The Dwyer Series 7000 Spirahelic® Pressure Indicating Transmitter provides local indication on a large, easy-to-read analog scale while also converting that pressure into a standard two wire 4-20 mA output signal. Positive pressure of compatible gases or liquids is measured with 1/2% of full scale accuracy. The gage employs a triple helix Bourdon tube movement with direct drive design to reduce friction and mass for exceptional responsiveness, repeatability and accuracy. Because there are no gears, springs, linkages or other complicated mechanisms, wear is practically eliminated. The electrical output signal is produced by a piezoresistive pressure sensor mounted on the pressure block. The pressure block also includes an integral filter plug to protect the gage interior from dirt and other particulates. Safety is assured with a solid front case design and a rear blowout hole.

**INSTALLATION**

1. Select a location free from excessive vibration where the temperature limits of 20° to 120°F (-6.7° to 49°C) will not be exceeded. The mounting surface should be vertical to match the position in which all standard gages are calibrated. Avoid locations in direct sunlight which may cause accelerated discoloration of the clear acrylic lens or where exposure to oil mist or other airborne vapors could likewise result in lens damage. Make sure that the case relief area on the rear is not obstructed. This hole is designed to direct pressure rearward in the event of failure or the Bourdon tube element. See complete safety recommendations in this bulletin.

2. Cut a 4.94" (125 mm) mounting hole and drill (3) 7/32" (5.56 mm) bolt holes on a 5.38" (136.53) bolt circle as shown in drawing above. Attach gage to panel with (3) 3/16" bolts of appropriate length.

3. Two 1/4" female NPT pressure connections are furnished to allow a choice of vertical or horizontal piping. The unused port should be plugged. Use a minimal amount of thread sealant. Too much could block the internal pressure passage.

**SPECIFICATIONS**

**GAGE SPECIFICATIONS**

- **Service:** Compatible gases & liquids
- **Wetted Materials:** Inconel® X-750 Bourdon Tube, Type 316L SS connection.
- **Housing:** Black polycarbonate case and clear acrylic cover.
- **Accuracy:** Grade 2A (0.5% F.S.).
- **Stability:** ± 1% F.S. /yr.
- **Pressure Limit:** 150% of full scale. Gage will maintain its specifications for overpressures up to 150% maximum range. Normal operation should be between 25% and 75% of full scale.
- **Temperature Limits:** 20 to 120°F (-6.67 to 48.9°C).
- **Size:** 4 -1/2" dial face (114.3 mm), Design conforms to ASME B40.1.
- **Process Connections:** Two 1/4" female NPT field selectable back or bottom connection.
- **Weight:** 17.1 oz (581 g).

**TRANSMITTER SPECIFICATIONS**

- **Accuracy:** 0.5% F.S.
- **Temperature Limits:** 20 to 120°F (-6.67 to 48.9°C).
- **Thermal Effect:** ±0.025% F.S. /°F (0.045% F.S./°C).
- **Power Requirements:** 10-35 VDC (2 wire).
- **Output Signal:** 4-20 mA DC.
- **Zero & Span Adjustments:** Externally accessible potentiometers.
- **Loop Resistance:** DC, 0-1250 ohms.
- **Current Consumption:** DC, 38 mA max.
- **Electrical Connections:** Screw Terminals.
- **Mounting Orientation:** Vertical.
- **Agency Approvals:** CE.
CAUTION: When installing fittings or pipe always use a second wrench on the 1” pressure block DO NOT allow torque to be transmitted from block to the gage case.

PNEUMATIC CALIBRATION TESTER
Use a dead weight tester or certified test gage with .125% or better accuracy. The test gage range should be comparable to the range of the Spirahelic® Pressure Indicating Transmitter being checked. Connect the lines from the two instruments to a tee and the third line from the tee to a controllable source of pressure. Apply pressure slowly so pressure equalizes throughout the system. Compare readings, if gage being tested is found to need calibration, return it, freight prepaid to the factory.

ELECTRICAL CONNECTIONS
CAUTION: Do not exceed specified supply voltage ratings. Permanent damage not covered by warranty will result. This unit is not designed for 120 or 240 volt AC line operation.

Electrical connections to the Series 7000 Spirahelic® Pressure Indicating Transmitter are made at the rear of the pressure gage. Feed stripped and tinned leads to the terminal block screws shown below, refer to Figure A for locations of the terminal block, span and zero adjustments.

PRESSURE RANGING
Each standard Series 7000 Spirahelic® Pressure Indicating Transmitter is factory calibrated to produce a 4 mA output signal at zero pressure and a 20 mA signal at full scale. Use the following procedure to check or adjust the output signal calibration.

1. With the unit connected to its companion receiver and power supply, an accurate milliammeter should be inserted in series with the current loop. A controllable pressure source capable of achieving the necessary full scale pressure should be connected to the pressure port of the transmitter and teed to an accurate pressure gage or manometer. The instrument should be calibrated in the same position in which it will be used. Vertical mounting is recommended.

2. Apply electrical power to the system and allow it to stabilize for 10 minutes.

3. With no pressure applied to the transmitter, adjust “Zero” control so that loop current is 4 mA.

4. Apply full scale pressure and adjust “Span” control so that loop current is 20 mA.

5. Relieve pressure and allow transmitter to stabilize to 2 minutes.

6. Zero and Span controls are slightly interactive so repeat steps 3 through 5 until zero and full scale pressures consistently produce loop currents of 4 and 20 mA respectively.

7. Remove milliammeter from the current loop and proceed with final installation of the transmitter and receiver.

2-Wire Operation - A external power supply delivering 10-35 VDC with minimum current capability of 40 mA DC (per transmitter), must be used to power the control loop. See Figure B for connection of the power supply, transmitter, and receiver. The range of the appropriate receiver load resistance (Rl) for the DC power supply voltage available is expressed by the formula and graph in Figure C. Shielded two wire cable is recommended for control loop wiring. If grounding is required use negative side of control loop after receiver see Figure B.
WIRE LENGTH
The maximum length of wire connecting transmitter and receiver is a function of wire size and receiver resistance. Wiring should not contribute to more than 10% of receiver resistance to total loop resistance. For extremely long runs (over 1000 feet), choose receivers with higher resistance’s to minimize size and cost of connecting leads. When the wiring length is under 100 feet, lead wire as small as 22 awg can be used.

MULTIPLE RECEIVER INSTALLATION
An advantage of the standard 4-20 mA DC output signal provided by the 7000 Spirahelic® Pressure Indicating Transmitter is that any number or receivers can be connected in series in the current loop. Thus, an A-701 digital readout, an analog panel meter, a chart recorder, process controlling equipment, or any combination of these devices can be operated simultaneously. It is necessary only that each be equipped with a standard 4-20 mA input and proper polarity of the input connections be observed when inserting the device into the current loop. If any of the receiving devices displays a negative or downscale reading this indicates that the signal input leads are reversed.

MAINTENANCE
Upon final installation of the Series 7000 Spirahelic® Pressure Indicating Transmitter and the companion receiver, no routine maintenance is required. A periodic check of the system calibration is recommended. The Series 7000 Spirahelic® Pressure Indicating Transmitter is not field serviceable and should be returned freight prepaid, to the factory (listed below) if repair is required (field repair should not be attempted and may void warranty).

Dwyer Instruments, Inc.
Attn: Repair Department
102 Highway 212
Michigan City, IN 46360
4 SAFETY

4.1 Scope

This Section of the Standard presents certain information to guide users, suppliers, and manufacturers toward minimizing the hazards that could result from the application of pressure gauges with their elastic elements. The user should become familiar with all sections of this Standard, as all aspects of safety cannot be covered in this Section. Consult the manufacturer or supplier or advice whenever there is uncertainty about the safe application of a pressure gauge.

4.2 General Discussion

4.2.1 Adequate safety results from intelligent planning and careful selection and installation of gauges into a pressure system. The user should inform users, suppliers, and manufacturers about the application and environment so that the supplier can recommend the most suitable gauge for the application.

4.2.2 The history of safety with respect to use of pressure gauges has been excellent. Injury to personnel and damage to property have been minimal. In most instances, the cause of failure has been misuse or application.

4.2.3 The pressure sensing element in most gauges is subject to high strains. Sudden pressurizations or applications exist where the possibility of catastrophic failure is present. Pressure regulators, chemical (diaphragm) seal, and other diaphragms, as well as Bourdon tube and syphons, and other similar items, are available for the use in hazardous or highly hazardous systems. The hazard potential increases as higher operating pressures are increased. Such systems are considered potentially hazardous and must be carefully evaluated:

- (a) compressed gas systems
- (b) oxygen systems
- (c) systems containing hydrogen or free hydrogen atoms
- (d) corrosive fluid systems (gas and liquid)
- (e) systems containing any explosive or flammable mixture or medium
- (f) systems containing radioactive or toxic fluids (liquids or gases)
- (g) systems where interdependence of gauges could cause a hazardous internal condition or where lower pressure gauges could be installed in higher pressure systems
- (h) systems containing radioactive or toxic fluids (liquids or gases)
- (i) systems where simultaneous sensing of the pressure is not possible

4.2.5 When gauges are to be used in contact with media having known or uncertain corrosive effects or known to be explosive, flammable, or unique and demanding physical phenomena can occur. In such cases the user should contact the manufacturer and be prepared to exchange information relative to the application and solicit his advice prior to installation of the gauge.

4.2.6 Fire or explosion conditions within a pressure system can cause pressure element failure with very violent effects. The point of complete diaphragm rupturing or melting the pressure gauge. Violent effects are usually the result of

- (a) hydrogen embrittlement
- (b) contamination of a compressed gas
- (c) formation of acetylides
- (d) weakening of soft solder joints by steam or other heat sources
- (e) weakening of soft soldered or silver brazed joints caused by heat sources such as fires
- (f) corrosion
- (g) fatigue
- (h) mechanical shock
- (i) excessive vibration

Failure in a compressed gas system can be expected to be violent and often violent effects.

4.2.7 Modes of Elastic Element Failure. There are four modes of elastic element failure, as follows:

4.2.7.1 Fatigue Failure. Fatigue failure caused by progressive stress generally occurs from the inside to the outside along a highly stressed edge radius of the diaphragm or crack that propagates along the edge radius. Such failures are usually more critical with compressed gas media than with liquid media. Fatigue cracks usually release the media fluid slowly. A case pressure buildup can be averted by providing pressure relief openings in the gauge case.

4.2.7.2 Overflow Failure. Overflow failure is caused by the application of internal pressure greater than the rated limits of the elastic element and can cause a pressure gauge is installed in a high pressure port of system. The effects of overflow are usually more critical in compressed gas systems than in liquid filled systems, are unpredictable and may cause parts to be propelled in to the user. Cases with pressure relief openings will not always retain expelled parts.

4.2.7.3 Corrosion Failure. Corrosion failure occurs when the elastic element has been weakened through the attack by corrosive chemicals present in either the media inside or the environment outside. Failure may occur as pinhole leakage through the element walls or as an element failure due to stress cracking brought about by chemical deterioration or embrittlement of the material.

A chemical (diaphragm) seal should be considered for use with pressure media that may have a corrosive effect on the element. The element could fail, causing the pressure relief valve to operate without a secondary protecting system, and can be the most hazardous component.

4.2.7.4 Explosive Failure. Explosive failure is caused by the sudden release of energy generated by a chemical reaction such as can result with adiabatic compression of oxygen in the presence of a hydrogen source. Experience has shown that there is no known means of predicting the magnitude or effects of this type of failure or mode of failure. Failure is a solid state or partition between the elastic element and the window and the window will not necessarily prevent parts being projected forward.

4.2.8 Pressure Connection. See recommendations in para. 4.2.10

4.3 Safety Recommendations

4.3.1 Operating Pressure. The pressure gauge selected should be such that the operating pressure occurs in the middle half (25 to 75%) of the scale. The full scale pressure of the gauge selected should be approximately two times the intended operating pressure. It should be necessary for the operating pressure to exceed 75% of full scale, contact the supplier for recommendations. This does not apply to test, retarded, or suppressed scale gauges.

4.3.2 Use of Gauges Near Zero Pressure. The use of gauges near zero pressure is not recommended because the accuracy of the gauge may be a large percentage of the applied pressure. If, for example, a 0.100 psi Grade B gauge is used to measure 5 psi, the accuracy of the gauge may be 5% of the applied pressure. In addition, the scale of a gauge is often laid out with the maximum full scale point set at the top of the scale. This can result in further inaccuracies when measuring pressures that are a small percentage of the gauge span.

4.3.3 Compatibility With the Pressure Medium. The elastic element is generally a thin walled member, which of necessity operates under high stress conditions and must be carefully selected for compatibility with the pressure medium being measured. Noncorrosive pressure element materials is impervious to every type of chemical attack. The potential for corrosive attack is established by many factors, including temperature, and the presence of a corrosive or toxic fluid. The medium through which the pressure is transmitted could affect the design, materials, and fabrication of the joints between its parts.

Common methods of joining are soft soldering, silver brazing, and welding. Joints can be affected by temperature, stress, and corrosive media. When application questions arise, these factors should be considered and discussed by the user and manufacturer.

4.3.4.5 Some special applications require that the pressure element assembly have a high degree of leak age integrity. Special arrangement should be made between the manufacturer and user to assure that the allowable leakage rate is not exceeded.

4.3.6 Case, Solid Front. It is generally accepted that a solid front case per para. 3.3.1 will reduce the possibility of parts being projected forward in the event of elastic element assembly failure. An exception is explosive failure of the elastic element assembly.

4.3.6.2 Cases, Liquid Filled. It has been generally agreed that the use of glycerine or silicone filling liquids is a good practice when gauges are used in liquids or high pressure gas systems. However, these fluids may not be suitable for all applications. They should not be used with strong oxidizing agents including, but not limited to, oxygen, chlorine, nitric acid, and hydrogen peroxide. The presence of oxidizing agents, potential hazard can result from chemical reaction, ignition, or explosion. The use of nitrogen, helium, inert, or non-flammable filling liquids, or both, may be more suitable for such applications.

The user shall furnish detailed information relative to the application of gauges having liquid filled cases and shall advise the gauge supplier prior to installation. Consideration should also be given to the instantaneous hydraulic effect that may be created by one of the modes of failure outlined in para. 4.2.7. The hydraulic effect due to liquid and media could cause the window to be projected forward even when a solid state failure occurs.

4.3.7 Restrictor. Placing a restrictor between the pressure connection and the elastic element will not reduce the possibility of parts being projected forward. The control flow of escaping fluid following rupture and reduces dangerous conditions.

4.3.8 Specific Service Conditions

4.3.8.1 Specific applications for pressure gauges exist where hazards are encountered for specific requirements, for design, construction, and use of gauges for these applications are specified by state or federal agencies or Underwriters Laboratories, Inc. Some of these specific service gauges are listed below. The list is not intended to be all inclusive and the user shall always advise the supplier of all application details.

4.3.8.2 Acetylene Gauges. A gauge designed to indicate acetylene pressure and to withstand the corrosive effects of ammonia. The gauge may bear the inscription AMMONIA on the dial. It may also include the level IV (see Section 5). The dial shall be clearly marked with a universal symbol and/or USE NO OIL in red color (see para. 6.1.2.1).

4.4 Reuse of Pressure Gauges

It is not recommended that pressure gauges be moved from one application to another. Should it be necessary, however, the following must be considered:

4.4.1 Chemical Compatibility. The consequences of incompatibility can range from contamination to explosive failure. For example, moving an oil service gauge to oxygen service can result in a catastrophic failure.

4.4.2 Partial Fatigue. The first installation may involve pressure exceeding the pressure rating most of the time, resulting in early fatigue in the second installation.

4.4.3 Corrosion. Corrosion of the pressure element assembly in the first installation may be sufficient to affect the gauge’s function in the second installation.

4.4.4 Other Considerations. When reusing a gauge, all guidelines covered in the Standard relative to application of gauges should be followed in the same manner as when a new gauge is selected.