3.0 Pressure Transmitter Selection

Each Tronic Line pressure transmitter has different features to meet specific performance, environmental, and price requirements. It is not possible to describe every possible condition that would require a specific model transmitter because there are an infinite number of possibilities. However, a systematic approach to selecting transmitters can assist in identifying which transmitter would best fit a specific application.

When selecting a pressure transmitter, the following information must be specified:

- **Model number**
- **Pressure range and reference**
- **Signal output**
- **Process connection**
- **Electrical connection**
- **Special options**

3.1 The **Model Number** is selected by matching the application requirements to the transmitter design capabilities. The application requirements are defined by parameters supplied by the user. The most important aspects of the application include:

-Performance requirements - accuracy
-Temperature ranges - media and ambient
-Media compatibility
-Shock and vibration resistance
-Moisture resistance
-EMI (electromagnetic interference) resistance

3.2 Pressure Range

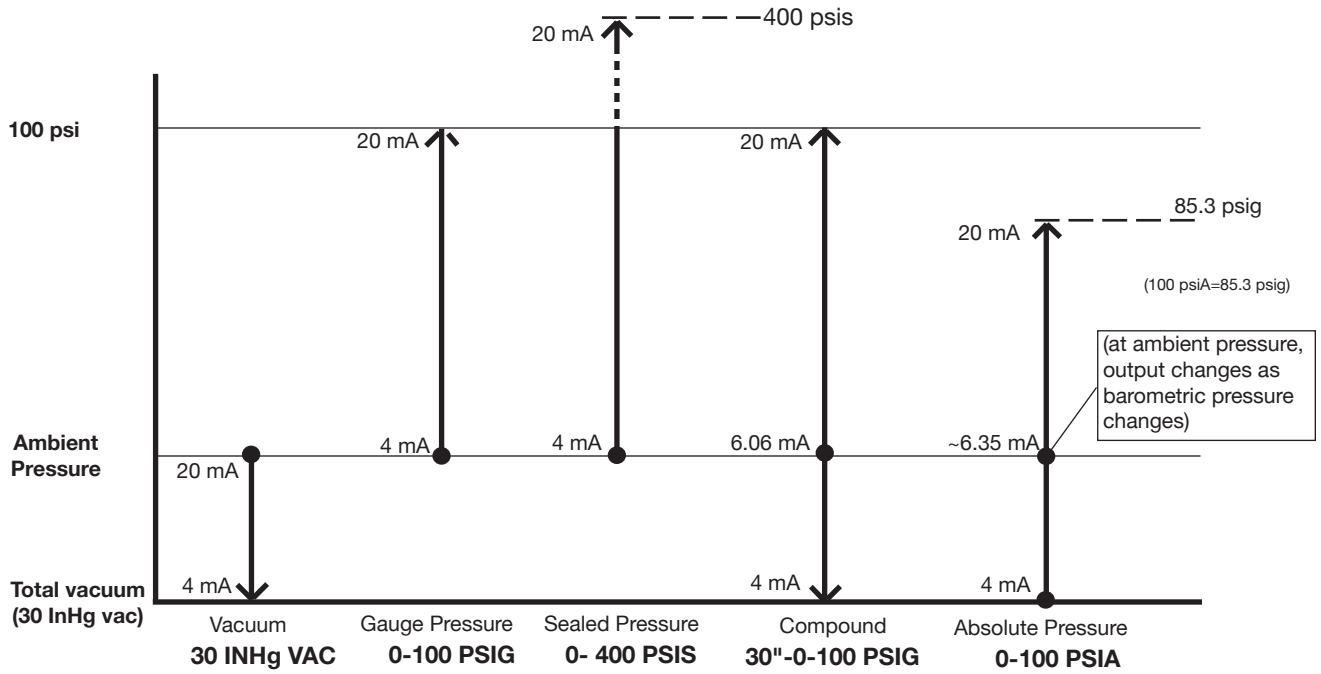
All WIKA transmitters, except for the UT-10 and UT-11, are fixed range. The range selected is determined by the application requirements. The **standard pressure range** of the transmitter should be equal to or greater than the highest expected working pressure generated by the application. The **maximum pressure** column on the data sheet defines the safety margin of pressure the transmitter can tolerate for short periods of time without damage. For example, a hydraulic system may normally generate 3000 psi. In unusual circumstances, pressure spikes lasting less than a millisecond may occur that are much higher than the normal working pressure. A 5000 psi S-10 transmitter can withstand overpressures of 11,600 psi for short periods. Exposure to pressure spikes 25,000 psi or greater will destroy the transmitter.

In liquid level applications, overpressure of a transmitter is unlikely. The transmitter range selected is the maximum pressure range of the transmitter that is as close as possible to the head pressure generated by the maximum liquid level. In the majority of applications, a standard range will meet or exceed performance requirements. For example, a tank holding 80 inches of water would use a standard range 0-100 inch water column (InWC) transmitter. Building a special range transmitter of 0-80 inches water column is possible, but the negligible increase in performance of this smaller span will usually not offset the additional cost and manufacturing lead time required to produce the special range. For example, a 100 InWC transmitter with 0.25% accuracy provides a reading of +/- 0.25 inches. The 80 InWC span provides +/- 0.20 inches or an improvement of only 0.05 inches.

After defining the pressure range, the **pressure reference** must be determined.

3.3 Pressure References

WIKA pressure transmitters and transducers are available in three references: *gauge, sealed, and absolute*. Gauge transmitters are referenced to atmospheric pressure and also include vacuum and compound ranges. The chart below shows the relationship between the types and the milliampere output at the various pressure ranges:



For transmitters with standard output signals, the rule "*the higher the pressure, the higher the output signal*" applies for all pressure references, compound, and vacuum ranges. Transmitters with reverse output (such as 20-4 mA) are available for special requirements.

Vacuum transmitters are vented to atmosphere and produce a 20 mA output when no vacuum is applied. The output decreases as the applied vacuum increases.

Gauge pressure transmitters are referenced to atmospheric pressure. With no pressure applied, the output is 4 mA. In WIKA low pressure piezoresistive industrial transmitters, including Model S-10, a vent tube inside the transmitter transfers the ambient pressure to the back of the diaphragm. There is enough clearance between the DIN connector retainer ring and transmitter body to allow ambient air pressure inside the transmitter. In OEM models, low pressure piezoresistive transmitters have a small vent hole in the case that is protected by a Teflon® or Gore-Tex® filter.

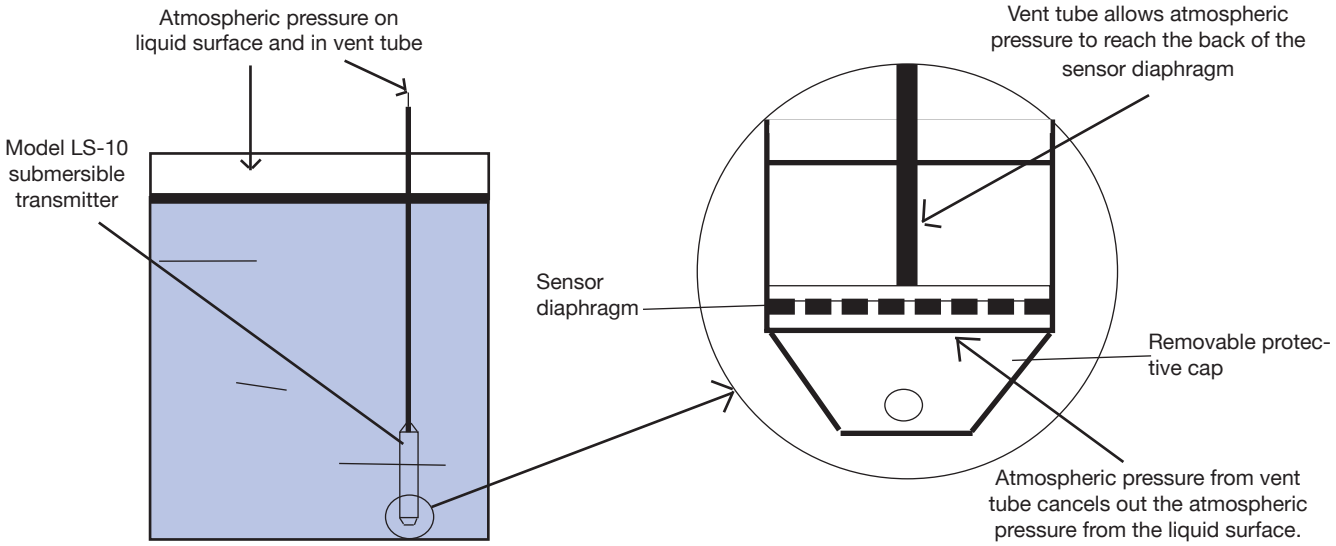
Sealed pressure transmitters are referenced to a sealed chamber behind the sensor at 14.7 psi. They are not vented directly to the atmosphere. WIKA transmitters with pressure ranges greater than 1000 psi use a sealed pressure reference. In higher pressure ranges, the output and performance of psig and psis types are virtually identical, because changes in barometric pressure are not large enough to introduce significant error. See page 18 for additional information about venting.

Compound ranges are vented to atmosphere, and measure both vacuum and pressure. They are used to measure the degree of vacuum or pressure relative to atmospheric pressure. Note that by convention, compound ranges are usually labeled with different engineering units across zero (30InHgVAC - 0 -100 psi). When programming a controller, the entire compound range should be considered as the same engineering units (-14.7psi - 0 - 100 psi).

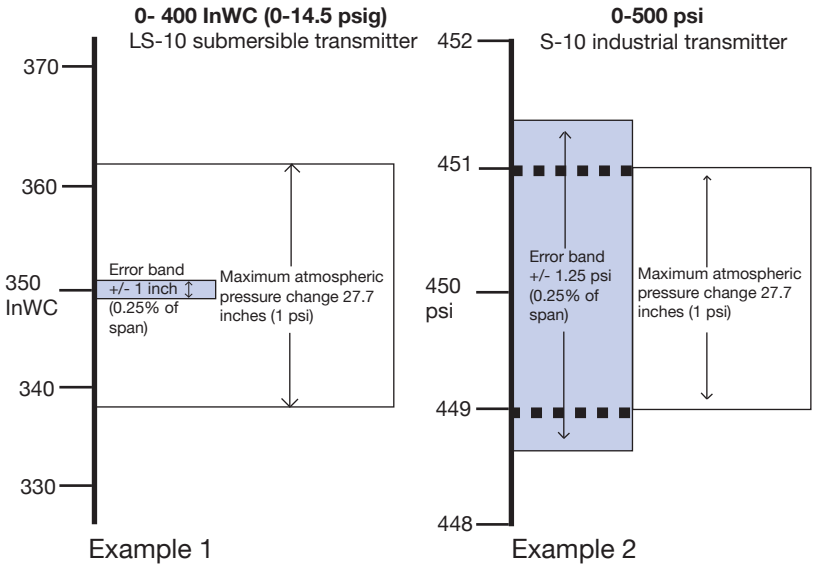
Absolute pressure transmitters are referenced to a sealed vacuum chamber located behind the sensor element. These transmitters sense changes in barometric pressure as the applied pressure is compared to a known vacuum. Absolute transmitters are used in applications where barometric pressure changes affect the operation of the system being measured. "False absolute" transmitters do not use a vacuum chamber behind the sensor but instead rely on an electronic offset of the output signal. They are less expensive but also less accurate than true absolute transmitters.

Product Example - venting transmitters to atmosphere

Atmospheric pressure can vary up to one psi depending upon weather conditions. Submersible transmitters are equipped with special vented cable containing a hollow capillary tube. This tube allows the transmitter to compensate for changes in ambient pressure. The vent tube equalizes the pressure behind the diaphragm so any changes in atmospheric pressure are cancelled from the output signal.



The error band is calculated by multiplying the transmitter span by its accuracy. The graphs below compare the error bands of a vented low pressure submersible and a sealed high pressure transmitter to the maximum possible atmospheric pressure change.



Industrial transmitters less than 400 psi span must be vented, since atmospheric pressure changes can be greater than the error band produced by the transmitter accuracy. *All WIKA Tronic piezoresistive transmitters with gauge, compound, or vacuum pressure ranges* are vented to atmosphere.

3.4 Signal Output

The 4-20 mA 2-wire analog system is in widespread use in industrial and process industries. The advantages of the 4-20 mA current loop include:

- High immunity to interference from electrical noise when compared to voltage signals.
- Low installation cost - only two wires are needed.
- Distances up to 10,000 feet are possible without additional amplification of the signal.
- The majority of existing meters, programmable logic controllers, and chart recorders accept this signal.
- The 4-20 mA signal provides built-in diagnostic capability. If a 0-5 volt transducer circuit produces a zero signal, it means either no pressure is applied to the system or the transmitter is disconnected or not functioning. If a 4-20 mA circuit fails, the output falls to 0 mA, which can be identified as an error signal by the controller instead of 0 pressure.

WIKA transmitters are available from stock in 4-20 mA 2-wire configurations. 0-20 mA 3-wire signals are available as a special order option. Pressure transducers with 3-wire voltage outputs are available with 0-5 volt, 0-10 volt, and 1-5 volt signals. Other voltage signals are available on special order.

Digital output signals with RS-232 communications are available in Models D-10 and the high accuracy P-10. The RS-232 signal is compatible with personal computers and provides high flexibility in monitoring and calibrating the transmitter. WIKA has PC-based software available to monitor, control, calibrate, and run diagnostic tests on RS-232 output transmitters.

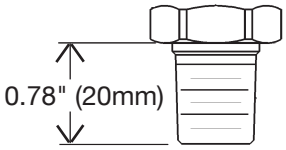
The digital and UniTrans transmitters are available with Fieldbus protocols. The digital transmitter is available for CANbus and its higher level protocols (CANopen, DeviceNet, SPS, J1939 etc.), and also for PROFIBUS DP and PA. The UniTrans is available with HART Protocol, which is a process industry standard.

Many custom output signals can be designed and manufactured by WIKA. Special signals are usually only cost effective in large quantities.

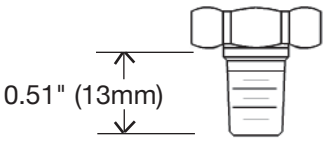
Refer to the specific data sheets or contact the factory for details regarding the availability of optional output signals for each model.

3.5 Process Connections

WIKA transmitters are available in a wide variety of process connections to meet specific applications. Standard industrial transmitters are stocked with a **1/2" NPT** (National Pipe Thread) male connection. The OEM and ECO-Tronic are available as standard in **1/4" NPT male.**



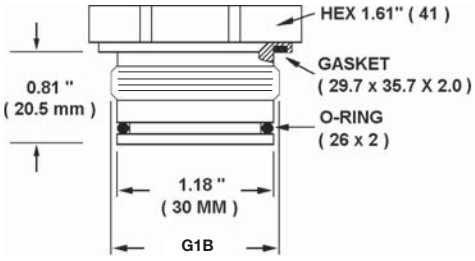
1/2" NPT male



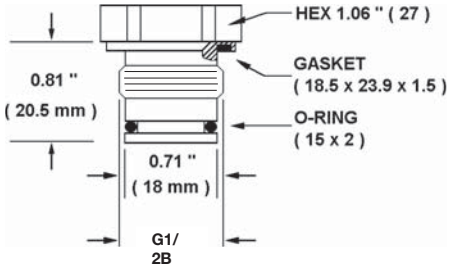
1/4" NPT male

All NPT male process connections have a 1/8" orifice leading up through the process connection to the sensing element. A **restrictor** can be installed in this orifice to protect the diaphragm from pressure spikes that sometimes occur in hydraulic systems. A restrictor can also be used to protect against damage by "water hammer" when measuring water pressure. Water hammer is a sudden increase in water pressure when the water momentum is instantaneously converted to pressure. Using a restrictor in WIKA industrial transmitters protects the sensor, but slows the response time from 1 millisecond to about 5 milliseconds. Another option that protects against water hammer and pressure spikes is an **arc eroded pressure port**. This is done using a process called "electric discharge drilling" and can produce a pressure port from 0.1mm to 1mm in diameter.

When measuring media that is viscous, crystallizing, or contains particulates, the NPT connection is not acceptable because the orifice may clog, producing errors in the signal or transmitter failure. For these applications, a WIKA transmitter with a **flush diaphragm** and straight thread is available. WIKA model numbers ending in X1 (S-11, F-21, etc.) feature the flush diaphragm. Transmitters in pressure ranges from 50 InWC (1.8 psi) to 30 psi are provided with a G1B straight thread. Pressure ranges from 50 psi to 8000 psi feature a G1/2B thread. Both sizes rely on an O-ring and gasket for sealing the connection. Buna-N O-rings are provided as standard, with Viton® O-rings available as an option if required for media compatibility.



G1B flush connection



G1/2B flush connection

Many other process connections are available. These include 1/8" NPT, female NPT, BSP (British Standard Pipe), SAE male or female, and VCR connections for high purity applications. High pressure industrial transmitters over 15,000 psi are equipped with an F-250-C (9/16-18) female autoclave connection. Other high pressure connections like the F-375-C are also available. Sanitary 3A transmitters feature a Tri-clamp® process connection which will be reviewed in a later section.

3.6 Electrical Connections

The standard electrical connection on industrial transmitters is the DIN EN 175301-803 (DIN 43650) connector. This connector features an internal connection block with solderless screw terminals, and a compression fitting to act as a strain relief for the cable entry point. Wiring is simplified, and the connector is easily removed from the transmitter by removing the center retaining screw in the top of the connector. The same connector is available with a 1/2" female conduit opening. This facilitates the use of flex-cable conduit to protect the wiring leading to the transmitter. Both of these connectors are rated IP 65. See page 25 for additional information about ingress protection (IP) ratings.

An additional level of protection is available by using a cable. The cable contains a vent tube to allow compensation for barometric pressure changes. This cable provides IP 67 protection.

The F-20 and F-21 transmitters with stainless steel junction boxes provide a high level of protection for industrial transmitters. They are rated IP 67 - NEMA 4X (both washdown and corrosion resistant). The F-2X series are available with a 1/2" female conduit or PG 13 cable compression fitting.

The maximum moisture protection is provided by IP 68 (NEMA 6P) rated submersible transmitters. The submersible electrical connection is designed to withstand permanent submersion and is provided on the LS-10, LH-10, and IL-10 submersible level transmitters.

Four or six pin military style plugs are available on Tronic industrial transmitters. These connectors do not provide any additional weather protection when compared to the standard DIN plug, but are popular due to their compact size and quick connect bayonet mount design.

Many other electrical connection options are available for all WIKA transmitters. Some are available on a custom order basis and may not be cost effective for small quantity orders. Please contact the factory for any electrical connectors not listed in the catalog.

3.7 Performance

Most users think of accuracy when they consider performance requirements. Industrial transmitter applications require anywhere from 0.05% to 1% accuracy class transmitters. Most industrial applications require 0.25% accuracy transmitters while OEM applications usually call for 0.5%. It *is important to consider repeatability, which in many industrial applications is more important than considering "accuracy" that matches a traceable standard*. The majority of WIKA transmitters fall into the 0.25% accuracy class. 0.1% or 0.05% is sometimes required for industrial laboratory applications where performance must match a traceable standard; for example, when calibrating other high accuracy pressure measurement devices.

Model Performance Comparison

Type	Vacuum	Compound	Absolute	Zero and span adjustment	Linearity	Repeatability	Temperature effect on zero per degree F
S-10	Yes	Yes	Yes	Yes	<0.25%	<0.05%	<0.012%
C-10	No	No	Yes	No	0.5%	0.05%	0.017%
P-10 accuracy digital	Yes	Yes	Yes	Yes, using RS-232 interface	0.1 or 0.05%	0.03%	0.005%
MH-1	No	No	No	No	≤0.5%	≤0.1%	≤0.017%
M-10	No	No	No	No	<0.25%	<0.05%	<0.012%
HP-1	No	No	No	Yes	<0.25%	<0.05%	<0.012
Special	See datasheets						