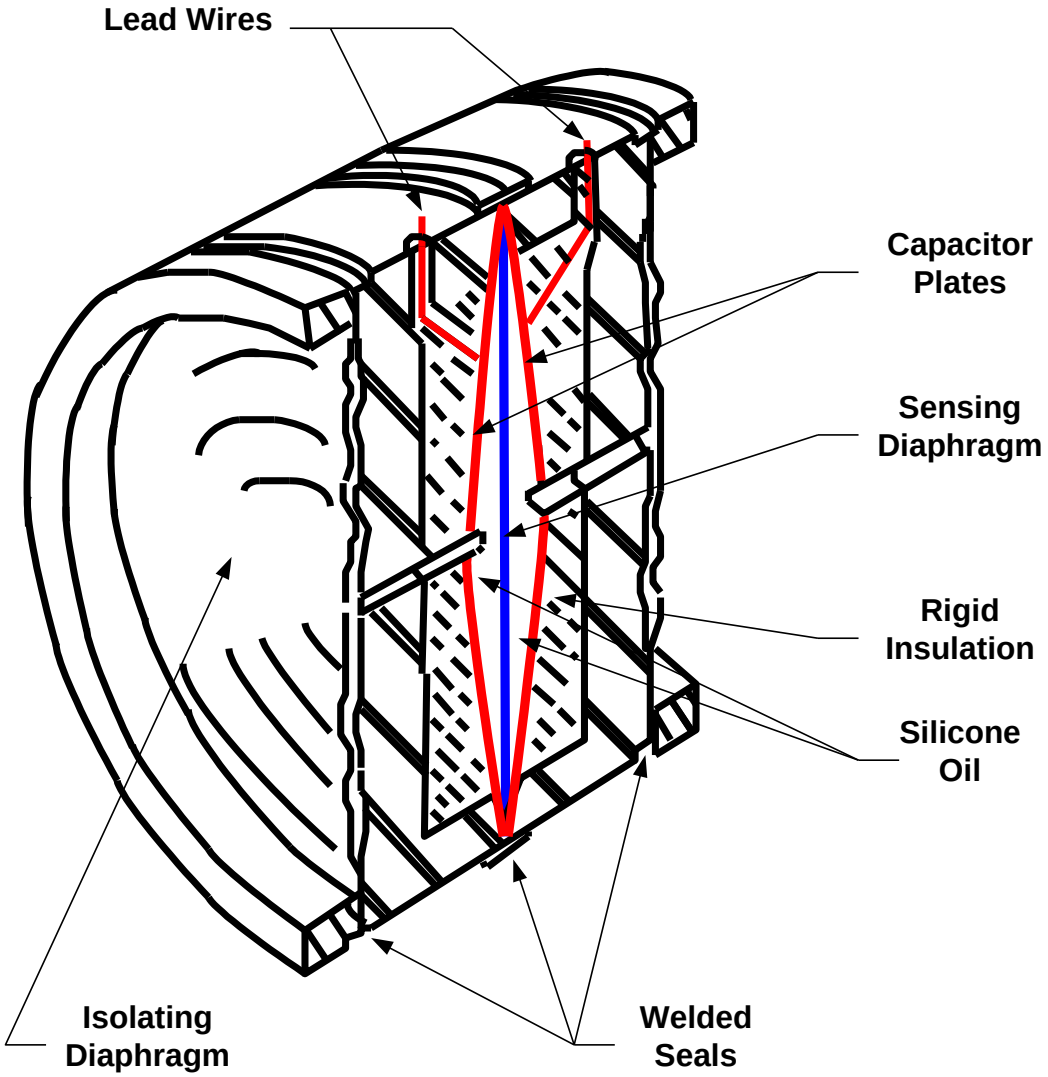


Figure 4 - Rosemont δ-CELL

The electrical block diagram for the Model 1151 Series ALPHALINE Analog Pressure Transmitter is shown in **Figure 5**.

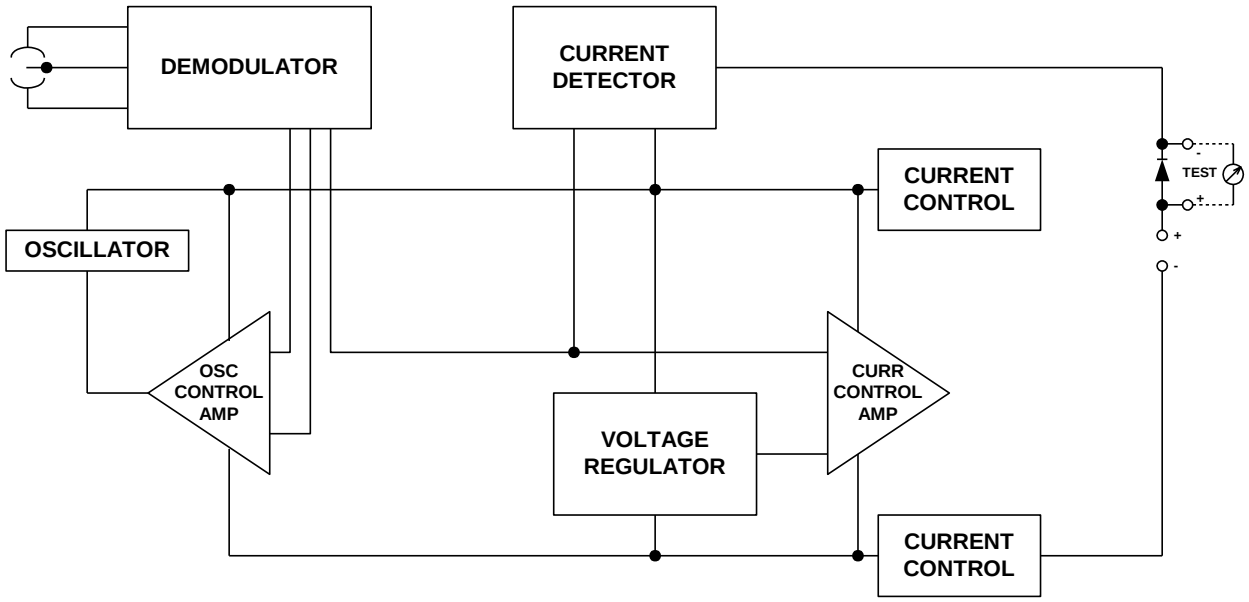


Figure 5 - Electrical Block Diagram

Commissioning the Transmitter

Commissioning consists of testing the transmitter, testing the loop, and verifying transmitter configuration data. Model 1151 Smart Pressure Transmitters may be commissioned either before or after installation. Rosemont recommends commissioning the transmitter on the bench before installation. This ensures that all transmitter components are in good working order and heightens familiarity with the device. To avoid exposing the transmitter electronics to the plant environment after installation, set the failure mode and transmitter security switches during the commissioning stage on the bench.

Setting Hardware Switches

The Model 1151 Smart Pressure Transmitter contains hardware switches that provide user-selectable operation of the failure mode and transmitter security. The switches are located on the electronics assembly just inside the electronics housing cover, as shown in **Figure 6**.

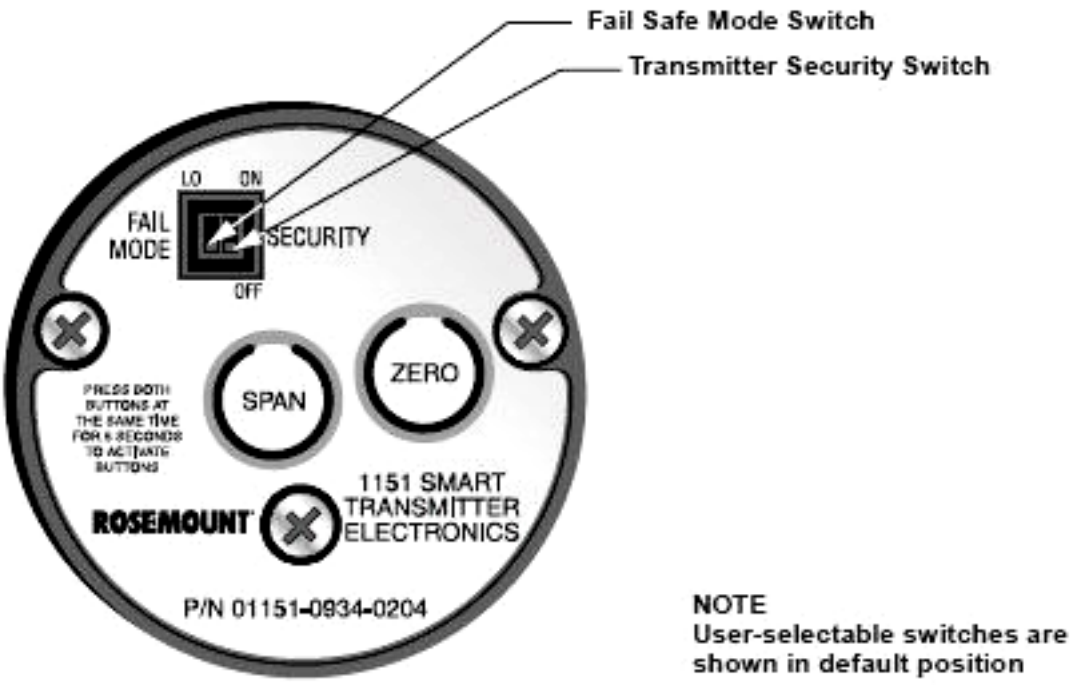


Figure 6 - Hardware Switches

Failure Mode Alarm Switch

As part of its normal operation, the Model 1151 Smart Pressure Transmitter continuously monitors its own operation. This automatic diagnostic routine is a timed series of checks repeated continuously. The electronics faceplate has HI and LO user-selectable failure mode settings. If the diagnostic routine detects a failure in the transmitter in analog output, the transmitter either drives its output below 3.8 mA or above 21.0 mA, depending on the position of the failure mode alarm switch.

Transmitter Security

Once the transmitter has been configured, it may be desirable to protect the configuration data from changes. The electronics assembly is equipped with a switch labeled SECURITY. **Figure 6** shows the switch location on the circuit side of the electronics housing. In the ON position, the switch prevents the accidental or deliberate change of configuration data. To enable the sending of configuration data, simply return the transmitter security switch to the OFF position.

The transmitter security switch must be in the OFF position before configuration changes can be made to the transmitter configuration.

Commissioning the Model 1151 with a HART-Based Communicator

To commission on the bench, connect a 17 to 45 VDC power supply and a current meter, such as the Rosemount Model 282 Validator. Connections should be made as shown in **Figure 7**. The power supplied to the transmitter should not drop below the transmitter lift-off voltage. If the transmitter is being configured when the power drops below the lift-off voltage, the configuration information may not be interpreted correctly by the transmitter. To enable communication, a resistance of at least 250 Ω must be present between the communicator loop connection and the power supply.

After the bench equipment is connected as shown in **Figure 7**, turn on the HART-based communicator by pressing the ON/OFF key. The communicator will search for a HART-compatible device and will indicate when the connection is made. If the connection is not made, the communicator will indicate that no device was found. If this occurs, refer to IRI-1E-16-EMP Troubleshooting.

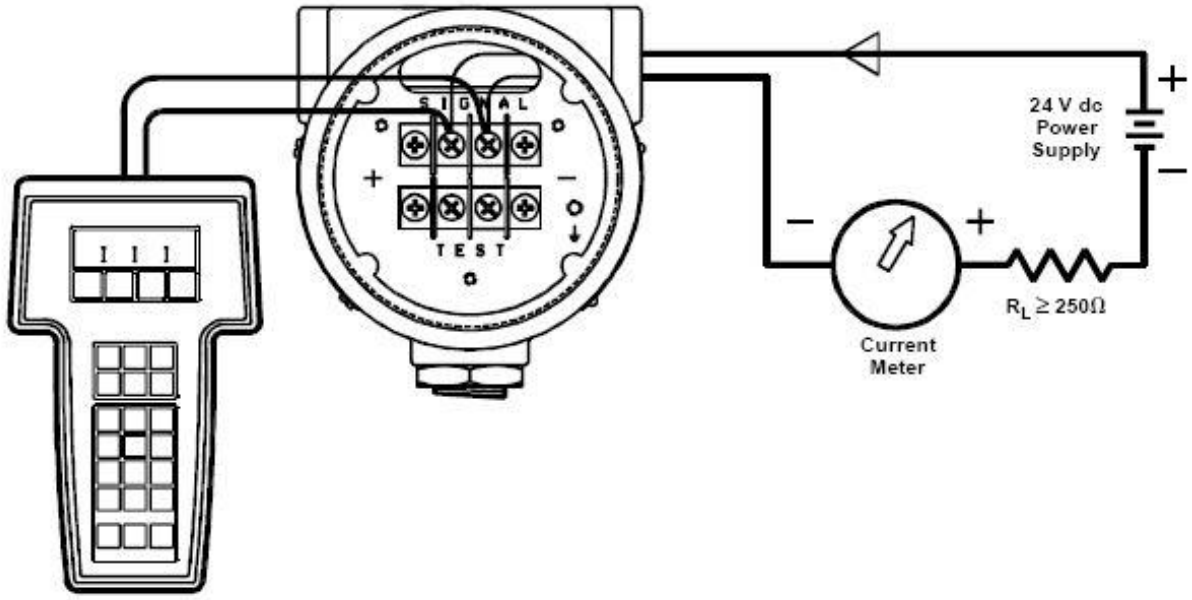


Figure 7 - Bench Wiring Hookup

Testing the Equipment and the Loop

Test functions verify that the transmitter, the communicator, and the loop are in good working order. Testing is recommended whenever component failure or a problem with loop performance is suspected.

Communicator Test

A communicator test is performed to ensure the communicator is working properly. Both the HART Communicator Model 275 and the Rosemount Model 268 Communicator perform self-tests after being turned on. If a problem is detected, the communicator will list a diagnostic message. Refer to The HART Communicator Model 275 manual for diagnostic messages associated with the communicator.

Transmitter Test

HART Comm.	1, 2, 1, 1
Model 268	F2, F2

Although the Model 1151 Smart Pressure Transmitter performs continuous self-diagnostics, a more extensive diagnostic routine can be initiated with the transmitter test function. The transmitter test routine can identify an electronics failure. If the transmitter test detects a problem, messages to indicate the source of the problem are displayed.

Loop Test

HART Comm.	1, 2, 2
Model 268	F2, F3

The loop test allows verification of the output of the transmitter, the integrity of the loop, and the operation of any recorders or similar devices. If commissioning the transmitter on the bench, repeat this test after the transmitter has been installed in the field. A reminder appears to set the loop to manual. Do so and proceed. The next display selects a discrete milliampere transmitter output level. To command the transmitter to output 4 mA, for example, select 4 mA. Check the current meter installed in the test loop to verify that it reads 4 mA. If so, end the loop test. If the output is not 4 mA, then the receiving meter is malfunctioning or the transmitter requires a digital trim as described on page 2-12.

Review Configuration Data

HART Comm.	1, 5
Model 268	Review Key

Review of the transmitter factory configuration data is recommended.

Checking the Transmitter Output

Process Variable

HART Comm.	2
Model 268	PV

Process variable readings can be obtained in engineering units and milliamperes. If the milliampere display does not agree with the actual loop reading given by a multimeter, a 4–20 mA trim is required.

The last step of startup and commissioning is to check the transmitter output. Obtain process variable readings in engineering units and milliamperes. If this display does not agree with the actual loop reading given by a multimeter, a 4–20 mA trim is required.

Range Points

HART Comm.	1, 3, 3
Model 268	F3, F2, F1

The Model 1151 Smart 4 and 20 mA range points can be viewed and edited with these fast key sequences.

1.2.4 Equipment Data

Manufacturer	Rosemont
Type	1151GP Gage Pressure Transmitter
Range	0-0.5 inH_2O to 6,000 psig (Depending on Model)
Accuracy	±0.25% of calibrated span

1.3 Equipment Connections and Interface

The Pressure Transmitter outputs are connected by 2-wire 4-20, as shown in **Figure 8**. Digital output signal superimposed on 4-20 mA signal, available for HART Communicator or control system interface.

An external power supply is required. Pressure Transmitters operate on 12.0 VDC with no load.

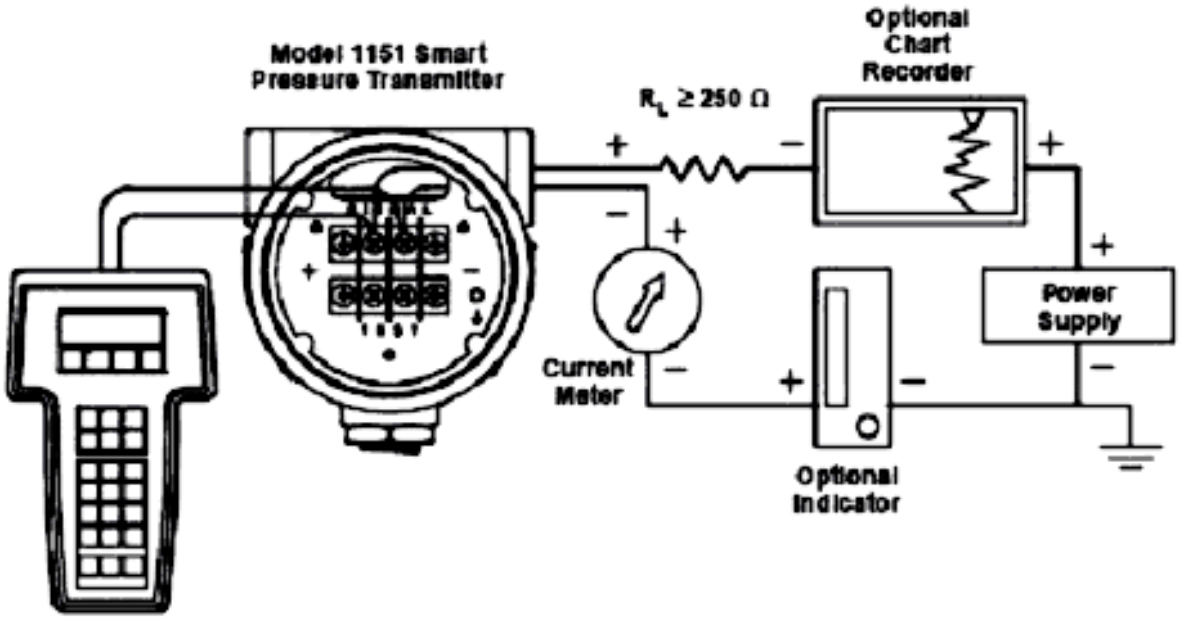


Figure 8 - Transmitter to Communicator Loop Connections

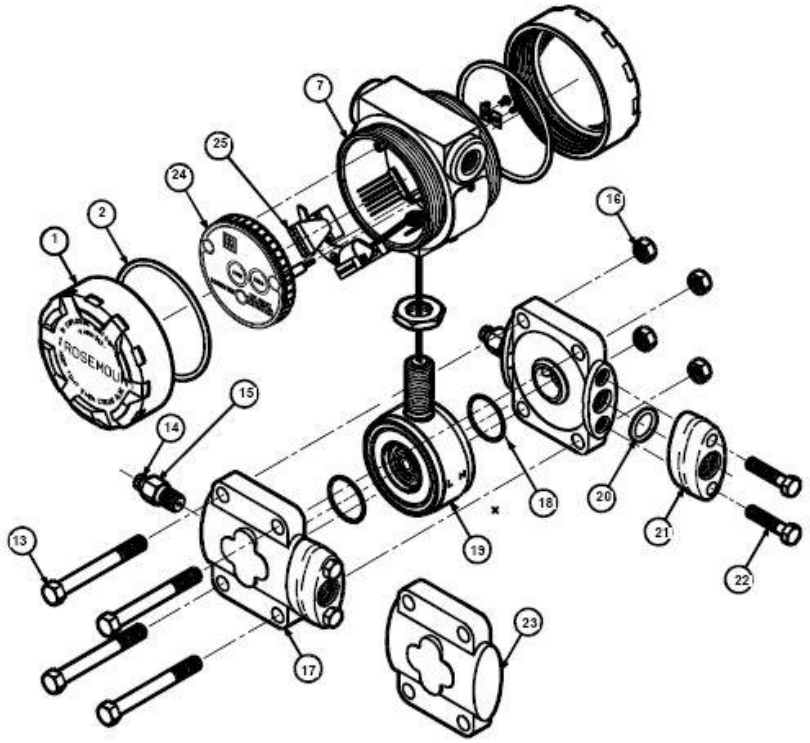
2.0 Equipment Major Parts

Chapter Objectives:

1. Describe how the equipment parts perform their function:
2. Draw from memory a diagram of the equipment showing major parts
3. State from memory, the names and functions of the major parts
4. Describe the location of the major parts

The major parts of the Pressure Transmitters, shown in **Figure 9**, are as follows:

1. Housing
2. δ-CELL Sensor
3. Electronics Module
4. Terminal Board
5. Display



1. Electronic Cover
2. O-ring
7. Electronics Housing
13. Process Flange Bolts
14/15. Valve Stem and Seat
16. Process Flange Nuts
17. Process Flange
18. Process Flange O-ring
19. Sensor Module
20. Flange Adapter O-ring
21. Flange Adapter
22. Flange Adapter Bolts
23. Blank Flange
24. Smart Transmitter Electronics
25. Board Spacer Kit

Figure 9 –Pressure Transmitter Components

2.1 Housing

The Model 1151 pressure transmitter is supplied with an aluminum or steel dual compartment housing designed to resist moisture and corrosion. The housing may be panel-mounted, wall-mounted, or attached to a 2-inch pipe through an optional mounting bracket. The sealed electronics module is mounted in a compartment that is isolated from the terminal side conduit entries. O-ring seals, as shown in **Figure 9**, protect the interior when the covers are properly installed. In humid environments, however, it is possible for moisture to accumulate in conduit lines and drain into the housing.

2.2. δ-CELL Sensor

The δ-CELL, shown in **Figure 10** contains a variable capacitance sensing element. Differential capacitance between the sensing diaphragm and the capacitor plates is converted electronically to a 2-wire 4-20 mADC, or 10-50 mADC signal. This approach is based on the following concepts:

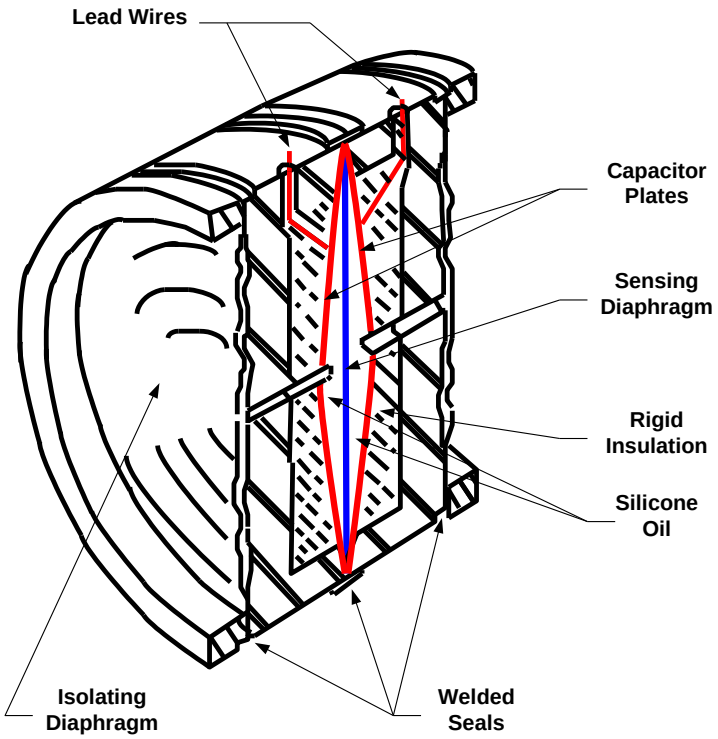


Figure 10 - Rosemont δ-CELL

$$P = K \frac{C_1 - C_2}{C_1 + C_2}$$

Where: **P** is the process pressure.
K is constant.
Ci is the capacitance between the high pressure side and the sensing diaphragm.
C_2 is the capacitance between the low pressure side and the sensing diaphragm.

$$I_{diff} + fV_{pp}(C_1 - C_2)$$

Where: I_{diff} is the difference in current from C_1 and C_2.
fV_{pp} is the peak-to-peak oscillation voltage.
f is the oscillation frequency.

I_{ref}

$$fV_{pp} = \frac{}{C_1 + C_2}$$

Where: I_{ref} is the constant current source.

$$P = \text{constant} \times I_{diff} = I_{ref} \frac{C_1 - C_2}{C_1 + C_2}$$

Theory of Operation

Process pressure is transmitted through an isolating diaphragm and silicone oil fill fluid to a sensing diaphragm in the center of the δ-CELL. The reference pressure is transmitted to the other side of the sensing diaphragm.

The position of the sensing diaphragm is detected by the capacitance plates on both sides of the sensing diaphragm. The capacitance between the sensing diaphragm and either capacitor plate is approximately 150 pf. The sensor is driven by an oscillator, at roughly 32 KHz and 30Vpp. It is then rectified through a demodulator.

Demodulator

The demodulator consists of a diode bridge D1-D8 which rectifies the AC signal.

The DC currents through transformer windings 1-12 and 3-10 are summed and controlled to be a constant by IC1 driving the oscillator.

The DC current through transformer winding 2-11 is a current directly proportional to pressure; i.e.,

$I_{diff.} = fV_{pp}(C_1 - C_2)$

The diode bridge and span temperature compensating thermistor are located inside the sensor module. The effect of the thermistor is controlled by resistors R4 and R5 located in the electronics housing.

Linearity Adjustment

Linearity is adjusted by a variable resistance network (R20, R22 and R23), capacitor C3 and diodes D9and D10. The currents generated through this part of the circuit are summed into the inputs of the oscillator control circuit. This provides a programmed correction which raises the oscillator peak-to-peak voltage to compensate for first order nonlinearity of capacitance as a function of pressure.

Oscillator
The oscillator, consisting of components Q1, T1, C19, C20, R29 and R30 has a frequency determined by the capacitance of the sensing element and the inductance of the transformer windings.

The sensing element capacitance is variable. Therefore, the frequency is variable about a nominal value of 32 KHz. IC1 is used as a feedback control circuit and controls the oscillator drive voltage such that:

$$fV_{pp} = \frac{I_{ref}}{C_1 + C_2}$$

Voltage Regulator
The transmitter uses zener diode D11, transistor Q2 and resistors R15 and R16 to provide a constant voltage of 6.4 VDC for the reference and 7 VDC to supply the oscillator, IC1, IC2, and IC3.

Zero and Span Adjustments
Zero adjustment components consist of potentiometer R35 and resistor R36 which develop a separate adjustable current that sums with the sensor current. Resistors R20 or R21 may be switched in by SW1 to add another fixed zero current which shifts the range of zero (0) adjustment to allow larger amounts of suppression or elevation.

Span adjustment is performed with R32 which determines the amount of loop current which is sensed and fed back to the current control amplifier IC3.

Current Control
The current control amplifier consists of IC3, Q3, Q4 and associated components. The 1C reference voltage is established at the junction of R10 and R13.
The current control amplifier drives the current control to a level such that the current detector feeds back a signal through R34 equal to the sum of the zero (0) current and the variable sensor current.

Current Limit
The current limit consisting of R18 and Q2 prevents the output current from exceeding 30 mA in an overpressure condition.

Reverse Polarity Protection
Reverse polarity protection is provided by diode D13.

2.3 Electronics Module

The electronics module consists of a circuit board enclosed in a metal housing. The module utilizes digital ASICs, microcomputer, and surface-mount technologies. The electronics digitize the input signal from the sensor and apply correction coefficients selected from nonvolatile

memory. The output section of the electronics module converts the digital signal to a 4-20 mA output and handles communication with the HART Communicator or Fisher-Rosemount control systems. An optional LCD meter plugs into the electronics module and displays the digital output in user-configured units.

Data Storage

The transmitters store configuration data in nonvolatile EEPROM memory in their electronics modules. This data is retained in the transmitters when power is interrupted, so the transmitters are functional immediately upon power-up.

D/A Conversion and Signal Transmission

The process variable is stored as digital data, enabling precise corrections and engineering unit conversion. The corrected data is then converted to a standard 4-20 mA current applied to the output loop. For higher accuracy the HART Communicator and Fisher-Rosemount control systems can access the process variable reading directly as a digital signal, bypassing the D/A conversion process.

Software Functionality

The software design permits remote testing and configuration of the transmitters via a HART Communicator, a Fisher-Rosemount control system, and any other hosts that support HART communications protocol. HART protocol uses an industry standard Bell 202 frequency shift keying (FSK) technique.

Diagnostics and Service

The user can perform on-line testing of the transmitter, power loop, analog signal, digital signal, and sensor. The integrity of the entire pressure measurement system is validated in a matter of seconds.

2.4 Terminal Board

The Terminal Board, shown in **Figure 11**, is mounted in the end of the housing opposite the display. All power to the transmitter is supplied over the signal wiring. Signal wiring does not need to be shielded, but twisted pairs should be used for the best results. Do not run unshielded signal wiring in conduit or open trays with power wiring or near heavy electrical equipment. High voltage may be present on the leads and may cause electrical shock.

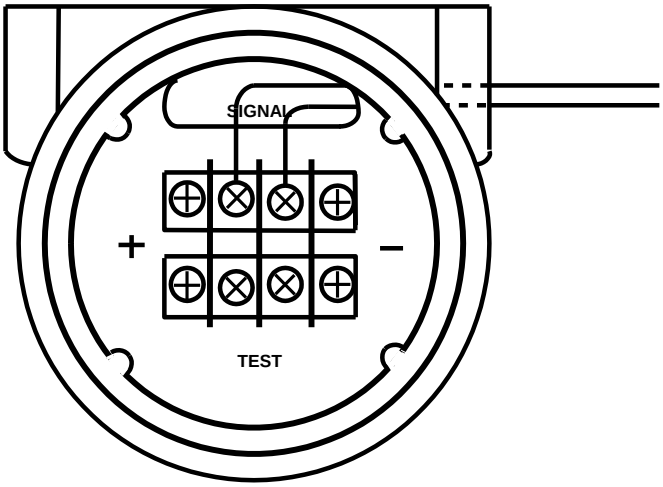


Figure 11 - Pressure Transmitter Terminal Board

To wire the transmitter for power, follow the steps below.

- Remove the transmitter covers. Do not remove the transmitter covers in an explosive atmosphere when the circuit is live.
- Connect the positive power lead to the terminal marked "+" and the negative power lead to the terminal marked "–".Crimped lugs are recommended when wiring to screw terminals.
- Tighten the terminal screws to ensure that good contact is made. No additional power wiring is required.
- Replace the transmitter covers. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

2.5 Display

The Rosemount LCD meter plugs directly into the Model 1151 Smart Pressure Transmitter to provide a highly accurate digital display of the process variable. This meter adds no voltage drop in the 4–20 mA current loop when connected directly across the transmitter test terminals. The LCD meter may be configured to meet specific requirements by using the left and right calibration buttons located on the meter face as shown in **Figure 12**. The analog bar graph is also shown in **Figure 12**. The 20-segment bar graph is factory calibrated and represents 4–20 mA directly. All display options, including the decimal point, may be reconfigured in the field using a Model 275 HART Communicator.

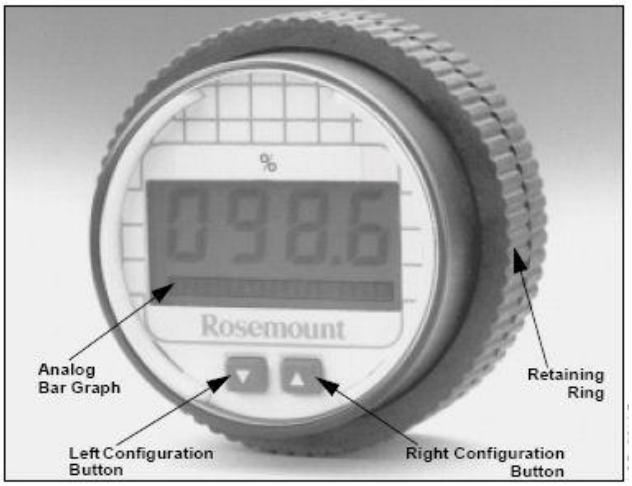


Figure 12 - Transmitter Display

No calibration equipment is required to configure the LCD meter, but between 4 and 20 mA must be flowing through the loop. The actual value of the current is not significant. In addition, meter configuration does not affect the transmitter/loop current. Use the following meter configuration procedure to properly configure the LCD meter:

1. Unscrew the retaining ring and lift the transparent cover off of the housing.
2. Press the left and right configuration buttons simultaneously and release them immediately.
3. To move the decimal point to the desired location, press the left configuration button.
4. To scroll through the mode options, press the right configuration button repeatedly until the desired mode is displayed.
5. Press both configuration buttons simultaneously for two (2) seconds. The meter displays "-------" for approximately 7.5 seconds while the information is being stored.
6. Press the left button for two (2) seconds.
7. To set the display numbers to a lower value, press the left configuration button, and to set the display numbers to a higher value, press the right configuration button. Set the numbers between –999 and 1000.
8. To store the information, press both configuration buttons simultaneously for two (2) seconds.
9. Press the right button for two (2) seconds.
10. To set the display numbers to a lower value, press the left configuration button, and to set the display numbers to a higher value, press the right configuration button. Set the numbers between –999 and 9999. The sum of the 4 mA point and the span must not exceed 9999.
11. To store the information, press both configuration buttons simultaneously for two (2) seconds. The LCD meter is now configured.
12. Make sure the rubber gasket is seated properly, replace the transparent cover, and replace the retaining ring.

3.0 Equipment Preventive and Corrective Maintenance

3.1 Preventive Maintenance

Preventive maintenance for the Pressure Transmitters is minimal and is limited to periodic recalibration. These procedures are addressed in IRI-IE-16-EMP.

3.2 Corrective Maintenance

Corrective maintenance consists of replacing transmitter and calibration. These procedures are addressed in IRI-IE-16-EMP

PRESSURE TRANSMITTER
IRI-IE-16–EMP
TRAINING EQUIPMENT MAINTENANCE PROCEDURE
I&E SECTION

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PREFACE

This Training Equipment Maintenance Training Procedure (EMP) has been designed to assist you in meeting the requirements of Module IRI-IE-16 of the I&E Section Training Program. It contains information pertaining to maintenance of the Pressure Transmitters. This includes purpose, precautions, limits and setpoints, procedures and references for maintaining equipment.

You should also inspect the equipment, identifying its components and controls. Should you have additional question about the equipment maintenance, ask your supervisor.

PRESSURE TRANSMITTERS
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References:

Purpose

This procedure provides information and guidance for the correct and safe use and maintenance of the Pressure Transmitters.

I. Precautions, Limitations, and Setpoints

A. Prior to performing any maintenance on the Pressure Transmitters, clear the work area of clutter and ensure adequate lighting exists to perform the desired work.

B. Do not remove the instrument cover in explosive atmospheres when the circuit is live.

C. Ensure that circuits supplying power to the Pressure Transmitters are disconnected.

D. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

E. Ensure that the correct replacement parts are available.

II. Procedure

The following procedures provide detailed instructions for conducting routine operations, as well as preventive and corrective maintenance on the Pressure Transmitters.

A. Operating Procedure

The 1151 Pressure Transmitters have no moving parts and are expected to last for the lifetime of the equipment being monitored. Powering of the external power supply is all that is required to place the equipment in service. There are no monitored functions required of the Pressure Transmitters.

B. Preventive Maintenance

The following steps are used by the equipment operator when performing preventive maintenance on Pressure Transmitters. The Model 1151 transmitter has no moving parts and requires a minimum amount of scheduled maintenance. The transmitter features a modular design for easy maintenance.

Troubleshoot Malfunction

The following provides summarized troubleshooting suggestions for the most common operating problems. If you suspect a malfunction despite the absence of any diagnostic messages on the communicator display, follow the procedures described here to verify that transmitter hardware and process connections are in good working order. Always deal with the most likely and easiest-to check conditions first.

Transmitter does not communicate with the HART 275.

__1. Loop Wiring

__a Check for a minimum of 250Ω resistance between the power supply and the communicator connection.

__b Check for adequate voltage to the transmitter. (If the communicator is connected and 250Ω resistance is properly in the loop, then the loop requires a minimum of 17 volts to operate.)

__c Check for intermittent shorts, open circuits, and multiple grounds.

__d Specify the transmitter by tag number. See the display sequence below.

__2. I.S. Barrier

__a Refer to appropriate I.S. Barrier documentation.

<u>High Output</u>

__1. Primary Element

__a Check for restriction at primary element.

__2. Impulse Piping

__a Check for leaks or blockage.

__b Ensure that blocking valves are fully open.

__c Check for entrapped gas in liquid lines and for liquid in dry lines.

__d Ensure that the density of fluid in impulse lines is unchanged.

__e Check for sediment in transmitter process flanges.

__3. Power Supply

__a Check the power supply output voltage at the transmitter. It should be 12 to 45 V dc.

__4. Power Supply

__a Check the power supply output voltage at the transmitter. It should be 12 to 45 V DC.

__5. Transmitter Electronics

__a Connect the HART 275 and enter the XMTR TEST mode to determine any electronic failures.

__b Make sure that post connectors are clean.

__c If the electronics are still suspect, substitute new electronics.

__6. Sensing Element

__a The sensing element is not field repairable and must be replaced if found to be defective. See "Disassembly procedure" later in this section for instructions on disassembly.

__b Check for obvious defects, such as a punctured isolating diaphragm or fill fluid loss.

Erratic Output

__1. Loop Wiring

__a Check for adequate voltage to the transmitter. It should be 12 to 45 V DC with no load.

__b Check for intermittent shorts, open circuits and multiple grounds.

__c Connect the HART and enter the LOOP TEST mode to generate signals of 4 mA, 20 mA, and user-selected values.

__2. Process Pulsation

__a Adjust the electronic damping with the HART 275.

__3. Transmitter Electronics

__a Connect the HART 275 and enter the XMTR TEST mode to determine any electronic failures.

__b Make sure that post connectors are clean.

__c If the electronics are still suspect, substitute new electronics.

__4. Impulse Piping

__a Check for entrapped gas in liquid lines and for liquid in dry lines.

Low Output or No Output

__1. Primary Element

__a Check the insulation and condition of primary element.

__b Note any changes in process fluid properties that may affect output

__2. Loop Wiring

__a Check for adequate voltage to the transmitter. It should be 12 to 45 VDC.

__b Check the milliamp rating of the power supply against the total current being drawn for all transmitters being powered.

__c Check for shorts and multiple grounds.

__d Check for proper polarity at the signal terminal.

__e Check loop impedance.

__f Check whether the transmitter is in multidrop mode, thus locking the output at 4 mA.

__g Connect the communicator and perform a loop test.

__h Check wire insulation to detect possible shorts to ground.

__3. Impulse Piping

__a Ensure that the pressure connection is correct.

__b Check for leaks or blockage.

__c Check for entrapped gas in liquid lines.

__d Check for sediment in the transmitter process flange.

__e Ensure that blocking valves are fully open and that bypass valves are tightly closed.

__f Ensure that density of the fluid in the impulse piping is unchanged.

__4. Transmitter Electronics

__a Connect the communicator and check the sensor limits to ensure calibration adjustments are within the sensor range.

__b Connect the communicator and perform a transmitter test to determine electronics failure.

__c Make sure the post connectors are clean.

__d If the electronics are still suspect, substitute new electronics.

__5. Sensing Element

__a The sensing element is not field repairable and must be replaced if found to be defective. See “Disassembly procedure” later in this section for instructions on disassembly.

__b Check for obvious defects, such as a punctured isolating diaphragm or fill fluid loss.

Transmitter Does Not Characterize Properly

__1. Pressure Source Correction

__a Check for restrictions or leaks.

__b Check for proper leveling or zeroing of the pressure source.

__c Check weights/gage to ensure proper pressure setting.

__d Determine if the pressure source has sufficient accuracy. (The pressure source should be at least three times more accurate that the Model 1151 Smart.)

__2. mA Meter

__a Determine if the mA meter is functioning properly.

__3. Power Supply

__a Check the power supply output voltage at the transmitter. It should be 12 to 45 V DC with no load.

__b Check for a minimum of 250Ω resistance between the Hart 275 and the power supply.

__4. Transmitter Electronics

__a Connect the communicator and perform a transmitter test to determine electronics failure.

__b Make sure the post connectors are clean.

__c If the electronics are still suspect, substitute new electronics.

__5. Sensing Element

__a The sensing element is not field repairable and must be replaced if found to be defective. See "Disassembly procedure" later in this section for instructions on disassembly.

__b Check for obvious defects, such as a punctured isolating diaphragm or fill fluid loss.

Online Testing

1. Connect the HART Communicator to the Pressure Transmitter.

2. Power the Communicator by pressing the On/Off key.

NOTE: If a device is found, the HART Communicator displays the Online menu (**Figure 1**). If no device is found, the Communicator displays the Main menu (**Figure 2**). If no device is found, check the connections, verify the presence of the 250 ohms load resistance in series in the loop, and retry by selecting "Online."

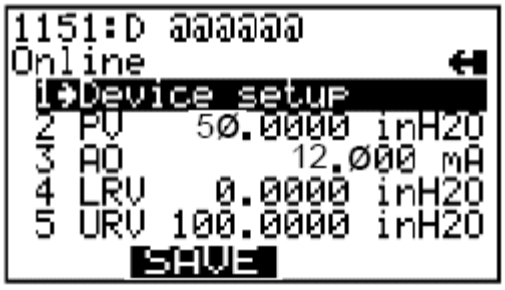

Figure 1 – Online Menu

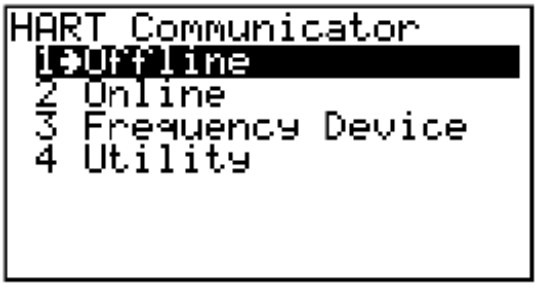

Figure 2 – Offline Menu

Pressure Transmitter Setup

From the "Device Setup" menu (**Figure 3**).

Figure 3 – Device Setup Menu

__1. To access the Process Variable menu, press the No.1 key. (If the PV and related engineering units do not appear depress the "select" key to view primary variable and the related engineering units.)

__2. To access the Diag/Service menu, press the No.2 key. (This menu offers device and loop tests as well as calibration options.) (**Figure 4**)

Figure 4 – Diagnostic / Service Menu

__3. To access "Basic Setup" from the "Device Setup" menu, press the No.3 key. This will bring up the menu displayed in **Figure 5**.

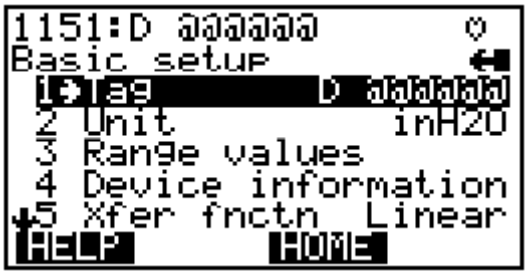

Figure 5 – Basic Setup Menu

__4. To access the "Detailed Setup" menu from the "Device Setup" menu, press the No.4 key. (This menu provides access to every editable device parameter and all device functions.)

__5. To access the "Review" menu from the "Device Setup" menu, press the No.5 key. (This menu lists all of the parameters stored in the connected device, including information about the measuring element, signal condition, and output. It also includes stored information about the connected device such as tag, materials of construction, and device software revision.)

Trimming Analog Output

Trimming the analog output is a calibration of the output circuitry, by setting the 4 and 20 mA points. Once the 4 and 20 mA points are set, all intermediate values are automatically adjusted.

__1. From the "Online Menu", select "Device setup" by pressing the No.1 key or the "right" arrow (select) key.

__2. From the "Device setup" menu, select "Diag/Service" by pressing the No.2 key.

__3. From the "Diag/Service" menu, select "Calibration" by pressing the No.3 key.

__4. From the "Calibration" menu, select "Trim analog output" by pressing the No.2 key.

__5. From the "Trim analog output" menu, select the desired option (D/H Trim" or Scaled D/H Trim") by pressing their respective numbered key, and follow the on-line instructions.

C. Corrective Maintenance

The transmitter is designed with a dual-compartment housing; one (1) compartment contains the electronics module, and the other compartment contains all wiring terminals and the communication receptacles. **Figure 6** shows a Cutaway of the Pressure Transmitter.

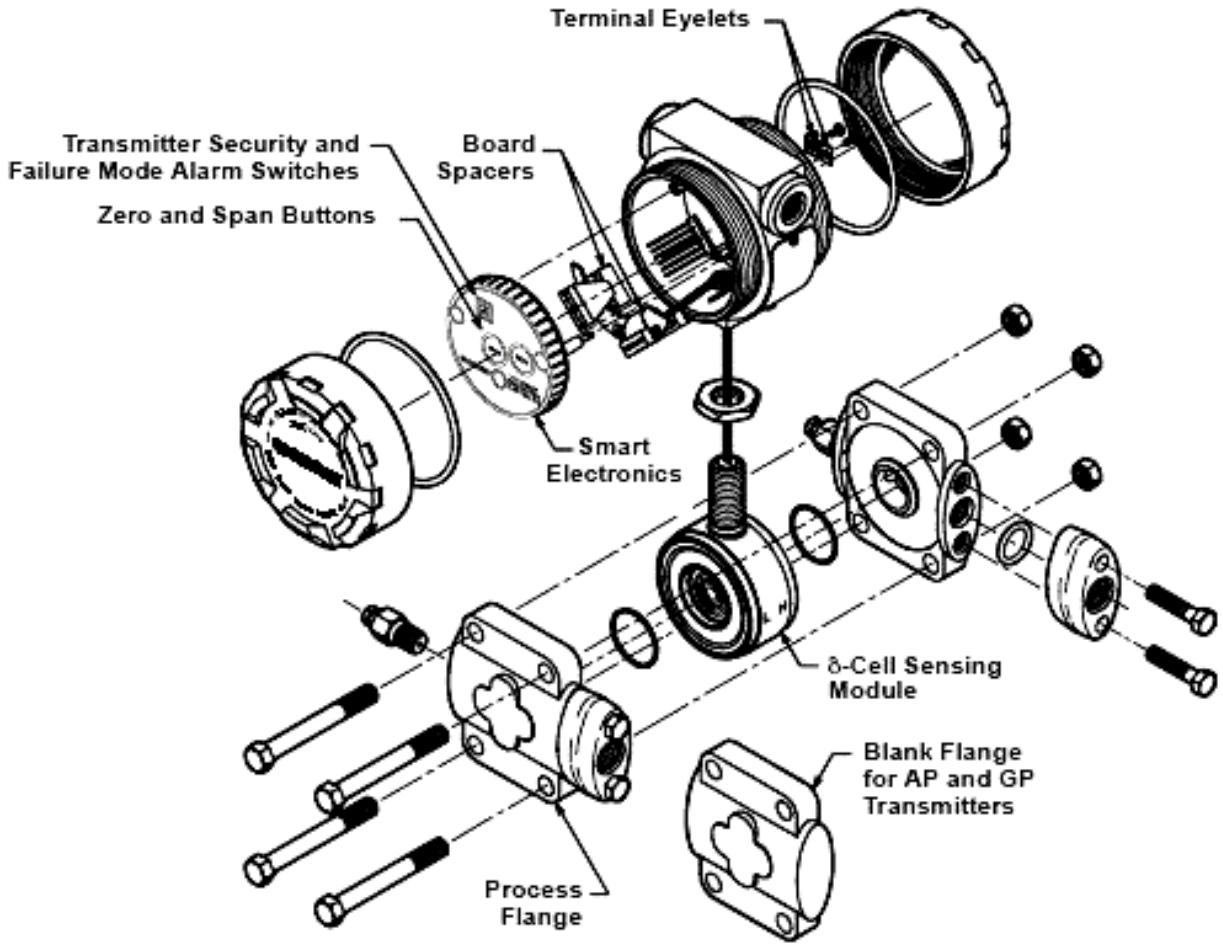

Figure 6 - Rosemont 1151 Pressure Transmitter Cutaway

Disassembly Procedure

The 1151GP electronics module is located in the compartment opposite the wiring terminals. The module is a non-repairable unit. The entire unit must be replaced if a malfunction occurs.

__1. The transmitter should be removed from service before disassembling the sensor body.

__2. Process flanges can be detached by removing the four large bolts.
__3. Isolating diaphragms may be cleaned with a soft rag, mild cleaning solution, and clear water rinse.

__4. Remove the LCD display, if applicable.

__5. Electrical connections are located in a compartment identified as TERMINAL SIDE on the nameplate. The signal and test terminals are accessible by unscrewing the cover on the terminal side. The terminals are permanently attached to the housing and must not be removed, or the housing seal between compartments will be broken.

__6. Firmly grasp the screws and assembly and pull it straight out of the housing, taking care not to damage the interconnecting pins.

NOTE: If you are replacing the electronics module with a new one, make sure the alarm switches are set in the same position.

Remove the Electronics Module

__1. Remove the cover from the terminal side of the transmitter.

__2. Remove the signal terminal + and – screws.

__3. Remove the electronics cover.

__4. Loosen the three captive screws on the smart electronics assembly.

__5. Pull the assembly slowly outward.

__6. Remove the header board.

__7. Remove the header board spacers.

Removing the Sensor from the Electrical Housing

__1. Unscrew the cover on the field terminal side of the transmitter.

__2. Disconnect the power source from the transmitter.

__3. Remove the smart electronics and header board.

__4. Loosen the lock nut.

__5. The threaded connection has a sealing compound on it and will initially be tight. Unscrew the sensing module from the electronics housing, being careful not to damage the sensor leads.

__6. Carefully pull the header assembly board through the hole.

__7. The sensing module is a welded assembly and cannot be further disassembled.

Reassembly Procedure
Connecting the Electrical Housing to the Sensor

__1. Inspect all O-rings and replace if necessary. Lightly grease with silicone oil to ensure a good seal. Use halocarbon grease for inert fill options.

__2. Insert the header assembly board through the electronics housing.

__3. Use a sealing compound (Loctite 222—Small Screw Threadlocker) on the threads of the sensor module to ensure a watertight seal on the housing.

__4. Screw the sensor module into the electrical housing making sure that at least five threads are engaged. Be careful not to damage or twist the sensor leads.

__5. Align the sensor module with the high and low pressure sides oriented for convenient installation.

__6. Tighten the lock nut.

Install the Smart Electronics and Header Board

__1. Slide the bottom half of one (1) spacer over one of the rows of bayonet connectors. Then repeat the procedure for the other row.

__2. Align the header board with the bayonet connector pins, and slide the header board halfway down the pins.

__3. Align the tops of both spacers with the bayonet connector pins, and slide them down the pins, pushing firmly on both the spacers and the header board to seat the board.

__4. Align the smart electronics assembly with the bayonet connector pins, making sure all pins line up with the proper receptacles.

__5. Next, push the assembly slowly inward until it is fully seated.

__6. Tighten the three (3) captive screws on the smart electronics assembly to secure it in place.

__7. Attach the electronics cover.

__8. Remove the cover from the terminal side of the transmitter. Two (2) eyelets that fit under the + and – signal terminal screws are provided to facilitate connections to HART-based communicator. The signal terminal is the upper block as indicated on the transmitter housing.

__9. Remove the signal terminal + and – screws. Attach an eyelet to each screw, and reinsert the screws.

__10. Reattach the cover on the terminal side, and tighten securely.

Reassemble Process Sensor Body

__1. Clean the sealing surfaces carefully.

__2. Place the greased flange O-ring around the isolator and push it into the cavity. For all HP transmitters and GP transmitters Ranges 9 and 10, place the backup ring, shiny side down, on top of the O-ring. This places the flat side of the backup ring against the O-ring.

__3. Carefully place the flange on top of the module, beveled side down so that the beveled flange surface mates with the beveled surface of the backup ring.

__4. Keeping the flange and module together, turn them over so the "L" side is up. Repeat Steps 2 through 3. As before, the flat side of the backup ring must rest against the O-ring.

__5. Insert the four (4) flange bolts. Tighten the nuts finger tight, making sure the flanges remain parallel. The transmitter may now be moved without disturbing the O-rings.

__6. Tighten one (1) bolt until the flanges seat.

__7. Torque down the bolt diagonally across.

__8. Torque down the first bolt.

__9. Torque down the two (2) remaining bolts.

__10. Inspect the flange-to-sensor seating to be sure that the flanges are not cocked.

__11. Check that all four (4) bolts are tightened to approximately 33 ft-lb.

__12. Recalibrate the transmitter.

Characterizing with a Model 275 Communicator

__1. Connect the Rosemount Model 275 HART communicator electrical connections to the SIGNAL terminal block. The 275 connections are not polarity sensitive.

__2. Turn the Model 275 on by pushing the I/O button.

__3. Follow the Model 275 menus to characterize:

__a Device setup

__b Detailed setup

__c Sensor

__d Pressure sensor

__e Sensor service

__f Characterize

__4. Follow the instructions on the screen.

__5. Verify the new transmitter configuration:

__a Tag

__b Range points

__c Linear/square root

__d Damping

__6. Verify that the Fail Safe Mode Switch and the Transmitter Security Switch on the smart electronics circuit board are reset.

__7. Attach the electronics cover and tighten.

__8. Put the transmitter back in service.

Industrial Resources, Inc.
I&E Section
Job Demonstration Check List (JDC)

I&E Technician
IRI-IE-16-JDC

Performance Measure: Pressure Transmitter

Name: _____

All Parts Satisfactorily Completed:

_____ _____
(Supervisor's Signature) (Date)

Supervisor's Comments: _____

_____

_____

_____

References:
- Training Module IRI-IE-16

Materials Needed:
- Pencil and Clipboard
- Equipment Maintenance Description – Pressure Transmitter IRI-IE-16-EMD
- Equipment Maintenance Procedure – Pressure Transmitter IRI-IE-16-EMP
- Associated Maintenance Checklist, Charts, Parts List, Technical Manuals

Safety/Environmental:
- Wear hard hats, safety glasses, safety toe shoe, and ear plugs as required.
- Discuss environmental hazards associated with performing maintenance of the equipment.
- Discuss any safety precaution that must be observed while performing the procedure.

Note: Always observe all plant safety rules in accordance with Industrial Resources, Inc. - Safety and Health Procedures and all Federal, State and/or Local OSHA Standards.

Part A: Locate Equipment

Locate and identify the following equipment and major components.

1. Housing
2. δ-CELL Sensor
3. Electronics Module
4. Terminal Board
5. Display

Satisfactorily Completed _____

Part B: Controls/Breakers

Locate and identify the following isolation devices.

1. Power Supply

Satisfactorily Completed _____

Part C: Preparation for Maintenance

This is to be performed under direction of the Supervisor.
Demonstrate the following preparation for use of the Pressure Transmitters.

1. Prior to performing any maintenance on a Pressure Transmitters, clear the work area of clutter and ensure adequate lighting exists to perform the desired work.
2. Do not remove the instrument cover in explosive atmospheres when the circuit is live.
3. Ensure that circuits supplying power to the Pressure Transmitters are disconnected.
4. Both transmitter covers must be fully engaged to meet explosion proof.
5. Ensure that the correct replacement parts are available.

Satisfactorily Completed _____

Part D: Operating Procedure

This is to be performed under direction of the Supervisor.
Demonstrate the following operational steps for the safe and efficient operation of the Pressure Transmitters.

1. Isolate the power supply to the Pressure Transmitters.

Satisfactorily Completed _____

Part E: Preventive Maintenance

This is to be performed under direction of the Supervisor.
Demonstrate the steps on the Pressure Transmitters required to perform the following preventive maintenance tasks.

Troubleshoot Malfunction

Transmitter does not communicate with the HART 275.

Loop Wiring
__e Check for a minimum of 250Ω resistance between the power supply and the communicator connection.
__f Check for adequate voltage to the transmitter. (If the communicator is connected and 250Ω resistance is properly in the loop, then the loop requires a minimum of 17 volts to operate.)
__g Check for intermittent shorts, open circuits, and multiple grounds.
__h Specify the transmitter by tag number. See the display sequence below.

I.S. Barrier
1. Refer to appropriate I.S. Barrier documentation.

High Output

Primary Element
1. Check for restriction at primary element.

(Continued on next page.)

Part E: Preventive Maintenance (Continued)

Impulse Piping
1. Check for leaks or blockage.
2. Ensure that blocking valves are fully open.
3. Check for entrapped gas in liquid lines and for liquid in dry lines.
4. Ensure that the density of fluid in impulse lines is unchanged.
5. Check for sediment in transmitter process flanges.

Power Supply
1. Check the power supply output voltage at the transmitter. It should be 12 to 45 V dc.

Transmitter Electronics
1. Connect the HART 275 and enter the XMTR TEST mode to determine any electronic failures.
2. Make sure that post connectors are clean.
3. If the electronics are still suspect, substitute new electronics.

Sensing Element
1. The sensing element is not field repairable and must be replaced if found to be defective. See "Disassembly procedure" later in this section for instructions on disassembly.
2. Check for obvious defects, such as a punctured isolating diaphragm or fill fluid loss.

Erratic Output

Loop Wiring
1. Check for adequate voltage to the transmitter. It should be 12 to 45 V dc with no load.
2. Check for intermittent shorts, open circuits and multiple grounds.
3. Connect the HART and enter the LOOP TEST mode to generate signals of 4 mA, 20 mA, and user-selected values.

Process Pulsation
1. Adjust the electronic damping with the HART 275.

Transmitter Electronics
1. Connect the HART 275 and enter the XMTR TEST mode to determine any electronic failures.
2. Make sure that post connectors are clean.
3. If the electronics are still suspect, substitute new electronics.

(Continued on next page.)

Part E: Preventive Maintenance (Continued)

Impulse Piping
1. Check for entrapped gas in liquid lines and for liquid in dry lines.

Low Output or No Output

Primary Element
1. Check the insulation and condition of primary element.
2. Note any changes in process fluid properties that may affect output

Loop Wiring
1. Check for adequate voltage to the transmitter. t should be 12 to 45 V dc.
2. Check the milliamp rating of the power supply against the total current being drawn.
3. Check for shorts and multiple grounds.
4. Check for proper polarity at the signal terminal.
5. Check loop impedance.
6. Check whether the transmitter is in multidrop mode, thus locking the output at 4 mA.
7. Connect the communicator and perform a loop test.
8. Check wire insulation to detect possible shorts to ground.

Loop Wiring
1. Ensure that the pressure connection is correct.
2. Check for leaks or blockage.
3. Check for entrapped gas in liquid lines.
4. Check for sediment in the transmitter process flange.
5. Ensure that blocking valves are fully open and that bypass valves are tightly closed.

Transmitter Electronics
1. Connect the communicator and check the sensor limits to ensure calibration adjustments are within the sensor range.
2. Connect the communicator and perform a transmitter test to determine electronics failure.
3. Make sure the post connectors are clean.
4. If the electronics are still suspect, substitute new electronics.

Sensing Element
1. The sensing element is not field repairable and must be replaced if found to be defective.
2. Check for obvious defects, such as a punctured isolating diaphragm or fill fluid loss.

Transmitter Does Not Characterize Properly
(Continued on the next page.)

Part E: Preventive Maintenance (Continued)

Pressure Source Correction
1. Check for restrictions or leaks.
2. Check for proper leveling or zeroing of the pressure source.
3. Check weights/gage to ensure proper pressure setting.
4. Determine if the pressure source has sufficient accuracy. (The pressure source should be at least three times more accurate that the Model 1151 Smart.)

mA Meter
1. Determine if the mA meter is functioning properly.

Power Supply
1. Check the power supply output voltage at the xmtr. It should be 12 to 45 V dc at no load.
2. Check for a minimum of 250Ω resistance between the Hart 275 and the power supply.

Transmitter Electronics
1. Connect the communicator and perform a transmitter test to determine electronics failure.
2. Make sure the post connectors are clean.
3. If the electronics are still suspect, substitute new electronics.

Sensing Element
1. The sensing element is not field repairable and must be replaced if found to be defective. See "Disassembly procedure" later in this section for instructions on disassembly.
2. Check for obvious defects, such as a punctured isolating diaphragm or fill fluid loss.

Online Testing
1. Connect the HART Communicator to the Pressure Transmitter.
2. Power the Communicator by pressing the On/Off key.

Pressure Transmitter Setup
1. To access the Primary Variable menu, press the No.1 key.
2. To access the Diag/Service menu, press the No.2 key.
3. To access "Basic Setup" from the "Device Setup" menu, press the No.3 key.
4. To access the "Detailed Setup" menu from the "Device Setup" menu, press the No.4 key.
5. To access the "Review" menu from the "Device Setup" menu, press the No.5 key.

(Continued on next page.)

Part E: Preventive Maintenance (Continued)

Trimming Analog Output

1. From the "Online Menu", select "Device setup" by pressing the No.1 key or the "right" arrow (select) key.
2. From the "Device setup" menu, select "Diag/Service" by pressing the No.2 key.
3. From the "Diag/Service" menu, select "Calibration" by pressing the No.3 key.
4. From the "Calibration" menu, select "Trim analog output" by pressing the No.2 key.
5. From the "Trim analog output" menu, select the desired option (D/H Trim" or Scaled D/H Trim") by pressing their respective numbered key, and follow the on-line instructions.

Satisfactorily Completed _____

Part F: Corrective Maintenance

This is to be performed under direction of the Supervisor.
Demonstrate the steps on the Pressure Transmitters required to perform the following corrective maintenance.

Disassembly Procedure

1. The transmitter should be removed from service before disassembling the sensor body.
2. Process flanges can be detached by removing the four large bolts.
3. Isolating diaphragms may be cleaned with a soft rag, mild cleaning solution, and clear water rinse.
4. Remove the LCD display, if applicable.
5. Electrical connections are located in a compartment identified as TERMINAL SIDE on the nameplate. The signal and test terminals are accessible by unscrewing the cover on the terminal side. The terminals are permanently attached to the housing and must not be removed, or the housing seal between compartments will be broken.
6. Firmly grasp the screws and assembly and pull it straight out of the housing, taking care not to damage the interconnecting pins.

NOTE: If you are replacing the electronics module with a new one, make sure the alarm switches are set in the same position.

(Continued on next page.)

Part F: Corrective Maintenance (Continued)

Removing the Electronics Module

1. Remove the cover from the terminal side of the transmitter.
2. Remove the signal terminal + and – screws.
3. Remove the electronics cover.
4. Loosen the three captive screws on the smart electronics assembly.
5. Pull the assembly slowly outward.
6. Remove the header board.
7. Remove the header board spacers.

Removing the Sensor from the Electrical Housing

1. Unscrew the cover on the field terminal side of the transmitter.
2. Disconnect the power source from the transmitter.
3. Remove the smart electronics and header board.
4. Loosen the lock nut.
5. The threaded connection has a sealing compound on it and will initially be tight. Unscrew the sensing module from the electronics housing, being careful not to damage the sensor leads.
6. Carefully pull the header assembly board through the hole.
7. The sensing module is a welded assembly and cannot be further disassembled.

Reassembly Procedure

Connecting the Electrical Housing to the Sensor

1. Inspect all O-rings and replace if necessary. Lightly grease with silicone oil to ensure a good seal. Use halocarbon grease for inert fill options.
2. Insert the header assembly board through the electronics housing.
3. Use a sealing compound (Loctite 222—Small Screw Threadlocker) on the threads of the sensor module to ensure a watertight seal on the housing.
4. Screw the sensor module into the electrical housing making sure that at least five threads are engaged. Be careful not to damage or twist the sensor leads.
5. Align the sensor module with the high and low pressure sides oriented for convenience.
6. Tighten the lock nut.

(Continued on next page.)

Part F: Corrective Maintenance (Continued)

Install the Smart Electronics and Header Board

1. Slide the bottom half of one spacer over one of the rows of bayonet connectors. Then repeat the procedure for the other row.
2. Align the header board with the bayonet connector pins, and slide the header board halfway down the pins.
3. Align the tops of both spacers with the bayonet connector pins, and slide them down the pins, pushing firmly on both the spacers and the header board to seat the board.
4. Align the smart electronics assembly with the bayonet connector pins, making sure all pins line up with the proper receptacles.
5. Next, push the assembly slowly inward until it is fully seated.
6. Tighten the three captive screws on the smart electronics assembly to secure it in place.
7. Attach the electronics cover.
8. Remove the cover from the terminal side of the transmitter. Two eyelets that fit under the + and – signal terminal screws are provided to the HART-based communicator. The signal terminal is the upper block as indicated on the transmitter housing.
9. Remove the signal terminal + and – screws. Attach an eyelet to each screw, and reinsert the screws.
10. Reattach the cover on the terminal side, and tighten securely.

Reassemble Process Sensor Body

1. Clean the sealing surfaces carefully.
2. Place the greased flange O-ring around the isolator and push it into the cavity. For all HP transmitters and GP transmitters Ranges 9 and 10, place the backup ring, shiny side down, on top of the O-ring. This places the flat side of the backup ring against the O-ring.
3. Carefully place the flange on top of the module, beveled side down so that the beveled flange surface mates with the beveled surface of the backup ring.
4. Keeping the flange and module together, turn them over so the "L" side is up. Repeat Steps 2 through 3. As before, the flat side of the backup ring must rest against the O-ring.
5. Insert the four flange bolts. Tighten the nuts finger tight, making sure the flanges remain parallel. The transmitter may now be moved without disturbing the O-rings.
6. Tighten one bolt until the flanges seat.
7. Torque down the bolt diagonally across.
8. Torque down the first bolt.
9. Torque down the two remaining bolts.
10. Inspect the flange-to-sensor seating to be sure that the flanges are not cocked.

(Continued on next page.)

Part F: Corrective Maintenance (Continued)

11. Check that all four bolts are tightened to approximately 33 ft-lb.
12. Recalibrate the transmitter.

Characterizing with a Model 275 Communicator

1. Connect the Rosemount Model 275 HART communicator electrical connections to the SIGNAL terminal block. The 275 connections are not polarity sensitive.
2. Turn the Model 275 on by pushing the I/O button.
3. Follow the Model 275 menus to characterize Device setup, Detailed setup, Sensor, Pressure Sensor, Sensor Service, and Characterize.
4. Follow the instructions on the screen.
5. Verify the new transmitter configuration for Tag, Range points, Linear/square root, and Damping.
6. Verify that the Fail Safe Mode Switch and the Transmitter Security Switch on the smart electronics circuit board are reset.
7. Attach the electronics cover and tighten.
8. Put the transmitter back in service.

Satisfactorily Completed _____

Part G: Personnel and Equipment Safety

Performed all aspects of the JDC using safe operating practices and following plant safety and environmental procedures.

Satisfactorily Completed _____

Industrial Resources, Inc.
I&E Section

1. (IRI-IE-16) Pressure is defined as _____.
   A. force applied through a distance
   B. force multiplied by the length of the arm applying the force
   C. force divided by the unit area
   D. force applied to a unit area

2. (IRI-IE-16) Atmospheric pressure is _____.
   A. the weight of a column of air acting on one square foot
   B. the weight of a column of air acting on one square inch
   C. equal to 14.17 psia
   D. equal to the gage pressure

3. (IRI-IE-16) A pressure sensing instrument when not connected to a process pressure will sense the_____but read zero gage pressure
   A. process pressure
   B. absolute pressure
   C. differential
   D. atmospheric pressure

4. (IRI-IE-16) Atmospheric pressure increases as the air becomes _____.
   A. more dense
   B. less dense
   C. more active
   D. less active

5. (IRI-IE-16) The Rosemont 1151 Pressure Transmitter uses _____as a sensing element.
   A. orifice
   B. δ-CELL
   C. pitot tube
   D. venturi

6. (IRI-IE-16) The Rosemont 1151 Pressure Transmitter sensing element uses _____ between the sensing diaphragm and the capacitor plates to determine the pressure.
   A. differential capacitance
   B. resistance
   C. voltage
   D. current

7 (IRI-IE-16) Commissioning of the Model 1151 pressure transmitter consist of _____and verifying the transmitter configuration data.

A. testing the loop
B. adjusting the impedance
C. establishing the voltage
D. adjusting the feedback current

8 (IRI-IE-16) As part of its normal operation, the Model 1151 Smart Pressure Transmitter continuously monitors its own operation. If the diagnostic routine detects a failure in the transmitter in analog output, the transmitter either drives its output below 3.8 mA or above 21.0 mA, depending on the position of the _____.

A. HART switch
B. On/Off switch
C. transmitter security switch
D. failure mode alarm switch

9. (IRI-IE-16) Rosemont recommends that Model 1151 Smart Pressure Transmitters be commissioned_____.

A. by Rosemont
B. after installation
C. before installation
D. after operating for 24 hours

10 (IRI-IE-16) The Model 1151 Smart Pressure Transmitter contains_____ that provide user-selectable operation of failure mode and transmitter security

A. hardware switches
B. software switches
C. software configurations
D. programming capabilities

11 (IRI-IE-16) When placed in the ON position, the _____ prevents the accidental or deliberate change of configuration data on the Model 1511.

A. HART switch
B. On/Off switch
C. transmitter security switch
D. failure mode alarm switch

12. (IRI-IE-16) The Pressure Transmitter Electronics Modules in the Model 1151 are repaired by _____.
    A. anyone
    B. vendors
    C. supervisors
    D. replacement

13. (IRI-IE-16) The model 1151 Pressure Transmitters store data in _____.
    A. the HART Communicator
    B. EEPROM memory
    C. the DCS
    D. hard drives

14. (IRI-IE-16) Testing of the Model 1151 Pressure Transmitters can be performed _____
    A. online only
    B. offline only
    C. prior to installation
    D. online, offline or prior to installation

15. (IRI-IE-16) Wiring to the terminal should be performed with_____.
    A. soldered connections
    B. hard wire connections
    C. crimped lug connections
    D. any means

16. (IRI-IE-16) Signal wire should be _____.
    A. twisted pairs
    B. shielded
    C. coaxial
    D. unshielded with power wiring

17. (IRI-IE-16) The optional Model 1151 display contains a _____ digit LCD meter.
    A. three
    B. four
    C. five
    D. six

18. (IRI-IE-18) When the Hart Communicator is connected to the Pressure Transmitter and the Offline Message appears, _____.

A. replace the transmitter
B. check the connections
C. replace the communicator batteries
D. run troubleshooting

19. (IRI-IE-16) When trimming the analog output on the Model 1151, the intermediate values _____, the 4 and 20mA points are set.
A. will be automatically adjusted if
B. must be set before
C. must be set after
D. must not be set unless

20. (IRI-IE-16) The model 1151 electronic module is replaced_____.
A. when the transmitter is replaced
B. once a year during calibration
C. by removing the cover and removing two screws
D. only at a Rosemont repair facility