



Introduction

While liquid tank level is a basic measurement in process plants, its importance cannot be overstated. An incorrectly measured level can not only result in inventory control problems, it can cause the vessel to overflow. That leads to lost product, environmental contamination, a safety hazard—or all three. Incorrect level measurement can also cause a pump failure. Pressure transmitters with diaphragm seals are affected by changes in temperature in two different ways:

1. The fill fluid **volume** changes
2. 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 offset is then present throughout the entire measurement range and results in an inaccurate output. The effect grows as the length of the capillary increases.

Yokogawa's DPharp transmitters offer three solutions to overcome these errors:

1. **Environmental compensation**
2. **Compensating capillaries**
3. **Digital remote sensors**

Solution 1 – Good Environmental Compensation

Standard on all Yokogawa diaphragm seal systems, the environmental compensation feature uses the pressure sensor's on-board temperature sensor and a set of coefficients to automatically and continuously correct for shifts in temperature during operation.

This feature compensates for the zero shift experienced during swings in ambient temperature and yields a more accurate level measurement without the need for additional engineering.



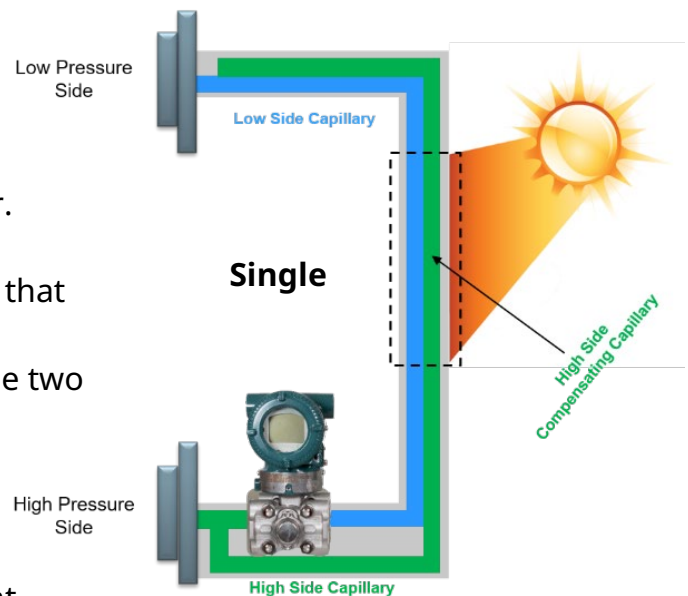
Yokogawa's DP level solutions overcome temperature effects to improve measurement accuracy—regardless of seal system configuration preference.

Solution 2 – Better Compensating Capillaries - Single

A Yokogawa DPharp transmitter can also be equipped with a special compensating capillary that eliminates errors due to changes in ambient temperature. This is a simple, reliable design with a single differential pressure transmitter.

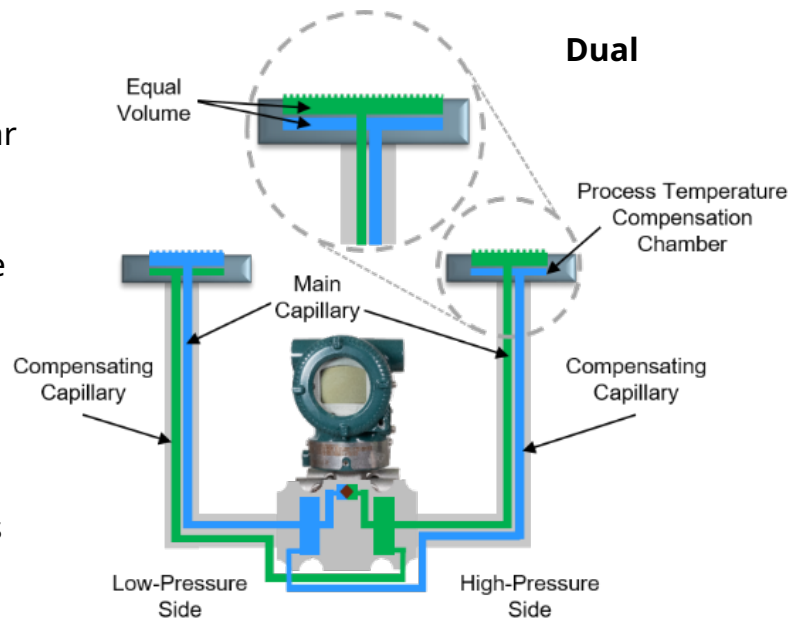
The high-side of the transmitter has a separate “leg” that runs along the low-side capillary. The compensation capillary equalizes the volume of fill fluid between the two sides of the transmitter, thus allowing for ambient temperature balance between them.

By eliminating the effects of changes in ambient temperature, it yields an accurate level measurement.



Compensating Capillaries - Dual

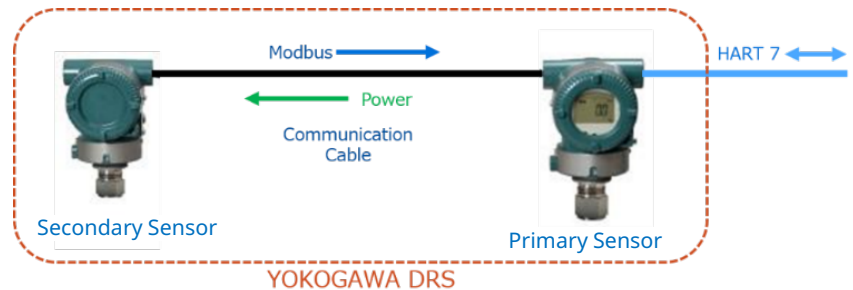
The dual compensating capillary design is similar in that it has compensation legs. However, the compensation capillaries also connect into a compensation chamber that is the same volume as the main chamber in each diaphragm seal. A temperature conductive plate between the main chamber and compensation chamber balances the entire system by exposing the same process temperature changes to both chambers. This reduces the influence of process temperature in the level measurement.



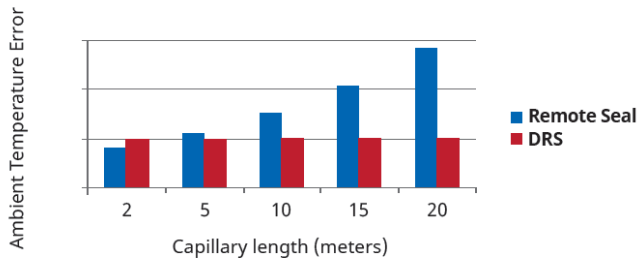
Solution 3 – Best (*in some applications*)

Digital Remote Sensor (DRS)

Traditional differential pressure measurements using capillaries suffer from reduced performance as capillary length increases. There is a point when the performance of the traditional system is no longer good enough for the measured parameter to be useful.



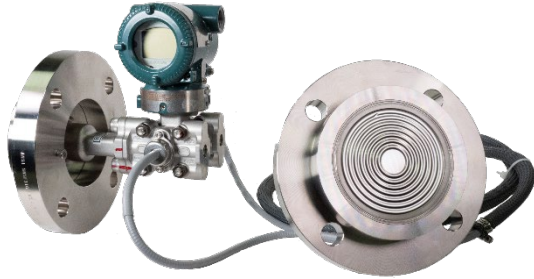
Yokogawa’s DRS can solve this problem. DRS uses two individual pressure sensors: one placed on the high-pressure tap and the second placed on the low pressure tap. The two sensors communicate via a dedicated communication cable. The system uses the information from the sensors to derive the differential pressure between the taps and transmits it via an analog 4 to 20 mA signal and a digital HART signal.



DRS compared to traditional remote seal systems

The HART signal also transmits the pressure at both the high-pressure and low-pressure taps. This system basically replaces the fluid filled capillaries of a traditional diaphragm seal system with electrical wiring, thus eliminating temperature effects of those capillaries.

Single Compensating Capillary System



Dual Compensating Capillary System



Traditional Mount



Direct Mount



ISA100 Wireless



Freestyle Seal System



Threaded Connection



Digital Remote Sensor



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