Liquid Level Measurement

The pressure measured at the bottom of a liquid filled tank is proportional to both the height (head) and density of the liquid. For best results the pressure should be sensed by a pressure transmitter mounted at the lowest point possible on the tank (Shown in Figure 1).

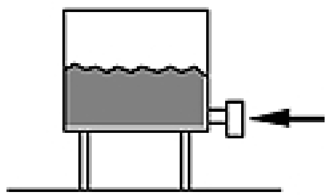

FIGURE 1

Example #1

An application requires the liquid level to be monitored in a 30 feet (ft) high vertical water tank. A full tank would generate a maximum head pressure of 30 ft of water. Since one foot of water is equivalent to 0.4335 PSI, the maximum pressure in PSI is 13 PSIG. As shown in Table 1, a pressure transducer with a range of 0 to 15 PSIG will accurately measure the liquid level within ±0.46”W.C.

TABLE 1: TANK LEVEL USING A HIGH ACCURACY (≤0.11% FS) PRESSURE TRANSDUCER

Full Scale Pressure Range	Tank Level (Water)	Accuracy of Level Reading
0 to15 PSIG	0 to 34.6 ft of water	±0.46”W.C.
0 to 25 PSIG	0 to 57.7 ft of water	±0.76”W.C.
0 to 50 PSIG	0 to115.3 ft of water	±1.52”W.C.
0 to 100 PSIG	0 to 230.7 ft of water	±3.04”W.C.

For liquids with densities different than water (1 g/cm³), pressure can be determined from liquid density (p), gravitational force (g) and liquid column height (h) with the formula:

$$P = \frac{pgh}{68947.6}$$

P = pressure in PSI

p = liquids density measured in g/cm³ (See Table 2)

g= gravitational force constant = $980 * \frac{cm}{sec^2}$

h = liquid column height in cm (Note: 1 in = 2.54 cm)

For liquid column height (h) in feet the formula simplifies to:

$$P = ph(0.4335)$$

Example #2

An application requires the liquid level to be monitored in a 50 ft high vertical tank filled with Carbon Tetrachloride. Table 2 lists the density of Carbon Tetrachloride at 1.595 g/cm³ and the maximum liquid height is 50 ft.

By using the simplified formula, the maximum pressure generated is:

$$P = ph\ (0.4335) = (1.595)(50)(0.4335) = 34.7\ \text{PSIG}$$

A pressure transducer with a range of 0 to 50 PSIG would be sufficient for monitoring levels in this tank.

Pressurized Vessels

A differential pressure transducer (DPT) is necessary for determining the level in a pressurized vessel. The high side pressure port is connected to the lowest point possible on the tank, and the low side pressure port is connected to the top of the tank. P in the formula would be the differential pressure measured.

TABLE 2: DENSITY OF VARIOUS LIQUIDS

Liquid	Density (g/cm³)	Temperature °C
Acetone	0.792	20
Alcohol, Ethyl	0.791	20
Alcohol, Methyl	0.810	0
Benzene	0.899	0
Brine, 10% CaCi	1.091	0
Brine 10% NaCi	1.078	0
Bunkers C Fuel Max.	1.014	15
Carbolic Acid	0.95-0.965	15
Carbon Disulfide	1.293	0
Carbon Tetrachloride	1.595	20
Chloroform	1.489	20
Distillate	0.85	15
Ether	0.736	0
Fuel 3 Max.	0.898	15
Fuel 3 Min.	0.966	15
Fuel 5 Max.	0.993	15

Fuel 6 Min.	0.993	15
Gasoline	0.66-0.69	-
Glycerin	1.26	0
Kerosene	0.82	-
Mercury	13.60	-
Milk	1.028-1.035	-
Naptha, Wood	0.848-0.810	-
Pentane	0.624	15
SAE 10 Lube	0.876	15
SAE 30 Lube	0.898	15
SAE 70 Lube	0.916	15
Salt Lake Crude	0.843	15
32.6° API Crude	0.862	15
35.6° API Crude	0.847	15
40° API Crude	0.825	15
48° API Crude	0.788	15
Sea Water	1.025	15
Turpentine	0.87	-
Water	1.00	4