Diaphragm Seal Transmitter (DFS)

YOKOGAWA
Co-innovating tomorrow™

DPharp Digital Pressure Transmitters| EJA-E Series, EJX-A Series

Yokogawa's Diaphragm Seal System (DFS) offer a cost-effective means of expanding the operating envelope of your differential pressure transmitter by isolating your transmitter from process temperatures beyond the limits of the transmitter or isolating it from viscous/corrosive fluids.

Suitable for multiple applications, Diaphragm Seals prevent process medium from entering directly into the pressure-sensing assembly of a differential, gauge, or absolute pressure transmitter.

When would you need to use a diaphragm seal?

- High temperature applications where the process temperature is beyond the specifications of the transmitter.
- Corrosive service.
- To isolate the process for safety reasons.
- Prevention of suspended solids from entering the transmitter capsule or impulse lines which could become plugged.

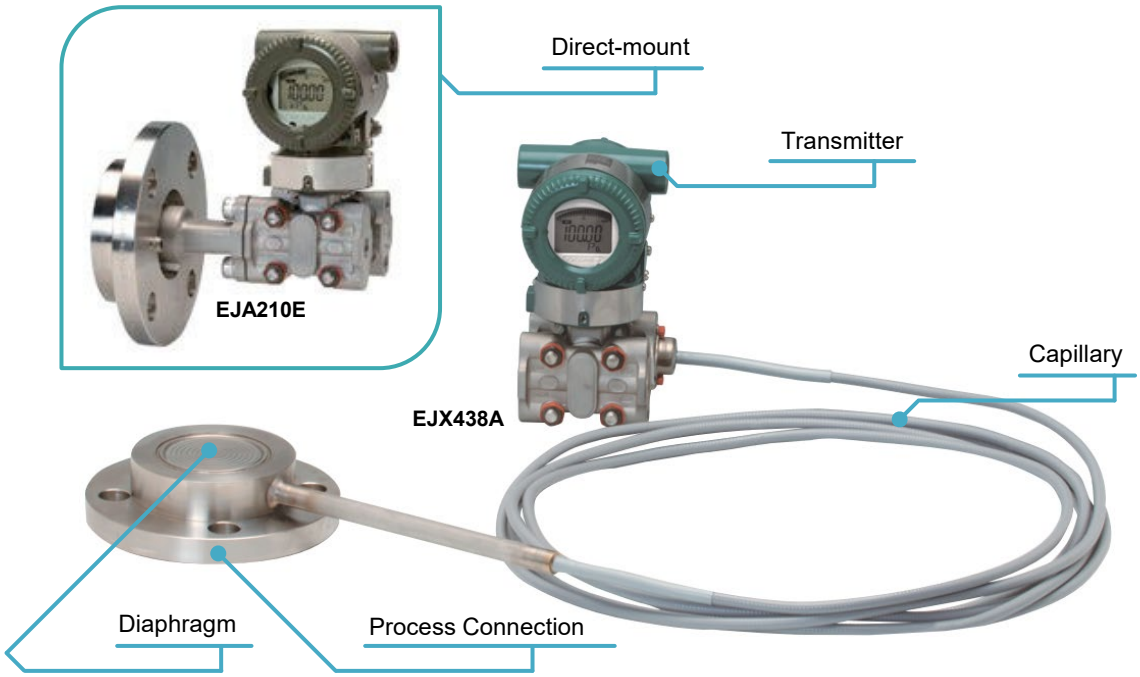

EJX210A

However, adding a diaphragm seal to a pressure transmitter can have a negative effect on the transmitter's performance. Accuracy of the system (diaphragm seal and transmitter) can be affected by changes in process temperature and swings in ambient temperature (referred to as Temperature Effects).

Yokogawa Diaphragm seal transmitters are designed to minimize this issue. Together with rugged construction and enhanced features, they give a consistent, reliable, accurate measurement.

Definition

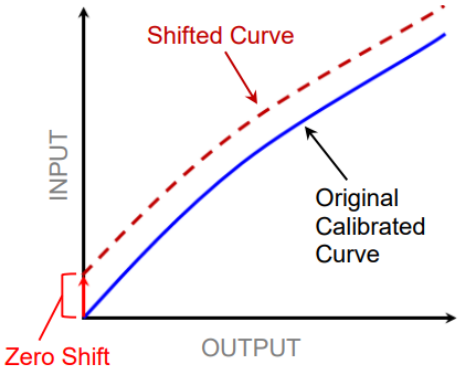
A diaphragm seal transmitter responds to changes in the process pressure at the diaphragm seal assembly. The assembly consist of a process connection and a wetted diaphragm. The seal disconnected to the transmitter via a capillary (or rigid direct-mount shaft). The changes in pressure are transmitted from the wetted diaphragm to the sensing mechanism of the pressure transmitter through liquid-filled capillary tubes. The liquid is a non-compressible fluid compatible with the process temperature and pressure; it is referred to as Fill Fluid.



Yokogawa diaphragm seal transmitters with direct-mount and capillary.

Temperature Effects

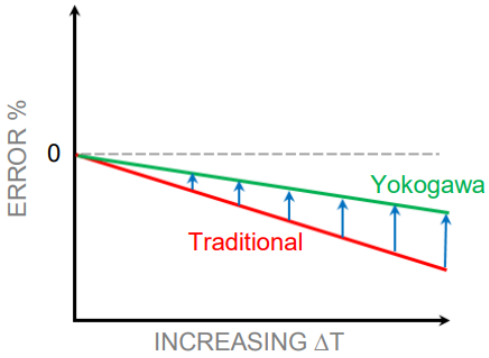
Pressure transmitters with diaphragm seals are affected by changes in temperature in two different ways. First, the fill fluid volume changes. Second, the fill fluid density changes. Both conditions, separately or collectively will cause a zero-shift. Zero-shift is defined as an error in which the transmitter output at zero pressure no longer indicates zero. This causes the entire calibration curve to shift the value of the difference. This yields an inaccurate output across the entire calibrated range.



Zero-shift causing parallel displacement of the original calibrated curve.

Volume

A Fill Fluid, like any liquid, changes volume (expands or contracts) as a result of temperature change (process and/or ambient). Seal systems have a set amount of volume to accurately transmit the pressure from the process connection to the transmitter, so any change in volume can cause the pressure reading to be inaccurate. How much of the pressure reading is actually due to changes in process pressure and how much to a change in volume of fill fluid due to process/ambient temperature change?



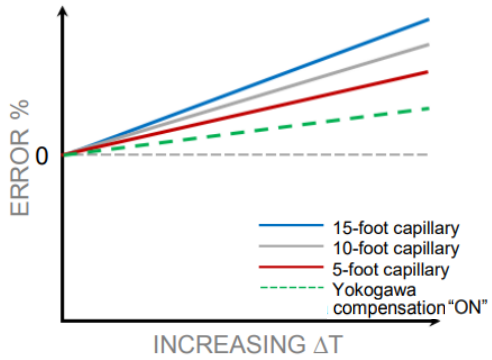
Graph illustrating the effects of volume induced error between Traditional transmitter/seals and Yokogawa's Transmitter/seal

All transmitters have temperature sensors located near (or, in the case of the Yokogawa, integral to) the pressure sensor to measure temperature. This temperature is used with special coefficients to correct the sensor output for the volume change of the small amount of fill fluid in the capsule (or cell) of the transmitter. To create these coefficients, the completed transmitter is put through testing under various temperature profiles.

Traditionally, the seal system is attached after these coefficients are generated. But what effect does the seal system fill fluid have on the measured pressure over the same temperature profile? In other words, why compensate for one and ignore the other; both have an effect. Yokogawa attaches the seal system to the transmitter and does the temperature coefficient testing as a completed system. This is how the unit will be used in the field, so why not develop the coefficients in that form? This process yields coefficients that are more accurate. Combined with pressure sensor's accurate integral temperature sensor, these more accurate coefficients enable Yokogawa diaphragm seal transmitters to reduce the effect of temperature induced volume changes to give you an accurate, consistent measurement.

Density

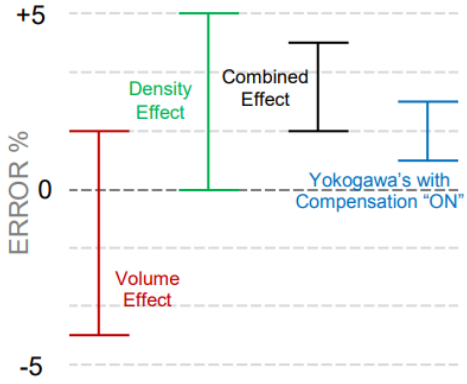
In liquid level applications, density of the fill fluid changing as ambient temperature changes causes the head pressure sensed by the transmitter to change. Head pressure is the pressure caused by vertical distance between the low-pressure and high-pressure process connections. The head pressure is compensated for during set-up of the transmitter; but what happens if the head-pressure no longer equals the value the unit was compensated for? The error can be especially prevalent in outdoor installations that have large ambient temperature swings between day & night and/or season-to-season. Additionally, the greater the vertical distance between process connections, the greater the error caused.



Graph illustrating the effects of head pressure change induced by density change. Three different capillary lengths are shown as well as Yokogawa density compensation being turned "ON".

This type of error is not unique to any one brand. All seal systems that use fill fluid experience this error. The key is to filter out the amount of the change in head pressure that is caused by the density change. Yokogawa is able to correct for this change. Knowing the relationship between temperature and fill fluid density, Yokogawa diaphragm seal transmitters can use the integral temperature sensor to actively compensate the output signal for the amount of zero shift cause by the change.

This compensation can be turned “OFF” or “ON” by the customer.



How the Effects Interact

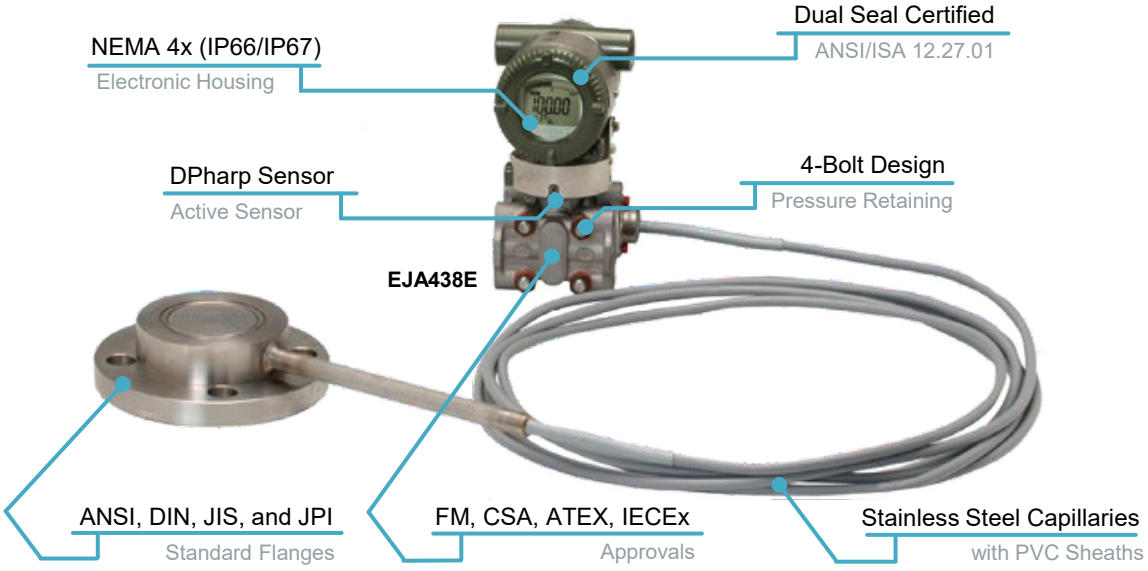
All this is great, but, bottom line, how does the diaphragm seal transmitter perform in use? The volume and density changes affect the system, but Yokogawa’s reduces these interacting effects to give a consistent, accurate, reliable measurement.

Graph illustrating the effects interacting to give a Combined Effect. This Combined Effect would be the performance of a traditional system. Compare this to Yokogawa performance with volume compensation and the density compensation “ON”.

Reliability

Yokogawa’s diaphragm seal transmitters use our DPharp active sensor, patented back check diagnostics, and rugged construction that allows users to run their plants safer and with less downtime.

Rugged Construction



Rugged construction of the EJA438E Gauge Pressure Transmitter

Patented Back Check Diagnostic

Yokogawa's pressure sensor used in these systems use patented real-time reverse check of the signal from sensor to output. This ensures that all calculations are performed correctly. It checks its math?

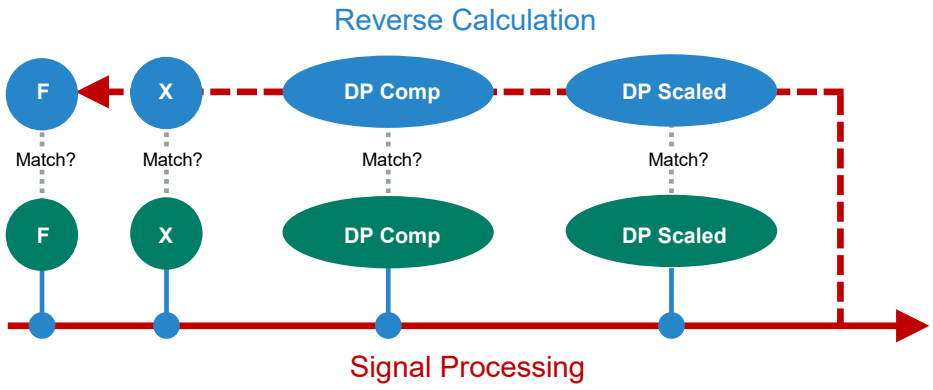


Diagram of Yokogawa's Back Check Diagnostics

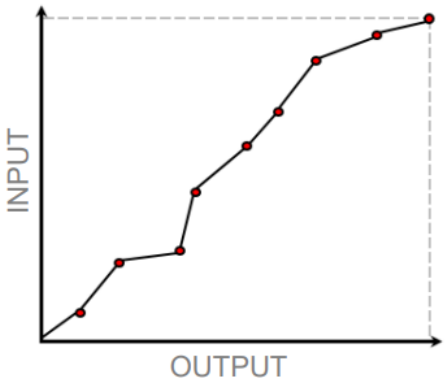
Active Sensor

The DPharp sensor is an active sensor. This means the sensor is constantly supplying a signal even if there has been no change in the process pressure. If the sensor signal is lost, the self-diagnostics knows that there is a problem. Competitor's analog sensors are passive. They do not provide a constant signal, so is the sensor working? An active sensor is an inherently safe sensor.

Enhanced Functions

Signal Characterization

Signal characterization is a versatile function available on all Yokogawa pressure transmitters. The function is used to compensate the analog 4 to 20 mA output signal for non-linear applications. Such applications include tank strapping or flow measurements; but it can be used in any application where the relationship between the pressure input and the desired output signal are known. This feature can use up to 10-points.



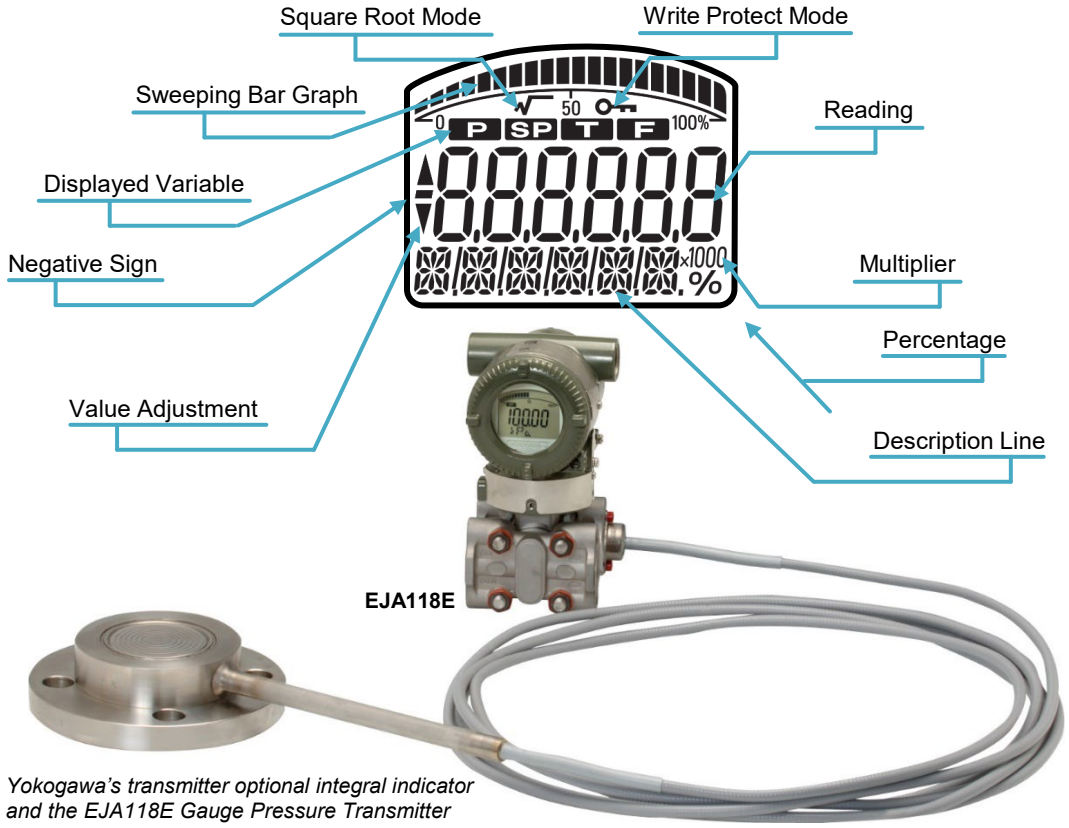
Signal Characterization

Local Parameter Setting

Parameter configuration can be done in the field without the use of a handheld communicator. By using the external zero adjustment screw and the integral indicator push button; the Tag Number, Unit of Measure, LRV, URV, Damping, Output Mode and Display can be updated. The transmitter can also be re-ranged with correct pressure being applied.

Integral Indicator

Yokogawa's transmitters have an expressive optional integral indicator that can be configured to display a range of different parameters.



Yokogawa's transmitter optional integral indicator and the EJA118E Gauge Pressure Transmitter

Conclusion

Yokogawa's Diaphragm Seal Transmitters are designed to minimize temperature effect, have a high reliability, and have enhanced features to give you a consistent, reliable, accurate measurement.

Accurate, Reliable, Consistent:

Plants run better with Yokogawa Pressure transmitters.

OpreX™ Yokogawa achieves operational excellence by providing products, services, and solutions based on the OpreX comprehensive brand that cover everything from business management to operations.

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