# Various Technics of Liquids and Solids Level Measurements (Part 2)

In part one of this series of articles, level measurement using a floating system was discusses and the instruments were recommended for each application. In the second part of these articles, level measurement with the aid of pressure instruments will be discussed.

## PRESSURE TYPE INSTRUMENTS

Pressure is exerted force per unit area. The pressure at a given depth, in a static liquid, is a result of the weight of the liquid acting on a unit area at that depth plus any pressure acting on the surface of the liquid. Level measurement based on pressure measurement is also referred to as hydrostatic tank gauging.

Pressure is not really a vector even though it looks like it in the sketches. The arrows indicate the direction of the force that the pressure would exert on a surface that it is contact with. Moreover, the pressure at a given depth does not depend upon the shape of the vessel containing the liquid or the amount of liquid in the vessel; only the variations of the height of the liquid column in an open tank for a specific liquid at a certain temperature will determine the force at the bottom of the tank.

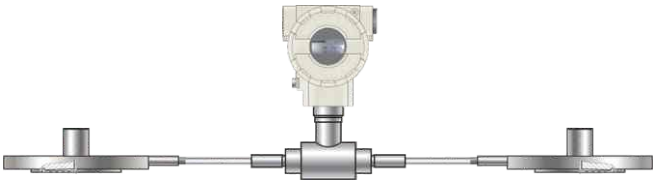
The force measured at the bottom of a liquid tank will represent the high of liquid level and by knowing the density of the liquid in the tank, the level measurement is performed correctly.

Use of pressure measuring elements to determine the liquid level has been performed successfully in both open tanks (top of the liquid column is open to the atmosphere) and closed tanks (liquid is in a pressurized tank). When measuring level in open tank, the effect of atmosphere pressure is compensated by utilizing a gauge pressure device and reading is directly proportional to the height of the liquid and its specific gravity. While in closed tanks, the effect of the pressurized air above the liquid column must come into consideration and be deducted from the measured value of the pressure at the bottom of the liquid column. Therefore, for closed tanks two pressures must be measured and for that matter use of differential pressure cells (DP cells) is mandatory.

To determine the hydrostatic pressure of a column of liquid, multiply the height of the liquid column by the density of the liquid. Therefore, if we know the hydrostatic pressure measured by the pressure sensor and also know the density of the liquid in that specific temperature, then we can calculate the height of the liquid column.

When the process liquid is viscous, sludge or corrosive to the sensor of the pressure measuring instrument, diaphragm seals are used to isolate the instrument from the process. The seals come with fill liquids such as silicon or other relatively non-compressable oils. A broad range of corrosion-resistant diaphragm are available in the market and at Indumart Inc..

Capillary tubes of the diaphragm seals should be as short as possible and shielded from the ambient temperature and radiation heat.



Fi. 9: Model with two remote diaphragm seals is suitable for closed tank applications. Indumart LTS360D

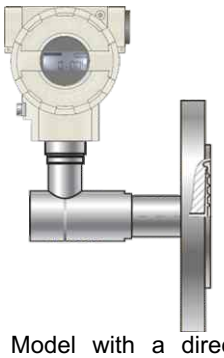


Fig. 10: Model with a direct diaphragm seal on the positive side and the low pressure is open to the atmosphere or it can be connected to the tank's top without a diaphragm seal. Indumart LTS360

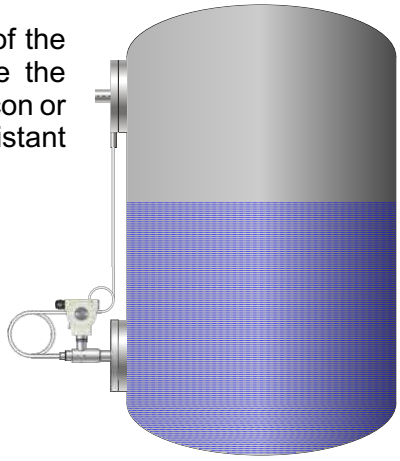


Fig 11: The LTS360D Series with direct diaphragm seal connected to the positive pressure chamber and a remote diaphragm seal connected to the low pressure chamber. This is suitable for level and density measurement applications in closed tanks.

Indumart LTS360D smart level transmitters are two-wire microprocessor-based instruments, which can measure liquid level, indicate the level value, and generate a 4-20 mA output signal directly or inversely proportional to the transmitter level measured. Digital communication for remote calibration and monitoring is also provided, superimposing a digital signal on the same pair of wires that carries the 4-20 mA signal.

Also the Indumart LTS360 smart level transmitters are two-wire microprocessor-based instruments, which can measure the liquid level head in open tanks, indicate the head pressure value on its wide LCD display, and generate a 4-20 mA output signal directly or inversely proportional to the liquid level of the tank. Digital communication for remote calibration and monitoring is also provided, superimposing a digital signal on the same pair of wires that carries the 4-20 mA signal.

In both models the thermal drift is automatically compensated using the signal from a thermistor integrated into the pressure sensor. The high accuracy sensor coupled with the temperature compensation feature give a measurement precision, which is more than adequate for even the most demanding applications.

A simpler level transmitter is the submersible level transmitter (LTF120 and LTF160). It measures the liquid height in reservoirs, lakes, food processing and many other applications. If applied in media other than water, the transmitter may be customized to have an output corresponding to height of the special medium. The transmitter housing can be specified as 316L stainless steel, titanium or Teflon; and their enclosures are sealed to IP68 protection class.

Fig. 12. LTF120 Submersible Level Transmitter.