White Paper

Better Together:

The Advantages of Using Two Interconnected Process Transmitters for Differential Pressure Measurement

By Rob Lukat

WIKA

Liquid level monitoring reaches a new height with WIKA's innovative solution: a system that uses two interconnected process transmitters for differential pressure measurement. This configuration is extremely precise, easy to install and use, and not susceptible to temperature variations.

The market offers several methods for measuring and monitoring liquid levels. For closed vessels, operators commonly choose a differential pressure transmitter. This is a proven technique, especially when the measuring instrument should not be immersed in the media, such as for tanks that have a grinder or hold aggressive substances. However, if the application requires high accuracy, this method of level measurement soon comes up against its limits.

Before making the case for using two interconnected process transmitters rather than other configurations or instruments, let's take a look at what is a differential pressure transmitter and how this pressure instrument measures liquid level.

What Differential Pressure Transmitters Do

Differential pressure transmitters were originally designed for use in pipes to measure pressure before and after the fluid encounters a filter, pump, or another interruption in flow. Standard differential pressure transmitters come with two process connections arranged side by side to measure the drop in pressure (d) between the higher and lower points (H and L, respectively, in Figure 1). Classic differential pressure transmitters can also measure flow rates. It wasn't long before users realized that differential pressure measurement could be used to determine liquid level as well.

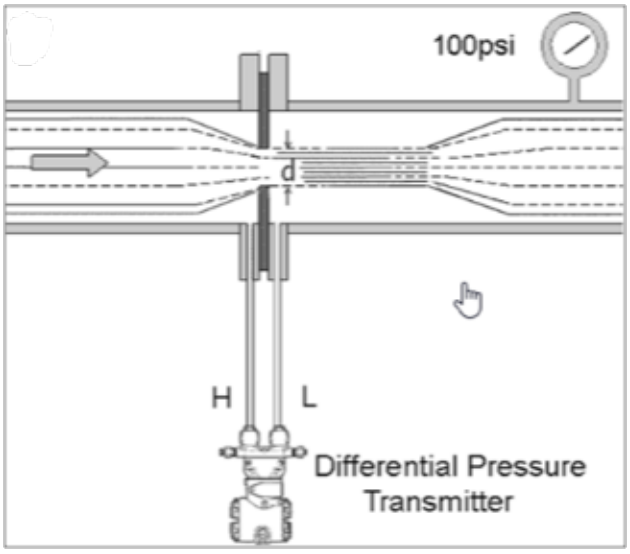

Figure 1: In a pipe, a differential pressure transmitter measures pressure drop (d) from the higher point (H) to the lower point (L).

Level Measurement with a Differential Pressure Transmitter: Advantages and Challenges

A differential pressure transmitter calculates level by measuring the differential pressure between the liquid and the gaseous phases of the fluid inside a closed tank. For precise calculations, important factors include:

- Geometry of the tank (horizontal or vertical, shapes of various lids and bottoms, etc.)
- Specific density of the medium
- Hydrostatic pressure

The distance between points H and L in a tank is necessarily much longer than in a pipeline, necessitating the use of tubing to bridge that distance (Figure 2). But not just any size of tube will do. For accurate measurements, these small pipes – capillaries, really – have to be so thin and limited in volume that they transmit media without any changes in pressure.

However, using capillaries creates its own set of challenges. Within an enclosed system, the pressure of a gas is directly proportional to its temperature. This is Gay-Lussac's Law. In larger pipes, an increase in temperature/pressure won't have much effect on differential pressure readings. But within the confines of a capillary, any changes in temperature and, thus, pressure are magnified. Measurement solutions with this kind of connection to the measuring points are sensitive to temperature. In the worst case scenario, severe fluctuations could result in false measured values.

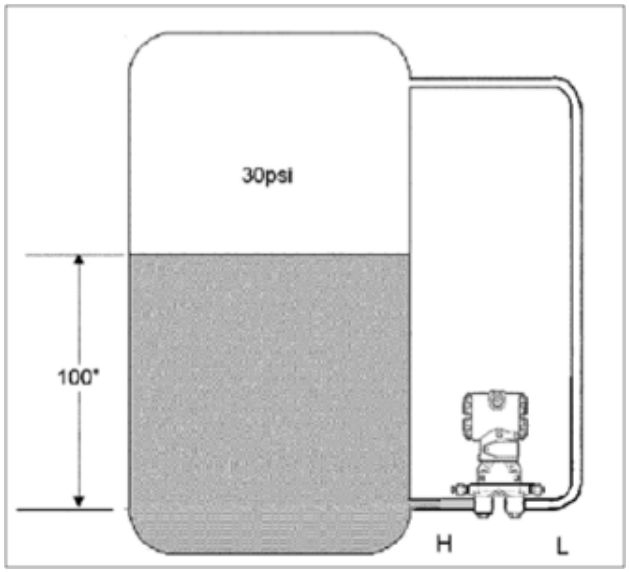

Figure 2: Differential pressure transmitter configured to measure level inside a tank.

Differential Pressure Measurement with Two Interconnected Process Transmitters

WIKA has developed a solution to the challenges of temperature fluctuations and inaccurate readings. Our innovative system takes two of the same process transmitter, such as the CPT-2X or IPT-2X, and connects them via a signal cable.

In this configuration, the subordinate process transmitter measures the gas pressure (P_1) and communicates that reading to the principal over an internal bus (Figure 3). The principal process transmitter measures the liquid pressure (P_2) and then calculates the difference between P_1 and P_2. Using that difference, as well as pre-programmed parameters like the tank's geometric variables and the liquid's specific density, the principal is able to determine the liquid's precise volume and level. It then sends that value to a control room and/or displays it on the transmitter as a digital or analog signal. The principal transmitter also parameterizes and powers the subordinate.

Without needing to use capillaries, this system handles even wide temperature fluctuations with ease. Its accuracy equivalent is up to 0.05 % of the set span. Furthermore, the signal cable is not susceptible to capillary-related failures.

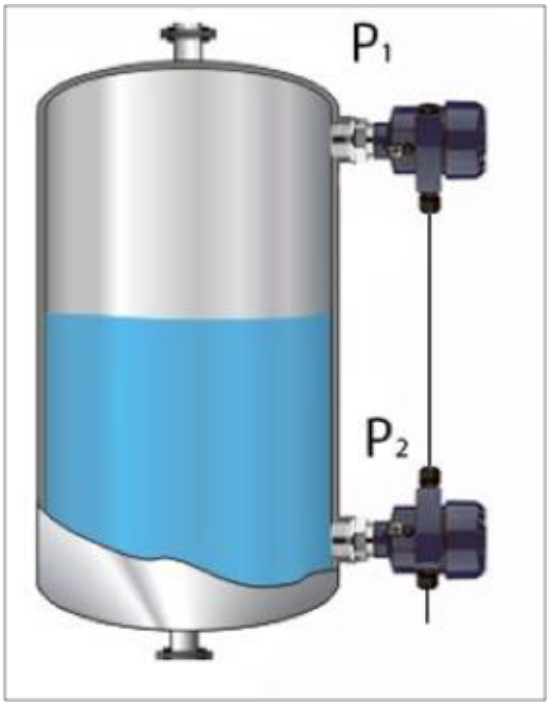

Figure 3: Level measurement using two interconnected process transmitters

VS.

Pressure Transmitters vs. Process Transmitters for Differential Pressure Measurement

In theory, this system could work with pressure transmitters as well as process transmitters. However, a system using pressure transmitters would require several additional components:

- A device to perform calculations
- A second voltage unit to power the subordinate
- Two pressure inputs

Because process transmitters have all the above components already baked in, it is a simpler, more cost-effective system.

Level Measurement in Diverse Media

A system that uses two process transmitters for differential pressure measurement is ideal for measuring level in mixed media.

In the manufacture of fruit juice, for example, this type of system can determine the concentrate-to-water ratio based on density and, hence, pressure change.

Another example is the bilge tanks in ships, where water mixes with lubricants and other fluids. The two connected process transmitters can accurately measure the differential pressure due to the media's density, and then indicate when the water level has reached the defined limit.

Advantages of Using Process Transmitters for Differential Pressure Measurement

WIKA's smart solution not only minimizes sensitivity to temperature variations, it also provides other important benefits:

- **Faster turnaround time.** Since there are no capillaries, there is no need to run upstream tests to verify that all air pockets have been eliminated from impulse and pressure lines.
- **Easier and cheaper replacement.** In the event of a malfunction, only the faulty process transmitter has to be replaced. When using traditional differential pressure transmitters, the entire system has to be replaced.
- **Optimized signal span.** As long as the process transmitter is not turned down past the recommended limit (normally less than 5:1), spans can be set up individually, scaling each transmitter's measuring range to the values actually relevant for the process.
- **Greater versatility.** This system is ideal for homogeneous liquids as well as heterogeneous media (see sidebar on previous page).

WIKA: An Expert in Differential Pressure Measurement

WIKA has long been a global leader in the manufacturing of measuring instruments, but we do more than that. Our engineers constantly look for innovative ways to solve tough challenges. This system of using two interconnected process transmitters to accurately monitor liquid levels is simply one of the many solutions our teams have designed to boost accuracy while saving customers money and time.

Should you measure level by using a level indicator, a classic differential pressure transmitter, or two process transmitters? Each application has its unique variables that affect the type of instrument you choose. For help in determining which solution is the most efficient and cost-effective for your process, contact the experts at WIKA USA.

Rob Lukat joined WIKA in 1999 as an applications engineer specializing in electronic pressure measurement. Since that time, he has held several positions actively involved with this division's sales and support. He is currently the Product Manager for Electronic Pressure Measurement at WIKA USA.

WIKA USA
1000 Wiegand Boulevard
Lawrenceville, GA 30043
Toll Free 1-888-WIKA-USA (945-2872)
Tel (770) 513-8200 Fax (770) 338-5118
info@wika.com • www.wika.com