Getting the vapours

Protecting expensive, safety-critical onboard systems from potential water ingress is not enough, UK testing specialist Versaperm argues – manufacturers also need to safeguard their kit against the damaging effects of liquid vapours

Whilst the majority of ship-bound electronic systems are protected by waterproof housings, enclosures and seals, water ingress is just one of the risks these systems face in a marine environment.

The presence of onboard vapours – such as water vapour, hydrocarbon vapour, hydrogen, solvents and CO_2, for example – can wreak havoc on electrical systems, causing unexpected failures and serious damage to vital onboard equipment. Worst of all, this damage can occur without crew being aware of the problem, until systems finally pack up.

"Water vapour is insidious," Chris Roberts, director at UK-based vapour permeability measurement specialist Versaperm, says. "Permeability actually causes major problems in everything from aerospace to corn flakes. However, electronics and navigation equipment are often safety-critical devices and the marine environment has a far more abundant supply of water vapour than most other areas."

In his view, marine electronics manufacturers tend to get it right when safeguarding their systems from water ingress, but neglect to fully consider the implications of vapour intake. Roberts continues: "[Materials such as] cellulose, ethylene vinyl alcohol [EVOH] or polyvinyl alcohol [PVOH] can form an excellent barrier against liquids, but allow water vapour to flow in virtually unchecked. Once water has got in to an electronics or other enclosure, it condenses and can't get out again."

It isn't just electronic systems that are at risk, Roberts adds; a whole host of onboard areas can be affected. "Laminates can de-laminate; fuel tanks and pipes can 'leak'; seals can fail; greases can get through 'impenetrable' barriers; and so on," he says. "Water vapour also encourages bacterial growth, usually on the water/oil interface, leading to corrosion and undesired changes in the lubricating oil characteristics."

Versaperm's vapour measuring system enables manufacturers to assess the vapour permeability of materials, enclosures and seals in relatively short timeframes

Measuring technique

Subsequently, Versaperm has received a steady flow of requests for use of its lab services from marine electronics manufacturers. The group maintains a vapour detection system at its HQ in Maidenhead, Berkshire, which can be hired and utilised by hardware developers for rigorous kit testing.

The main system, which measures 1m x 0.6m x 0.6m, is designed to measure how quickly vapour flows into the tested system in a range of different conditions, enabling testers to trial various enclosure materials and seals, to determine the best solution to minimise vapour influx. Hydrogen, oxygen, water, CO_2 and solvent vapours are among the vapour types that the Versaperm system has been developed to measure.

The Versaperm system utilises a different measurement methodology to the conventional process of arranging gravimetric measurements. Gravimetric measuring, Roberts explains, typically involves either deploying the test material as a barrier over the top of a small cup, filled with water, or, more commonly, desiccant measuring gain. The material is weighed before testing begins. Then, effectively acting as a seal over the cup, the material is weighed again at intervals ranging from several days to several months, to assess how much of the water vapour has permeated through the material.

Although proven, this method, by necessity, can take a significant amount of time to yield conclusive results. In contrast, the Versaperm system is intended to assess the viability of each material sample, enclosure or seal sometimes within as little as 30 minutes.

"If a material sample is being tested then, roughly speaking, moisture-laden air is pumped past one side of the material, and dry air passed by the other," Roberts explains. "The water vapour passes through the material and the number of molecules that pass through is counted. The system is extremely precise, measuring into the parts per million – and, for some materials, parts per billion – ranges.

"Typically we are trying to mimic the environment the sample is subjected to, dry on one side and wet on the other, so we can accurately reproduce the performance of the test material in use.

"If a finished component or product is being tested instead of a flat sample, the system again utilises a wet and a dry gas, but one will effectively be resident in, or passed through, the component."

Such testing can thereby enable manufacturers to fine hone their products to significantly increase their resistance to vapour ingress, as well as to ditch production processes that only add to the problem.

"Manufacturing itself can change the vapour permeability of a material," Roberts concludes. "I know of one case where blow moulding allowed four times more vapour through than was the case with a flat sample of the same material."

The Versaperm system is also available for purchase, and possibly the more economic option for companies determined to subject their product ranges to regular checks. *SBI*