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Model 2024 Differential Pressure Transmitter

ROSEMOUNT®
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Product Manual

Model 2024 Differential Pressure Transmitter

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

For equipment service needs outside the United States, contact the nearest Rosemount representative.

Within the United States, the Rosemount National Response Center is at your service 24 hours a day, and is a single-point contact for all Rosemount equipment service needs. If at any time you are not sure what to do, you have a question about using the product, or you have a service or support request, call the center toll free at 1-800-654-RSMT (7768). This contact is your fastest link to quick and complete answers about any Rosemount Group product or service.

⚠CAUTION

The products described in this document are NOT designed for nuclear applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Rosemount Sales Representative.

SNF-0004

Rosemount Model 2024 Differential Pressure Transmitter may be protected by one or more of the following U.S. Patent Nos. 4,370,890; 4,381,677; 4,519,253; 4,745,810; 4,748,852; Des. 297,315. Mexico Patentado Nos. 151,290; 154,663; 154,961. May depend on model. Other foreign patents issued and pending.

Fisher-Rosemount satisfies all obligations coming from legislation to harmonize product requirements in the European Union.

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MODEL 2024

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SECTION 1

Installation

INTRODUCTION

The Model 2024 is a compact and lightweight differential pressure transmitter for applications requiring direct mounting and repair by replacement. The Model 2024 is available with outputs of 4–20 mA (Code A) or 1–5 V dc (Code M – Low Power) in ranges of 0–50/250 inH_2O (0–12.4/62.2 kPa) or 0–200/1,000 inH_2O (0–49.7/248.6 kPa). This section includes instructions for mounting transmitter and wiring the terminals, as well as special instructions for liquid level measurement.

BEFORE INSTALLATION

The accuracy of pressure measurement depends to a great extent on proper installation of the transmitter and impulse piping. For flow measurement, proper installation of the primary measurement element is also critical. Because of economic and process-related considerations, pressure transmitters often must be installed in harsh environments. Within these environments, transmitters should be placed so as to minimize vibration, shock, and the effects of temperature fluctuations.

MOUNTING

The Rosemount® Model 2024 Differential Pressure Transmitter may be directly mounted at the point of measurement or to a manifold. It may also be mounted by means of a mounting bracket.

Process connections are ¼–18 NPT on the transmitter flange. ½–14 NPT process connections are supplied by use of flange adapter unions. The adapters allow users to disconnect the transmitter from the process simply be removing the adapter bolts. The process connections are on 2¹/₈ -in. (54-mm) centers to allow direct mounting to orifice flanges; by rotating the adapters, however, connection centers of 2 in. (51 mm) or 2¼-in. (57 mm) also may be obtained.

⚠CAUTION

When assembling flange adapters to the transmitter, the correct Rosemount O-ring must be used. Failure to use the correct O-ring can lead to process leakage which may result in a hazardous condition. Use only the O-ring specified for use with the Rosemount Model, as indicated in the spare parts list, Figure 6-2.

NOTE
All four flange bolts must be in place for a tight seal. The two hex head flange-holding bolts are not pressure retaining.

To ensure a tight seal on the mounting adapters or manifold, first finger-tighten the bolts and then wrench-tighten the first bolt to approximately 400 ±50 in-lb. Then in a cross pattern, wrench-tighten the second bolt to approximately 400 ±50 in-lb.

The transmitter may be rotated for mounting convenience. As long as the transmitter is mounted so that both isolating diaphragms are at the same elevation, this rotation will not cause zero shift. If the isolating diaphragms are not at the same elevations, the transmitter should be rezeroed to cancel the liquid head effect caused by the difference in height of the process connections. Rezero the transmitter after mounting to compensate for any mounting effect.

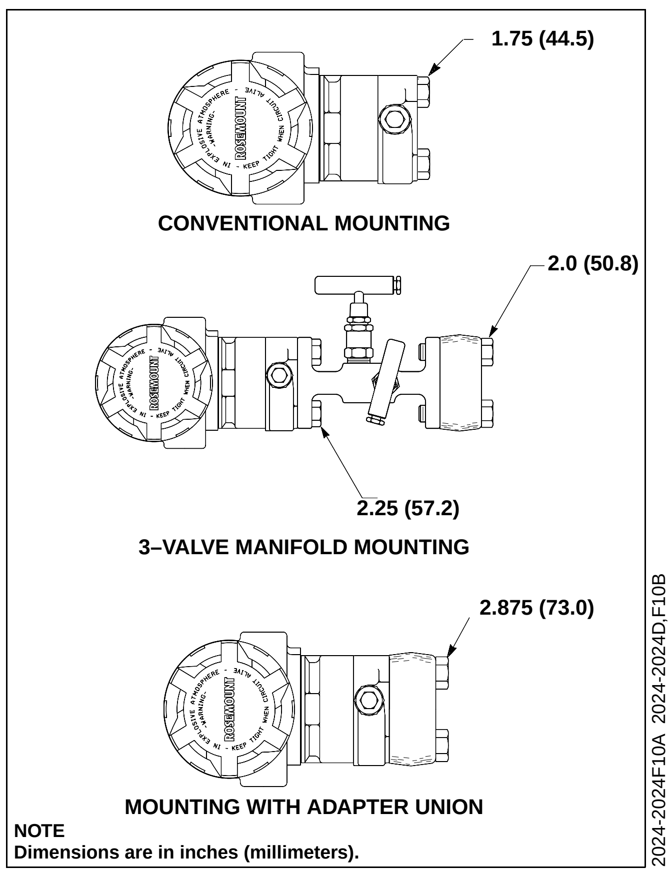


FIGURE 1-1. Required Mounting Bolt.

NOTE

Bolts provided with some manifolds for mounting the transmitter to the manifold may not be long enough to fully thread into the Model 2024. Because of this, all bolts required to properly mount the Model 2024 are supplied with the transmitter. Refer to Figure 1-1 to find the correct bolt length for the desired mounting configuration.

IMPULSE PIPING

The best location for the transmitter in relation to the process pipe depends on the process material. Consider the following general rules in determining transmitter location:

- Ensure that corrosive or hot process material does not come in contact with the transmitter.
- Ensure that sediment does not build up in the impulse piping.
- Ensure that the liquid head remains balanced on both legs of the impulse piping.
- Keep impulse piping as short as possible.
- Avoid ambient temperature gradients and fluctuations.
- Weatherize impulse piping to prevent freezing of process in impulse lines.

Different measurement conditions call for different piping configurations. For liquid pressure and differential pressure service, place taps to the sides of the line to prevent sediment deposits, and mount the transmitter beside or below these taps so gases can vent into the process line. For gas pressure and differential pressure service, place taps in the top or side of the line, and mount the transmitter beside or above the taps so the liquid will drain into the process line. For the steam pressure and differential pressure service, place the taps to the side of the line, and mount the transmitter below to ensure that the impulse piping stays filled with condensate. See Figure 1-2 for diagram of these arrangements. In steam or other elevated temperature services, it is important that the operating temperatures not exceed the transmitter's limit. Refer to **Temperature Limits** on Page 5-2.

In steam service, lines should be filled with water to prevent live steam from contacting the transmitter. Condensate chambers are not needed, since the volumetric displacement of the transmitter is negligible. The piping between the process and the transmitter must transfer the pressure at the process taps to the transmitter. In this pressure transfer, there are five possible sources of error: leaks, friction loss (particularly if purging is used), trapped gas in a liquid line, liquid in a gas line, and temperature-induced density variation between the legs. The last three factors all involve head error.

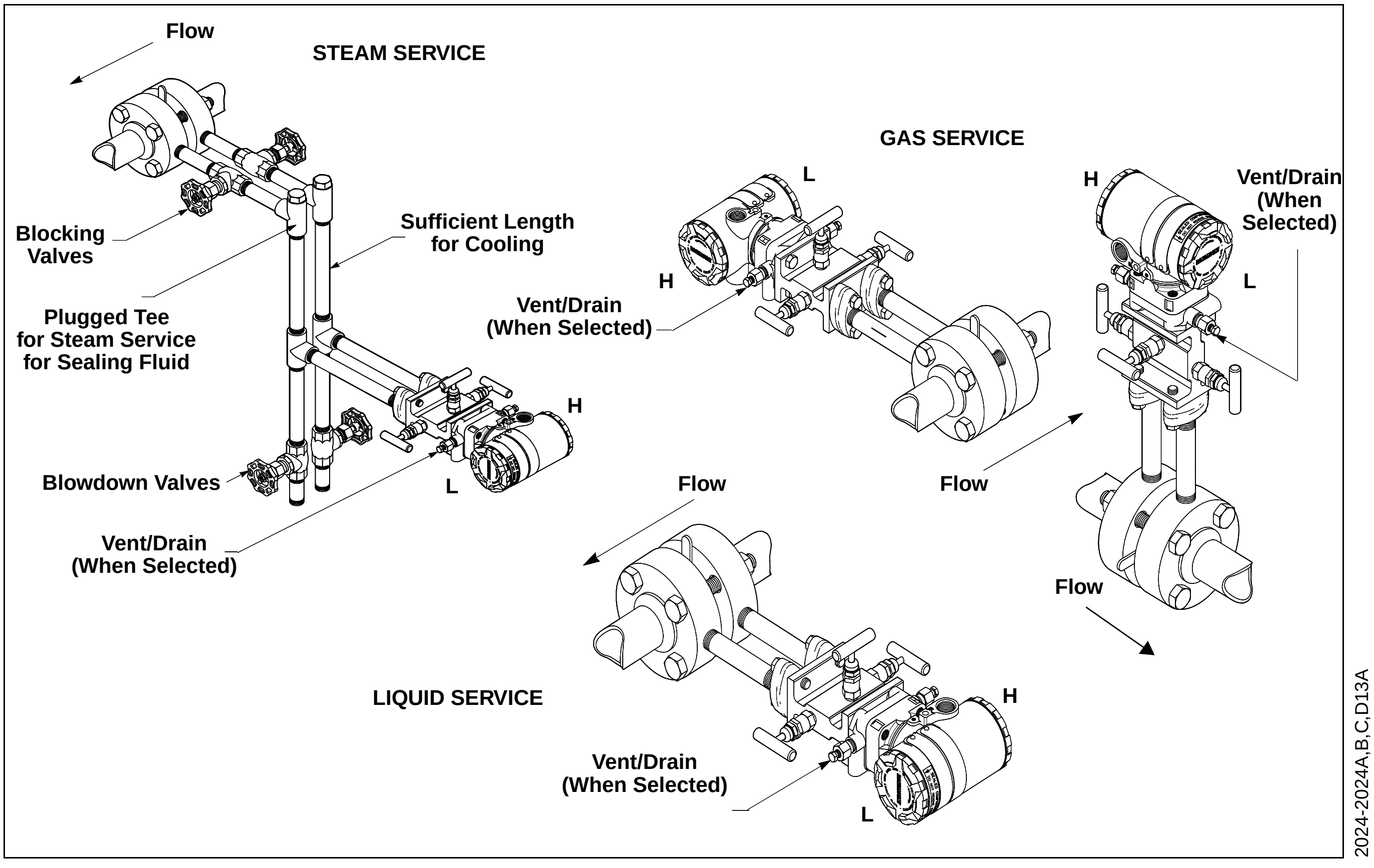


FIGURE 1-2. Installation.

To minimize the potential for error, observe the following precautions:

- Make impulse piping as short as possible.
- Slope piping at least one inch per foot (8 cm per meter) **up** toward the process connection for liquid and steam.
- Slope piping at least one inch per foot (8 cm per meter) **down** toward the process connection for gas.
- Avoid high upoints in liquid lines and low points in gas lines.
- Keep both impulse legs at the same temperature.
- Use impulse piping of sufficient diameter to avoid friction effects.
- Drain all liquid/condensate from gas piping legs.
- Vent all gas from the liquid piping legs.
- Fill both piping legs to the same level when using a sealing fluid.
- Avoid purging through the transmitter. When purging, make the purge connection close to the process taps, and purge through equal lengths of the same size pipe.

WIRING

Wiring for the Model 2024 depends on the output of the transmitter, but some general information is common to the procedures for wiring both outputs. The signal terminals are located in a separate compartment of the electronics housing. This compartment also contains terminals for test equipment or remote meter connection. To wire the connections, remove the cover on the side marked “Terminals” on the nameplate. For transmitters with 4–20 mA dc outputs (Code A), use the following instructions. For transmitters with 1–5V dc outputs (Code M-Low Power), skip to the heading: 1–5 V dc Output Wiring.

4–20 mA dc Output Wiring

Connect power to the (+) SIGNAL and (–) COMMON terminals. Figure 1-3 shows the terminal locations. The negative COMMON terminal is common to both the positive signal and the positive test terminals.

The test connections have the same 4–20 mA dc signal as the signal connections. Test equipment or a remote meter can be connected across the positive TEST terminal and the COMMON terminal. No additional wiring is required.

⚠CAUTION

Do not connect powered signal wiring to the test terminal. Power can burn out the diode in the test connection.

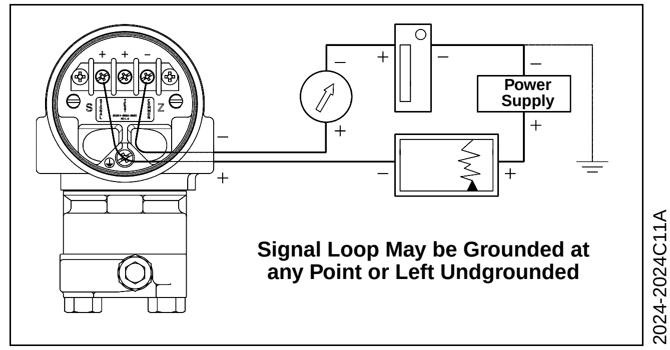


FIGURE 1-3. 4–20 mA Field Wiring.

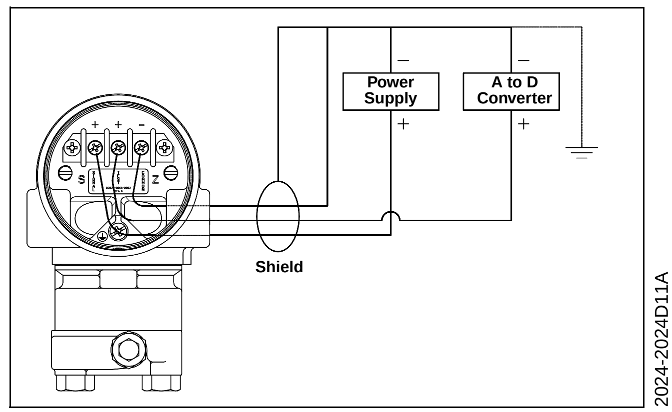


FIGURE 1-4. 1–5 V dc Field Wiring.

Signal wiring need not be shielded, but twisted pairs should be used for best results. Do not run signal wiring in conduit or open trays with other power wires or near heavy electrical equipment. Signal wiring may be grounded or ungrounded at any point on the signal loop, but grounding is recommended at the power supply. The transmitter case may be grounded or ungrounded. Power supply regulation is not critical.

Conduit connections on the transmitter housing should be sealed or plugged to avoid moisture accumulation in the housing.

Maximum output current is limited to 33 mA dc.

1–5 V dc Output Wiring

The *maximum* input voltage for the low power Model 2024 transmitter is 14 V dc. Figure 1-4 shows the connection detail for the power wiring and instrument connections.

Connect the dc positive wire to the (+) POWER terminal and the dc negative wire to the (–) COMMON terminal. Connect the positive signal wire of the readout device or A/D converter to the SIGNAL terminal and the negative signal wire to the COMMON terminal. Shielded pair wiring is generally used, and all common leads should be connected to the same ground.

When power supplies and readout devices are located close together, three-conductor shielded cables should be used. In this case, a single ground wire should be used for the transmitter common, the negative terminal of the power supply, and the negative terminal of the readout device. This ground should also be common to the shield.

LIQUID LEVEL MEASUREMENT

Differential pressure transmitters used for liquid level applications measure hydrostatic pressure head. Liquid level and specific gravity of a liquid are factors in determining pressure head. This pressure is equal to the liquid height above the tap multiplied by the specific gravity of the liquid. Pressure head is independent of volume or vessel shape.

OPEN VESSELS

A pressure transmitter mounted near a tank bottom measures the pressure of the liquid above the taps.

Make a connection to the high pressure side of the transmitter. Vent the low pressure side to the atmosphere. Pressure head equals the liquid's specific gravity multiplied by the liquid height above the tap.

Zero range suppression is required if the transmitter lies below the zero point of the desired level range. Figure 1-5 shows a liquid level measurement example.

CLOSED VESSELS

Pressure above a liquid affects the pressure measured at the bottom of a closed vessel. The liquid's specific gravity multiplied by the liquid height plus the vessel pressure equals the pressure at the bottom of the vessel.

To measure true level, the vessel pressure must be subtracted from the vessel bottom pressure. To do this, make a pressure tap at the top of the vessel and connect this to the low side of a differential pressure transmitter. Vessel pressure is then equally applied to both the high and low sides of the transmitter. The resulting differential pressure is proportional to liquid height multiplied by the liquid's specific gravity.

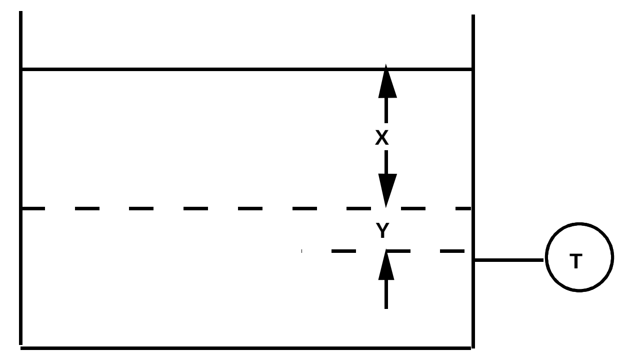
Dry Leg Condition

Low-side transmitter piping will remain empty if gas above the liquid does not condense. This is a dry leg condition. Range determination calculations are the same as those described for bottom-mounted transmitters in open vessels. See Figure 1-5.

Wet Leg Condition

Condensation of the gas above the liquid causes the low side of the transmitter piping to fill slowly with liquid. The pipe is purposely filled with a convenient reference fluid to eliminate this potential error. This is a wet leg condition.

The reference fluid will exert a head pressure on the low side of the transmitter. Zero elevation of the range must then be made. Figure 1-6 shows an example of a wet leg condition.



Let **X** equal the vertical distance between the minimum and maximum measurable levels (200 in.).
Let **Y** equal the vertical distance between the transmitter datum line and the minimum measurable level (50 in.).
Let **SG** equal the specific gravity of the fluid (0.9).
Let **h** equal the maximum head pressure to be measured in inches of water.
Let **e** equal head pressure produced by **Y** expressed in inches of water.
Let **Range** equal **e** to **e** + **h**.

Then h = (**X**)(**SG**)
= 200 x 0.9
= 180 inH_2O
e = (**Y**)(**SG**)
= 50 x 0.9
= 45 inH_2O
Range = 45 to 225 inH_2O

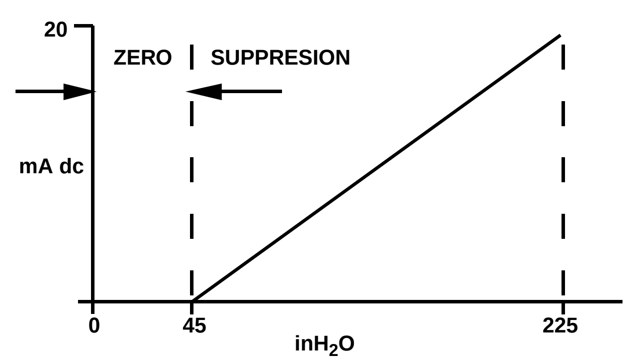
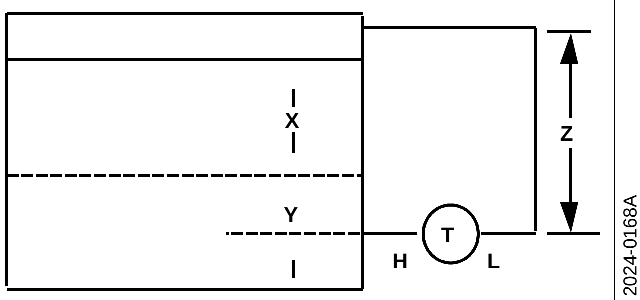


FIGURE 1-5. Liquid Level Measurement Example.

Bubbler System in Open Vessels

A bubbler system that has a top-mounted pressure transmitter can be used in open vessels. This system consists of an air supply, pressure regulator, constant flow meter, pressure transmitter, and tube that extends down into the vessel.

Bubble air through the tube at a constant flow rate. The pressure required to maintain flow equals the liquid's specific gravity times the vertical height of the liquid above the tube opening. Figure 1-7 shows an example of a bubbler system measurement.



Let **X** equal the vertical distance between the minimum and maximum measurable levels (300 in.).
Let **Y** equal the vertical distance between the transmitter datum line and the minimum measurable level (50 in.).
Let **z** equal the vertical distance between the top of the liquid in the wet leg and the transmitter datum line (400 in.).
Let $\mathbf{SG_1}$ equal the specific gravity of the fluid (1.0).
Let $\mathbf{SG_2}$ equal the specific gravity of the fluid in the wet leg (1.1).
Let **h** equal the maximum head pressure to be measured in inches of water.
Let **e** equal the head pressure produced by **Y** expressed in inches of water.
Let **s** equal head pressure produced by **z** expressed in inches of water.
Let **Range** equal **e** – **s** to **h** + **e** – **s**.

Then h = $(\mathbf{X})(\mathbf{SG_1})$
= 300 x 1.0
= 300 in H_2O
e = $(\mathbf{Y})(\mathbf{SG_1})$
= 50 x 1.0
= 50 inH_2O
s = $(\mathbf{z})(\mathbf{SG_2})$
= 400 x 1.1
= 440 inH_20
Range = **e – s** to **h + e – s**.
= 50 – 440 to 300 + 50 – 440
= –390 to –90

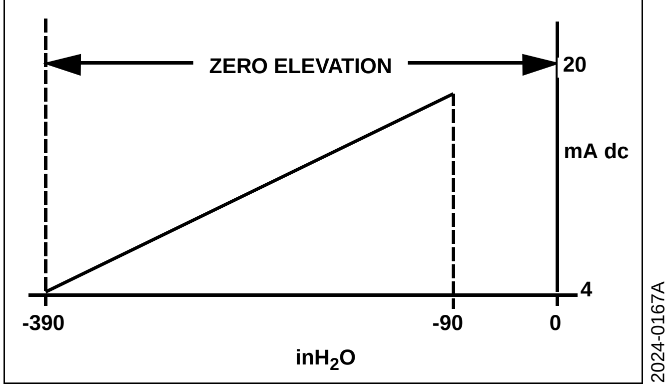
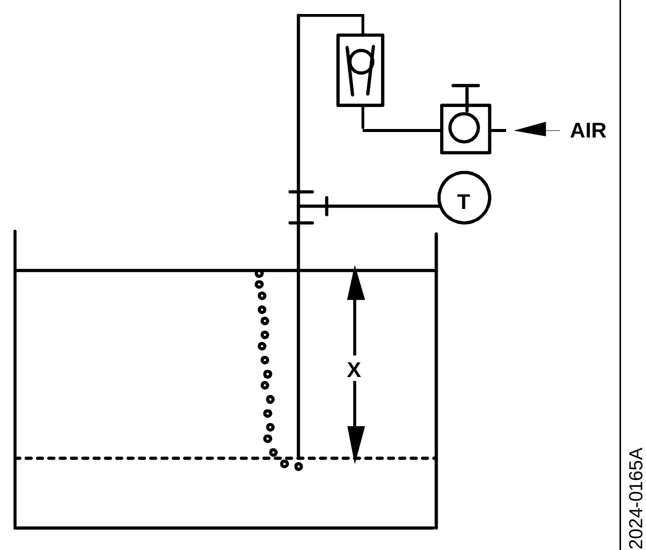


FIGURE 1-6. Wet Leg Example.



Let **X** equal the vertical distance between the minimum and maximum measurable levels (100 in.).
Let **SG** equal the specific gravity of the fluid (1.1).
Let **h** equal the maximum head pressure to be measured in inches of water.
Let **Range** equal **zero** to **h**.

Then h = **(X)(SG)**
= 100 x 1.1
= 110 inH_2O
Range = 0 to 110 inH_2O

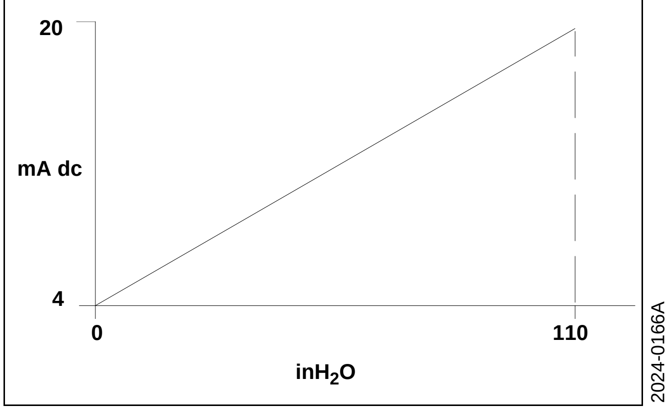


FIGURE 1-7. Bubbler Liquid Level Measurement Example.

SECTION
2

Calibration

The Model 2024 transmitter is factory-calibrated. The user may recalibrate the Model 2024 to within the limits of the transmitter as shown below:

Transmitter Ranges: 0 to 250 inH_20 (0 to 62.2 kPa).
0 to 1,000 inH_20.
(0 to 248.6 kPa).

Zero Elevation Suppression:

Range 2: 4 mA (1 V dc for Low Power) point is adjustable from –125 to 125 inH_20 (–31.1 to 31.1 kPa).

Range 3: 4 mA (1 V dc for Low Power) point is adjustable from –500 to 500 inH_2O (–124.3 to 124.3 kPa).

Minimum Span: Range 2: 50 inH_20 (12.4 kPa).
Range 3: 200 inH_20 (49.7 kPa).

Maximum Span: Range 2: 250 inH_20 (62.2 kPa).
Range 3: 1,000 inH_20 (248.6 kPa).

Zero and span adjustments are made by turning white plastic screws located in the terminal compartment. See Figure 2-1.

As with any transmitter that uses potentiometers for zero and span adjustments, the potential exists for movement of the potentiometer blades if the blades are kept in contact with the adjustment screws and the transmitter is subjected to temperature extremes or significant vibration. To prevent this from occurring, the final step in calibration requires backing off the screws slightly to break contact between the potentiometer blades and the adjustment screw slot surfaces (factory calibration procedures include this step).

Also, because a degree of mechanical backlash exists in all potentiometers, there will be a dead band when direction of adjustment is changed. The simplest procedure to follow when the desired setting is overshot is to purposely overshoot a larger amount before reversing the direction of the adjustment.

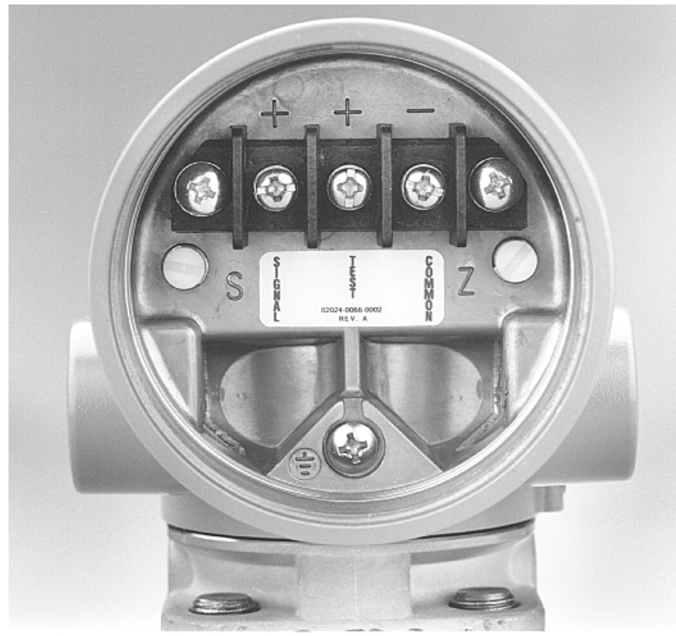


FIGURE 2-1. Zero and Span Adjustments.

To recalibrate the transmitter, use an accurate pressure source, output meter, and follow these steps:

1. Apply a pressure that is equivalent to the lower calibrated value to the high side of the transmitter. Then turn the zero adjustment screw until the output of the transmitter is 4 mA (1 V for Low Power).
2. Apply a pressure that is equivalent to the higher calibrated value to the high side of the transmitter. Then turn the span adjustment screw until the output of the transmitter is 20 mA (5 V for Low Power).
3. Repeat Steps 1 and 2 as necessary to verify the 4 mA (1 V) and 20 mA (5 V) readings. Adjusting the span potentiometer will have an effect of less than 1% of the calibrated span on the 4 mA (1 V) reading.
4. After adjusting the zero and span, back off the adjustment screws slightly to break contact between the potentiometer blades and the adjustment screw slot surfaces.

SECTION
3

Theory of Operation

INTRODUCTION

The Rosemount Model 2024 Differential Pressure Transmitter contains a free-floating variable capacitance sensing element, as shown in Figure 3-1. Differential capacitance between the sensing diaphragm and the capacitor plates on both sides of the sensing diaphragm is converted electronically to a two-wire 4–20 mA dc signal in transmitters with Output Code A. In transmitters with Output Code M, capacitance is converted to a three-wire, 1–5 V dc signal.

NOTE
Do not attempt to open the electronics compartment. Both the sensor and the electronics circuit are environmentally sealed in the electronics housing. Only the terminal side of the electronics housing is accessible.

The circuit has two major electrical loops as shown in Figure 3-2.

The input loop consists of the voltage-controlled oscillator (VCO), the capacitive pressure cell, the demodulator, and the current inverter. These components act together as a feedback loop for the VCO control amplifier, which controls the frequency amplitude product of the VCO output such that the sum of the capacitance currents of the two cell halves equals the reference current through resistor R7.

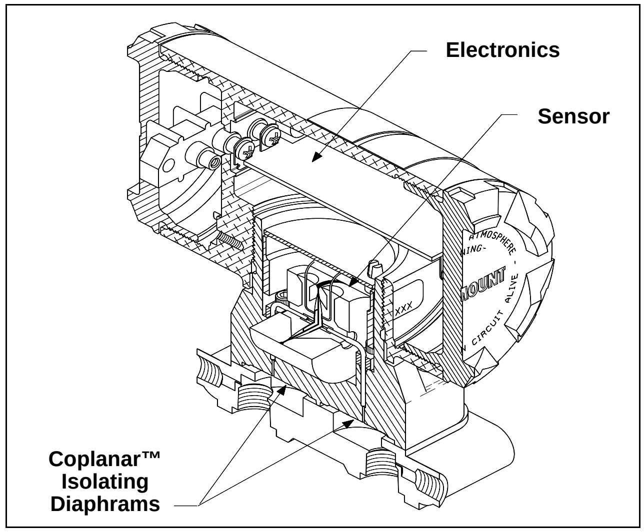


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FIGURE 3-1. Free-floating Cell.

The difference of the capacitance currents is fed to the output loop as the electrical analog of the pressure input. This difference current is linear with diaphragm pressure, and is approximately zero at zero diaphragm pressure.

The output loop for Code A consists of the current-sensing element and a current control amplifier that compares the span amplifier's output to the load current. Zero adjustment is incorporated in this loop.

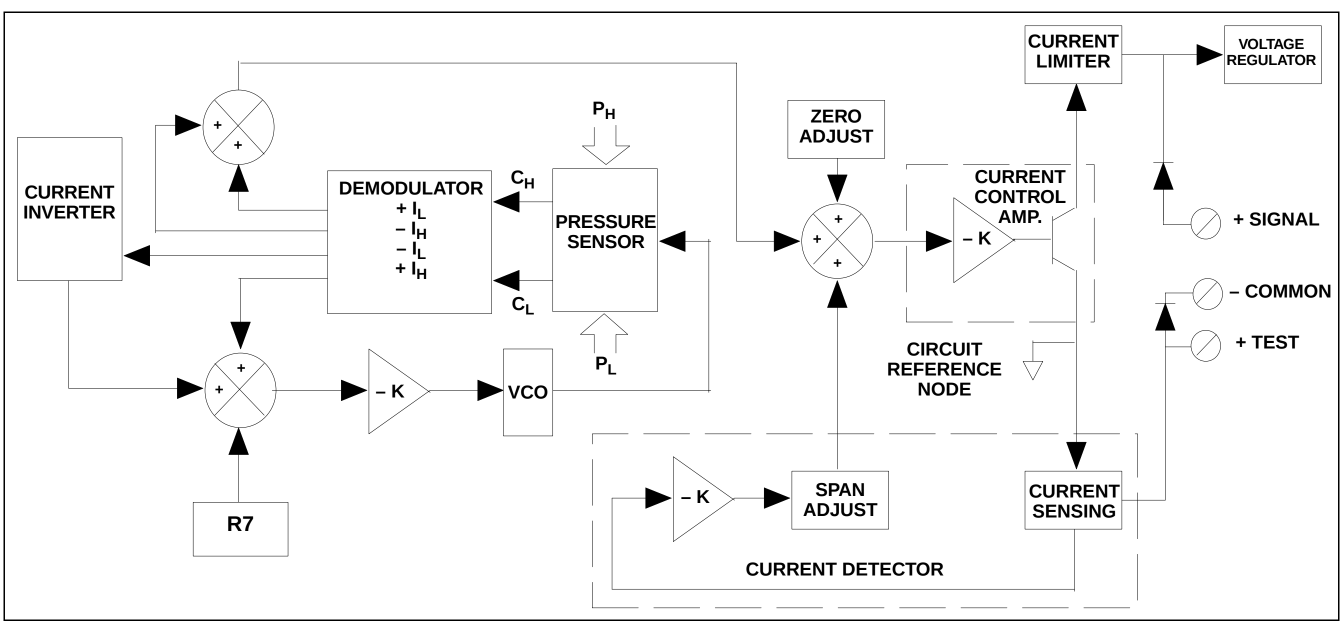

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FIGURE 3-2. Electrical Block Diagram (Output Code A).

Current for powering the circuitry bypasses the current control amplifier and is returned at the circuit reference node so that total current flows through the current-sensing element.

For Code M electronics, the output loop consists of a zero offset and variable gain control of a current-to-voltage converter. The voltage regulator provides a 4.5 V positive rail and a +2 and +1 volts for circuit reference purposes.

VOLTAGE-CONTROLLED OSCILLATOR (VCO)

The VCO section of a type 4046 integrated circuit phase-locked loop drives the sensor. It produces a square wave and a frequency proportional to the output of the VCO control amplifier. The associated range components set the lower limit at approximately 70 kHz and the upper limit above 300 kHz. When in control, the amplitude-frequency product will approximate the inverse of the sum of the active capacitances of the two cell halves.

DEMODULATOR

The demodulator, which converts the ac currents of the two cell capacitances and C1 to dc currents, consists of the diodes contained in the IC2 package plus associated filtering capacitors. Two diodes are associated with each cell half, producing two identical and opposite (sign) currents for each. Another pair of diodes associated with C1 subtracts the cell stray capacitance. Resistor R3 determines the degree of subtraction. The 0.01 microfarad capacitors associated with these diodes average out the pulsating current through the diodes.

CURRENT INVERTER

The current inverter inverts the signal from one of the diodes to obtain a sum of the currents from each of the cell halves. The inverter has a gain of –1 determined by resistors R8 and R9.

VCO CONTROL AMPLIFIER

Proper transmitter operation depends on maintaining a fixed current through the active capacitance of the two cell halves. To do this, the VCO control amplifier adjusts the frequency of the VCO until the amplitude and frequency of the drive to the pressure cell is sufficient to produce combined active capacitance currents from each of the cell halves equal to the reference current through resistor R7. At that point, the positive and negative inputs on the VCO control amplifier are at the same voltage.

CURRENT DETECTOR (OUTPUT CODE A)

The current detector senses and offsets the 4–20 mA signal current and scales it for comparison to the cell output. Resistor R25 is in the 4–20 mA path and provides a voltage proportional to the load current. Resistor R20 then converts that voltage to a signal current to the summing point of the amplifier. Resistor R18 performs the offsetting. Resistor R18 allows span amplifier (IC3) output to match the reference voltage when the signal current is 4 mA, thus eliminating the effects of the gain controls at the 4 mA point.

CURRENT CONTROL AMPLIFIER (OUTPUT CODE A)

The current control amplifier includes the output-damping components. The amplifier operates by controlling the 4–20 mA signal current so that the output voltage plus the rate of change of that output voltage are proportional to the sensor difference current. The result is output current that follows a nearly classical first-order response to a change in sensor current (caused by a change in pressure input). Transistor Q1 forms the output section of the amplifier.

CURRENT LIMITER (OUTPUT CODE A)

Resistors R27 and D7 limit the amount of current from the current control amplifier by reducing the drive to the output transistor as the limit point is approached. The limit current is roughly equal to the Zener voltage of 1 V divided by the value of resistor R27.

VOLTAGE REGULATOR (OUTPUT CODE A)

The voltage regulator provides a constant 6 V for the positive rail and +2 and +1 volts for circuit reference purposes.

TEMPERATURE COMPENSATION

Temperature compensation is achieved by small adjustments to the sensor sum current. By using a negative temperature coefficient thermistor (R4) with effect-limiting resistors (R5 and R6), the effective resistance of resistor R7 can be modified slightly by changing temperature. Resistor R6 in parallel with the thermistor limits the network's maximum resistance at low temperature (thermistor > 3 MOhms at –40 Degrees F [–40 Degrees C]), and resistor R5 in series with the thermistor limits the network's minimum resistance at high temperatures (thermistor > 10 kOhms at 185 Degrees F [85 Degrees C]). Because the thermistor network temperature characteristics are equal and opposites to that of the pressure sensor, conformal error is minimized, and this simple resistor network gives good span temperature compensation.

SECTION

4

Troubleshooting

GENERAL

The Rosemount Model 2024 Differential Pressure Transmitter is nonrepairable. Troubleshooting is limited to determining the cause of failure. In most cases, if the transmitter malfunctions, it will need to be replaced. In the event of malfunction, check the following areas to determine if the transmitter is at fault:

Wiring

1. See **WIRING** on Page 1-3 of this manual to ensure that the field wiring is connected to the proper terminals.
2. Check for sufficient voltage to the transmitter. See **Power Supply** on Page 5-1 of this manual.

Impulse Piping

1. Check the manifold/blocking valves to ensure proper operation, and make sure that all valves are in the correct position.
2. Check the impulse lines and isolating diaphragm areas of the transmitter to ensure that they are free of sediment or blockage.
3. Recalibrate the transmitter. If calibration is not possible, the transmitter must be replaced.

RETURN OF MATERIALS

To expedite the return process outside the United States, contact the nearest Rosemount representative.

Within the United States, call the Rosemount National Response Center using the 1-800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the name of the process material the product was last exposed to.

⚠CAUTION

People who handle products exposed to a hazardous substance can avoid injury if they are informed and understand the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

The Rosemount National Response Center will detail the additional information and procedures necessary to return goods exposed to hazardous substances.

SECTION
5

Specifications

Functional Specifications

Service

Liquid, gas, and vapor.

Range

Code

2: 0–50 to 0–250 inH_2O (0–12.4 to 0–62.2 kPa).
3: 0–200 to 0–1,000 inH_2O (0–49.7 to 0–248.6 kPa).

Output

Code

A: 4–20 mA dc.
M: 1–5 V dc, low power.

Power Supply

External power supply required.

Output Code A

Operates on 12 to 36 V dc, with no load.

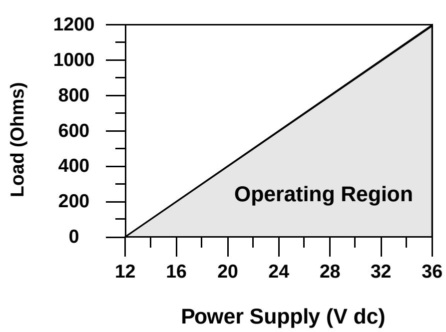
Output Code M

Operates on 6 to 14 V dc.

Load Limitations

Output Code A

Maximum Load = 50 × (Power Supply Voltage – 12)



Output Code M

Requires a minimum load impedance of 1 MΩ.

Hazardous Locations Certifications

Factory Mutual (FM) Approvals

E5 Explosion Proof for Class I, Division 1, Groups B, C, and D; Dust-Ignition Proof for Class II, Division 1, Groups E, F, and G. Suitable for Class III, Division 1, indoor and outdoor (NEMA 4X) hazardous locations.

I5 Intrinsically safe for use in Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; and Class III, Division 1 when connected in accordance with Rosemount drawing 02024-0150. Temp. Code T4. Non-incendive for Class I, Division 2, Groups A, B, C, and D.

Canadian Standards Association (CSA) Approvals

C6 Explosion Proof for Class I, Division 1, Groups C and D; Dust-ignition Proof for Class II, Division 1, Groups E, F, and G; Suitable for Class III, indoor and outdoor hazardous locations, CSA enclosure 4; factory sealed. Approved for Class I, Division 2, Groups A, B, C, and D.

Intrinsically safe for Class I, Division I, Groups A, B, C, and D when connected in accordance with Rosemount drawing 02024-1064. Temperature Code T3C.

BASEEFA/CENELEC Intrinsically Safe Approval

I1 EEx ia IIC T5 (T_{amb} = 40 °C).
EEx ia IIC T4 (T_{amb} = 70 °C).

BASEEFA Type N Approval

N1 Ex N II T5 (T_{amb} = 70 °C).
IP54.

Standards Association of Australia (SAA) Approvals

I7 Intrinsically Safe Approval
Ex ia IIC T5 (T_{amb} = 40 °C).
Ex ia IIC T4 (T_{amb} = 70 °C).
Class I, Zone 0.
IP54.

N7 Type N Approval
Ex n IIC T5 (T_{amb} = 40 °C).
Ex n IIC T4 (T_{amb} = 70 °C).
Class I, Zone 2.

E7 Flameproof Approval
Ex d IIC T6.
Class I, Zone 1.
IP65.

Span and Zero

Continuously adjustable.

Zero Elevation and Suppression

4 mA (1 V dc for Low Power) point adjustable between:

Range

2: –125 and 125 inH_2O (–31.1 to 31.1 kPa)
3: –500 and 500 inH_2O (–124.3 to 124.3 kPa)

Zero elevation and suppression must be such that the minimum and maximum span limits and the upper range limit are not exceeded.

Temperature Limits

Process
–20 to 220 °F (–29 to 104 °C)

Ambient
–40 to 185 °F (–40 to 85 °C)(1)

Storage
–50 to 185 °F (–46 to 85 °C)

(1) Electronics temperature limits decrease three degrees for every one degree increase in process temperature above 185 °F (85 °C).

Static Pressure and Overpressure Limits

0 psia to 2,000 psig (0 to 13.79 MPa) on either side without damage to the transmitter. Operates within specifications between static line pressures of 14.7 psia and 2,000 psig (0.1 to 13.79 MPa). 6,000 psig (41.37 MPa) burst pressure.

Humidity Limits

0 to 100% relative humidity.

Volumetric Displacement

Less than 0.005 cubic in. (0.08 cm^3).

Damping

Fixed at a maximum of 0.2 second at reference conditions.

Turn-on Time

Output Code A
1.5 seconds maximum at reference operating conditions.

Output Code M
0.1 second maximum at reference operating conditions.

Performance Specifications

(Zero-based spans, reference conditions, and 316L SST isolating diaphragms)

Accuracy

±0.25% of calibrated span. Includes combined effects of linearity, hysteresis, and repeatability.

Dead Band

None.

Stability

±0.25% of upper range limit for six months.

Temperature Effect (Total)

Less than ±1.5% of upper range limit per 100 °F (55 °C).

Static Pressure Effect

Zero Error
Less than ±0.5% of upper range limit per 1,000 psi (6.9 MPa). Correctable through rezeroing at line pressure.

Span Error
Less than ±0.5% of reading per 1,000 psi (6.9 MPa).

Vibration Effect

Less than ±0.1% of upper range limit shift per test condition of SAMA PMC 31.1 Section 5.3.

Power Supply Effect

Less than ±0.01% of calibrated span per volt.

Load Effect

Output Code A
No load effect other than the change in voltage supplied to the transmitter.

Output Code M
Less than ±0.09% of calibrated span for a load change of 1 MΩ to infinity.

Mounting Position Effect

Zero shift of up to 3.0 inH_2O (0.75 kPa), which can be calibrated out.

Physical Specifications

Materials of Construction

Isolating Diaphragms
316L SST, Hastelloy C-276.

Drain/Vent Valves (if selected)
316 SST, Hastelloy C.

Flange
316 SST.

Adapters
Plated carbon steel, 316 SST.

Wetted O-rings
Glass filled TFE.

Fill Fluid
Silicone oil.

Bolts
Plated carbon steel.

Electronics Housing
Low-copper aluminum. NEMA 4X.

Paint
Epoxy-polyester.

Process Connections

1/4–18 NPT on 2 1/8-inch (54 mm) center or 1/2–14 NPT on 2-, 2 1/8-, or 2 1/4-inch (51, 54, or 57 mm) centers with adapters.

Electrical Connections

1/2–14 NPT conduit connection, screw terminals, and internal grounding stud.

Weight

6 lb (2.7 kg) excluding options.

SECTION
6

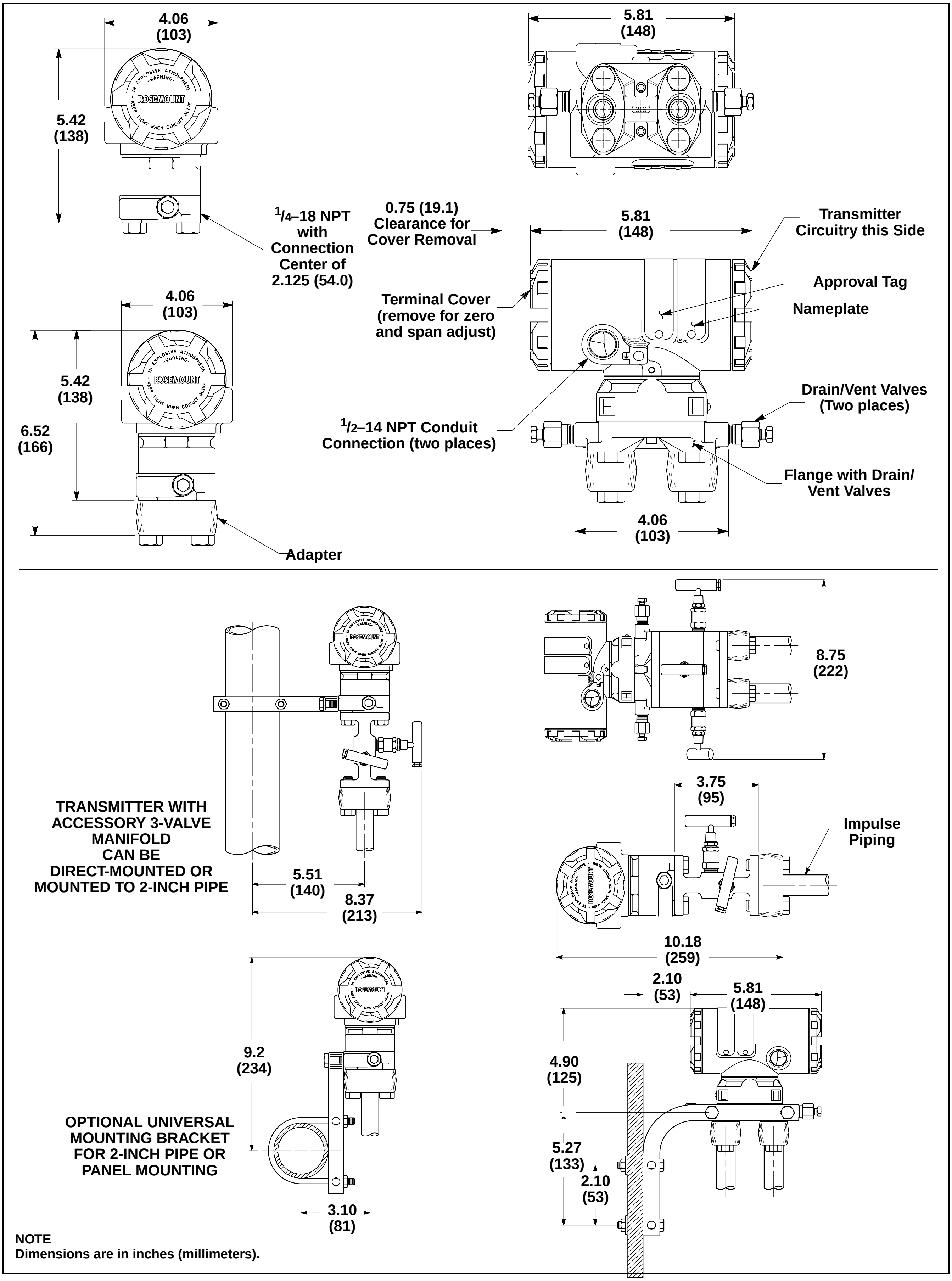
Reference Data

TABLE 6-1. Model Structure

Model	Transmitter Type	
2024D	Differential Pressure Transmitter	
Code	**Range**	
2	0–50 to 0–250 in H_2O (0–12.4 to 0–62.2 kPa)	
3	0–200 to 0–1,000 in H_2O (0–49.7 to 0–248.6 kPa)	
Code	**Output**	
A	4–20 mA Linear with Input	
M	1–5 V dc Low Power	
Code	**MATERIALS OF CONSTRUCTION**	
	Flange Adapters	**Isolating Diaphragms**
12A	Plated CS	316 SST
22A	316 SST	316 SST
22B	None	316 SST
19A(1)	Plated CS	*Hastelloy C-276*
29A(1)	316 SST	*Hastelloy C-276*
29B(1)	None	*Hastelloy C-276*
Code	**Drain/Vent Valves**	
0 (1)	None	
2	316 SST	
3 (1)	*Hastelloy C*	
Code	**Fill Fluid**	
S	Silicone Oil	
Code	**Housing Conduit Thread**	
1	1/2–14 NPT	
Code	**Options**	
B4	Universal Mounting Bracket for 2-in. pipe and panel mounting, SST bolts	
E5	Factory Mutual (FM) Explosion-Proof Approval	
I5	Factory Mutual (FM) Non-incendive and Intrinsic Safety Approval (entity concepts)	
C6	Canadian Standards Association (CSA) Explosion-Proof Intrinsic Safety and Non-Incendive Approval	
I1	BASEEFA Intrinsic Safety Approval	
N1	BASEEFA Type N Approval	
I7	Standard Association of Australia (SAA) Intrinsic Safety Approval	
N7	Standard Association of Australia (SAA) Type N Approval	
E7	Standard Association of Australia (SAA) Flameproof Approval	
Typical Model Number: 2024D 2 A 22B 0 S 1 B4		

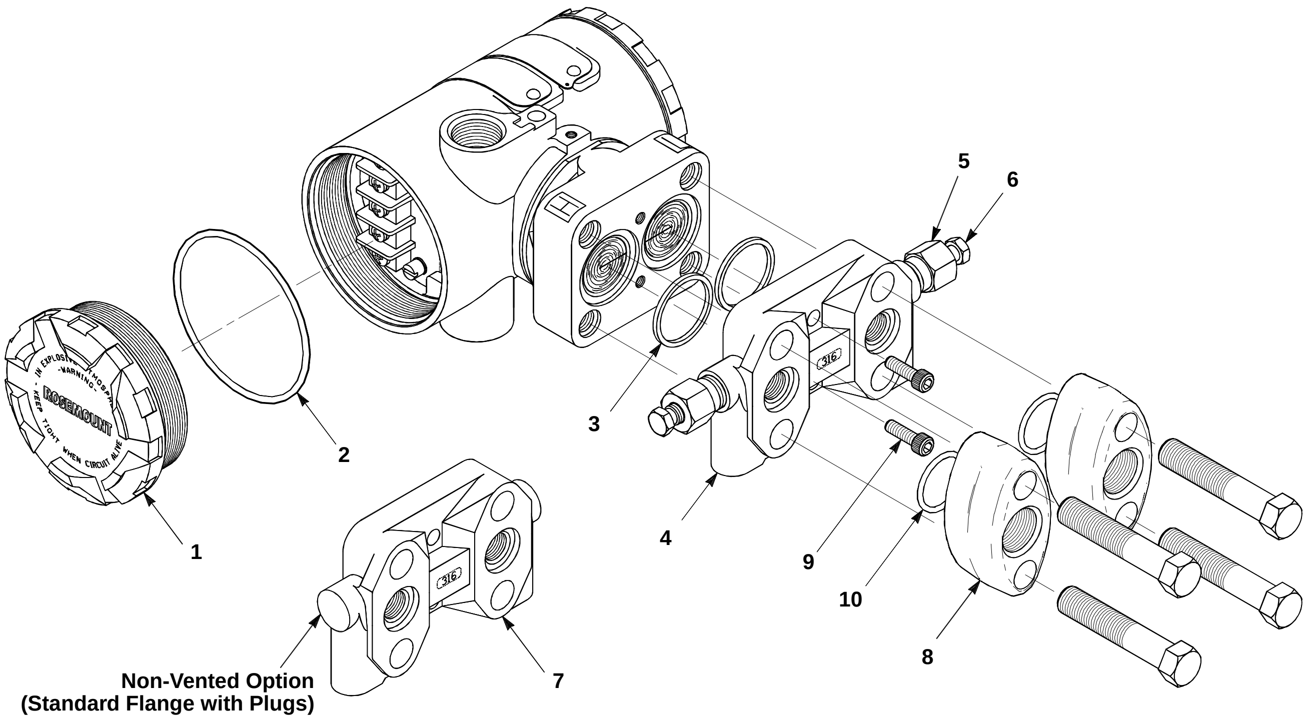
NOTE
Coplanar flange is 316 SST with all ordering codes.

(1) Meets NACE materal requirements per MR 01–75.



2024-2024B,E,A,D,C10A 2024-2024H11B 2024-2024G11A 2024-2024H,B11A

FIGURE 6-1. Dimensional Drawing and Mounting Configurations.



2024-2024A12B

Part Description	Item No.	Part Number	Spares Category[1]
Flange, 316 SST, (valves not included)	4	03031-0023-0022	—
Flange, 316 SST, non-vented	7	03031-0023-2022	—
Kit, Drain/Vent Valve			
Valve Stem, 316 SST	6	01151-0028-0022	A
Valve Seat, 316 SST	5		
Valve Stem, *Hastelloy C*	6	01151-0028-0023	A
Valve Seat, *Hastelloy C*	5		
Process Adapter Union			
½–14 NPT, Plated Carbon Steel	8	02024-0068-0005	—
½–14 NPT, 316 SST	8	02024-0069-0002	—
O-rings			
Process Flange, *Teflon*	3	03031-0234-0001	B
Electronics Cover, Buna-N	2	03031-0232-0001	B
Flange Adapter, *Teflon*	10	03031-0242-0001	B
Cover, Electronics Housing	1	03031-0547-0001	—
Mounting Bracket, SST Bolts	—	02024-0054-0003	—

(1) Rosemount recommends one spare part for every 25 transmitters in Category A, and one spare part for every 50 transmitters in Category B.

FIGURE 6-2. Illustrated Spare Parts List

FIGURE 6-3. CSA Intrinsic Safety Approval Drawing.

FIGURE 6-4. Index of Intrinsically Safe Barrier Systems and Entity Parameters.

FIGURE 6-4a. Continued

FIGURE 6-4b. Continued

FIGURE 6-4c. Continued

FIGURE 6-4d. Continued

INDEX

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