Instruction

MI 020-357
June 2009

I/A Series® Pressure Transmitter Functional Safety Manual

FOXBORO™

Contents

Purpose

This safety manual documents the user responsibilities for installation and operation of the I/A Series Pressure Transmitter in a Safety Instrumented Function (SIF). In order to ensure the safe usage of this product, all procedures in this document must be followed. This manual should be read in addition to the appropriate instructions for the transmitter being installed, see Reference Documents.

Scope

The information in this document applies to the following products when -S2 is shown as an option in the model code (See Figure 1):

IAP10 Absolute Pressure Transmitter with HART Communication

IDP10 Differential Pressure Transmitter with HART Communication

IGP10 Gauge Pressure Transmitter with HART Communication

IAP20 Absolute Pressure Transmitter with HART Communication

IGP20 Gauge Pressure Transmitter with HART Communication

Acronyms and Definitions

AcronymsDefinitions

DDDangerous Detected

DUDangerous Undetected

FITFailures in Time (failures per 1E09 hours)

FMEAFailure Modes and Effects Analysis

FTAFault Tree Analysis

HFTHardware Fault Tolerance

LT Product Lifetime

MPamegaPascals

MTTRMean Time to Repair

PFD_{AVG}Average Probability of Failure on Demand

psi Pounds per square inch

PTIProof Test Interval

SD Safe Detected

SFFSafe Failure Fraction

SFRSSafety Requirements Specification

SIF Safety Instrumental Function

SIL Safety Integrity Level

SU Safe Undetected

Reference Documents

The following documents are referenced by this Safety Manual or define or constrain its contents. Where the contents of this Safety Manual conflict with those of a referenced document, the contents of the most recent document shall take precedence.

- Safety Requirements Specification, I/A Series Pressure Transmitter, Document MI 020-357.
- Product Specifications, I/A Series Electronic Pressure Transmitters with HART® Communication Protocol for Absolute and Gauge Pressure Measurement, Document PSS 2A-1C13 B.
- Product Specifications, I/A Series Electronic d/p Cell® Transmitters Model IDP10 with HART® Communication Protocol for Differential Pressure Measurement, Document PSS 2A-1C14 B.
- Product Specifications, I/A Series Electronic Pressure Transmitters Model IGP10 Gauge Pressure Transmitter for High Pressure Measurement, Document PSS 2A-1C13 F.
- Product Specifications, I/A Series Electronic Pressure Transmitters IAP10 and IGP10 Absolute and Gauge Pressure Transmitters with Sanitary Process Connections, Document PSS 2A-1C13 K.
- Product Specifications, I/A Series Electronic Pressure Transmitters IAP10 and IGP10 Absolute and Gauge Pressure Transmitters with Pulp and Paper Process Connections, Document PSS 2A-1C13 L.
- Instruction - Installation, Operation, Calibration, Configuration, and Maintenance, I/A Series Pressure Transmitters, IAP10 Absolute Pressure and IGP10 Gauge Pressure with HART Communication, Document MI IAP10-T/IGP10-T.
- Instruction - Installation, Operation, Calibration, Configuration, and Maintenance, I/A Series Pressure Transmitters, IDP10 Differential Pressure with HART Communication, Document MI IDP10-T.
- Instruction - Installation, Operation, Calibration, Configuration, and Maintenance, I/A Series Pressure Transmitters, IAP20 Absolute Pressure and IGP20 Gauge Pressure with HART Communication, Document MI IAP20-T/IGP20-T.
- Instruction - I/A Series Intelligent Pressure Transmitters Operation, Configuration, and Calibration Using a HART Communicator, Document MI 020-366.
- Instruction - Intelligent Field Device Configurator, Document MI 020-495.
- Instruction - PC50 Intelligent Field Device Tool, Installation and Parts List, Document MI 020-501.
- Instruction - PC50 Intelligent Field Device Tool, Operation Using HART Communication Protocol, Document MI 020-505.
- Failure Modes, Effects, and Diagnostic Analysis Report, I/A Series Pressure Transmitter, exida Document INV 05/11-10 R001, V1 R1, 2006 January 25

Safety Specifications

Product Identification

See Figure 1 for transmitter data plate contents.

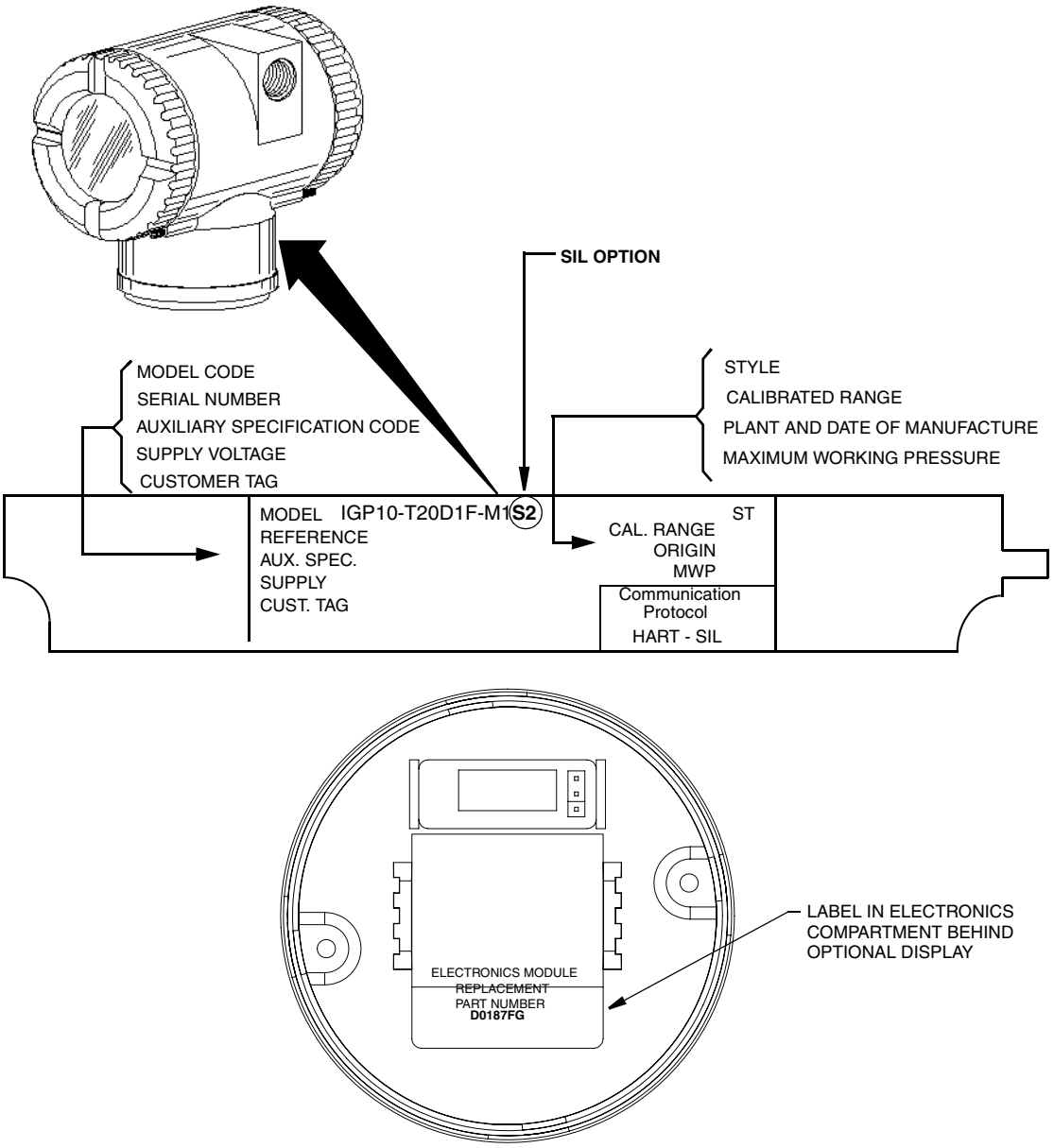


Figure 1. Sample Transmitter Identification

Safety Related Parameters

The following variables and interfaces can be used as part of a Safety instrumented Function:

Variables: Pressure;

Interfaces: 4 to 20 mA analog current. Use in absolute, gauge, or differential pressure measurement applications as indicted by the model code.

Safety Accuracy: 2%

Safety Response Time: 750 ms maximum (with Damping set to 0 s)

Measurement Updates: Every 50 ms.

Fail Low: In rare cases, certain extreme conditions such as memory failures are signaled within the Fail Low range independent of the configured setting for the failsafe strategy. For example, a processor failure may result in a 3.8 mA output.

⚠ WARNING

To ensure safe fault monitoring, the DCS must be capable of recognizing both the Fail High and Fail Low conditions as malfunction indicators.

NOTE

1. The HART interface and/or the local interface (if present) may be used to examine data, but are not to be used as a safety critical means of communication.
2. The write protect jumper must be in the Protect position during normal operation as detailed in the configuration and operation section.
3. The user can verify that the transmitter is operating in the secured (SIL) mode using a HART Communicator as follows:
   - From the Top Level Online menu, select **Device Setup** and then **Diagnostic Info**.
   - Verify that the **SIL Mode** item indicates **OK: Required + Active**.

Reliability Data

These data are valid with the following requirements:

- The logic solver (user SIF) must detect both out of range currents, both over and under, and must act upon their detection to bring the system to a safe state.
- The system operates in a low demand mode. (The frequency of demands for operation made on the system is no greater than one per year and no greater than twice the proof test frequency.)

Failure Data According to IEC 61508

Table 1. Failure Data According to IEC61508

Device	λ	λ_s	λ_{dd}	λ_{du}	SFF
I/A Series Pressure Transmitter	3680 FIT	2150 FIT	1160 FIT	366 FIT	90.06%

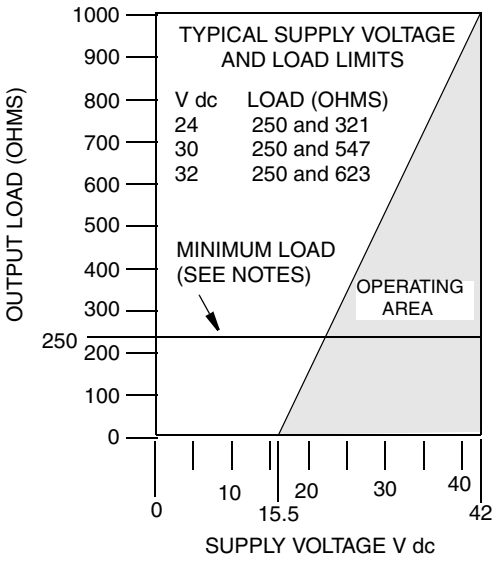
The PFD_{AVG} value for a single I/A Series Pressure Transmitter is 1.6e-3 per year (Proof test interval is 1 year)

The PFH value for the single I/A Pressure Transmitter is 1.87e-7.

The I/A Series Pressure Transmitter performs internal diagnostic functions to detect random faults of its hardware. All internal diagnostics execute detected faults within the diagnostic test interval of 11 minutes. The transmitter detects and mitigates systematic faults that could result in failure on demand prior to a demand occurring.

Environmental Limits

Parameter	Limits
Sensor Body Temperature	
Silicone fill fluid	-46 and +121°C
Fluorinert fill fluid	-29 and +121°C
Neobee fill fluid	-18 and +121°C
pvdf inserts	-7 and +82°C
Electronics Temperature	
Without LCD	-40 and -85°C
With LCD	-29 and +85°C
Relative Humidity	0% and 100%
Terminal Voltage	The loop must be designed to provide a minimum of 15.5 V at the transmitter terminals to allow for SIS operation up to 21 mA with a safe margin and allowance for HART communication.
Voltage Supply and Loop Load for SIF Applications	



NOTES:
1. THE MINIMUM LOAD FOR THE HART COMMUNICATOR IS 250 Ω.
2. THE TRANSMITTER CAN FUNCTION WITH AN OUTPUT LOAD LESS THAN THE MINIMUM PROVIDED THAT A REMOTE CONFIGURATOR IS NOT CONNECTED TO IT. CONNECTING A REMOTE CONFIGURATOR WHILE OPERATING IN THIS AREA COULD CAUSE OUTPUT DISTURBANCES AND/OR COMMUNICATION PROBLEMS
3. THIS SIF SUPPLY VOLTAGE VS LOAD CURVE ALLOWS FOR A SAFETY MARGIN TO COMPLY WITH SIL CERTIFICATION.

Vibration	6.3 mm Double Amplitude: from 5 to 15 Hz with Aluminum Housing and from 5 to 9 Hz with 316 ss Housing - 0 to 30 m/s^2 from 15 to 500 Hz with Aluminum Housing and 0 to 10 m/s^2 from 9 to 500 Hz with 316 ss Housing
Weatherproofing	Dusttight and weatherproof per IEC IP66 and NEMA 4X.

Refer to the appropriate PSS for detailed operating, storage, and transportation condition specifications.

PSS 2A-1C13 B	IAP10 and IGP10 Pressure Transmitters
PSS 2A-1C14 B	IDP10 Differential Pressure Transmitter
PSS 2A-1C13 F	IGP10 High Pressure Transmitter
PSS 2A-1C13 K	IAP10 and IGP10 Pressure Transmitters with Sanitary Process Connections
PSS 2A-1C13 L	IAP10 and IGP10 Pressure Transmitters with Pulp and Paper Process Connections

Application Limits

IAP10 and IGP10

Table 2. Span Limits and Maximum Overrange Pressure

	Span Limits[a]		**Maximum Overrange Pressure**[a]	
Span Code	**kPa**	**inH_2O**	**kPa**	**inH_2O**
B[b]	0.87 and 50	3.5 and 200	1.3	300
Span Code	**MPa**	**psi**	**MPa**	**psi**
C	0.007 and 0.21	1 and 30	0.31	45
D	0.07 and 2.1	10 and 300	3.1	450
E	0.7 and 21	100 and 3000	31	4500
F[c,d]	14 and 42	2000 and 6000	59	8400
G[c,d]	35 and 105	5000 and 15,000	137	19,500
H[c,d]	70 and 210	10000 and 30,000	231	33,000
K[c,d]	17 and 52	2500 and 7500	79	11,250

(a) Values listed are in absolute or gauge pressure units, as applicable.

(b) Applies to IGP10 with sanitary or pulp and paper process connections only.

(c) Not available with pressure seals.

(d) Applicable to IGP10 only.

IAP20 and IGP20

Table 3. Span Limits and Maximum Overrange Pressure

Span Code	Span Limits[a]		Maximum Overrange Pressure[a]	
	kPa	inH_2O	MPa	psi
A[b,c]	0.12 and 7.5	0.5 and 30	25	3625
B	0.87 and 50	8.7 and 500	25	3625
	MPa	psi	MPa	psi
C	0.007	1 and 30	25	3625
D	10 to 300	10 and 300	25	3625
E	100 to 3000	100 and 3000	31	4500
F[b]	200 to 5000	200 and 5000	52	7500

(a) Values listed are in absolute or gauge pressure units, as applicable.

(b) Applicable to IGP20 only.

(c) Not available with pressure seals.

The maximum overrange pressure may be different depending on the bolting material. Refer to Table 4.

Table 4. Maximum Static and Overrange Pressure

Transmitter Configuration (Bolting Material)	Maximum Static and Overrange Pressure Rating[a,b]	
	MPa	Psi
Option -B2, -D3 or -D7	25	3625
Option -B1 or -D5	15	2175
Option -B3	20	2900
Option -D1	16	2320
Option -D2, -D4, -D6, or -D8[c]	10	1500
Option -D9	40	5800

(a)Either side can be at higher pressure during overrange.

(b)When Structure Codes 78/79 are used (pvdf insert in the Hi side process cover), the maximum overrange is 2.1 MPa (300 psi) and temperature limits are -7 and +82°C (20 and 180°F).

(c)Limited to operating temperatures ranging from 0 to 60°C (32 to 140°F).

IDP10

Table 5. Span Limits and Maximum Overrange Pressure

Span Code	Span Limits	
	kPa	inH_2O
A[a]	0.12 and 7.5	0.5 and 30
B	0.87 and 50	3.5 and 200
C	7.0 and 210	28 and 840
Code	**MPa**	**psi**
D	0.07 and 2.1	10 and 300
E	0.7 and 21	100 and 3000

Transmitter Configuration Bolting Material	Maximum Overrange Pressure[b,c]	
	MPa	psi
-B7. -B2. -D3, -D7	25	3625
-B1, -D5	15	2175
-B3	20	2900
-D1	16	2320
-D2, -D4, -D5, -D8[b]	10	1500
-D9	40	5800

(a) Not available with pressure seals.

(b) When Structure Codes 78/79 are used (pvdf insert in the Hi and Lo side process cover), the maximum overrange is 2.1 MPa (300 psi) and temperature limits are -7 and +82°C (20 and 180°F).

(c) Static Pressure rating of 40 MPa (5800 psi) with Option Code -Y.

Electromagnetic Compatibility

The I/A Series Pressure Transmitter conforms to the following EMC requirements:

- NAMUR NE21 (August 1998 German and May 1999 English)
- EMC directive 2004/108/EC per EN 61326-1.

Lifetime Limits

According to section 7.4.7.4 of IEC 61508-2, a useful lifetime, based on experience, should be assumed.

Although a constant failure rate is assumed by the probabilistic estimation method, this only applies provided that the useful lifetime of components is not exceeded. Beyond their useful lifetime the result of the probabilistic calculation method is therefore meaningless, as the probability of failure significantly increases with time. The useful lifetime is highly dependent on the component itself and its operating conditions - temperature in particular (for example, electrolyte capacitors can be very sensitive).

This assumption of a constant failure rate is based on the bathtub curve, which shows the typical behavior for electronic components. Therefore it is obvious that the PFD_{AVG} calculation is only valid for components that have this constant domain and that the validity of the calculation is limited to the useful lifetime of each component.

Table 6 shows which components are contributing to the dangerous undetected failure rate and therefore to the PFD_{AVG} calculation and their estimated useful lifetime.

Table 6. Useful Lifetime of Components Contributing to λdu

Type	Useful Life at 40°C
Capacitor (electrolytic) - Tantalum electrolytic, solid electrolyte	Approximately 500,000 hours

As there are no aluminum electrolytic capacitors used, the tantalum electrolytic capacitors are the limiting factors with regard to the useful lifetime of the system. The tantalum electrolytic capacitors that are used in the I/A Series Pressure Transmitter have an estimated useful lifetime of about 50 years.

When plant experience indicates a shorter useful lifetime than indicated in this document, the number based on plant experience should be used.

Certification Data

The I/A Series Pressure Transmitter is classified as a Type B device according to IEC 61508, having a hardware fault tolerance of 0.

NOTE

Type B component: "Complex" component (using micro controllers or programmable logic); for details see 7.4.3.1.3 of IEC 61508-2.

Based on internal diagnostics, the I/A Series Pressure Transmitter has a Safe Failure Fraction of 90.06% (assuming that the logic solver is configured to detect over-scale and under-scale currents) and therefore may be used up to SIL 2 as a single device.

The I/A Series Pressure Transmitter has a proof test interval of 1 year in order to maintain a SIL 2 rating, allowing it to be used as a single device.

Note that per IEC 61508-2 section 7.4.3.1.4, the preceding information allows the I/A Series Pressure Transmitter, when used in a 1 of 2 system architecture, to be used as a SIL 3 application with an HFT of 1.

All I/A Series Pressure Transmitter diagnostics have a maximum Diagnostic Test Interval of 11 minutes

Personnel

It is the responsibility of the user organization to ensure that personnel involved in the use and maintenance of the product are properly trained and qualified to carry out their activities.

Installation

The I/A Series Pressure Transmitter is to be installed per its Instruction for Installation, Operation, Calibration, Configuration, and Maintenance. The appropriate documents are listed in the Reference Documents section.

Configuration and Setup

The configuration and setup of the I/A Series Pressure Transmitter can be found in its Instruction for Installation, Operation, Calibration, Configuration, and Maintenance. The appropriate documents are listed in the Reference Documents section. The configuration parameters are repeated here for convenience.

Table 7. Configuration Parameters

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator (when provided)	Remote Configurator(f)	
Descriptors					
Tag Number	8 characters maximum	Tag Number	No	Yes	
Descriptor	16 characters maximum	Tag Name	No	Yes	
Message	32 characters maximum	Inst Location	No	Yes	
Input					
Calibrated Range	LRV to URV in units listed in (a) below	See (b) below when not specified per S.O.	Yes	Yes	
Output					
Meas #1 Output	4 to 20 mA or fixed current Specify poll address (1-15) for fixed current	4 to 20 mA	Yes	Yes	
Meas #1 Mode	See Note (c)	Linear	Yes	Yes	

Table 7. Configuration Parameters (Continued)

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Integral Indicator (when provided)	Remote Configurator(f)	
Meas #1 EGUs	If Linear, see Note (a). If Square Root, see Note (d)	Same as Calibrated Range	Yes	Yes	
Meas #2 Mode	See Note (c)	Linear	Yes	Yes	
Meas #2 EGUs	If Linear, see Note (a). If Square Root, see Note (d)	Same as Calibrated Range	Yes	Yes	
Temp. Sensor Fail Strategy	Normal oper or failsafe	Failsafe	Yes	Yes	
Failsafe	High or Low	High	Yes	Yes	
External Zero	Enabled or Disabled	Enabled	Yes	Yes	
Damping	0 to 32 seconds	0 seconds	Yes	Yes	
Poll Address (g)	0 - 15	0	Yes	Yes	
LCD Indicator(e)	Meas #1 EGU or % Lin	Meas # 1 EGU	Yes	No	

(a) psi, inHg, ftH_2O, inH_2O, atm, bar, mbar, MPa, Pa, kPa, kg/cm2, g/cm2, mmHg, torr, mmH_2O

(b) For IAP10: Span Code C: 0 to 30 psi; Span Code D: 0 to 300 psi; Span Code E: 0 to 3000 psi.

For IGP10: Span Code C: 0 to 30 psi; Span Code D: 0 to 300 psi; Span Code E: 0 to 3000 psi; Span Code F: 0 to 6000 psi; Span Code G: 0 to 15000 psi; Span Code H: 0 to 30000 psi; Span Code K: 0 to 7500.

For IAP20: Span Code A: 0 to 30 inH_2O; Span Code B: 0 to 200 inH_2O; Span Code C: 0 to 30 psi; Span Code D: 0 to 300 psi; Span Code E: 0 to 3000 psi.

For IGP20: Span Code A: 0 to 30 inH_2O; Span Code B: 0 to 200 inH_2O; Span Code C: 0 to 30 psi; Span Code D: 0 to 300 psi; Span Code E: 0 to 3000 psi; Span Code F: 0 to 0 to 5000 psi.

For IDP10: Span Code A: 0 to 30 inH_2O; Span Code B: 0 to 200 inH_2O; Span Code C: 0 to 30 psi; Span Code D: 0 to 300 psi; Span Code E: 0 to 3000 psi.

(c) IAP10, IGP10, IAP20, IGP20: Linear; IDP10: Linear or type of square root.

(d) gal/s, gal/m, gal/h, gal/d, Mgal/d, ft^3/s, ft^3/m, ft^3/h, ft^3/d, Igal/s, Igal/m, Igal/h, Igal/d, l/s, l/m, l/h, Ml/d, m^3/s, m^3/m, m^3/h, m^3/d, bbl/s, bbl/m, bbl/h, bbl/d, %flow.

(e) Measurement #2 can be displayed at any time by pressing the Enter button regardless of the local display

(f) Remote configurator provides a noninterferring means for the user to perform some setup, configuration, and maintenance activities. See restrictions below.

(g) Device is **not** safety compliant if in multidrop mode (Poll Address 1-15).

Note these additional restrictions:

- The write protect jumper shall be in the **Protect** position during normal operation (that is, whenever the safety function must be active). To activate write protection, power down the transmitter and remove the display. Then remove the jumper or move it to the lower position as shown on the exposed label. Replace the display and restore power to the transmitter.
- At any time the write protect jumper is not in the **Protect** position (see above), the configuration can be altered by means of the local display or HART Communicator. In this state, the transmitter output is not to be considered to be reliable. Other means of determining whether the safety variable has exceeded its limit shall be implemented for the duration of this state. The jumper shall be returned to the **Protect** position when the calibration and/or configuration activity is complete using the procedure described above.
- **The protective function provided by the milliampere output is not available when the local interface (if present) is used to perform manual configuration or calibration operations.**
- The I/A Series Pressure Transmitter has a worst case response time of 750 ms or less for a 90% response to a pressure input change with user configurable damping set to 0 seconds damping. For damping settings other than 0, the user is responsible for the worst case response time calculations and that the resulting response time is appropriate for the application.
- Each configuration change must be verified after it is made. The verification procedure varies depending on the configurator that is used to make the change.
  - When a HART Communicator is used, the user must verify that the transmitter's internal verification process completes as follows:
    - From the Top Level Online menu, select **Device Setup** and then **Diagnostic Info**.
    - The **Database Verify** item changes from **Idle** to **Verifying** when new configuration data is sent to the transmitter. The transmitter then performs internal checks to verify the changes, which takes up to two minutes. The display then changes to **Verify Complete**.

    The user must then power cycle the HART Communicator and verify the value shown in each changed parameter.
  - When any other HART device (for example, a PC-Based Configurator) is used, the user must terminate the program, power cycle the transmitter, and restart the program. The user must then verify the value shown in each changed parameter.
  - When the local interface is used, the user must use the View menu to verify the value shown in each changed parameter.
- In order to validate the entire configuration before placing the I/A Series Pressure Transmitter into service, the Proof Test should be performed on the transmitter.

Startup

There are no safety-specific requirements for startup.

Preventive Maintenance

Periodic Proof Testing

A suggested proof test is described in Table 8. This test will detect approximately 83% of possible DU failures in the I/A Series Pressure Transmitter.

Table 8. Steps for Proof Test

Step	Action
1	Bypass the safety PLC or take other appropriate action to avoid a false trip.
2	Send a HART command to the transmitter to go to the high alarm current output and verify that the analog current reaches that value. This tests for compliance voltage problems such as low loop power supply voltage or increased wiring resistance and also tests for other possible failures in the current loop circuitry.
3	Send a HART command to the transmitter to go to the low alarm current output and verify that the analog current reaches that value. This tests for quiescent current related failures.
4	Apply a pressure to the transmitter that is 5 to 10% above the configured URV. Verify that the output reaches 20.5 +/-0.1 mA. Release applied pressure. This tests that the transmitter can reach its off scale high overrange condition. If the output fails to reach 20.5, verify that the terminal voltage meets the minimum requirements. If there is still a problem, contact the Invensys Process Systems Customer Service Center at 1-866-746-6477.
5	Reconfigure the LRV so that the vented or equalized pressure condition is 5 to 10% of the ranged span below the new LRV value. Verify that the output reaches 3.75 +/-0.1 mA. If there is a problem, contact the Invensys Process Systems Customer Service Center at 1-866-746-6477. Reconfigure the LRV back to its proper value. This tests that the transmitter can reach its off scale low overrange condition.
6	Perform a minimum two-point calibration check of the transmitter using the 4 to 20 mA range points as the calibration points and compare the transmitter display reading and the current level value to a known reference measurement.
7	If the calibration is off by more than 2%, contact the Invensys Process Systems Customer Service Center at 1-866-746-6477 for assistance.
8	If the calibration is correct, restore the loop to operation.
9	Remove the bypass from the safety PLC or otherwise restore normal operation.

Periodic Inspection

Other than the proof test, no periodic inspection is required.

Periodic Parts Replacement

No periodic parts replacement is required.

Firmware Updates

The firmware is not field upgradeable. For firmware updates the transmitter is to be returned to the factory. Contact the Invensys Process Systems Customer Service Center at 1-866-746-6477 for a return authorization and shipping instructions.

Other Preventive Maintenance

No other preventive maintenance is required.

Required Maintenance Documentation

A record of the configuration should be maintained, including the configuration password.

A maintenance log shall be kept. Each log entry shall contain:

- The cause for the maintenance activity (scheduled maintenance such as proof test, error code, other anomaly) and its date and time;
- The maintenance action taken;
- The personnel performing the maintenance;
- The date(s) on which the maintenance was initiated and concluded.

Fault Handling

How to Detect a Fault

Faults can be detected via:

- Observation;
- Analog current output going to the alarm state resulting from internal diagnostics check;
- Fault code being annunciated via the HART interface.

Repair and Replacement

Parts replacement is generally limited to the electronics module assembly, housing assembly, sensor assembly, terminal block assembly, cover O-rings, and optional display. A proof test must be performed after any field repair. Repair in the field at a finer level should not be attempted; the transmitter should be returned to the factory for repair. Contact the Invensys Process Systems Customer Service Center at 1-866-746-6477 for a return authorization and shipping instructions.

Revalidation Procedures

When returning the I/A Series Pressure Transmitter to service after repair or replacement, the proof test will provide validation of proper configuration and operation.

Fault Reporting Requirements

Faults should be recorded in the maintenance log and reported to the Invensys Process Systems Customer Service Center at 1-866-746-6477.

(Faults can be reported via e-mail to ips.csc@invensys.com. Please include the transmitter model, serial number, fault code or description, date and time.)

Demand Reporting Requirements

In order to verify the mode of operation, (low-demand or high demand), each demand on a SIF involving the I/A Series Pressure Transmitter should be recorded in the maintenance log and reported to the manufacturer:

Invensys Process Systems, Inc.

33 Commercial Street

Foxboro, MA 02035-2099

(Demands can be reported via e-mail to ips.csc@invensys.com. Please include the transmitter model, serial number, date and time.)

Shutdown

No special procedure is necessary when removing power to the transmitter. (All configuration data are retained through loss of power.)

Tools

Tools Necessary for Maintenance

- PC-Based Configurator or HART Communicator. (The transmitter can be configured without one of these but the process is considerably more involved.)
- Means to provide pressure to perform a two-point calibration check of the transmitter.
- An independent means of measuring the pressure. This means should have an accuracy at least ten times better than the safety accuracy of the transmitter.

Tools Necessary for Revalidation

- PC20 Configurator, PC50 Configurator, or HART Communicator. (The transmitter can also be configured with the local display but the process is more involved.)
- Means to provide pressure to perform a two-point calibration check of the transmitter.
- An independent means of measuring the pressure. This means should be accurate to at least ten times better than the safety accuracy of the transmitter.

Procedures for Tools Maintenance

(not applicable)

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