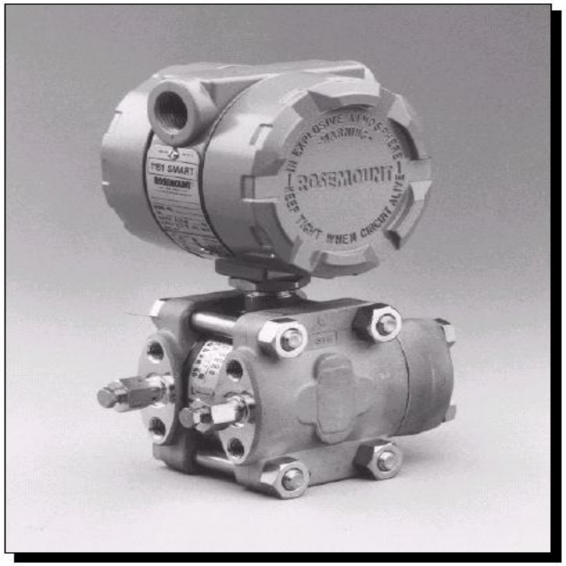

Transmitters

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Instrumentation Lab (010)

VESIT,chembur.

Index

Introduction to Transmitters

- What is Transmitter?
- Why Transmitters are used?
- How Transmitters are used?
- Transmitter Overview

What is Transmitter?

- **Transmitter** is a **secondary transducer**
- **It converts physical signal** directly OR signal **generated by primary sensor**
- **Responds to a measurement variable OR Measurand)** into **suitable signal level OR standardized Transmission signal** which can be used for further processing OR can be displayed on indication system.
- It is an **instrument** used to transmit the information in a **standard format** over a long distance.
- Standard format signal levels for Electronic Transmitter is **4 – 20 mA DC @24 VDC**;
- Standard signal levels for Pneumatic Transmitter is 0.2 – 1 Kg / sq. CM (g) OR 3 – 15 psig ;

- Most Common Industrial Transmitter is a combination of Transducer & signal conditioning circuit that produces an output current proportional to measurand.
- Process control industry's standard current signal is 4 to 20 mA
- 4 mA represents 0 % or Zero scale.
- 20 mA represents 100 % or Full scale.
- The Current signal is used because it is NOT affected by wire impedance & Noise.

Why Transmitter are used?

- Signals generated by sensors / Transducers are very weak and unable to inform to indication / control system.
- Output of a sensors affected by interferences.
- Receiving systems/ instruments accepts standard signals only.
- Sensors data is required to send over long distance.

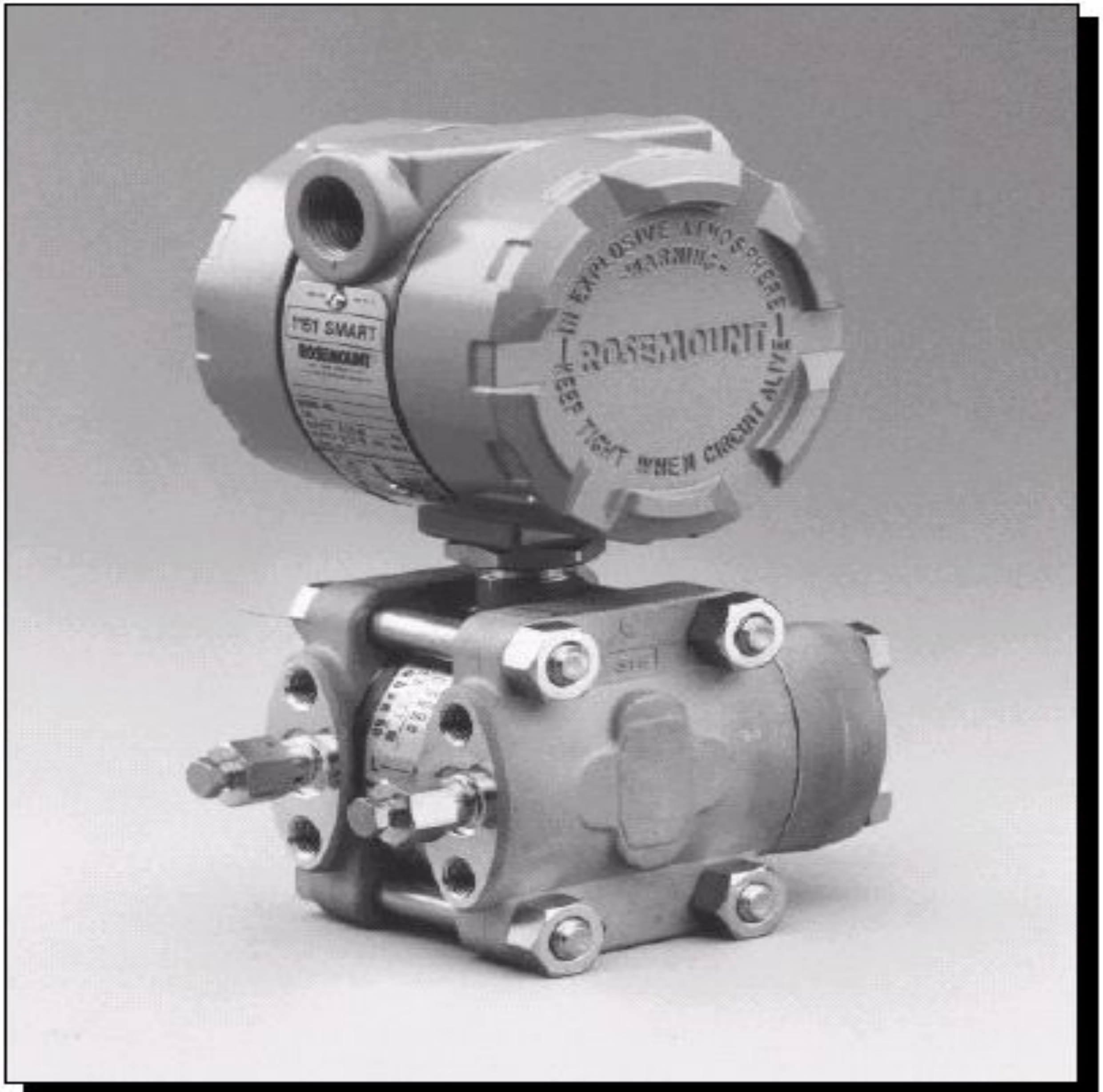
How Transmitters are used?

- Transmitters are signal conditioning systems which can be coupled with the sensors to convert sensor information into standard form of signals.
- Standard signals are then transmitted through communication medium (cables) over a long distance to the receiving devices/systems.
- Thus Transmitters acts as converters.

TRANSMITTER OVERVIEW

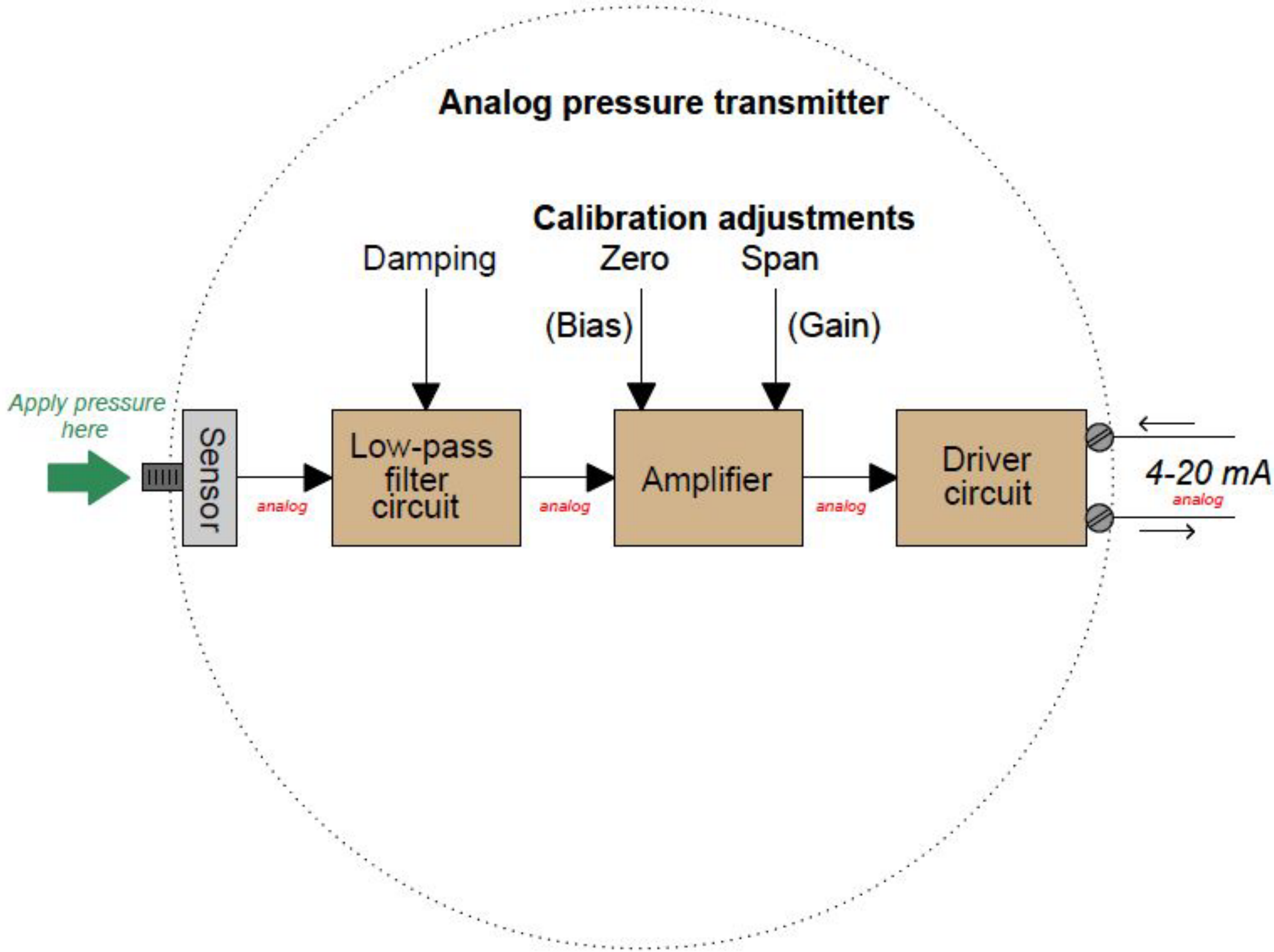
- Transmitters bring true precision to the measurement of flow, level, gage and absolute pressures, vacuum, and specific gravity.
- With proven performance, quality, and reliability, they provides accurate measurement using the variable capacitance principle.
- It is virtually unaffected by changes in temperature, static pressure, vibration, and power supply voltage.

Sensor Module



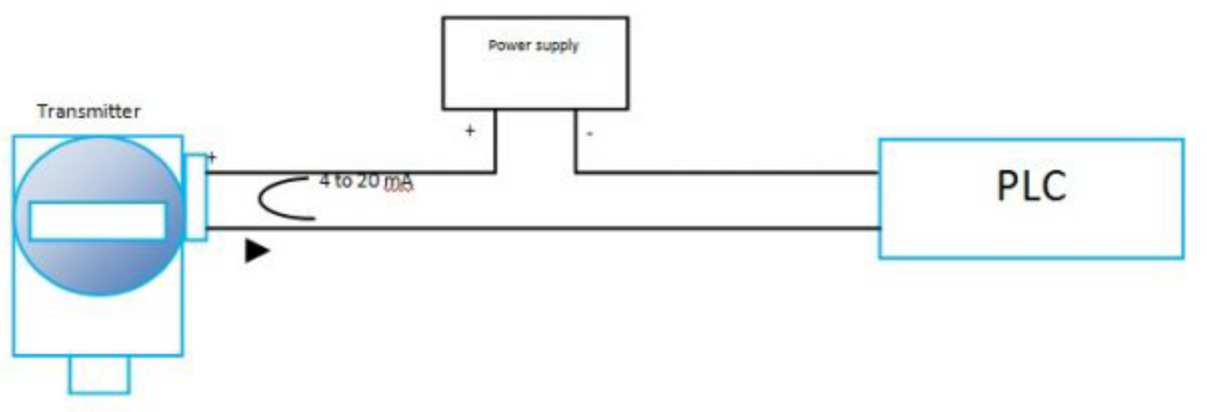
S / C Module

Sensor Module



Analog pressure transmitter
Calibration adjustments
Damping
Zero
(Bias)
Span
(Gain)
Apply pressure here
Sensor
analog
Low-pass filter circuit
analog
Amplifier
analog
Driver circuit
4-20 mA
analog

All devices in a 4-20 mA current loop need to be supplied power from somewhere in order to function. Two-wire devices receive their power from the process signal loop itself. The power for the loop usually comes from the transmitter power supply or some other kind of external power supply, and all of the power for the system travels through the wires that also carry the signal. Since this setup only requires two wires, loop-powered instruments are also referred to as two-wire devices.



Advantage

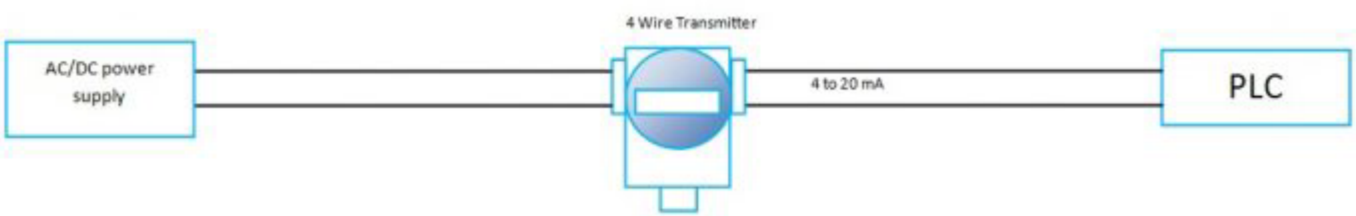
- Simple and easy display for 4-20 mA transmitter
- Low cost solution for display
- Easy Agency approvals(safety purpose)
- Local power not required

Disadvantage

- Limited output options
- Does not support relays
- Does not support LED display

The simplest form of 4-20 mA measurement loop is one where the transmitter has two terminals for the 4-20 mA signal wires to connect, and two more terminals where a power source connects. These transmitters are called “4-wire” or self-powered. The current signal from the transmitter connects to the process variable input terminals of the PLC to complete the loop.

The power supply can be AC or DC depending upon the model.



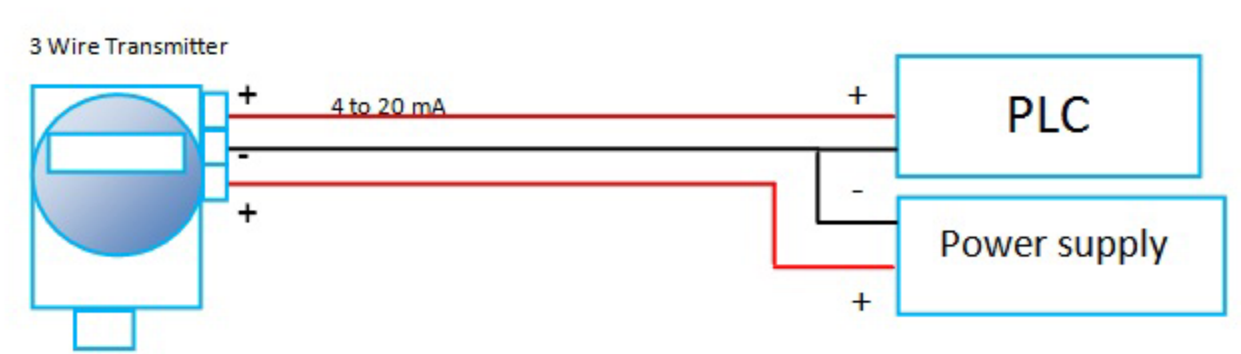
Advantages of 4-wire transmitter

- More capabilities than 2 wire (relays, LEDs, serial communications)
- Easier to understand the wiring
- No need to worry about voltage drop
- Excellent isolation (power from input/outputs)

Disadvantage of 4 wire transmitter

- Requires a separate local power supply
- Generally more expensive
- More wiring requirements
- Limited hazardous area options

A three-wire connection is essentially the same as a four-wire connection except that the isolation just discussed is not present; a three-wire device does not float in comparison to the current loop. In a three-wire connection, the process signal return from the device and the common of the power supply are a shared connection.



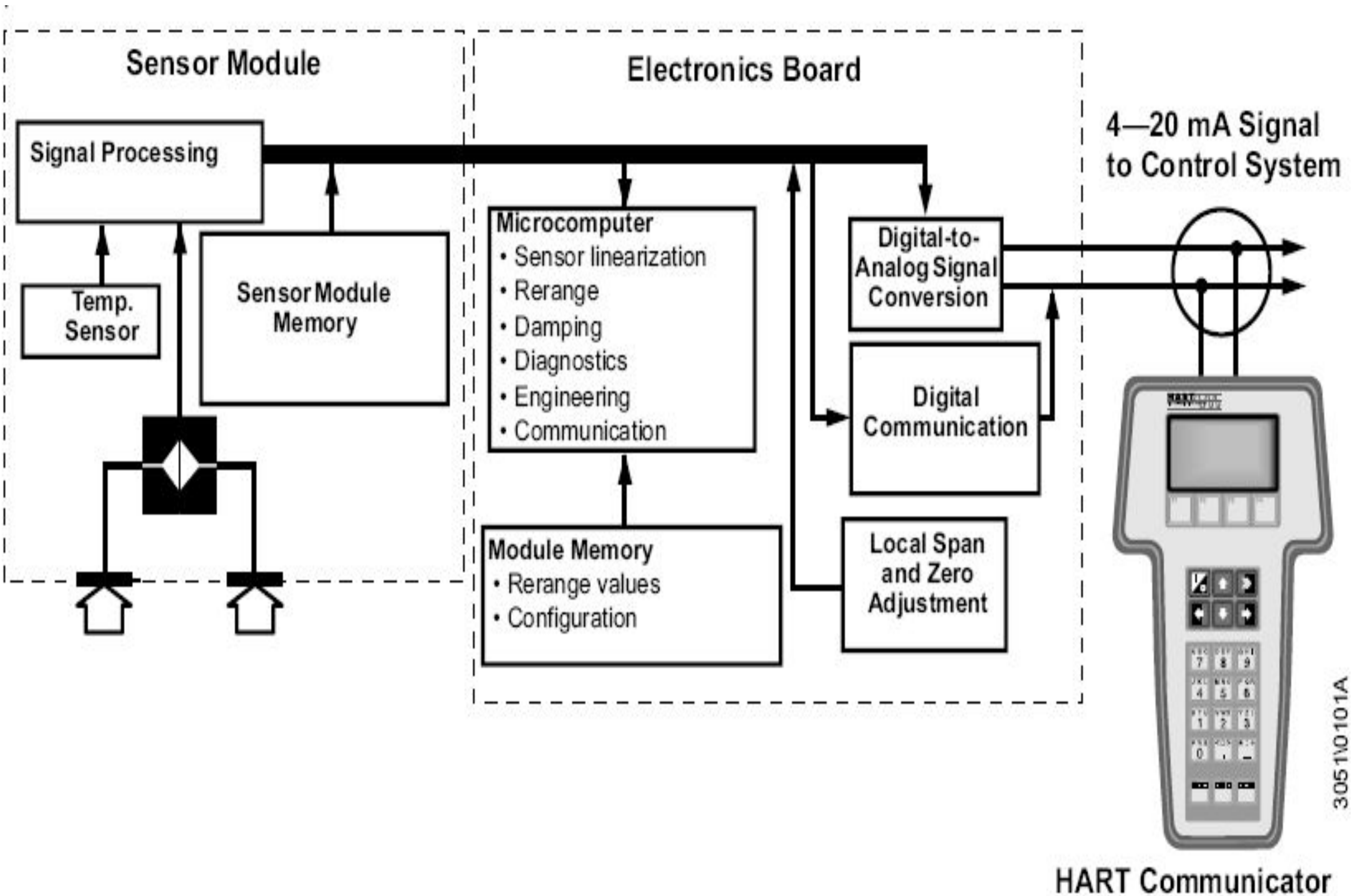
Advantage

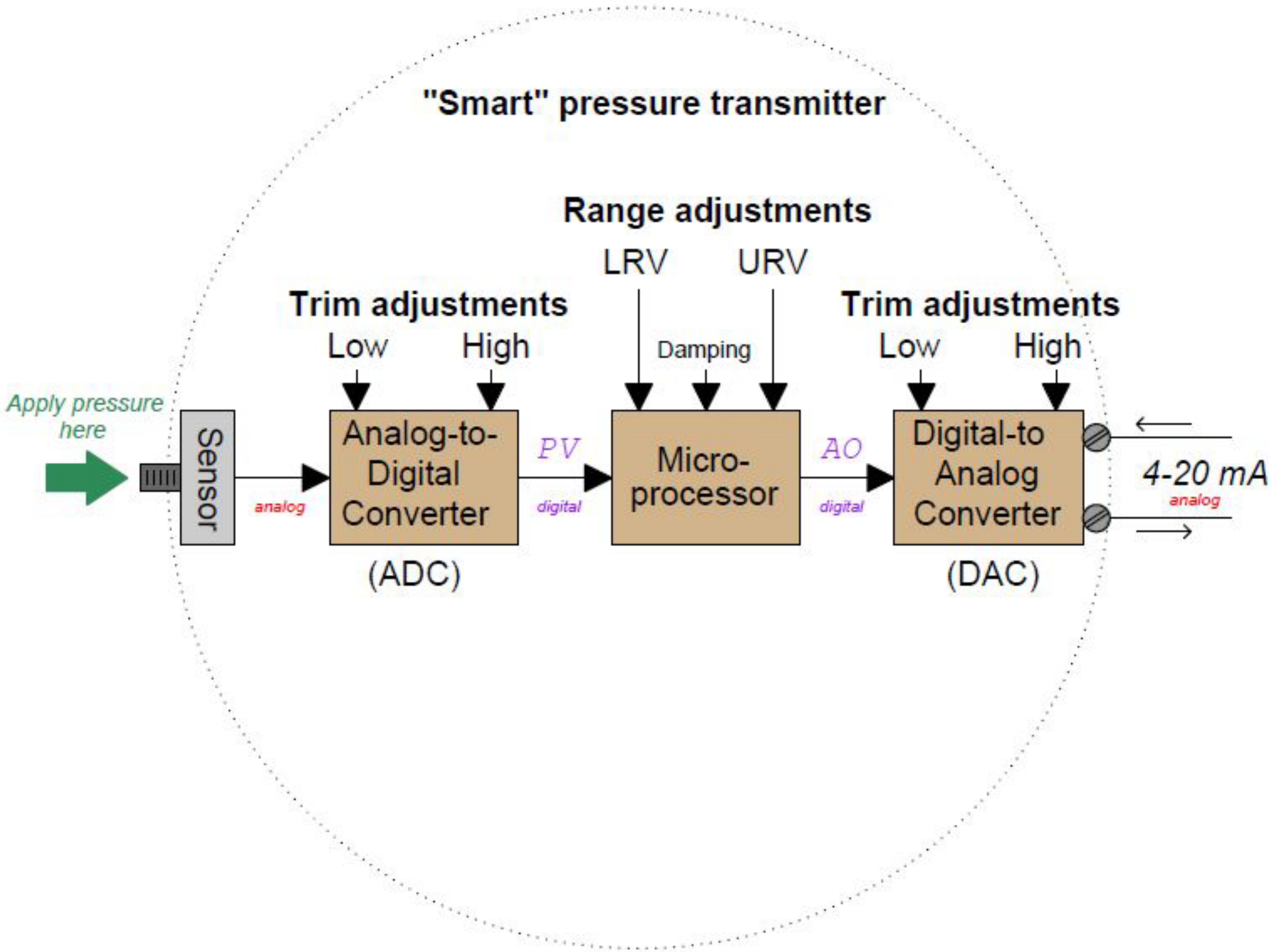
- Lower cost than 4 wire
- Easier to wire (fewer connections)

Disadvantage

- No isolation, very susceptible to ground loops
- May be confusing to wire.

SMART Transmitter Block Diagram




"Smart" pressure transmitter
Range adjustments
LRV
URV
Trim adjustments
Low
High
Damping
Trim adjustments
Low
High
Apply pressure here
Sensor
analog
Analog-to-Digital Converter
(ADC)
PV
digital
Micro-processor
AO
digital
Digital-to Analog Converter
(DAC)
4-20 mA
analog

TRANSMITTER OVERVIEW

- The Model 3051C Coplanar™ design is offered for Differential Pressure (DP),Gage Pressure (GP) and Absolute Pressure (AP) measurements.
- The Model 3051C utilizes Rosemount Inc. capacitance sensor technology for DP and GP measurements.
- Piezoresistive sensor technology is utilized in the Models 3051T and 3051C AP measurements.

Transmitter Operation

- The major components of the Model 3051 is the sensor module and the electronics housing.
- The sensor module contains the oil filled sensor system (isolating diaphragms, oil fill system, and sensor) and the sensor electronics.
- The sensor electronics are installed within the sensor module and include a temperature sensor (RTD), a memory module, and the capacitance to digital signal converter (C/D converter).

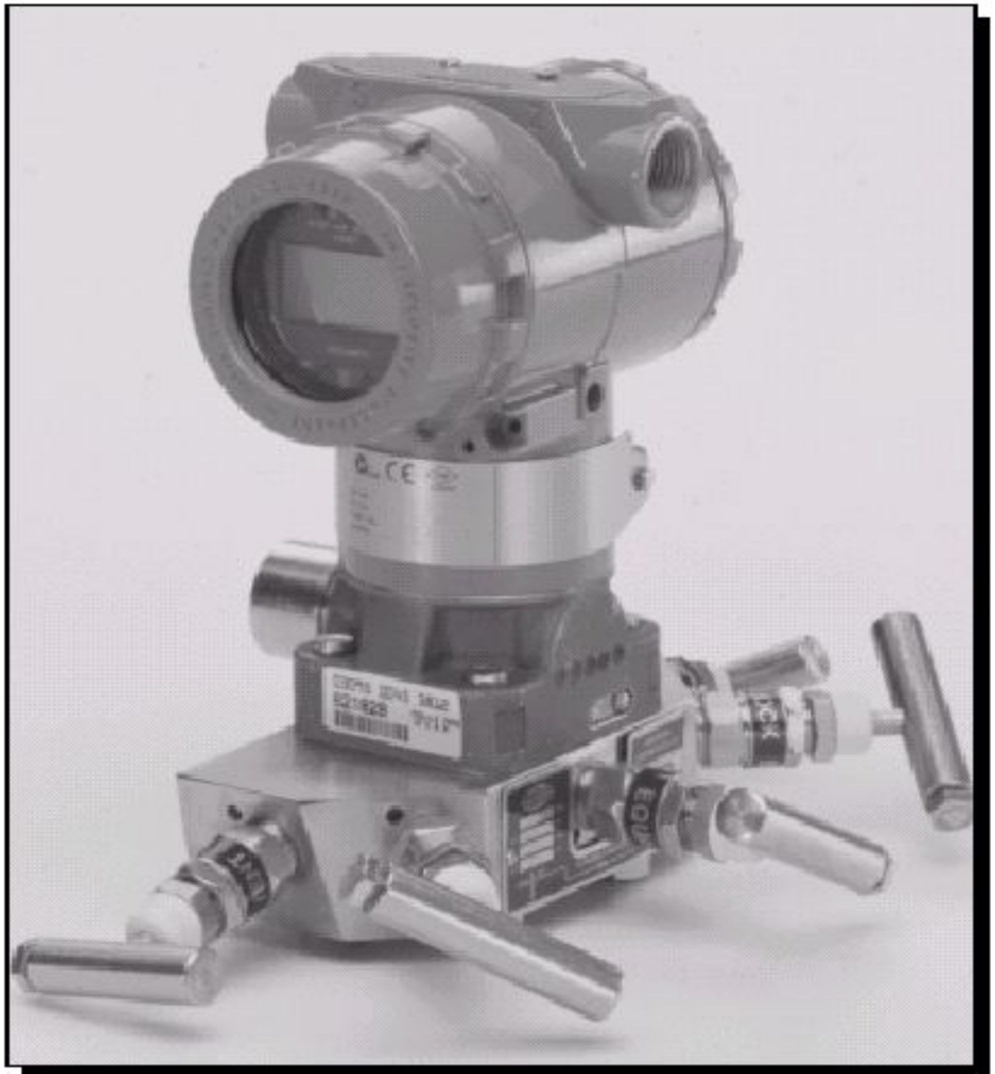
- The electrical signals from the sensor module are transmitted to the output electronics in the electronics housing.
- The electronics housing contains the output electronics board (microprocessor, memory module, digital to analog signal converter or D/A converter), the local zero and span buttons, and the terminal block.

- When Differential pressure is applied to the isolating diaphragms, the oil deflects the center diaphragm, which then changes the capacitance.
- This capacitance signal is then changed to a digital signal in the C/D converter.
- The microprocessor then takes the signals from the RTD and C/D converter calculates the correct output of the transmitter.
- This signal is then sent to the D/A converter, which converts the signal back to an analog signal and superimposes the HART signal on the 4-20 mA output.

Transmitter Photographs

Model 2024 Differential Pressure Transmitter

Multivariable™ Mass Flow Transmitter



Magnetic Flowmeter Flowtubes

Integral Mount Magnetic Flowmeter System

Rosemount 5300 Series

Superior Performance Guided Wave Radar

Radar Level Transmitter

Rosemount 644 Head and Rail Mount Temperature Transmitters

Smart Temperature Transmitters

Model 3051 Pressure Transmitter

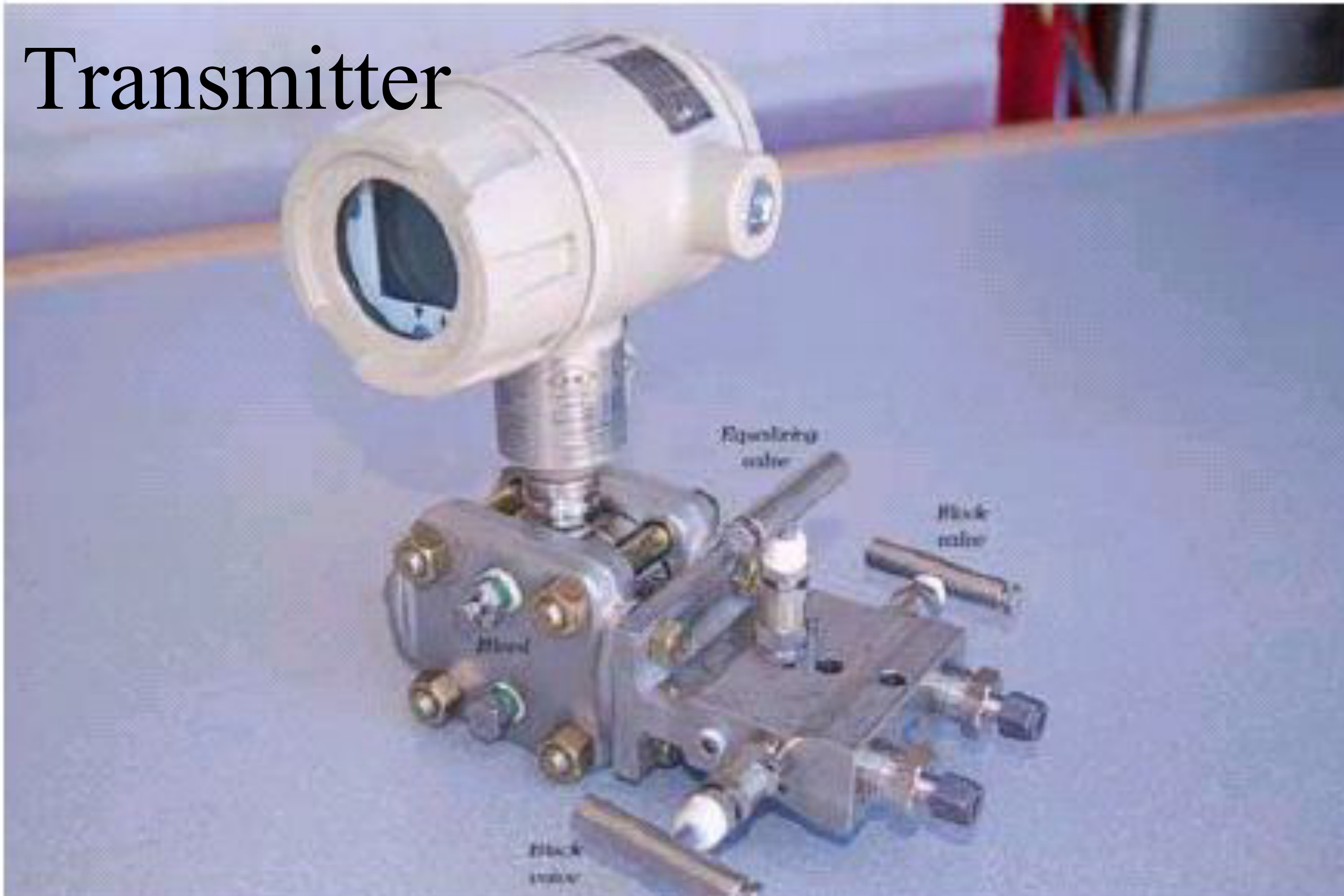
with HART protocol®

Smart Vortex Flowmeter

Model 848T Eight Input Temperature Transmitter with FOUNDATION™ Fieldbus

Device Revision 04

Pneumatic DP Transmitter



Remote seal DP Transmitter

Extended Diaphragm DP Transmitter

Transmitter Classification

- **Based on the type of medium.**
  - **Electronic Output(Typical 4-20 mA DC)**
  - **Pneumatic Output (3-15 Psig)**
- **Based on the signal Transmission.**
  - Conventional (Analog)
  - SMART or INTELLIGENT (Analog + HART)
  - FF compatible(Digital)
- **Based on the Parameter measurement.**
- Transmitters are broadly classified based on the parameters to be measured .
- **Based on Mounting Arrangement.**

Transmitter Classification based on Signal Transmission

- **Conventional (Analog)**
  - DPT / GPT /APT
  - TT / FT / LT
- **SMART or INTELLIGENT (ANALOG + HART)**
  - DPT
  - Capacitance Type LT
  - Radar LT
  - Ultrasonic LT
- FF compatible (Digital)
  - DPT
  - Magnetic Flow meter
  - Vortex Flow meter
  - Mass Flow meter

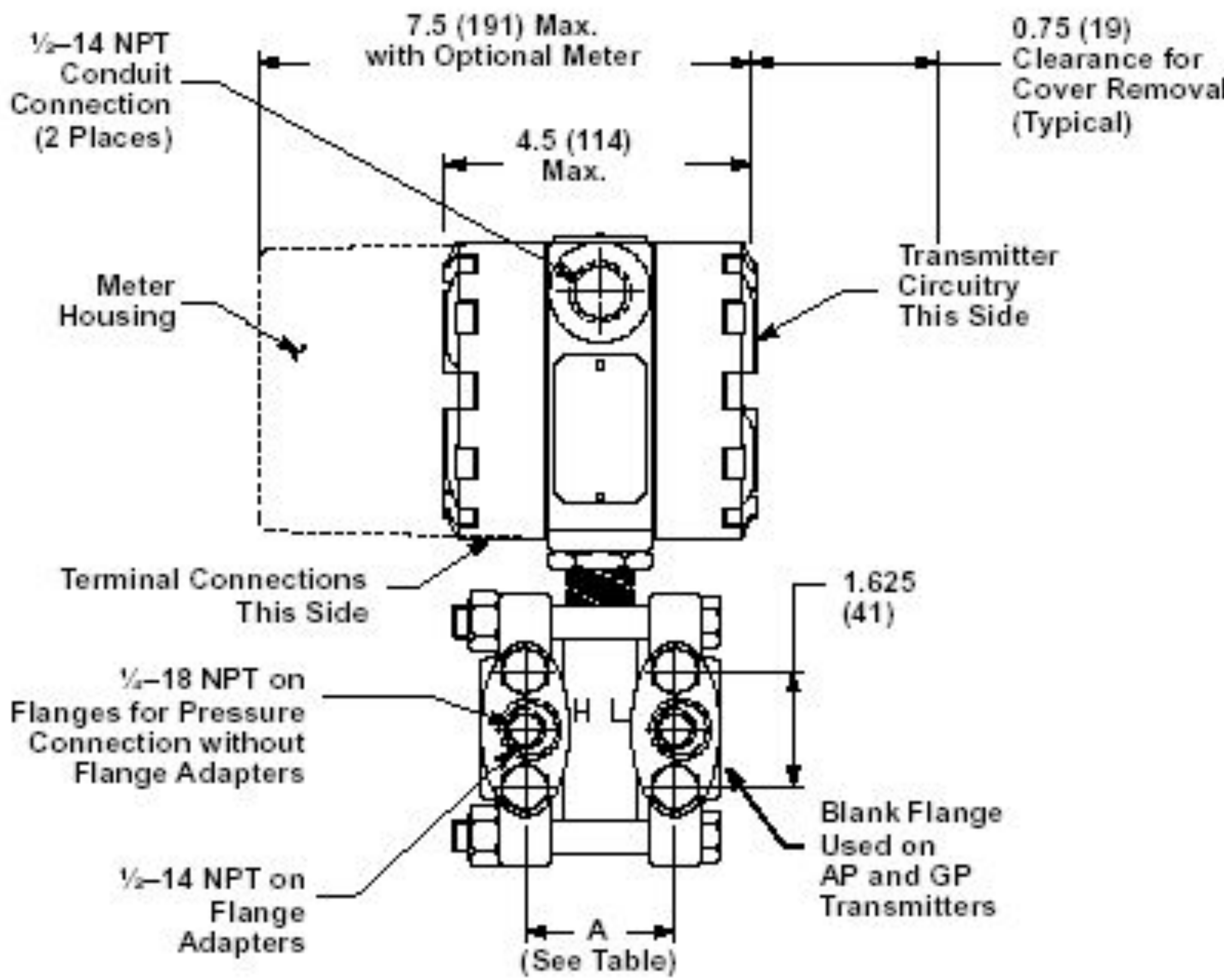
Transmitter Classification based on parameter measurement

- **Pressure**
  - DPT
  - GPT
  - APT
- **Level**
  - DPT
  - Capacitance Type LT
  - Radar LT
  - Ultrasonic LT
- **Flow**
  - DPT
  - Magnetic Flow meter
  - Vortex Flow meter
  - Mass Flow meter
- **Temperature**
  - Head Mounted
  - Remote
- **Miscellaneous**
  - pH Transmitter
  - Conductivity
  - Consistency

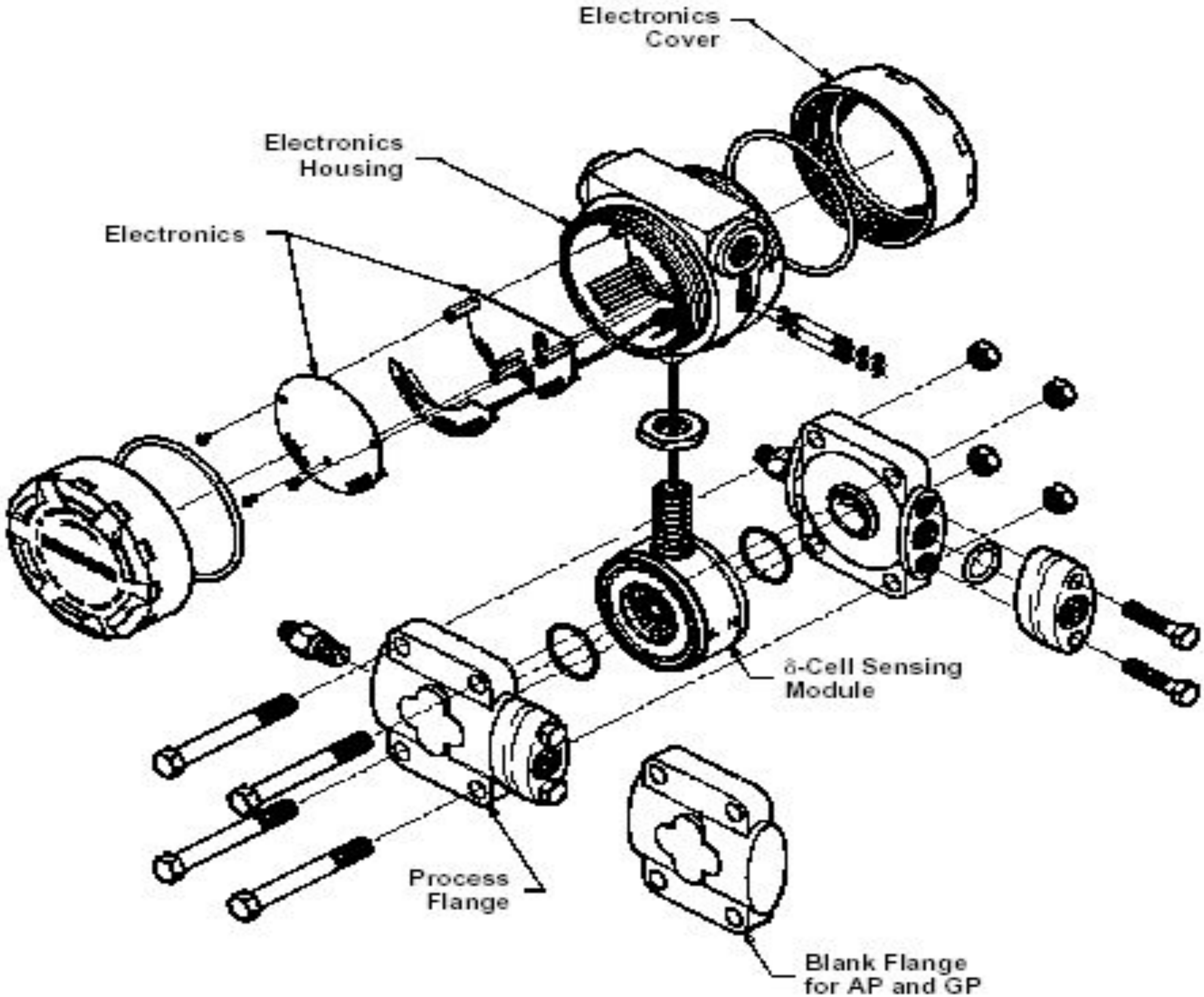
Transmitter Classification based on Type of Mounting Arrangement

- 2 inch stanchion Mounting
  - DPT
  - GPT
  - APT
  - TT
  - Magnetic flow Transmitter
- Tank Mounting
  - DPT
  - Capacitance Type LT
  - Radar LT
  - Ultrasonic LT
- DIN Rail Mounting
  - TT
  - Power transmitters
- Flanged Mounting
  - Integral Magnetic Flow meter
  - Vortex Flow meter
  - Mass Flow meter

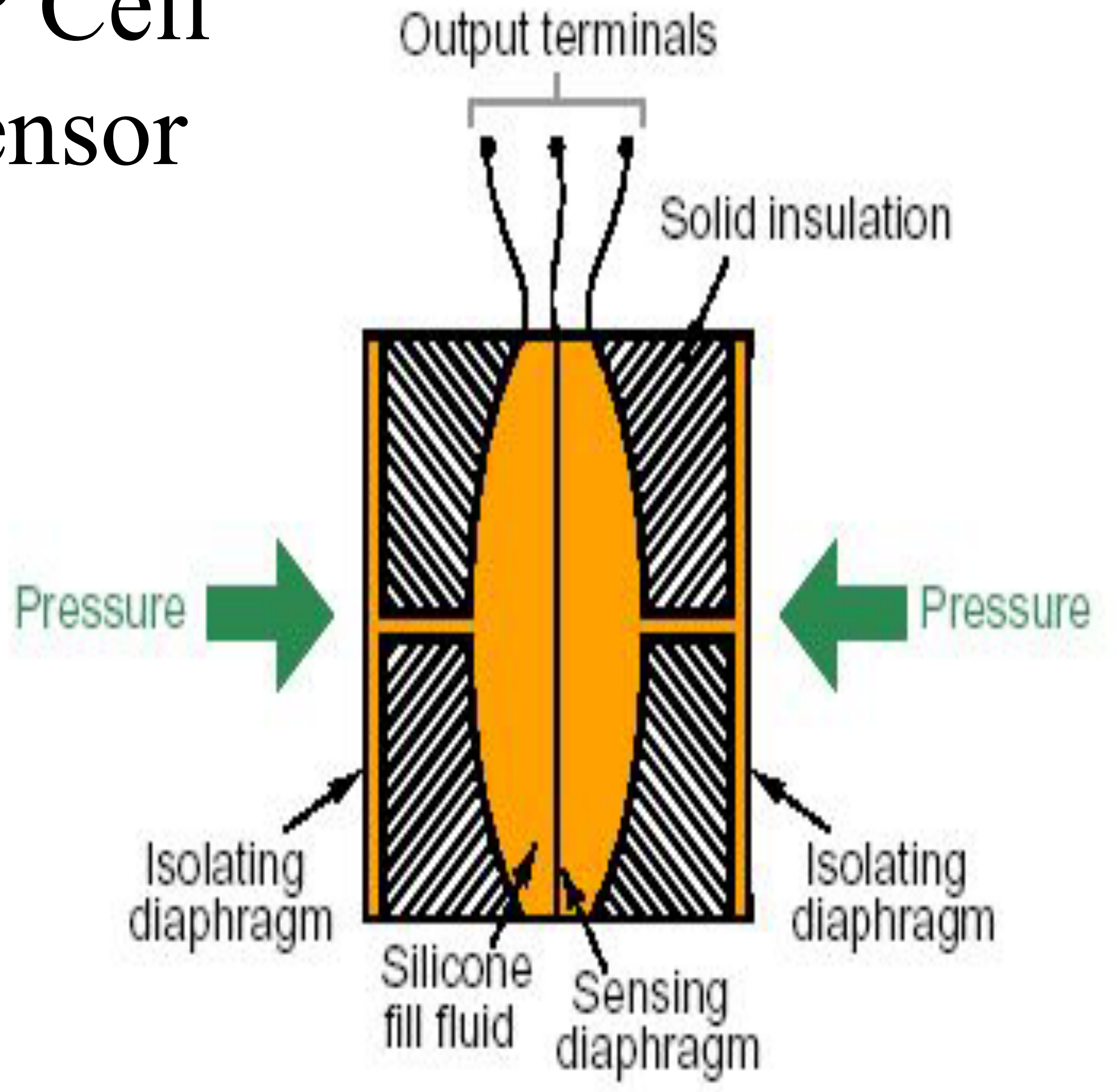
Dimensional Drawing for DP Transmitter.

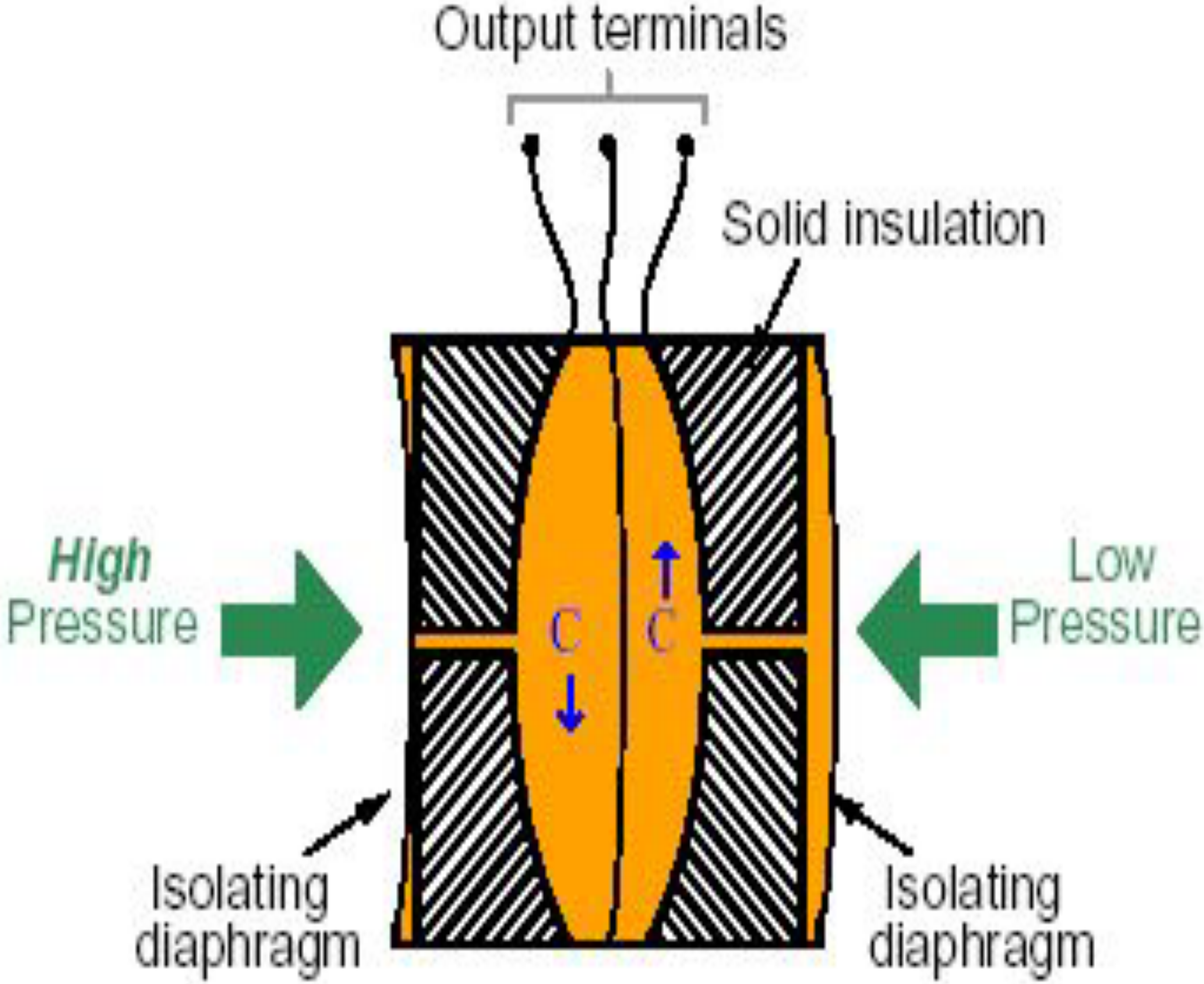


Differential Pressure (DP) Transmitter Exploded View.

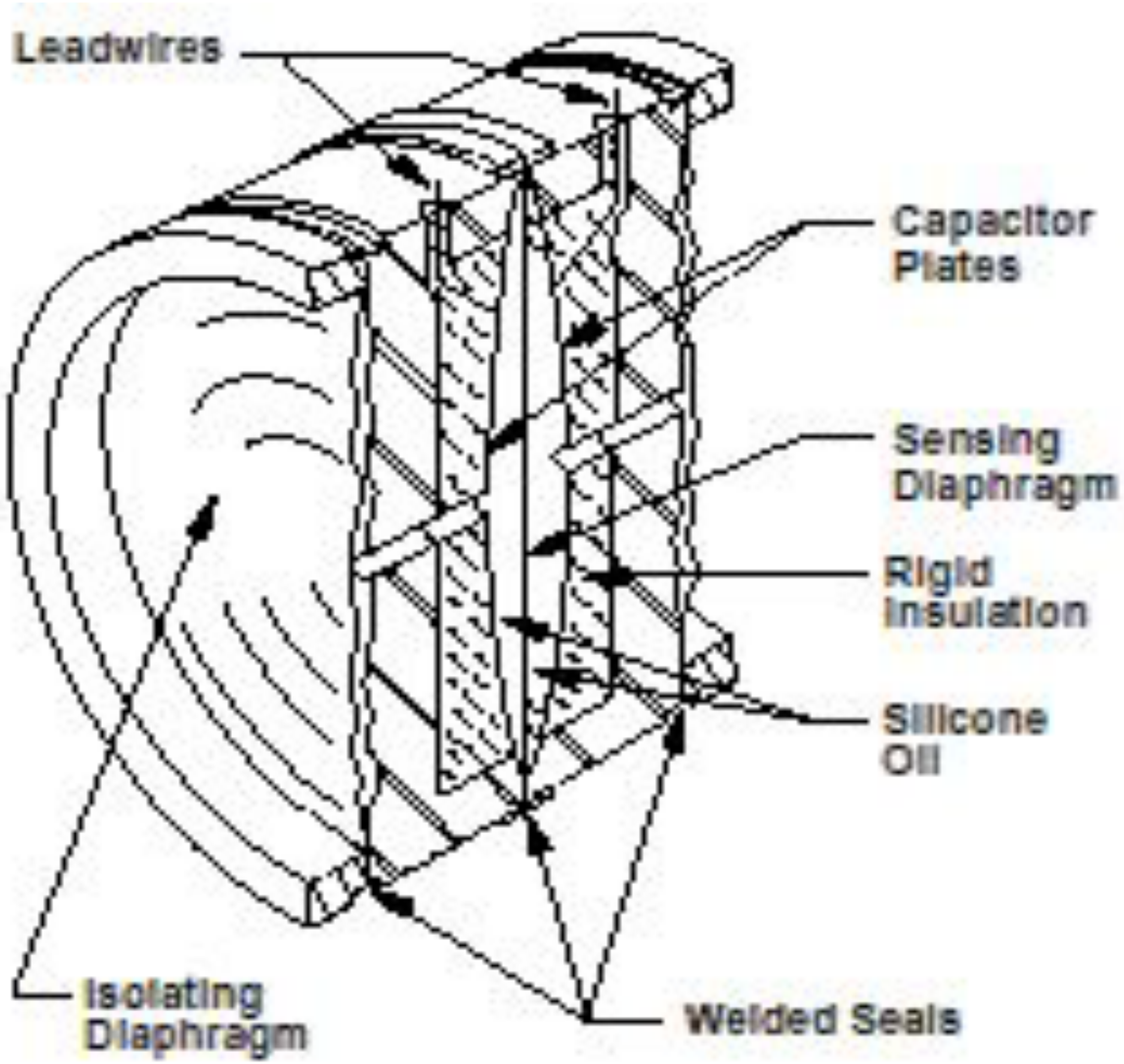


DP Cell Sensor

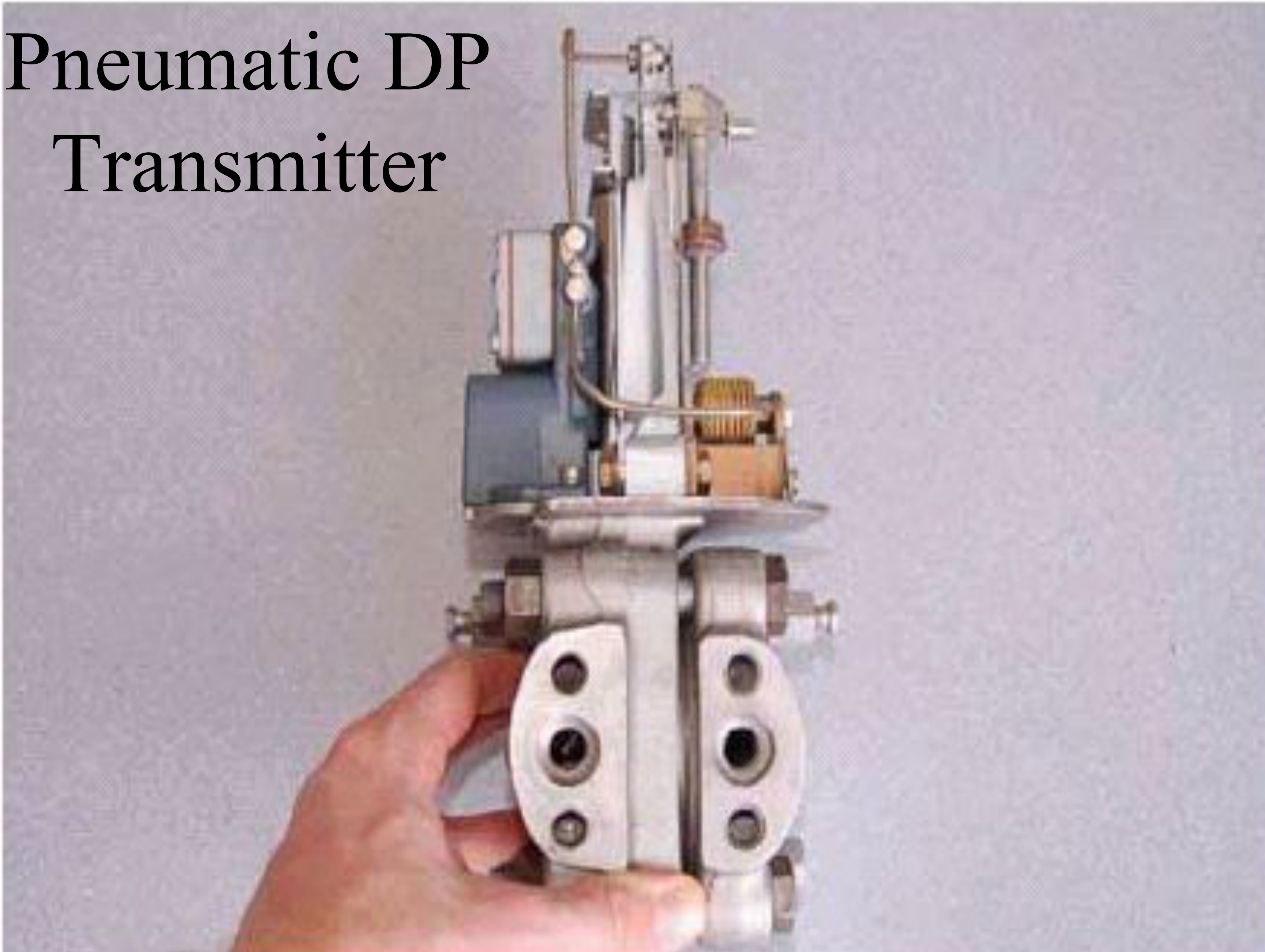



Output terminals
Solid insulation
High
Pressure
C
C
Low
Pressure
Isolating
diaphragm
Isolating
diaphragm

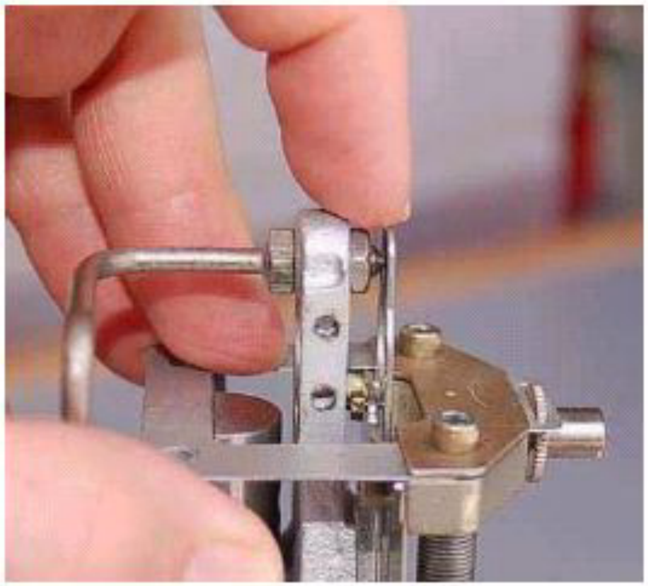
DP Cell Sensor

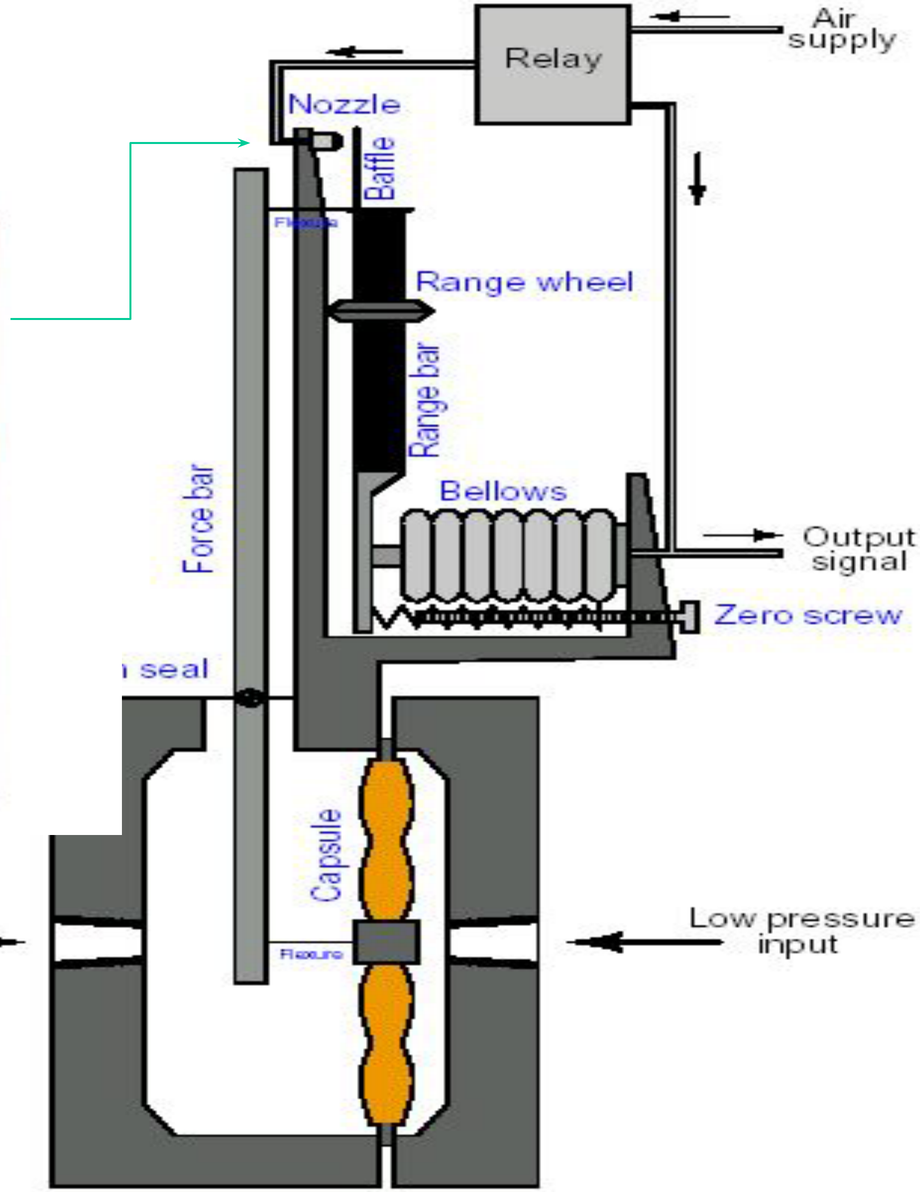


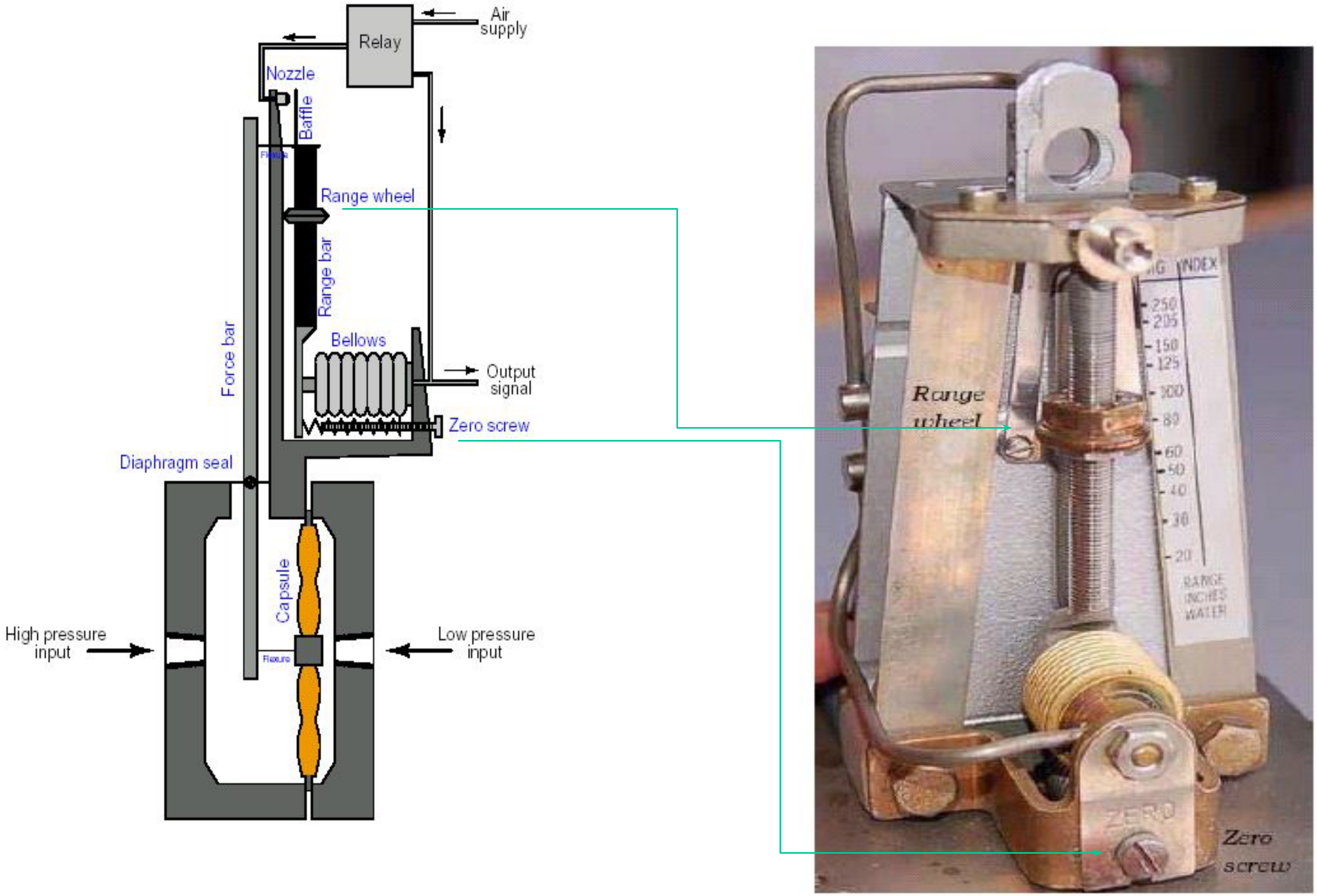
Pneumatic DP Transmitter



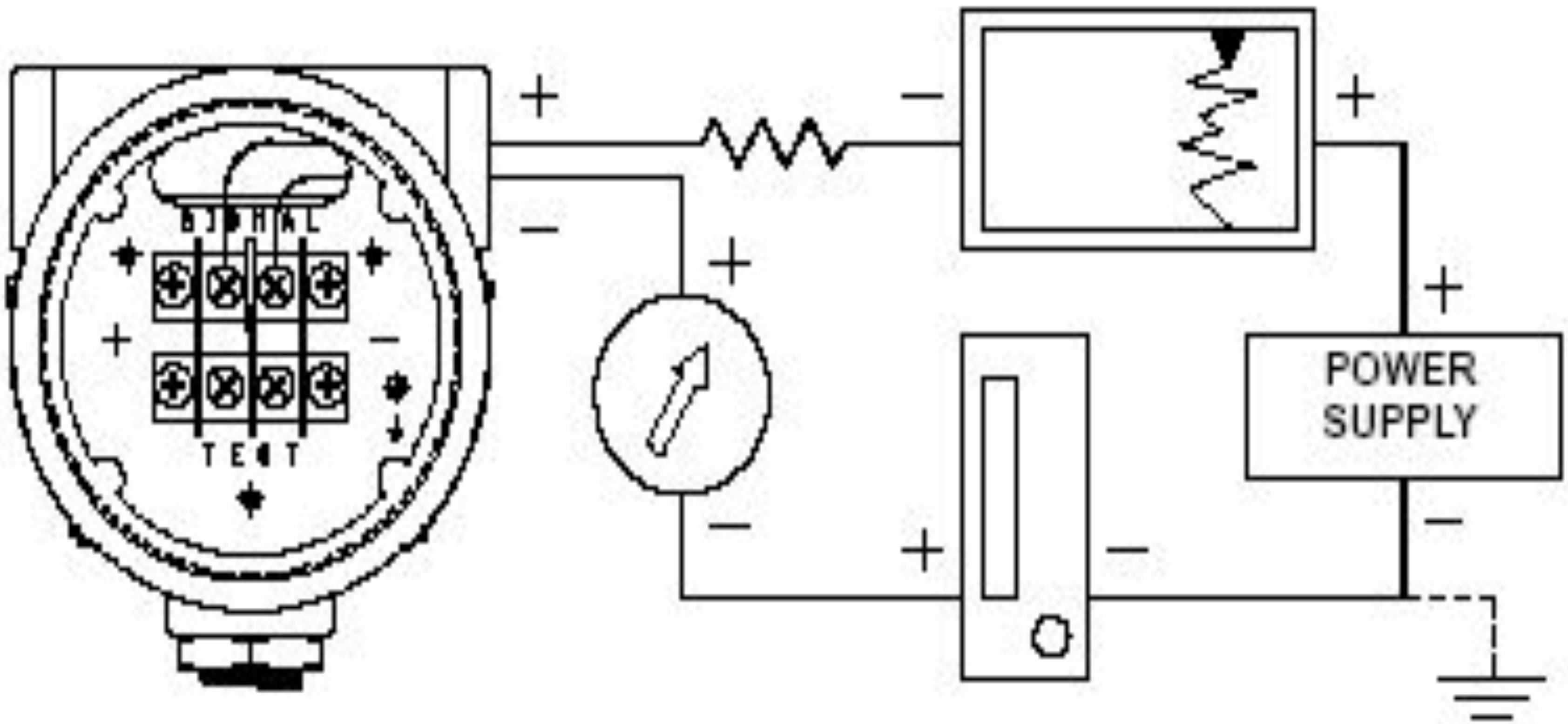
Pneumatic DP Transmitter



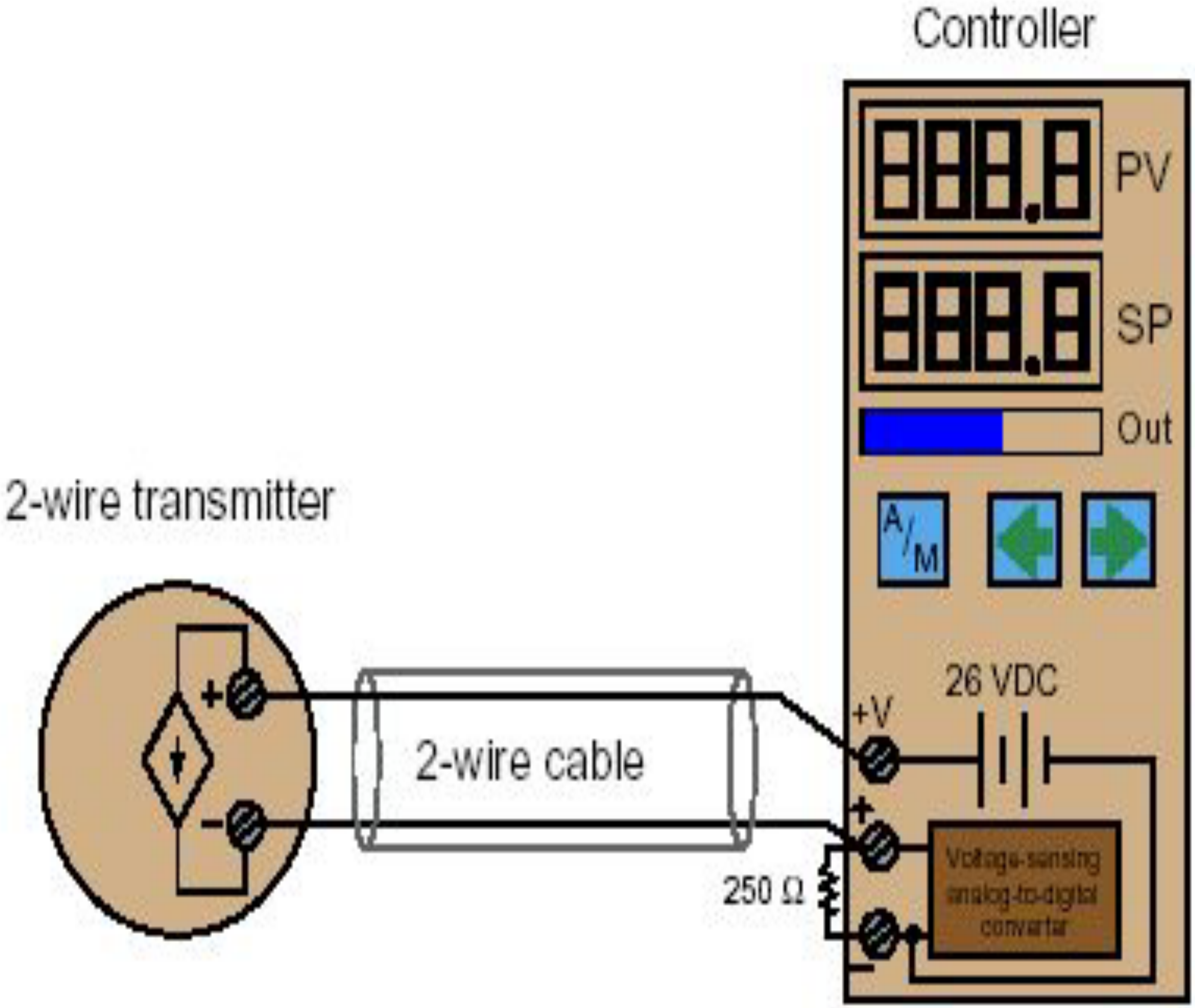



Relay
Air supply
Nozzle
Baffle
Flexure
Range wheel
Range bar
Force bar
Bellows
Output signal
Zero screw
Diagram seal
Capsule
Flexure
High pressure input
Low pressure input
Range wheel
INDEX
250
205
150
125
100
80
60
50
40
30
20
RANGE INCHES WATER
ZERO
Zero screw

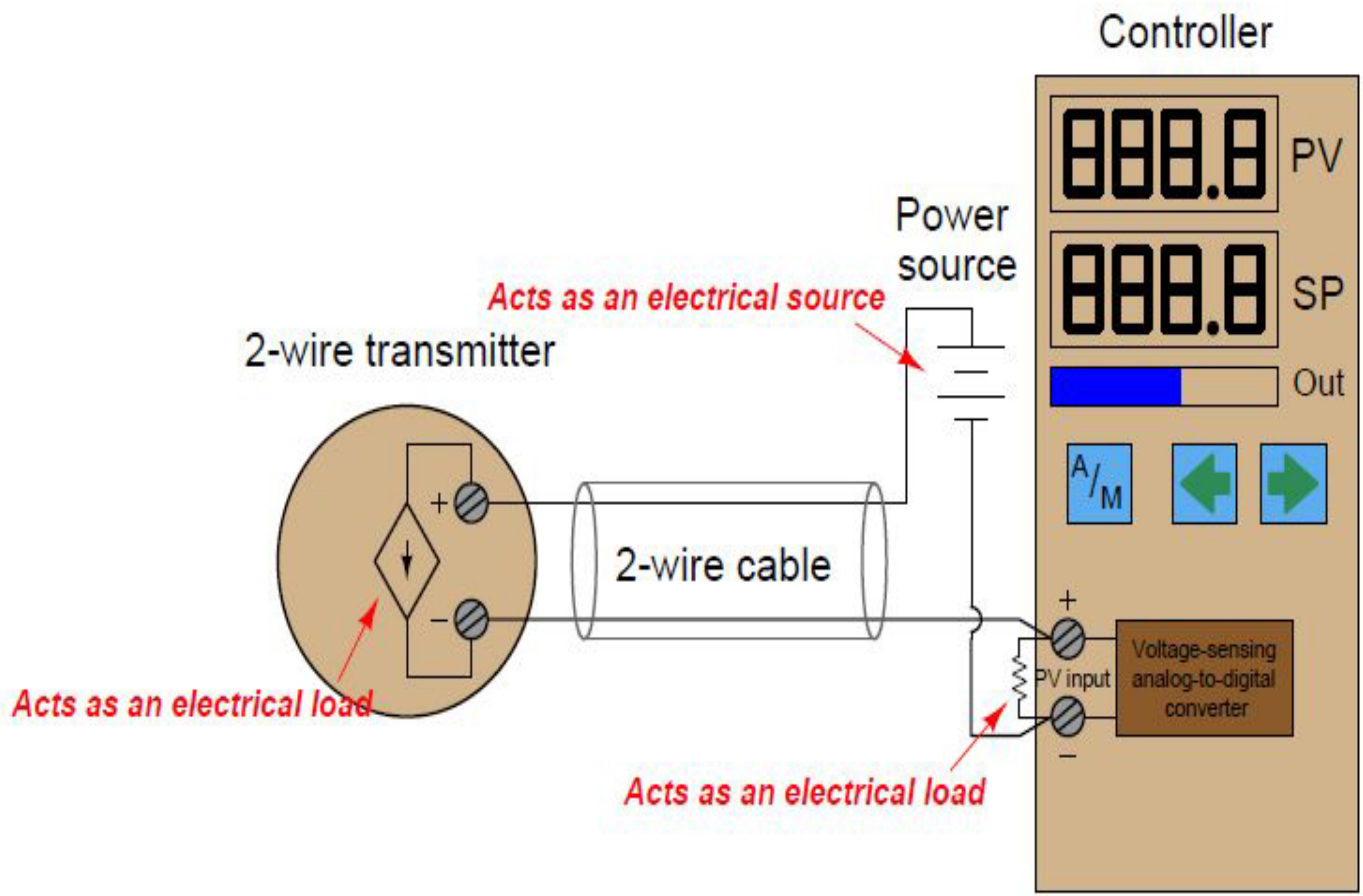
Transmitter Terminal Connections.



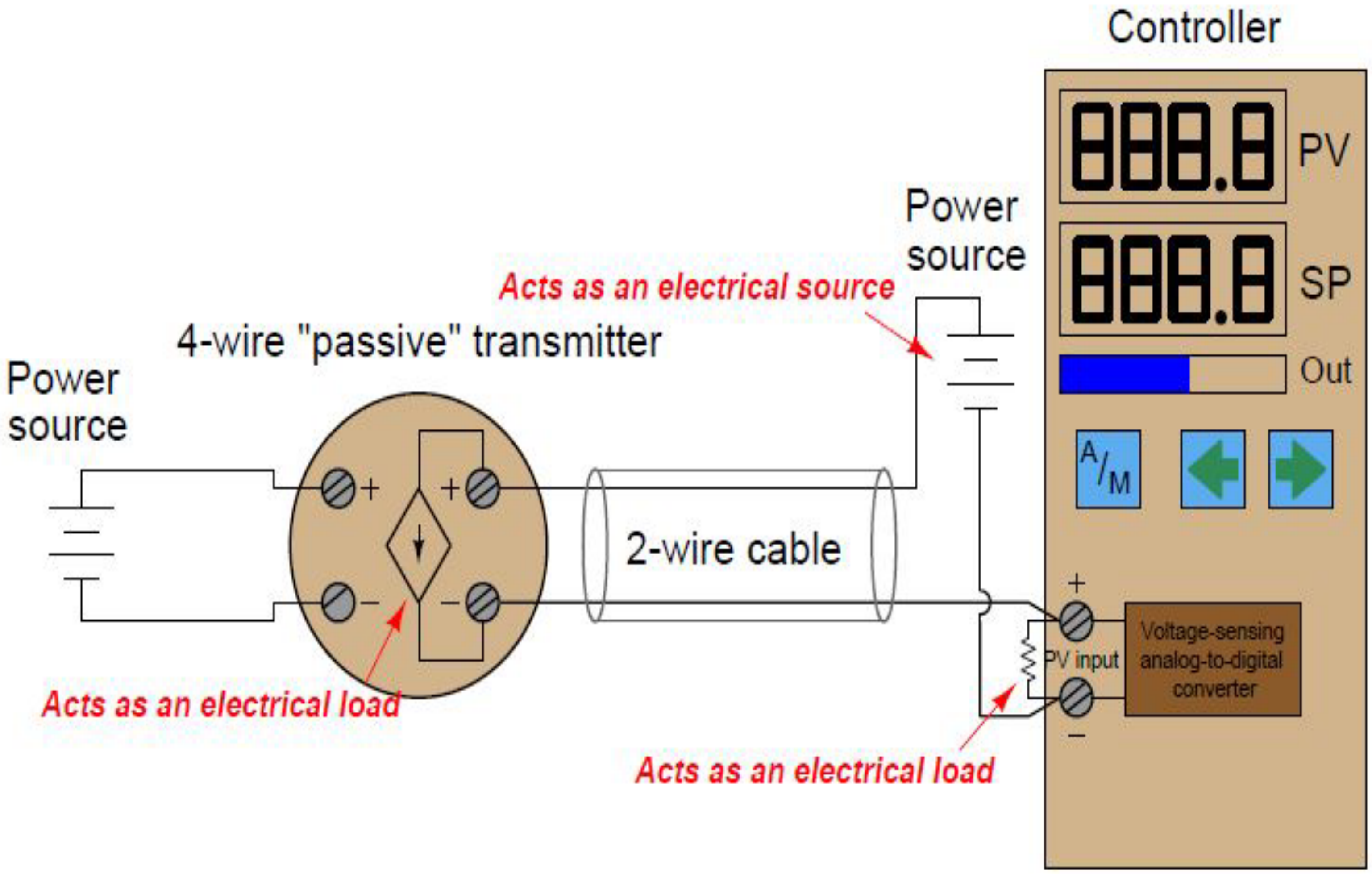
The signal loop may be grounded at
any point or left ungrounded.


Controller
PV
SP
Out
A/M
2-wire transmitter
+
-
2-wire cable
26 VDC
+V
+
-
250 Ω
Voltage-sensing
analog-to-digital
converter

2 wired Loop Powered Transmitter



4 wired self Powered Transmitter



Transmitter Installation Guidelines

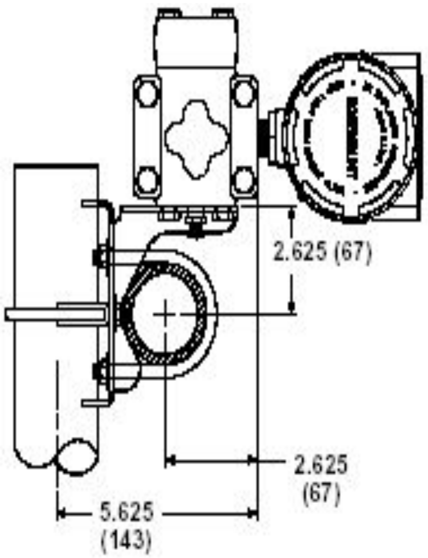
- General Considerations
- Mechanical Considerations
- Environmental Requirements
- Access Requirements .
- Process Flange Orientation
- Housing Rotation
- Terminal Side of Electronics Housing
- Circuit Side of Electronics Housing
- Exterior of Electronics Housing
- Mounting Effects.
- Process Connections
- Mounting Brackets

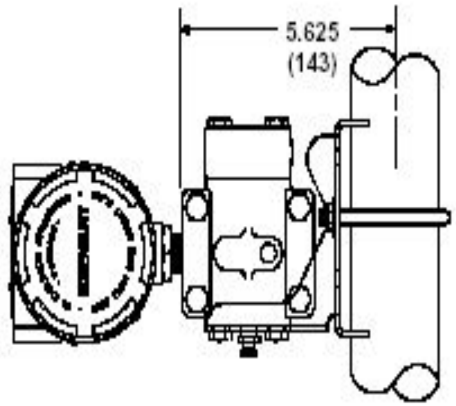
Typical DP Transmitter Installation

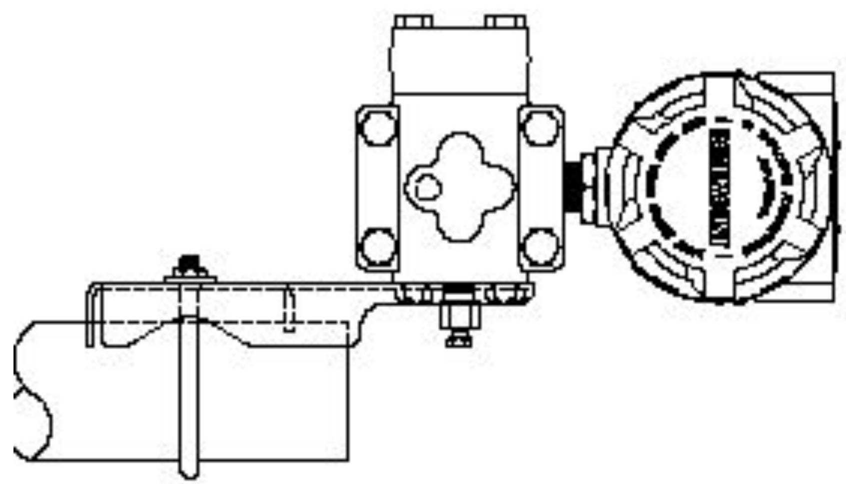
Installation

- Mounting Requirements (for Steam, Liquid, Gas) . Taps
- Drain/Vent Valves
- Impulse Piping
- Electrical Considerations
- Wiring Conduit Sealing
- Power Supply Grounding
- Signal Wiring Transmitter Case
- Grounding Effects

Pressure Transmitters- 2” pipe Mounting







GENERAL CONSIDERATIONS

- The accuracy of a flow, pressure, or level measurement depends on proper installation of the transmitter and impulse piping.
- The piping between the process and transmitter must accurately transmit process pressure to the transmitter.
- Mount the transmitter close to the process and use a minimum of piping to achieve best accuracy.
- Keep in mind, however, the need for easy access, safety of personnel, practical field calibration, and a suitable transmitter environment.
- In general, install the transmitter so as to minimize vibration, shock, and temperature fluctuations. Installations in food, beverage, and pharmaceutical processes may require sanitary seals and fittings.

CONSIDERATIONS

- Transmitters may be mounted in several ways. They may be panel-mounted, wall-mounted, or attached to a 2-inch pipe through an optional mounting bracket.
- Mount the transmitter to minimize ambient temperature changes. The transmitter electronics temperature operating limits are either

  (–40 to 85 °C) or (–29 to 66 °C) or (–29 to 93 °C)

- Mount the transmitter to avoid vibration and mechanical shock, and to avoid external contact with corrosive materials.

CONSIDERATIONS

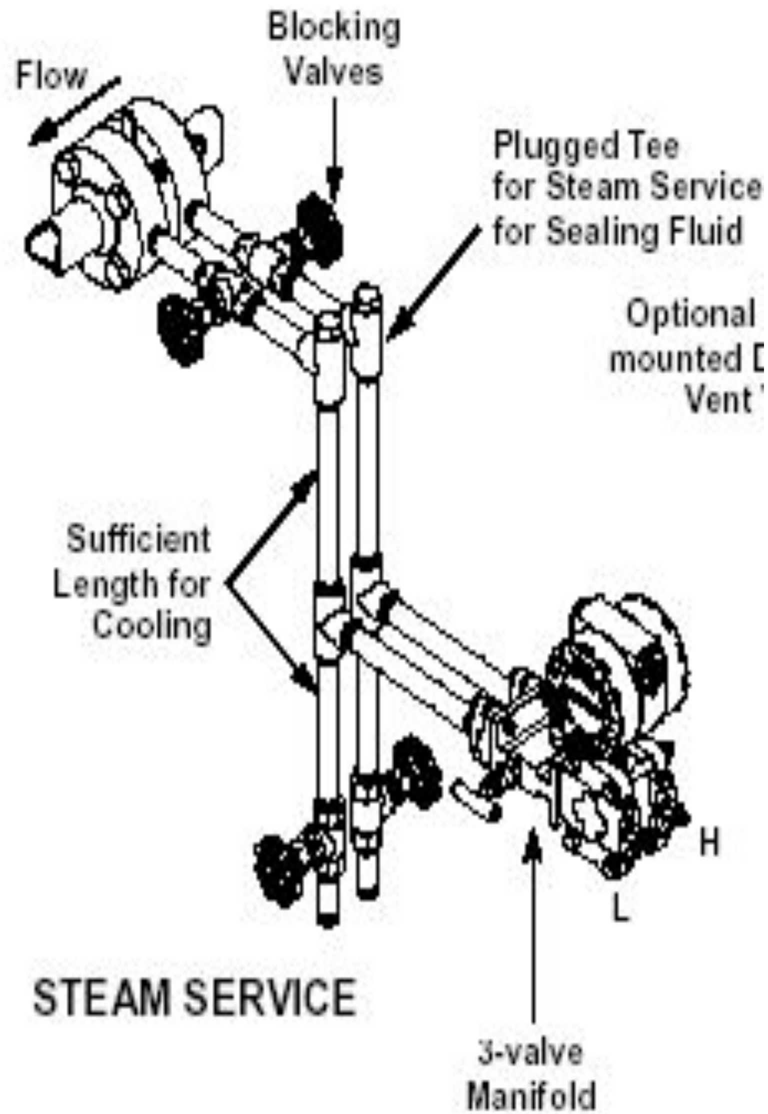
- When choosing an installation location and position, take into account the need for access to the transmitter.
- Orient the process flanges to enable process connections to be made.
- For safety reasons, orient the drain/vent valves so that process fluid is directed down and away from technicians when the valves are used.
- consider the need for a testing or calibration input.

Electrical CONSIDERATIONS

- Mount the transmitter so that the terminal side is accessible.
- A ¾-inch clearance is required for cover removal with no meter.
- A 3-inch clearance is required for cover removal if a meter is installed.
- If practical, provide approximately 6 inches clearance so that a meter may be installed later.
- The analog Model 1151 uses local span and zero screws, which are located under the nameplate on the side of the transmitter.
- Allow 6 inches clearance if possible to allow access for on-site maintenance.

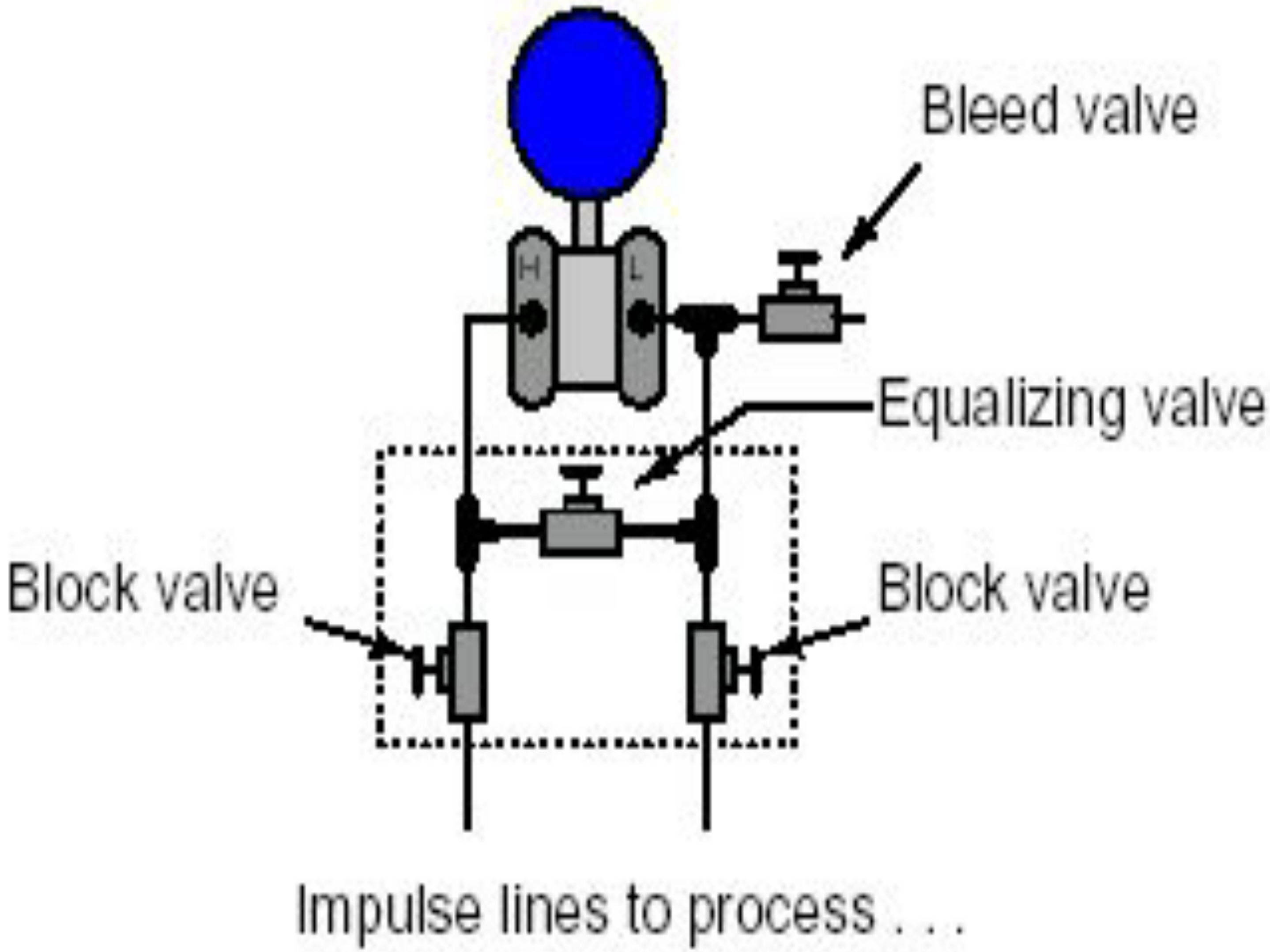
Mounting Requirements (for Steam, Liquid, Gas) Taps

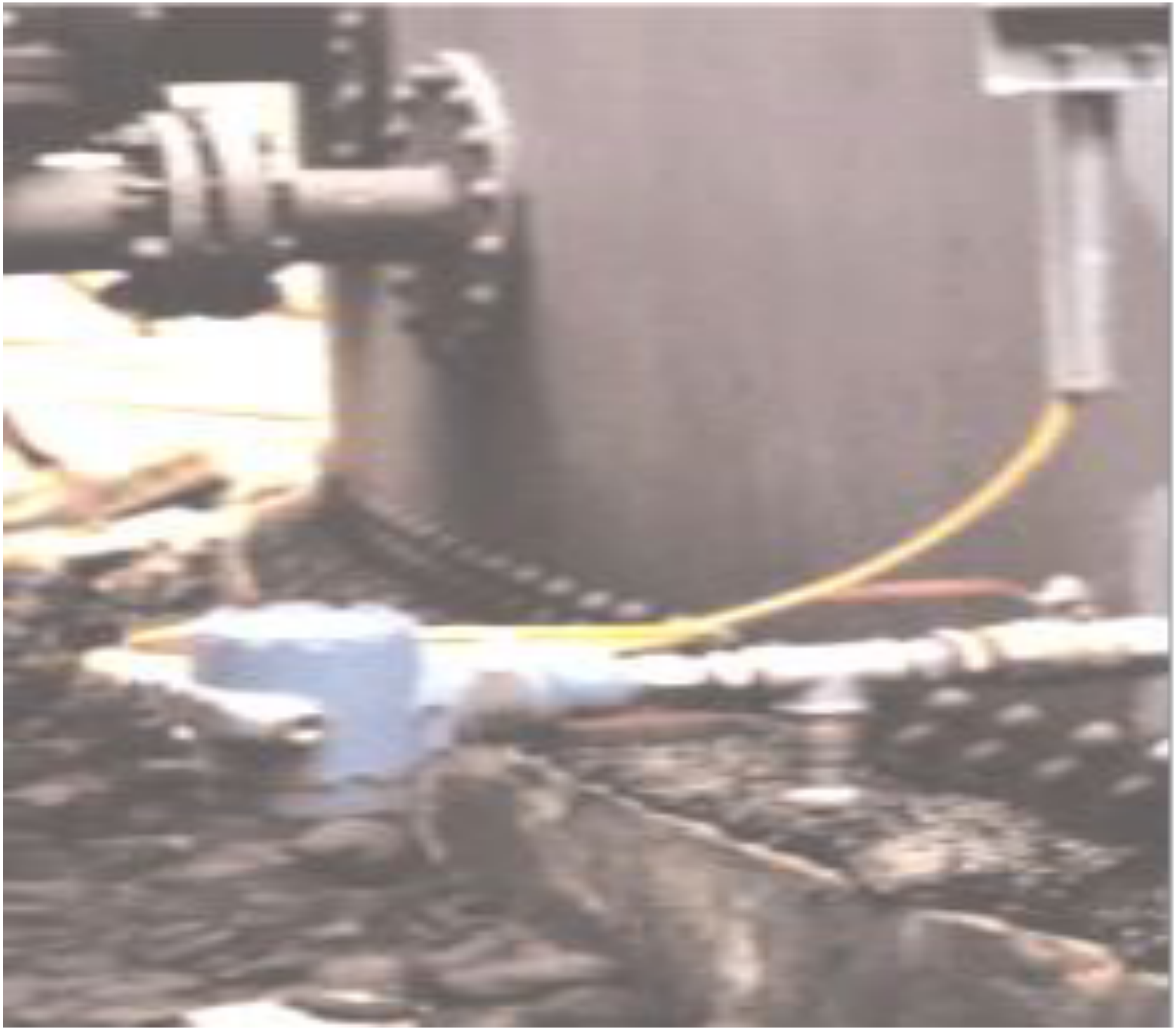
- Different measurement conditions call for different piping configurations.



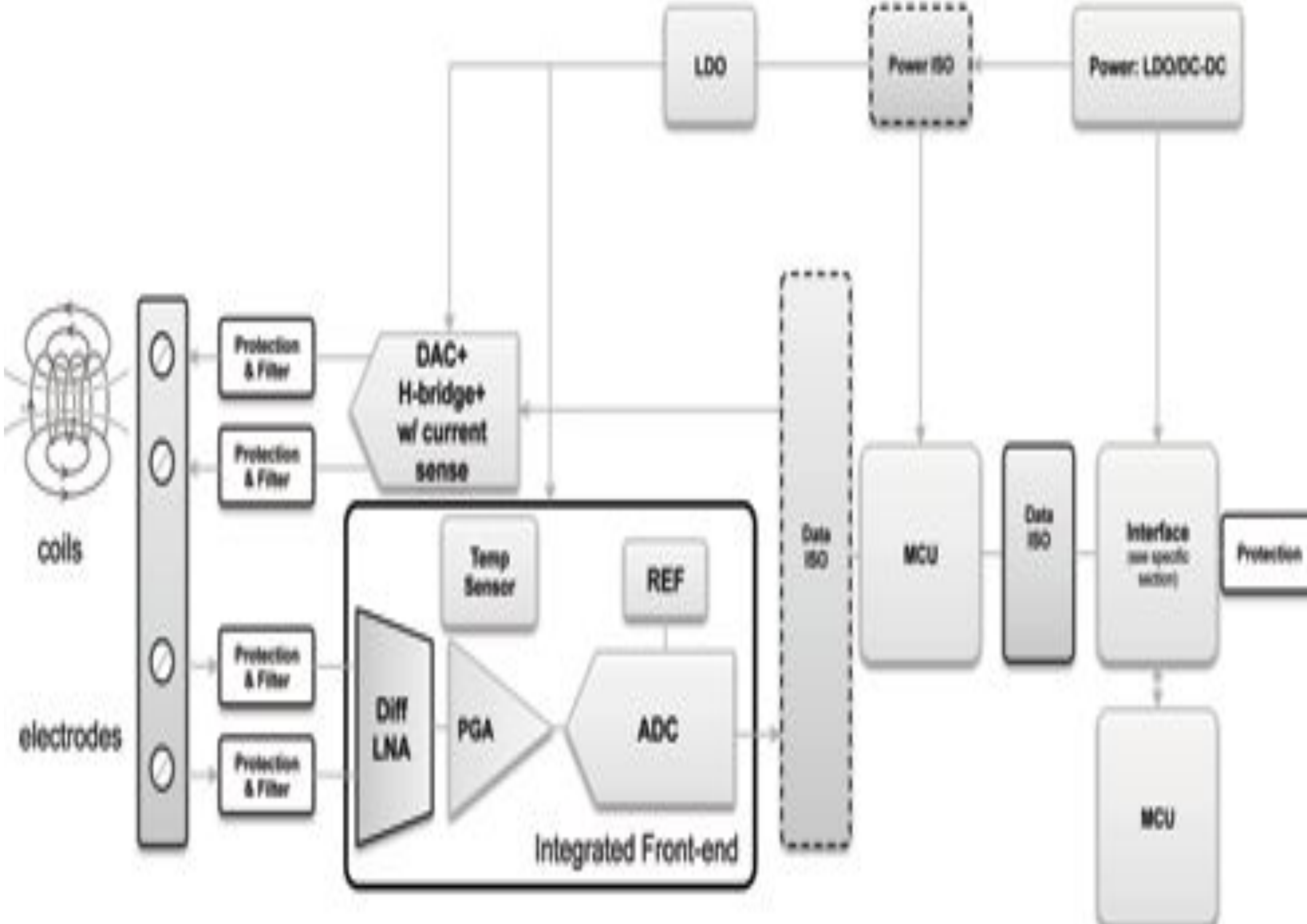
For steam flow measurement

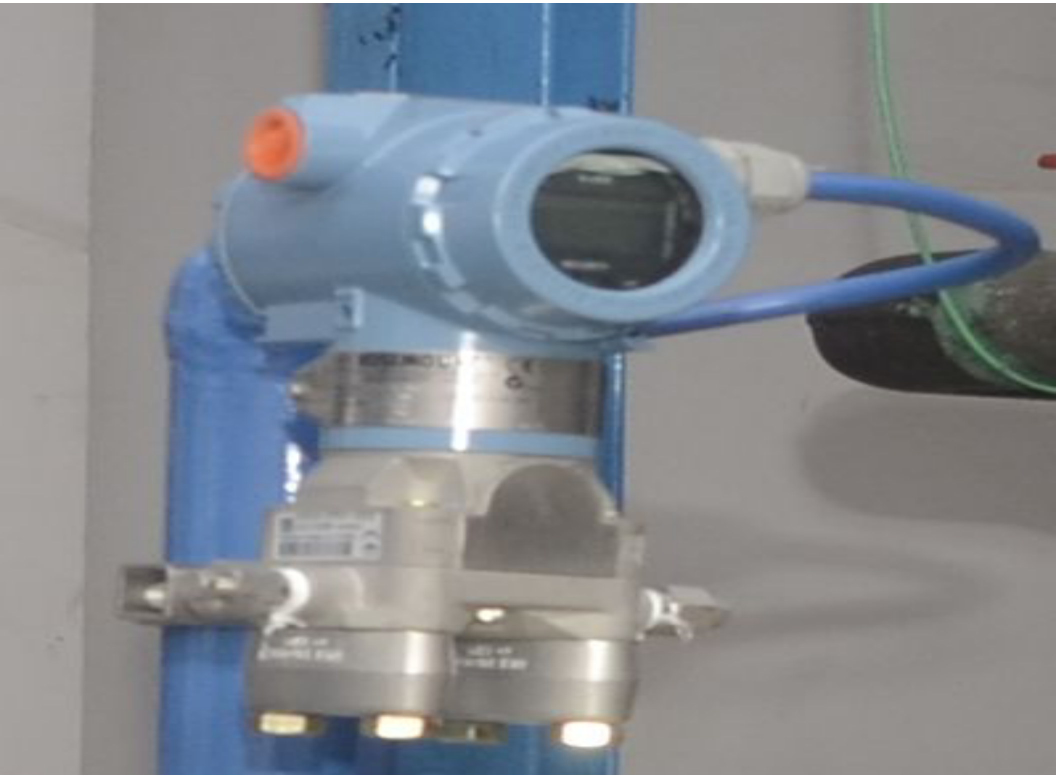
- Place taps to the side of the line with the transmitter mounted below them,
- To ensure that the impulse piping stays filled with condensate.


Bleed valve
H
L
Equalizing valve
Block valve
Block valve
Impulse lines to process . . .



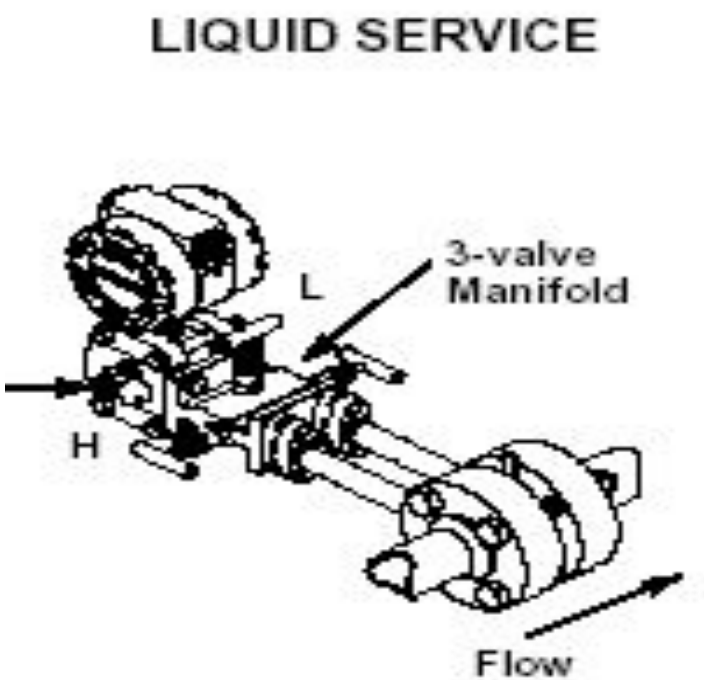
Transmitters Installations in Process Lab

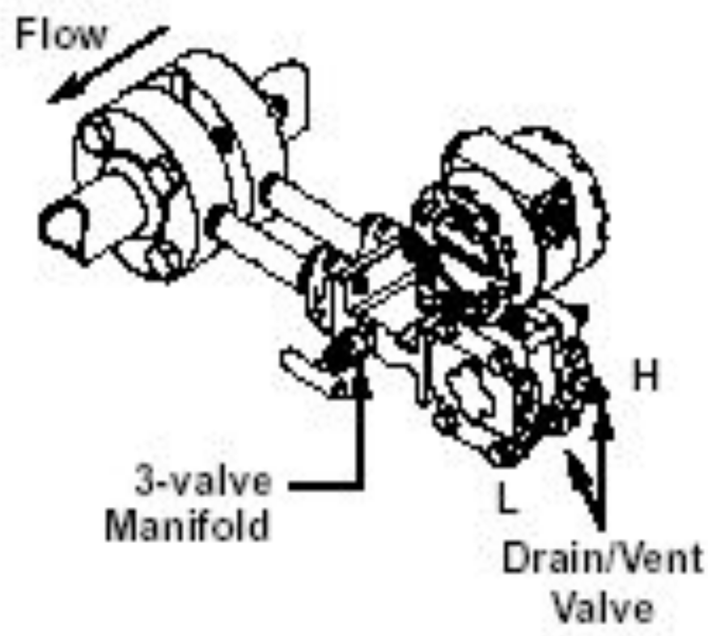

LDO
Power ISO
Power: LDO/DC-DC
coils
Protection & Filter
Protection & Filter
DAC+ H-bridge+ w/ current sense
Data ISO
MCU
Data ISO
Interface
Protection
Temp Sensor
REF
electrodes
Protection & Filter
Protection & Filter
Diff LNA
PGA
ADC
Integrated Front-end
MCU



For liquid flow measurement

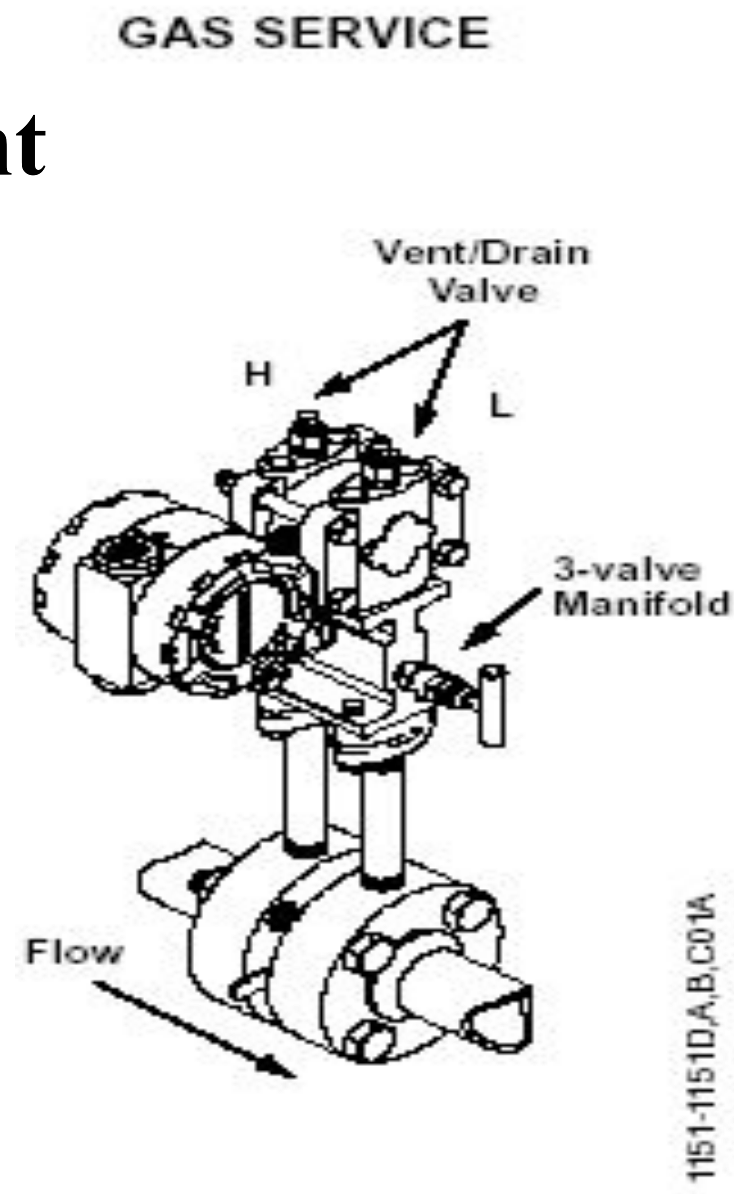
- place taps to the side of the line to prevent sediment deposits,
- and mount the transmitter beside or below these taps so gases can vent into the process line.





For gas flow measurement

- place taps in the top or side of the line
- mount the transmitter beside or above the taps so liquid will drain into the process line.



Drain/Vent Valves

- For liquid service, mount the side drain/vent valve upward to allow the gases to vent.
- For gas service, mount the drain/vent valve down to allow any accumulated liquid to drain.
- For steam service, lines should be filled with water to prevent contact of the live steam with the transmitter.

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.
- Connection are made to the high pressure side of the transmitter, and low pressure side is vent 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. liquid level measurement example.

Closed Vessels

- Pressure above a liquid affects the pressure measured at the bottom of a closed vessel.
- The liquid 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 the 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 specific gravity.

Dry Leg Condition

- it's a condition when Low-side transmitter piping will remain empty if gas above the liquid does not condense.

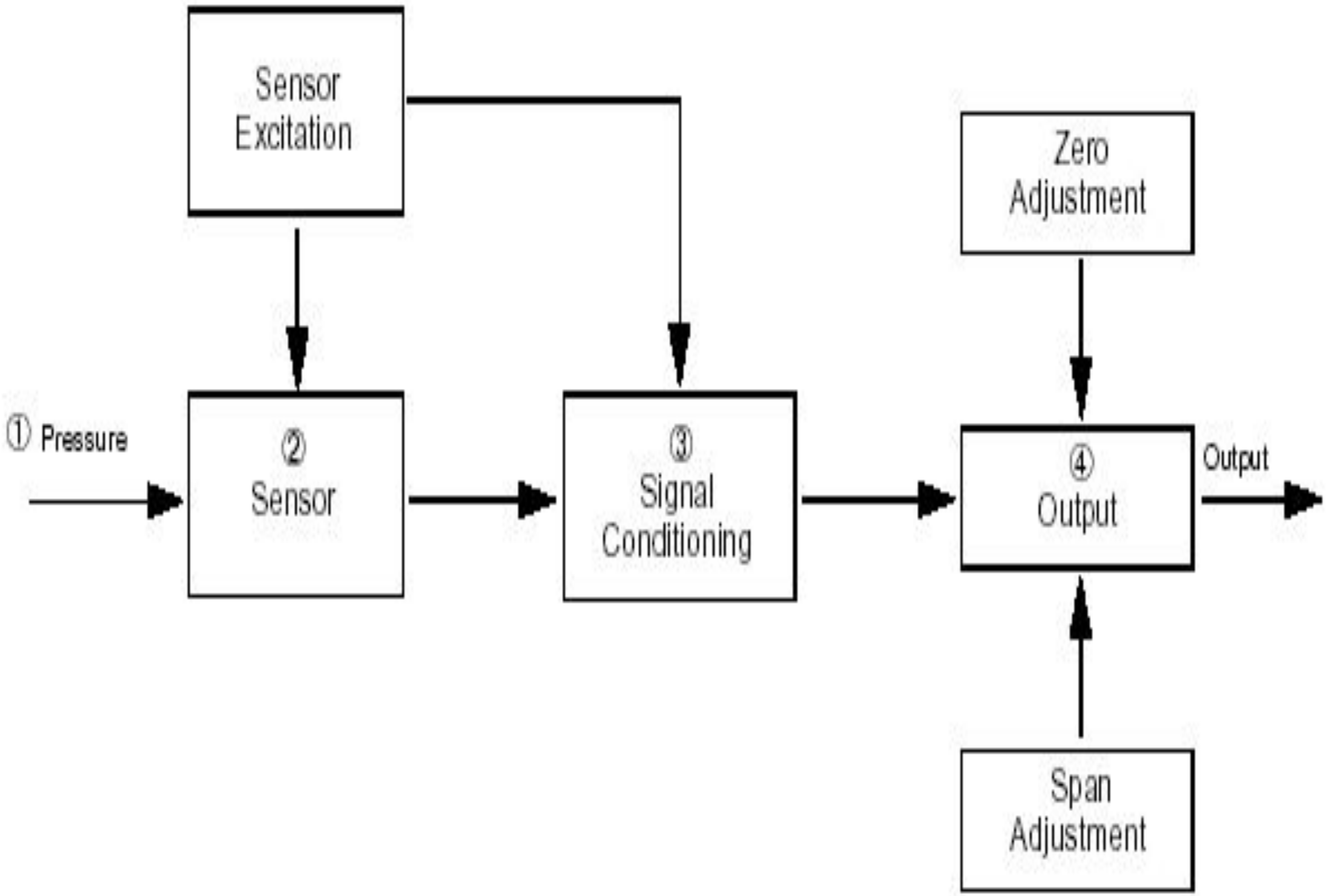
Wet Leg Condition

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

Calibration

- Calibration of the Rosemount Model 1151 Pressure Transmitter is simplified by its compact and explosion-proof design, external span and zero adjustments,

Transmitter Data Flow with Calibration Options.



This data flow can be summarized in four major steps:

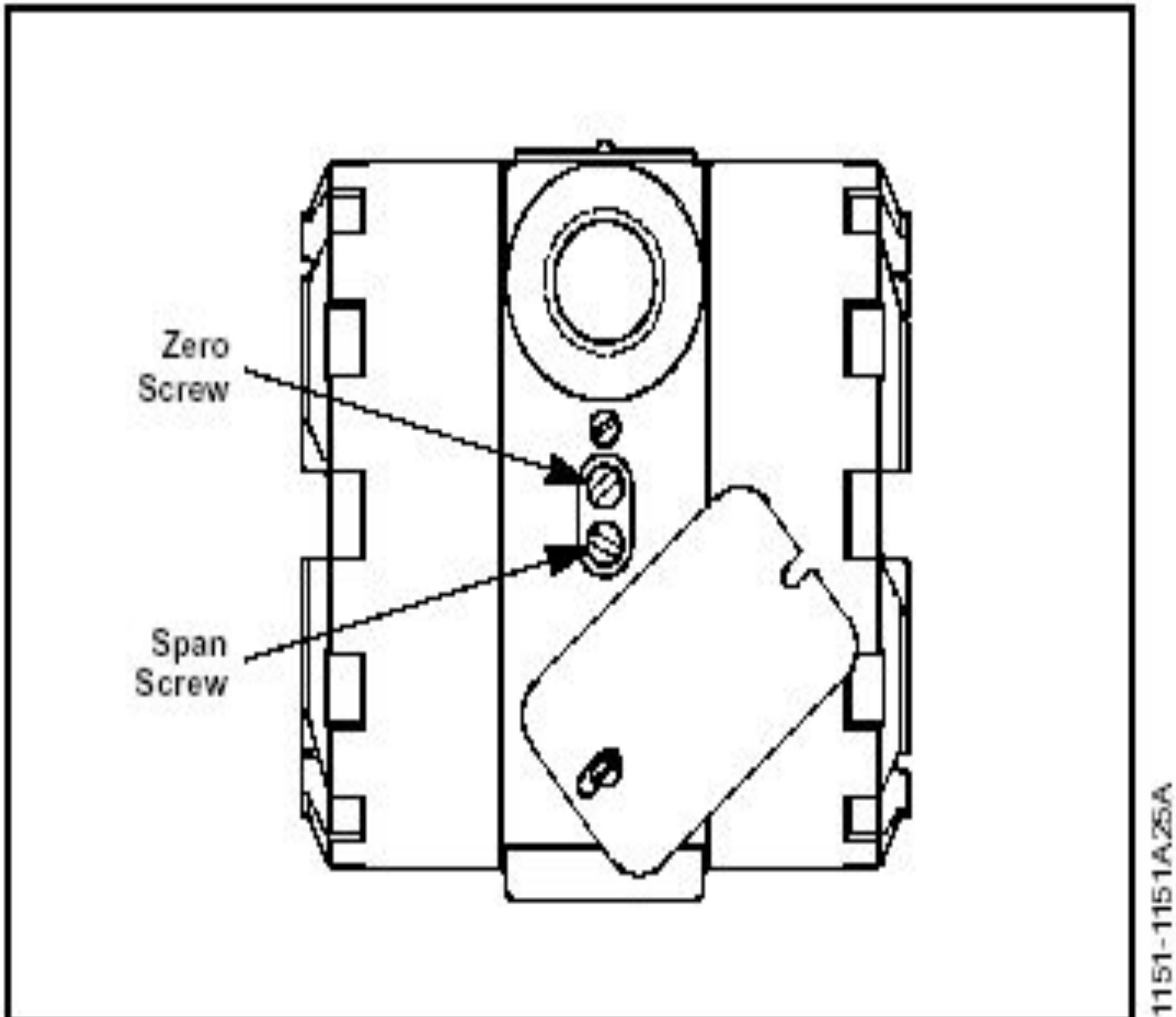
1. Pressure is applied to the sensor.

2. A change in pressure is measured by a change in the sensor output.

3. The sensor signal is conditioned for various parameters.

4. The conditioned signal is converted to an appropriate analog output.

Zero and Span Adjustment Screws.

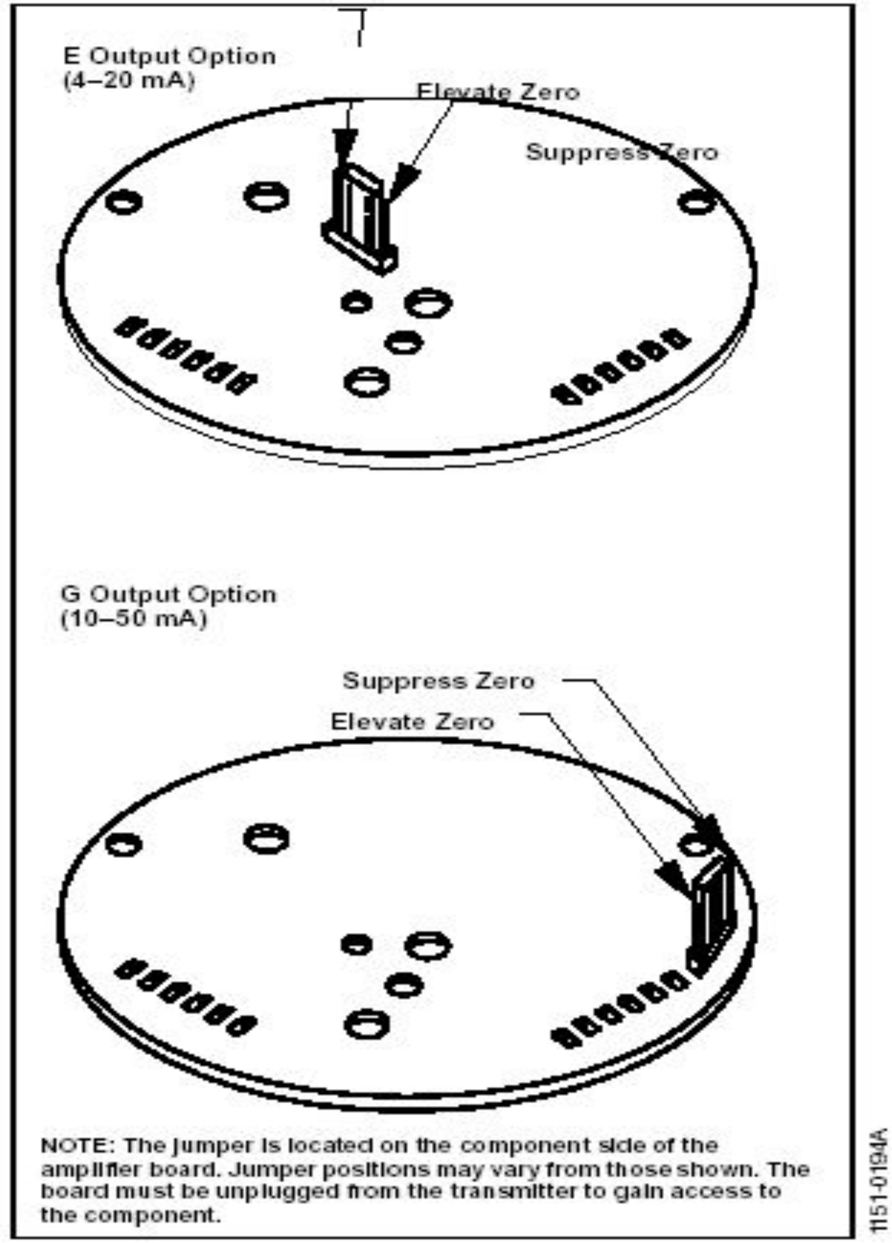


ZERO AND SPAN ADJUSTMENT

- The zero and span adjustment screws are accessible externally behind the nameplate on the terminal side of the electronics housing.
- The output of the transmitter increases with clockwise rotation of the adjustment screws.
- The zero adjustment screw and ELEVATE ZERO/SUPPRESS ZERO jumper do not affect the span.

- Span adjustment, however, does affect zero.
- This effect is minimized with zero-based spans. Therefore, when calibrations having elevated or suppressed zeros are made, it is easier to make a zero-based calibration and achieve the required elevation or suppression by adjusting the zero adjustment screw (and ELEVATE ZERO/SUPPRESS ZERO jumper as required).
- For large amounts of elevation or suppression, it may be necessary to reposition the ELEVATE/SUPPRESS ZERO jumper.
- To do this, remove the amplifier board, and move the jumper to the ELEVATE or SUPPRESS position as required.

Elevation and Suppression Jumper Settings.



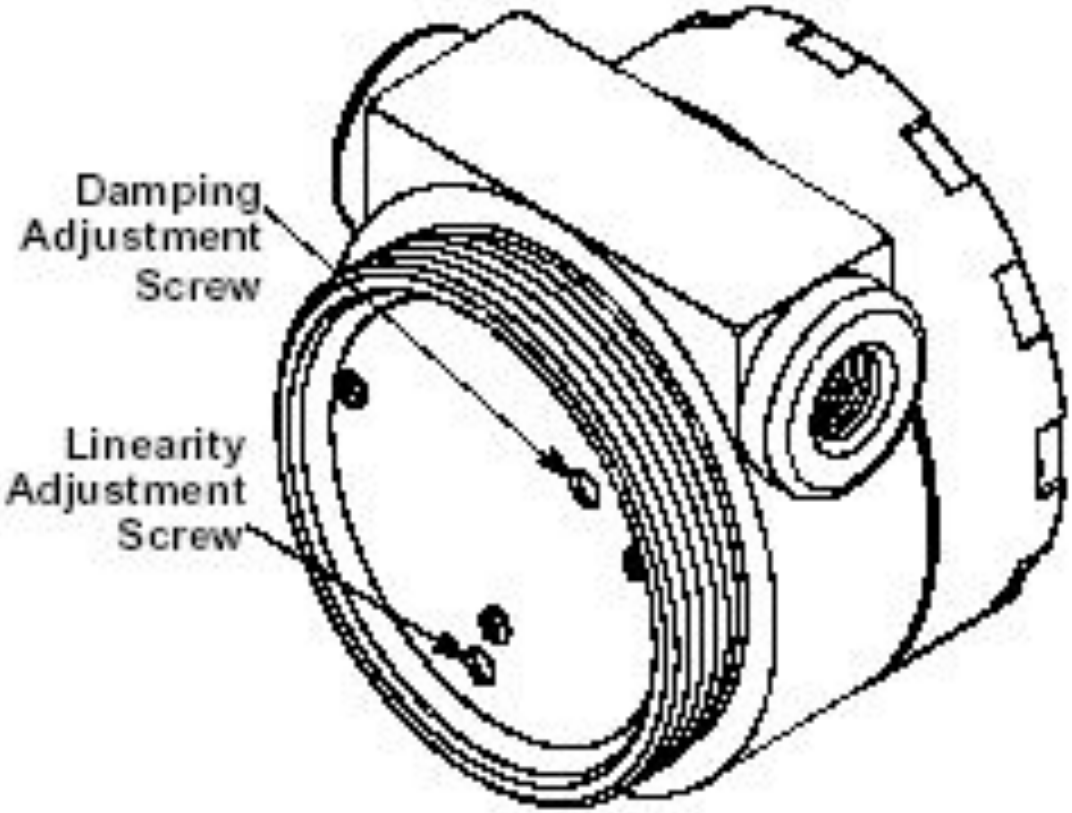
Desired calibration of 0to 100 inH2O

- 1. Adjust the zero. -With zero input applied to the transmitter, turn the zero adjustment screw until the transmitter reads 4 mA.
- 2. Adjust the span. - Apply 100 inH2O to the transmitter high side connection. Turn the span adjustment screw until the transmitter output reads approximately 20 mA.

Desired calibration of 0to 100 inH2O

- 3. Release the input pressure and readjust the zero output to read 4 mA ±0.032 mA.
- 4. Re-apply 100 inH2O to the transmitter. If the output reading is greater than 20 mA, divide the difference by 3, and subtract the result from 20 mA. Adjust the 100% output to this value.
- If the output reading is less than 20 mA, divide the difference by 3 and add the result to 20 mA. Adjust the 100% output to this value.

Damping and Linearity Adjustment Screws.



Access to linearity and damping adjustments is gained by removing cover on circuit board side.
Location of linearity adjustment screws may vary slightly between output codes.

LINEARITY ADJUSTMENT

- In addition to the span and zero adjustments, a linearity adjustment screw (marked LIN) is located on the solder side of the amplifier board.
- This is a factory calibration adjusted for optimum performance over the calibrated range of the instrument and normally is not readjusted in the field.
- The user may, however, maximize linearity over a particular range.

DAMPING ADJUSTMENT

- The amplifier boards for output are designed to permit damping of rapid pulsations in the pressure source through adjustment of the damping screw shown in Figure
- The adjustment is marked DAMP on the solder side of the amplifier board. The settings available provide time constant values between 0.2 and 1.66 seconds.
- The instrument is calibrated and shipped with this control set at the counterclockwise stop (0.2 second time constant).
- It is recommended that the shortest possible time constant setting be selected. Since the transmitter calibration is not influenced by the time constant setting, the damping may be adjusted with the transmitter connected to the process.
- Turn the damping control clockwise until the desired damping is obtained.

STATIC PRESSURE SPAN CORRECTION FACTOR

- High static pressure causes a systematic span shift in the transmitter.
- It is linear and easily correctable during calibration.

Smart Transmitters

- Smart Transmitters are microprocessor based, which can store data digitally to correct for sensor non- linearity’s & perform temp. OR pressure compensation.

Intelligent Transmitters

The main contribution of the addition of a microprocessor to the transmitter has been the ability to calibrate the unit over a much wider range than the actual span needed for the particular application. This resulted in much increased rangeability without sacrificing accuracy, because by memorizing the temperature and pressure effects on zero and span the smart transmitter can automatically correct for these variations, and therefore the performance of the unit is only a function of repeatability, linearity, and hysteresis. In addition to lower error and higher rangeability, the smart transmitters are also more flexible. Because their calibration curve is in the microprocessor's memory, one can electronically change the zero and the span of the transmitter through the keyboard of a portable terminal (Figure 2.9g) and the microprocessor will automatically match the minimum and maximum output signals to the newly set measurement inputs without affecting instrument calibration.

Smart transmitters also allow for two-way communications with the control room, can be used to automatically rezero the instrument by opening valves to equalize pressures on the two sides of a d/p cell, and can monitor loop status, output, and configuration. Smart transmitters can also memorize and recall tag numbers and failure or initialization modes, can provide damping and temperature compensation, and can change their outputs to maintain them fixed under certain conditions or to switch from direct to reverse action. They can also linearize nonlinear signals or provide other function generation functions. In addition to zero, span, and upper and lower range values, engineering units can also be changed.

More recent smart transmitter designs are also provided with spare or standby sensors or with multiple sensors. This allows the user to switch, for example, from an RTD to a TC sensor while using the same transmitter. It is hoped that in the not too distant future, the capabilities of smart transmitters will include *automatic* span switching. This would be useful in many applications where the process variable being detected changes over a wide range and better accuracy could be obtained if the transmitter switched to a low span when detecting low measurement values. Such automatic span switching could, for example, increase the rangeability of orifice plates, which today is limited by the full span error of the d/p cell, because at, say, 10% flow the orifice differential is only 1% and the full scale error of 0.25% or 0.5% makes the actual error 25% or 50%. If at low flows the d/p

Features of Smart Transmitters

- •Contribution of microprocessor is to calibrate unit over a wide range than actual span needed for particular application.
- •Zero / Span settings can be changed electronically through Keyboard.
- •High Turndown ; i.e. Ability to adjust span setting (Sensing Range) of a Transmitters.
- •Allow for 2 way Communication with control Room.
- •Standby sensor OR Multiple sensors facility allows to switch from an RTD to a TC sensor while using the same Transmitter.
- It can also memorize and recall tag Numbers & Failure modes, provide Damping & Temperature Compensation.

Specifications

- Functional Specifications
- Performance Specifications.
- Physical Specifications

DIFFERENTIAL PRESSURE INSTRUMENTS		SHEET ____ OF ____	
NO / BY / DATE / REVISION		SPEC. NO.	REV.
		CONTRACT	DATE
		REQ. - P.O.	
		BY / CHK'D	APPR.

	1	Tag No.	Service
GENERAL	2	Function	Record ☐ Indicate ☐ Control ☐ Blind ☐ Trans ☐ Integ ☐ Other ____
	3	Case	MFR STD ☐ Nom Size ____ Color: MFR STD ☐ Other ____
	4	Mounting	Flush ☐ Surface ☐ Yoke ☐ Other ____
	5	Enclosure Class	General Purpose ☐ Weather proof ☐ Explosion proof ☐ Class ____
			For use in Intrinsically Safe System ☐ Other ____
	6	Power Supply	117V 60 Hz ☐ Other ac ____ dc ☐ ____ Volts ____
	7	Chart	12 in. Circ. ☐ Other ____ Range ____ No. ____
	8	Chart Drive	24 hr Other ____ Elec. ☐ Spring ☐ Other ____
	9	Scale	Type ____ Range: 1 ____ 2 ____ 3 ____
XMTR	10	Transmitter Output	4-20 mA ☐ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____
			For Receiver, See Spec Sheet ____
CONTROLLER	11	Control Modes	P=Prop (Gain), I=Integral (Auto Reset), D=Derivative (Rate)
			Sub: s=Slow, f=Fast If☐ Df ☐ P ☐ PI ☐ PD ☐ PID ☐ I_s ☐ D_s ☐
			Other ____
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ☐ Other ____
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other ____
	15	Manual Reg.	None ☐ MFR STD ☐ Other ____
	16	Output	4-20 mA ☐ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____
UNIT	17	Service	Flow ☐ Level ☐ Diff. Pressure ☐ Other ____
	18	Element Type	Diaphragm ☐ Bellows ☐ Mercury ☐ Other ____
	19	Material	Body ____ Element ____
	20	Rating	Overrange ____ Body Rating ____ psig
	21	Diff. Range	Fixed ☐ Adj. Range ____ Set At ____
	22		Elevation ____ Suppression ____
	23	Process Data	Fluid ____ Max Temp. ____ Max. Press. ____
	24	Process Conn.	½ in. NPT ☐ Other ____
	25	Alarm Switches	Quantity ____ Form ____ Rating ____
	26	Function	Meas. Var. ☐ Deviation ☐ Contacts To ____ on Inc. Meas.
	27	Options	Pressure Element ☐ Range ____ Material ____
			Temp. Element ☐ Range ____ Type ____
			Filt Reg. ☐ Sup. Gage ☐ Output Gage ☐ ____ Charts
			Valve Manifold ____
			Cond. Pots ☐ Adj. Damp ☐ Integral Sq. Rt. Ext. ☐
			Integrator ____
			Other ____
	28	MFR & Model No.	____

Rev.	Tag	Adj. Range	Set Range	Scale or Chart	Scale Factor	Service	Notes

Specifications
FUNCTIONAL SPECIFICATIONS

- **Service-** Liquid, gas, and vapor applications.
- **Ranges-** Minimum span equals the upper range limit (URL) divided by rangedown. Rangedown varies with the output code.
- **Outputs**
- **Analog -** 4–20 mA dc, linear with process pressure.
- **Analog-** 10–50 mA dc, linear with process pressure.
- **Analog-** 4–20 mA dc, square root of differential input pressure between 4 and 100% of input. Linear with differential input pressure between 0 and 4% of input.

- **Low Power-** 0.8 to 3.2 V dc, linear with process pressure.
- **Low Power-** 1 to 5 V dc, linear with process pressure.
- **Power Supply -** External power supply required. Transmitter operates on:
- 12 to 45 V dc with no load
- 30 to 85 V dc with no load
- 5 to 12 V dc for Output
- 8 to 14 V dc for Output

- **Current Consumption (Low Power Only)**
- **Under Normal Operating Conditions**
- 1.5 mA dc.& 2.0 mA dc.
- **Span and Zero**
- Span and zero are continuously adjustable.
- **Hazardous Locations Certifications**
- Stainless steel certification tag is provided.
- **Temperature Limits-Electronics Operating**
- –40 to 200 °F (–40 to 93 °C).
- –20 to 200 °F (–29 to 93 °C).
- –20 to 150 °F (–29 to 66 °C).
- **Sensing element operating**
- Silicone fill: –40 to 220 °F (–40 to 104 °C).
- Inert fill: 0 to 160 °F (–18 to 71 °C).

- **Static Pressure Limits**
- Transmitters operate within specifications between the following limits:
- **Model 1151DP**
- 0.5 psia (3.45 kPa) to 2,000 psig (13790 kPa).
- **Model 1151HP**
- 0.5 psia (3.45 kPa) to 4,500 psig (31027 kPa).
- **Model 1151AP**
- 0 psia to the URL.
- **Model 1151GP**
- 0.5 psia (3.45 kPa) to the URL.

- **Overpressure Limits**
- Transmitters withstand the following limits without damage:
- **Model 1151DP**
- 0 psia to 2,000 psig (0 to 13790 kPa).
- **Model 1151HP**
- 0 psia to 4,500 psig (0 to 31027 kPa).
- **Burst Pressure Limit**
- All models: 10,000 psig (68.95 MPa) burst pressure on the flanges.
- **Humidity Limits**
- 0 to 100% relative humidity.
- **Volumetric Displacement**
- Less than 0.01 in3 (0.16 cm3).

- **Damping**
- Numbers given are for silicone fill fluid at room temperature. The minimum time constant is 0.2 seconds (0.4 seconds for Range 3). Inert filled sensor values would be slightly higher.
- **Turn-on Time**
- Maximum of 2.0 seconds with minimum damping. Low power output is within 0.2% of steady state value within 200 ms after application of power.

PERFORMANCE SPECIFICATIONS

- **Accuracy**
- ±0.2% of calibrated span for Model 1151DP & All other ranges and transmitters, ±0.25% of calibrated span.
- **Stability**
- ±0.2% of URL for six months & ±0.25 for all
- other ranges. ±0.25% of URL for six months.
- **Short Circuit Condition** No damage to the transmitter will result when the output is shorted to common or to power supply positive (limit 12 V).
- **Mounting Position Effect**
- Zero shift of up to 1 inH2O (0.24 kPa) that can be calibrated out.

- **EMI/RFI Effect**
- Output shift of less than 0.1% of span when tested to IEC 801-3 from 20 to 1000 MHz and for field strengths up to 30 V/m.

PHYSICAL SPECIFICATIONS

- **(STANDARD CONFIGURATION)**
- **Wetted Materials**
- **Isolating Diaphragms**
- 316L SST, Hastelloy C-276, Monel, gold-plated Monel, or Tantalum.
- **Drain/Vent Valves**
- 316 SST, Hastelloy C, or Monel.
- **Process Flanges and Adaptors**
- Plated carbon steel, 316 SST, Hastelloy C, or Monel.
- **Wetted O-rings**
- Viton With gold-plated Monel diaphragms,
- special fluorocarbon O-rings are supplied.

Non-wetted Materials

- **Fill Fluid**
- Silicone oil or inert fill.
- **Bolts and Bolting Flange (GP and AP only)**
- Plated carbon steel.
- **Electronics Housing**
- Low-copper aluminium. NEMA 4X. IP 65, IP 66.
- **Cover O-rings -** Buna-N.
- **Paint -** Polyurethane.
- **Process Connections -** ¼–18 NPTF
- **Electrical Connections-** ½–14 NPTF conduit entry
- **Weight -** 12 lb (5.4 kg)

Applications

- Petrochemical industry
- Fertilizer industry
- Pulp & paper industry
- Sugar factory
- Rubber chemicals
- And many more.

Instrument installation details serve several purposes:

1. They indicate the proper mounting of instruments including supports, orientation and arrangement.
2. They detail the hook-up of instruments including power supply (air or electric), signal output (pneumatic or electronic) and connections to process lines. Hookup details may be rather complicated for special devices such as analyzers.
3. They indicate the quantity, sizes and materials of construction for the equipment which serve as a convenient takeoff for procurement of materials.
4. They serve as a convenient communications link between the instrument group and other groups (piping, vessel and electrical) so that the necessary services are provided for the instruments.

Several precautions should be observed in designing installation details:

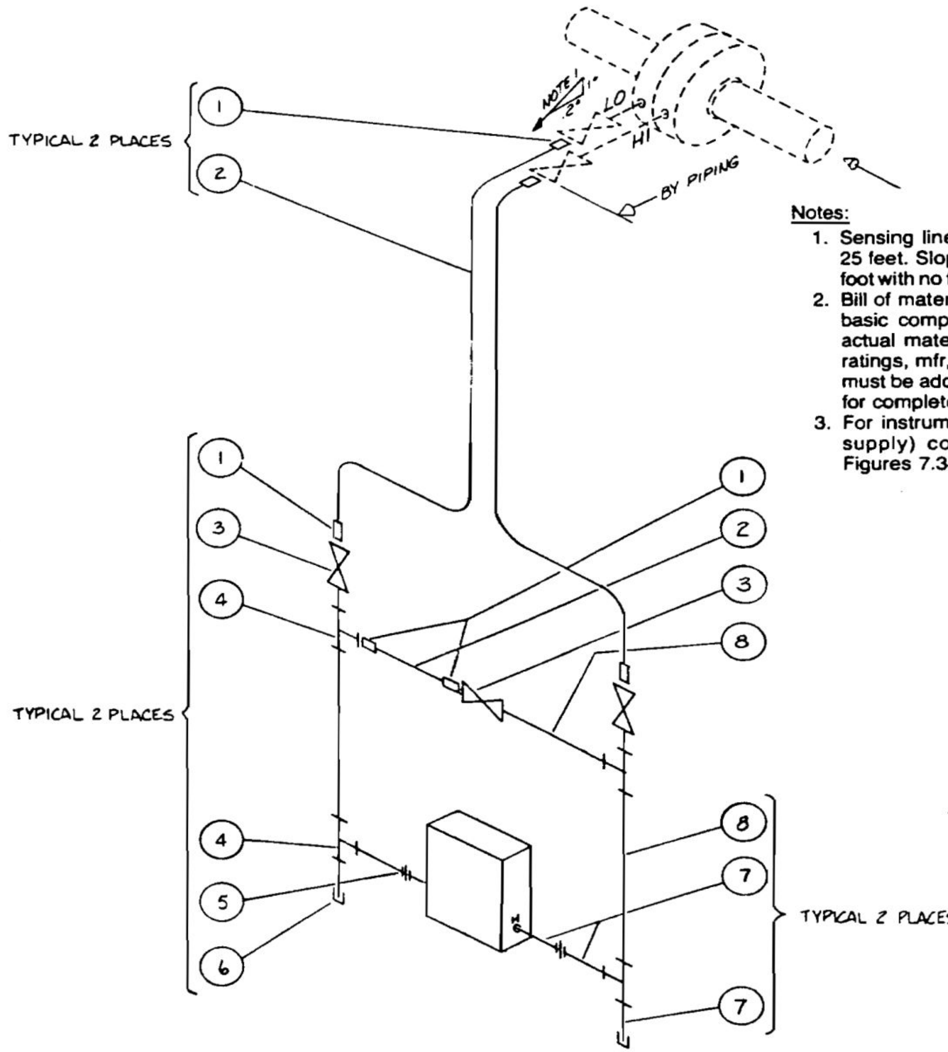
1. All materials must be suitable for the process operating conditions (pressure, temperature and corrosion properties) for normal as well as extreme conditions. Piping specifications usually designate materials for various services and instrument specifications list deviations from the piping specifications that are allowed or required. Examples of such deviations include the use of stainless steel tubing instead of standard pipe, or using 3,000 psig bar stock gauge valves instead of 600 psig forged steel gate valves. Other frequent deviations from piping specifications are the use of tubing and tubing fittings or screwed fittings instead of flanges or welding fittings that are required for the main pipe lines.

2. Where process lines contain vapors that may condense, the connecting instrument lines should be arranged to be self-draining, or seal pots should be installed to insure constant head pressure conditions at the instrument sensing elements.

3. Instrument lead lines containing dangerous fluids (i.e., toxic, high pressure, high temperature, or corrosive) must be properly vented or drained so that misoperation will not result in personnel or property damage.

4. Instrument lead lines containing fluids that may freeze at ambient conditions must be protected by heat tracing and insulating or by sealing with a non-freezing fluid compatible with the process fluid.

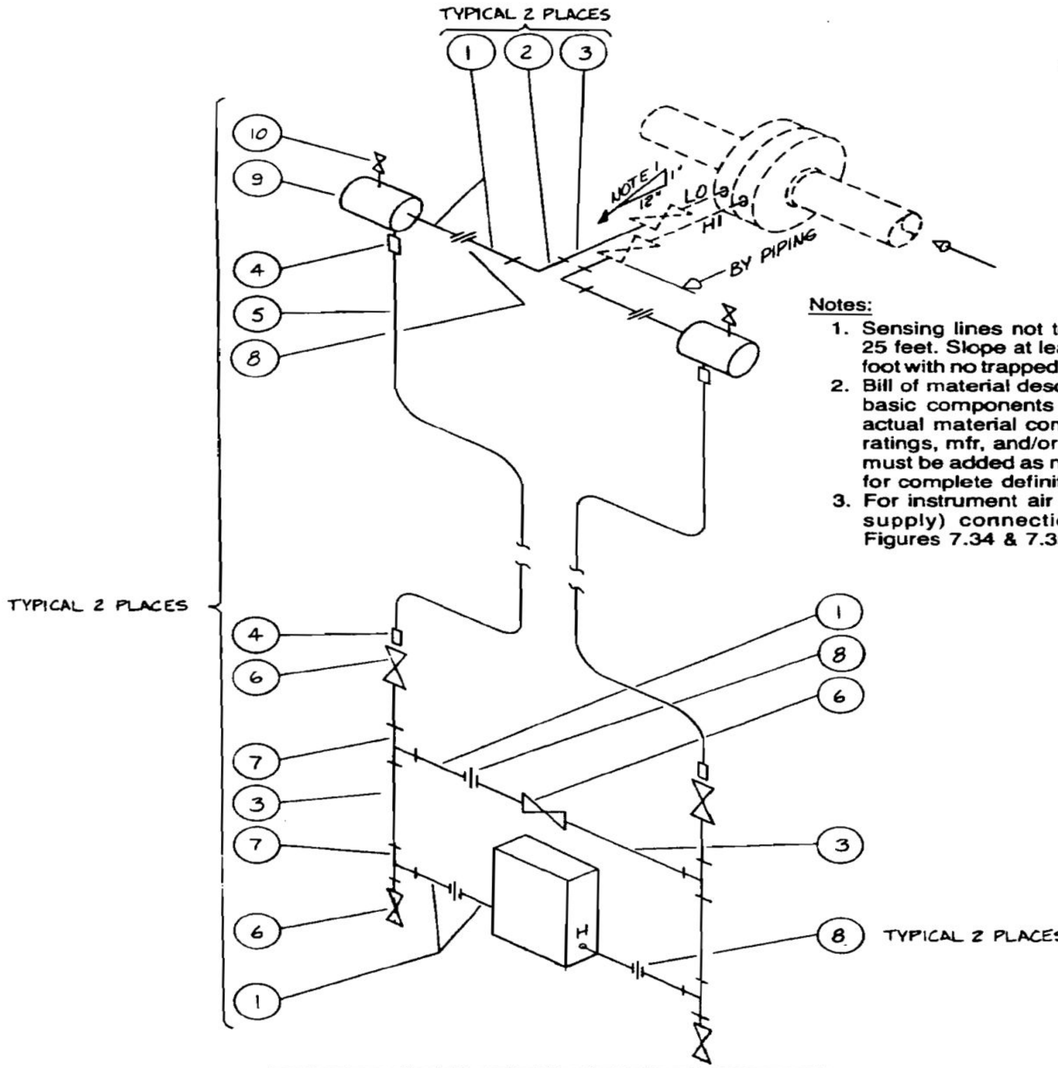
5. There are other requirements that need to be observed for installation of instrument devices. Reference should be made to vendors' instructions to insure proper installation of various devices, particularly if the devices serve unusual functions or are built for special purposes.



Notes:

1. Sensing lines not to exceed 25 feet. Slope at least 1" per foot with no trapped sections.
2. Bill of material describes the basic components required; actual material composition, ratings, mfr, and/or part no's must be added as necessary for complete definition.
3. For instrument air (signal & supply) connections, see Figures 7.34 & 7.35.

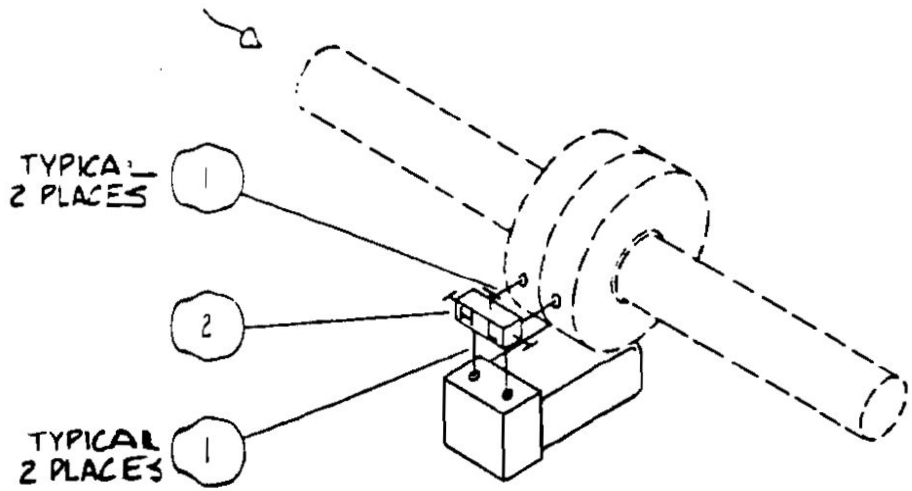
BILL OF MATERIAL		
ITEM	QTY	DESCRIPTION
1	6	1/2" T x 1/2" NPT MALE CONNECTOR
2	A/R	1/2" O.D. x .049" WALL SEAMLESS TUBING
3	3	1/2" NPT M x F VALVE
4	4	1/2" NPT TEE
5	2	1/2" NPT UNION
6	2	1/2" NPT CAP
7	6	1/2" NPT x 3" LG. NIPPLE TBE
8	A/R	1/2" NPT PIPE



Notes:

1. Sensing lines not to exceed 25 feet. Slope at least 1" per foot with no trapped sections.
2. Bill of material describes the basic components required; actual material composition, ratings, mfr, and/or part no's must be added as necessary for complete definition.
3. For instrument air (signal & supply) connections, see Figures 7.34 & 7.35.

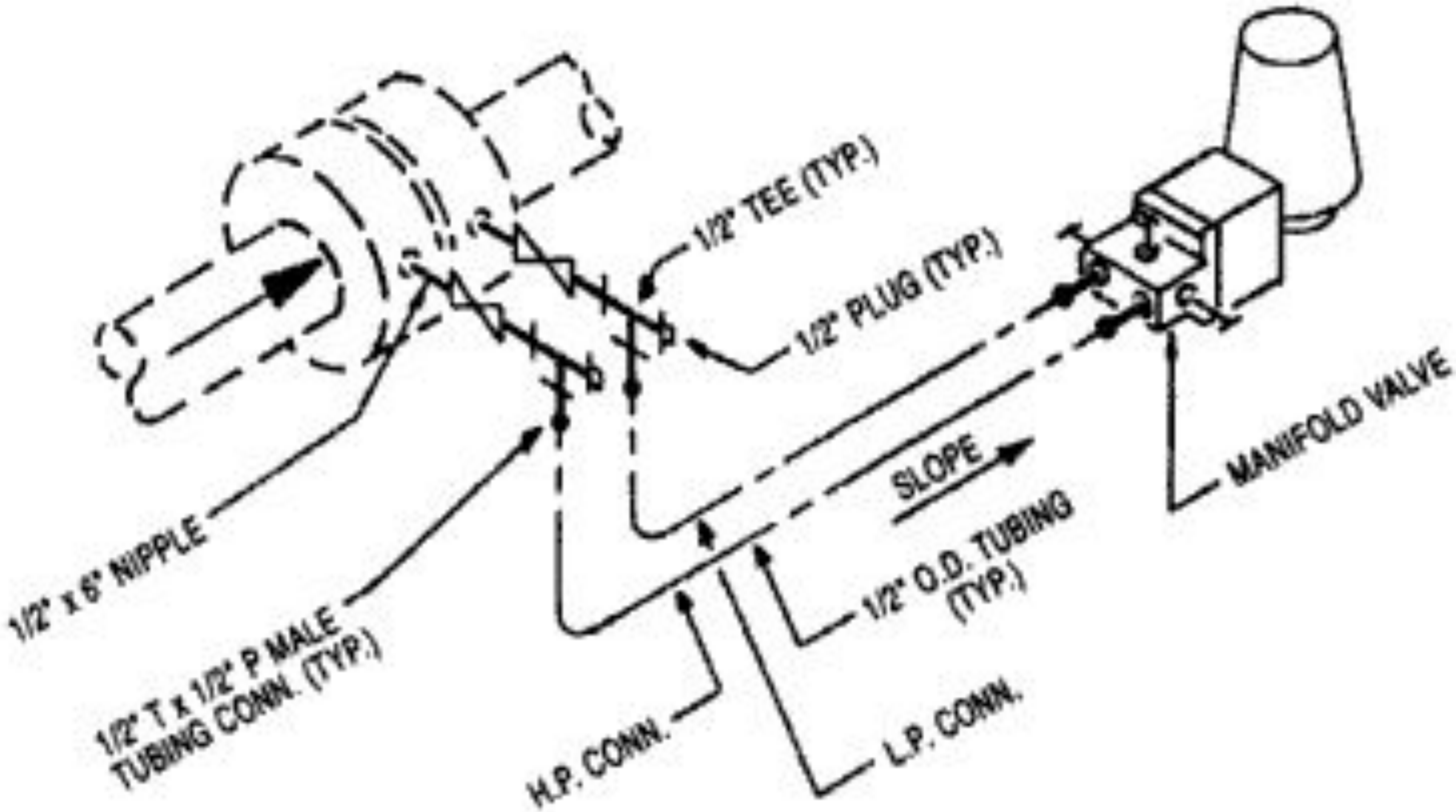
BILL OF MATERIAL		
ITEM	QTY	DESCRIPTION
1	9	1/2" x 3" LG. NIPPLE - TBE
2	2	1/2" NPT ELBOW
3	A/R	1/2" NPT PIPE
4	4	1/2" T x 1/2" NPT MALE CONNECTOR
5	A/R	1/2" O.D. x .049" WALL SEAMLESS TUBING
6	5	1/2" NPT MxF VALVE
7	4	1/2" NPT TEE
8	5	1/2" NPT UNION
9	2	CONDENSATE POT
10	2	VENT VALVE



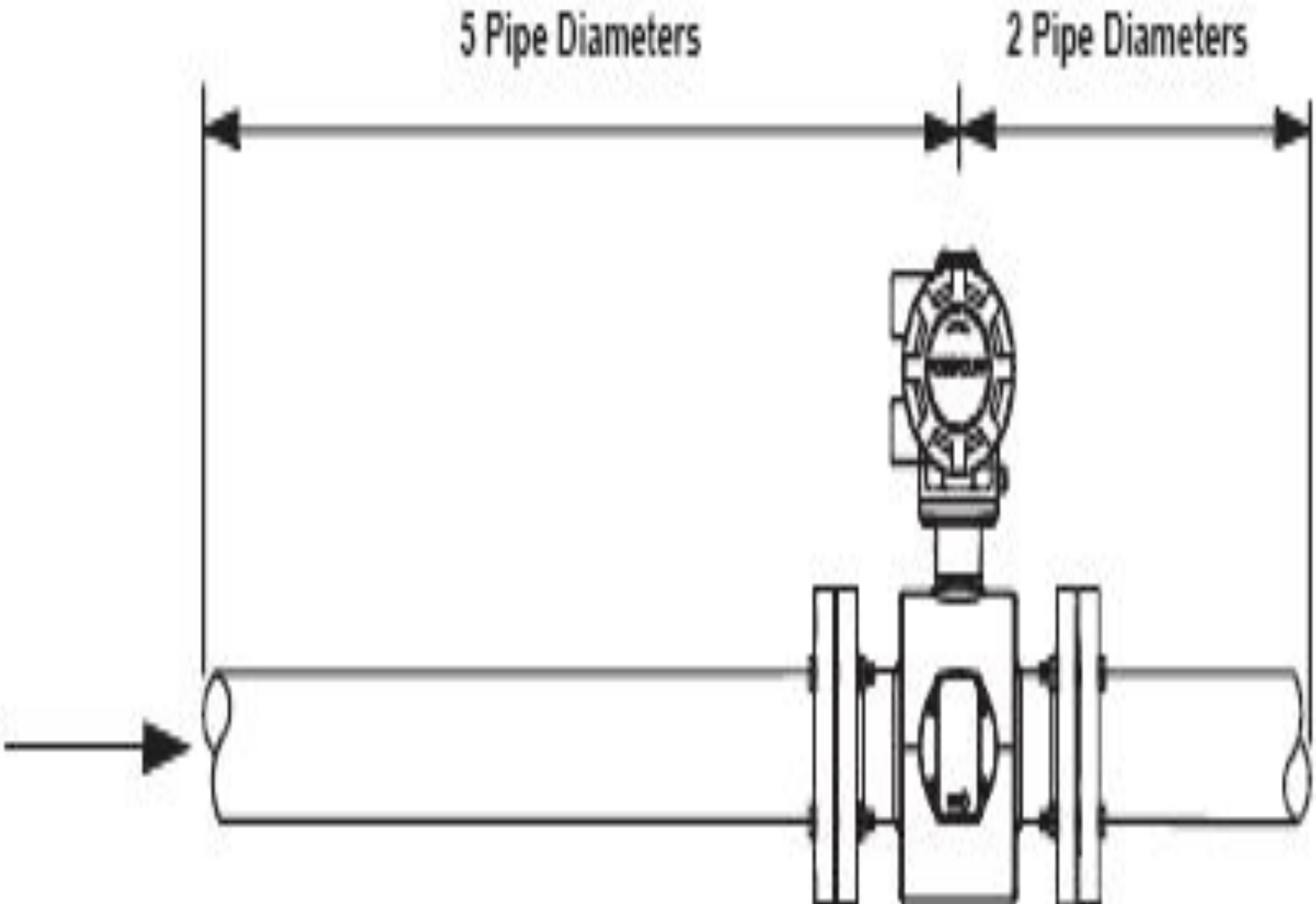
LIQUID SERVICE

BILL OF MATERIAL		
ITEM	QTY	DESCRIPTION
1	4	1/2" NPT × 3" LG NIPPLE, TBE
2	1	3-VALVE MANIFOLD

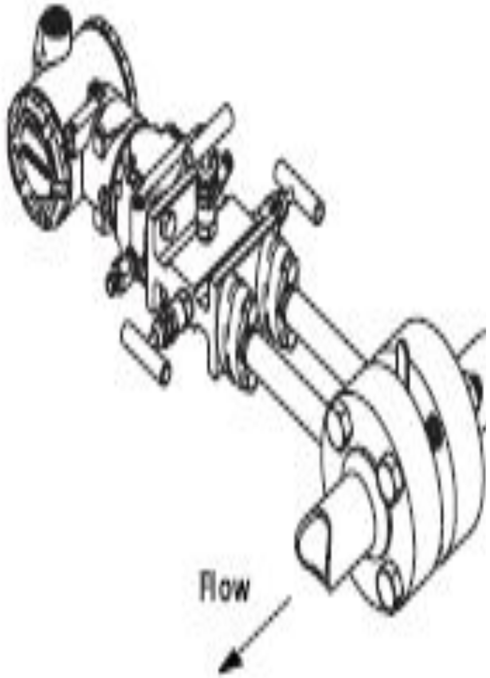
Figure 7.10. Typical differential pressure-sensing flow transmitter—close-coupled in liquid service.



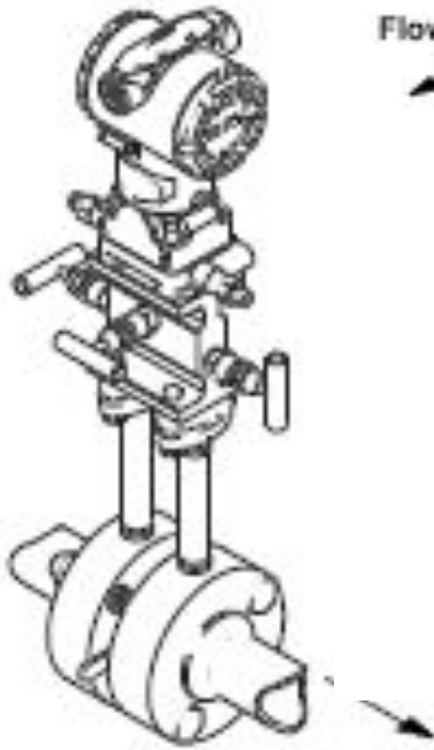
1/2" TEE (TYP.)
1/2" PLUG (TYP.)
MANIFOLD VALVE
SLOPE
1/2" x 6" NIPPLE
1/2" T x 1/2" P MALE
TUBING CONN. (TYP.)
1/2" O.D. TUBING
(TYP.)
H.P. CONN.
L.P. CONN.


5 Pipe Diameters
2 Pipe Diameters

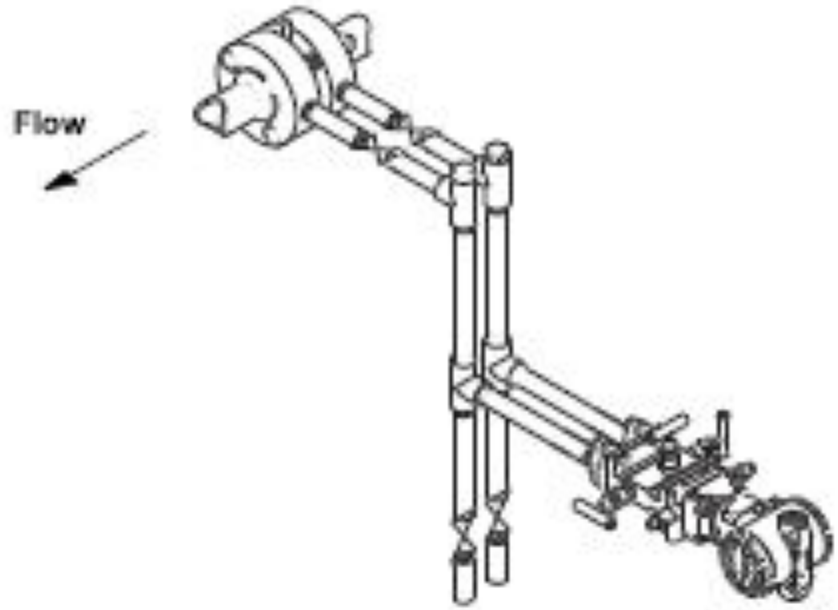
GAS OR LIQUID SERVICE



GAS SERVICE



STEAM SERVICE

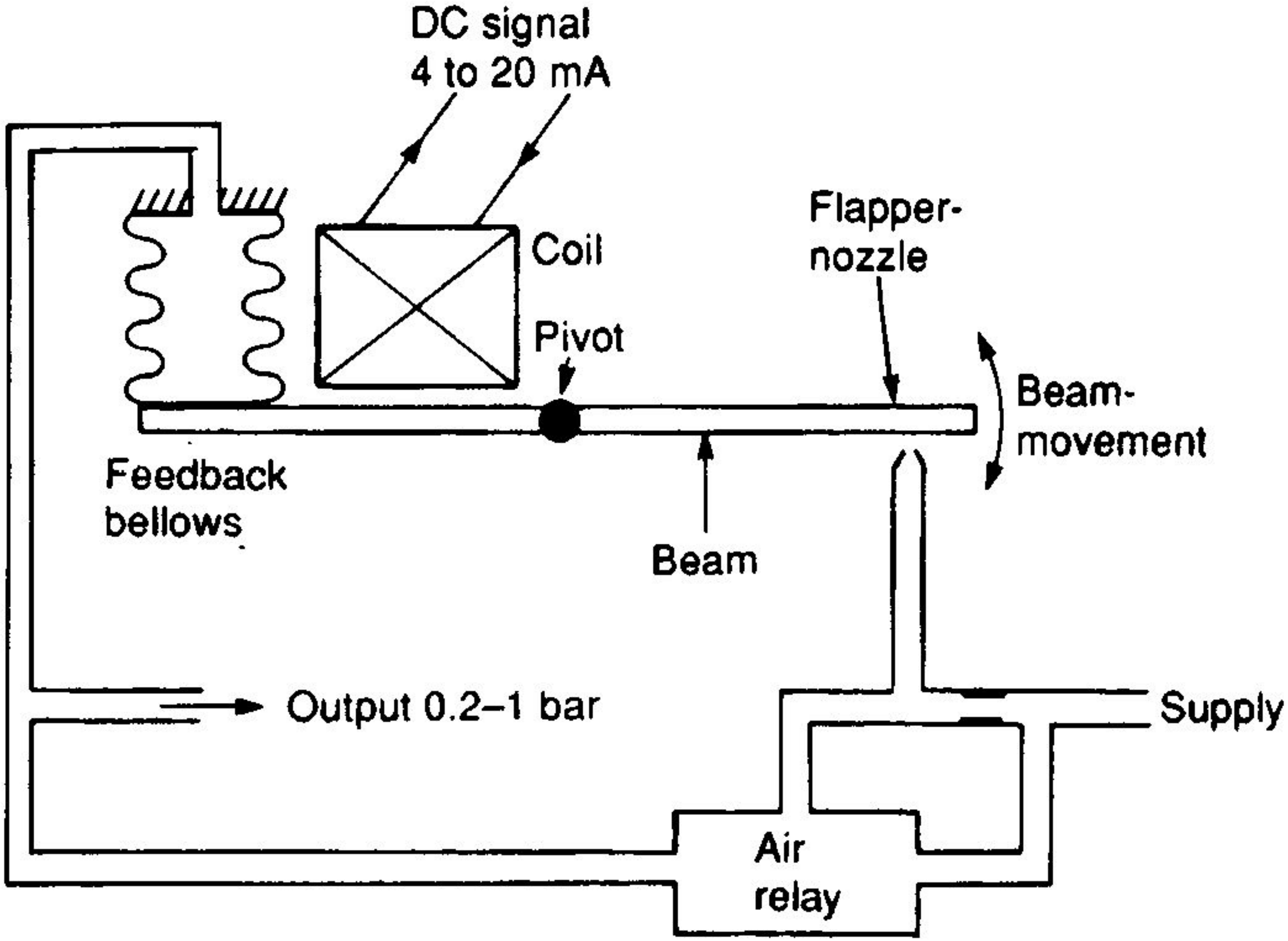


Terminology

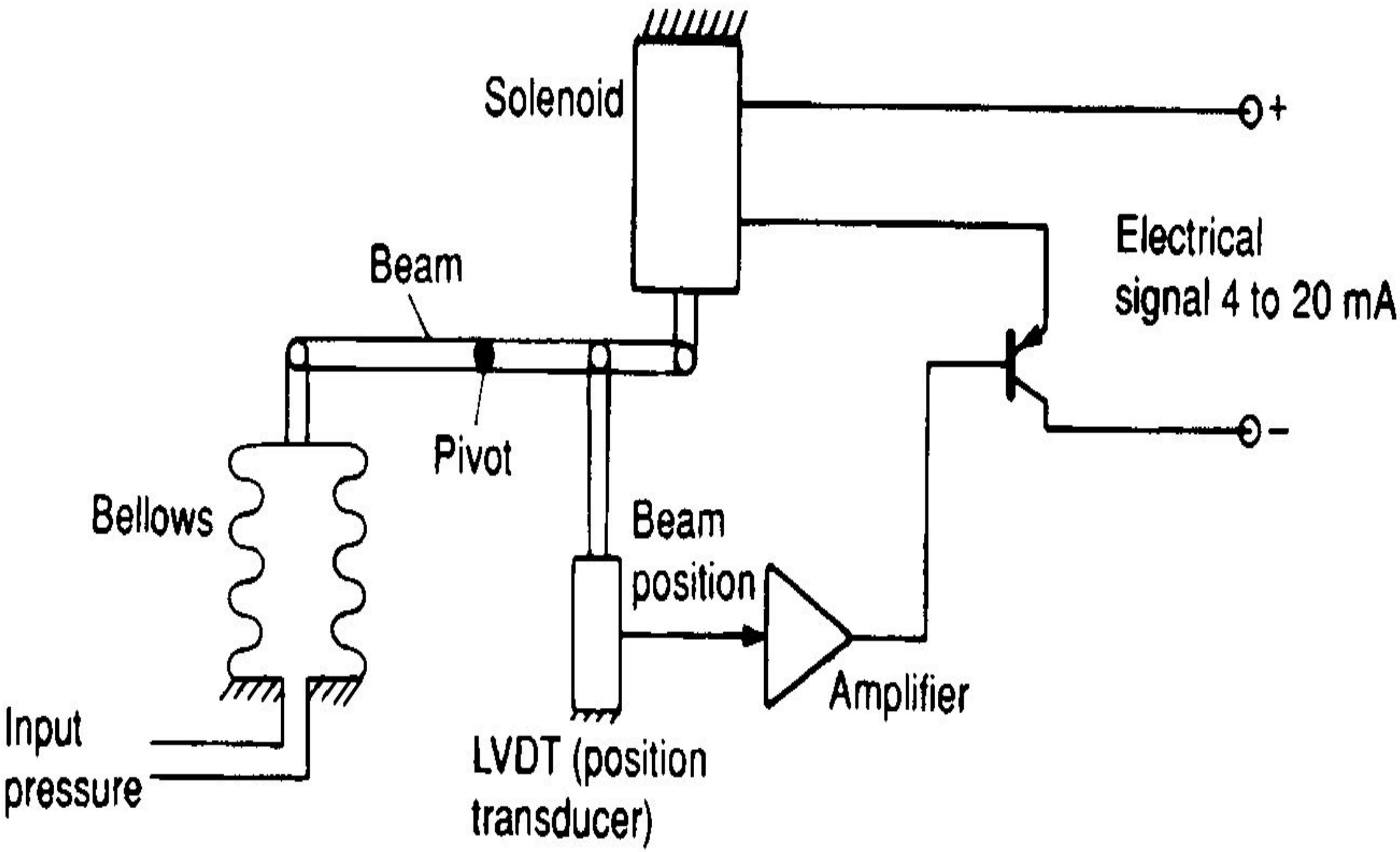
- **Calibration** Operations that adjust for minor effects such as span shift and zero shift. These effects are usually caused by outside influences such as rotating a transmitter, or mounting a transmitter on its side.
- **Damping** Output function that increases the response time of the transmitter to smooth the output when there are rapid input variations.
- **Lower Range Limit (LRL)** Lowest value of the measured variable that the transmitter can be configured to measure.
- **Lower Range Value (LRV)** Lowest value of the measured variable that the analog output of the transmitter is currently configured to measure.

- **Reranging** Configuration function that changes the transmitter 4 and 20 mA settings.
- **Span** Algebraic difference between the upper and lower range values.
- **Upper Range Limit (URL)** Highest value of the measured variable that the transmitter can be configured to measure.
- **Upper Range Value (URV)** Highest value of the measured variable that the analog output of the transmitter is currently configured to measure.
- **Zero Trim** A zero-based, one-point adjustment used in differential pressure applications to compensate for mounting position effects or zero shifts caused by static pressure.

Current to pressure (I-P) converter



Pressure to current (P-I) converter



Any Questions ???

Thank You

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102/103