Submersible Sensors

Advanced electronics have combined with the latest CVD technology to produce pressure transducers that can be used in a wide range of marine applications.

Pressure transducers are currently used throughout the marine sector to perform a wide variety of tasks, offering dependable operation in particularly aggressive conditions. From fuel tanks, hydraulic system reservoirs and flood alarm systems to bilges, potable water storage tanks and cooling systems, marine sensors are built for long and reliable service and can withstand everything from high pressure hydraulic spikes originating from pumps and valves to extremes of temperature, mechanical shock and vibration.

Key to the ability of pressure transducers to work reliably and accurately under such a wide range of marine operating conditions is the way in which sensor diaphragms and electronics packages are constructed. Current devices combine the latest chemical vapour deposition technology with ASIC electronics to form powerful instruments. These compact devices can provide high levels of accuracy, with excellent hysteresis characteristics, over millions of cycles, and can be effectively manufactured in submersible form.

Before looking at exactly how this is achieved, let's consider precisely what these devices are and how they are used. A pressure transducer converts pressure, typically that of fluid or gas, into an electrical signal. By delivering a continuous output of electrical signals that correspond to the precise pressure status, transducers offer a range of options for the control system. For example, a gradual decrease in pressure might trigger a series of escalating alarm signals, allowing appropriate action to be taken before the ultimate level is reached, triggering an automatic shutdown.

In marine applications, pressure transducers are ship-wide and can function under harsh conditions, including turbulent liquids, liquids containing foreign material, sea water, liquid interfaces, high temperature environments and high-pressure fluids. In equipment such as propulsion units and gear boxes, the monitoring and management of oil, temperature and clutch pressure with transducers can make a major difference to performance and overall efficiency.

The fact that these devices can cope with constant shipboard vibration, yet continue to give accurate readings, is impressive, particularly when you consider the sensitivity of these devices and the accuracy of the measurements they can provide. Given that pressure transducers in particular are mechanical structures composed of more than one material, it would not be surprising if the extremes of temperature and vibration that can be experienced at sea were capable of corrupting output signals. However, today's market-leading manufacturers have addressed all such challenges to offer pressure transducers that deliver exceptionally high levels of performance.

Three factors that have been integral to the success of the latest transducers are the use of sputtered thin film technology, chemical vapour deposition (CVD) technology and ASIC (application specific integrated circuits) electronics packaging. It is the successful combination of these mechanical and electronic technologies that has enabled pressure transducers to offer such reliable and accurate performance.

Sputtered Thin Film Technology

Pressure sensors contain a thin sealed sensing element or diaphragm that is in direct contact with the pressure media. Displacement of the diaphragm thus causes the strain gauge to flex, either in compression or under tension, with the electrical output being directly proportional to the pressure or vacuum applied. Output from the sensor is connected to onboard electronics, with the entire unit being contained in a compact and sealed stainless steel housing.

Sputtered thin film technology, which evolved around thirty years ago as a manufacturing process applied during the production of integrated electronic circuits, is a technique whereby a solid target material is bombarded by energised particles, causing it to release atoms. These are then deposited onto a sensing structure in a thin film and to a defined sensor pattern. The application of the sputtered thin film layer during manufacture results in a sensitive, robust sensor that is suitable for direct contact with almost all liquids, oils and gases, offering the flexibility of use that has proved to be one of the great strengths of pressure transducers.

Chemical Vapour Deposition (CVD)

Chemical vapour deposition (CVD) has offered another highly effective technology that can be used in the manufacture of pressure transducers, producing compact devices that provide high levels of accuracy with excellent hysteresis characteristics. CVD sensors can also be manufactured economically, since they are produced on wafers in large batches, using polysilicon deposited on a stainless steel substrate, with the strain gauge patterns being chemically milled. The wafer is then divided to produce individual sensor beams, which are laser-welded to a stainless steel summing diaphragm and pressure port, before being connected to internal electronics for signal conditioning and amplification. This process not only results in a highly accurate and resilient component but also enables sensor assemblies to be mass produced in volume and at low unit cost.

ASIC

A factor that has significantly increased the potential for pressure transducers to be tailored to the needs of the marine sector has been the development of sophisticated electronics packaging. The integral electronic signal conditioning that has been supplied with pressure transducers over recent years often incorporates advanced ASIC technology. With ASIC, the performance and functionality of each transducer can be tuned to meet the specific requirements of individual customers. As with CVD, the benefits of ASIC technology have also brought reductions in manufacturing costs, which can only lead to an even greater presence of pressure sensors in marine applications.

Gems Sensors and Controls manufactures a range of highly versatile and resilient pressure transducers using CVD, including the 2600 Series, a submersible sensor offering stability and accuracy in a variety of enclosure options rated at IP65 and above. For other marine applications, the Gems 5000 Series transducer, which utilizes capacitance technology, is cased in duplex stainless steel, providing a tough resistance to the corrosive effect of sea water, and has provided a highly efficient solution on board ship in low pressure applications, such as gauging large but shallow tanks.

Statistically, the result of combining extremely sensitive pressure sensing elements with a sophisticated electronics package has resulted in some impressive statistics; responses to changes in pressure have been measured at 1msec or less, while sensor accuracy has shown almost zero drift over time. What's more, this level of performance can be maintained over long periods; transducers can now offer an operating life in excess of 100 million cycles, offering a valuable level of defence for shipboard systems at a low price and with little or no need for maintenance.

The technological advances recently applied to pressure transducers have enabled their use in vessels from commercial to military to become so widespread that solutions to specific problems sought by shipboard engineers are now often found in standard units, negating the need for custom solutions. The popularity of pressure transducers in marine applications has, in turn, made their designers ever more familiar with shipboard requirements and ever more able to provide devices that meet the challenges of life at sea.

For more information about how Gems Sensors & Controls finds solutions for the marine applications, please contact us by phone 1.800.378.1600, email info@gemssensors.com or visit our website www.GemsSensors.com.