

Sub-Sea

Level Measurement with Pressure Sensors

Sub-sea level measurement can be accomplished with the use of a pressure sensor. Typically an ROV (Remotely Operated Vehicle) is lowered into the ocean with the pressure port either installed inside an enclosure or completely exposed to the sea water. As the ROV is submerged, the water pressure is exerted on the diaphragm of the pressure sensor. The deeper the system is submerged, the higher the pressure. By calculating salt water density at 1.025 (or 2.5% more dense than fresh water at 4°C) a correlation between pressure and output signal can be made to measure the depth of the equipment.

For Example: A pressure sensor is packaged with a pressure range of 0-5075 PSI (350 Bar) and a 4-20mA output signal. At the surface, the pressure sensor will read 0 PSI or 4mA. As the sensor is submerged with the equipment, the pressure will increase along with the linear output signal up to 20mA at a depth of approximately 12,000 feet (3657.6 meters). This is calculated by:

$$(5075 \text{ PSI} \times 27.68 \text{ inches of water column} \times 1.025 \text{ density}) / 12 \text{ inches} = \text{approx. } 12,000 \text{ feet}$$

Pressure sensors submerged in sea water need certain **mechanical considerations** in order to survive the environment. Because sea water is corrosive, the wetted material should be evaluated. AST packages a sensor with all 316L stainless steel wetted parts including the pressure sensing element, housing and electrical connection. With lower oxygen content deep in the

ocean and continuous movement of the water, pitting and crevices are minimal. When equipment is removed, oxygen is introduced from the atmosphere and starts the corrosion process. With proper maintenance (rinsing the equipment including the sensor), the sensor will survive.

Because most sensors employ a separate diaphragm than the pressure port, extreme care should be taken to confirm that the **wetted materials** of the pressure port are compatible with stainless steel. Also, the method used to hold the diaphragm to the pressure port is critical. For pressure sensing elements that clamp the diaphragm using an O-ring, the user needs to examine its compatibility. AST's one piece 316L construction and a thick diaphragm membrane without any welds or O-rings. This creates an ideal match for sea level measurement. The diaphragm is thicker, leading to longer life, there is no potential leak path, and only one material to consider.

The **electrical termination** is also a key factor for sub-sea applications. AST uses a wet, plug able style connector from Teledyne Impulse. The connector can withstand 10,000 PSI of pressure, is made of 316L material, and completely seals the electronics of the pressure sensor. The threaded connector is made with gold contacts and glass reinforced epoxy in order to maintain media compatibility and long-term use.

