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Extreme tests at the North Sea

Exposing devices to extreme temperatures, saltwater, fouling, permanent vibrations, explosive atmospheres: tests in real-life conditions can be very telling. This is why steute opted to conduct a 1-year corrosion test at and in the North Sea for several of its switchgear series.

This foot switch for actuating a winch on a mooring hook is continually exposed to saltwater, fouling and seagull droppings – and yet functions perfectly.

As the name says, the switching devices in the steute "Extreme" range are developed especially for use in extreme environments. Conditions might include damp, dirt, very high or very low temperatures, impact from a high-pressure cleaner or, especially in maritime applications, permanent exposure to saltwater or salt spray. The design details of sensors and electromagnetic switches from this range therefore have to differ significantly from those of "normal" industrial switchgear. The sealing must be highly effective, while the housings are made from extremely durable plastics or especially coated, saltwater-resistant aluminium. Screws and other fastening elements are stainless steel.

The sort of applications the steute Extreme developers have in mind can be illustrated using three implemented examples. One Extreme foot switch is used in a coal terminal at a German sea port to actuate the winches on mooring hooks which secure the freight ships. In addition to splash water, these switches are application is an Extreme emergency pull-wire exposed to algae fouling and bird droppings. A second, even more corrosive

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application is an Extreme emergency pull-wire switch used in a salt processing plant where salty residue settles directly on the switches. The third application is different again, with steute Extreme switches being used on chalk quarry conveyors in the United Arab Emirates. Apart from the highly alkaline dust here, the switches are also exposed to damp (due to the proximity of the sea) and huge differences between nighttime and daytime temperatures.

Over the course of the development process, the suitability of the switchgear for such environments must be tested and proven. This takes place under reproducible standardised conditions in the steute test laboratory or at specialist third-party sites. For example, for the salt spray tests used to test the behaviour of the switchgear in corrosive atmospheres, the DIN EN ISO 9227 standards apply.

This salt spray test is very significant for many customers of sensors and switches from the steute Extreme range because they plan to use these switches on oil rigs, on ships, in chemicals plants or in loading terminals at sea ports. And this test is widely known and recognised. Manufacturers of sheet metal coated especially to withstand corrosion, for example, often declare "XX hours in salt spray test" as documentation of the efficiency of their corrosion protection.

But however informative and well known such standardised tests are, they do not necessarily reflect reality. Scientists from the Fraunhofer IFAM (Institute for Manufacturing Technology and Advanced Materials) in Bremen recently pointed out, and not for the first time, that the results of standard salt spray tests "do not always sufficiently demonstrate the failure performance of coatings" (see Editor's note).

As one of the reasons for this, the scientists cite the fact that standard corrosion tests take place under constant conditions, whereas in practice the conditions (temperature, humidity, current, saltwater impact...) change often and drastically. This is why in some areas, e.g. corrosion protection in steel manufacturing, tests involving changing exposure cycles have been performed since the 1990s.

Best option: testing in Extreme real-life conditions

Thus desirable, because meaningful, are corrosion tests in changing, albeit defined real conditions. IFAM offers such conditions at its field test site on the North Sea island of Helgoland. Here components can be tested in "real" conditions, such as those found on the docks of sea ports. The conditions are those changing dynamically with the weather, but also additional factors such as algae fouling, etc.

In order to investigate the suitability of its Extreme switchgear for such applications, steute commissioned IFAM with a 1-year outdoor test at its test site on Helgoland.

One year exposure on the South Mole – in and out of the water

The test set-up: several examples each from selected Extreme switchgear series – including position switches, foot switches and pull-wire switches – were installed at splash water level in an exposed position on the South Mole for one year. Some devices were installed lower down, at tidal level, in order to determine the performance of the devices in the changing

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water movements of the North Sea. Answers were sought to questions such as: How will the housing materials and coatings of the switches fare? Will the stainless steel components stand up to the wear and tear? Where will fouling be visible, and will it impact the operability of the switches?

The ultimate aim of the tests was therefore to expose the switches to very extreme and dynamic conditions beyond any standardised tests, in order to detect any weakpoints the devices might have.

These tests have now been completed. Just the appearance of the switches after a year in saltwater and splash water, but also the subsequent functional tests reveal: the devices from the different series are resistant to saltwater. The devices with reinforced plastic housings were in a particularly good condition. Here steute uses outdoor-compatible plastic pairings of polyester and polyamide to UL 746C, footnote "f1".

The coating system for the devices with metal housings is also suitable for maritime applications. It comprises several mixed powder coatings which are applied to a pre-passivated aluminium surface and meets the challenge of finding a solution to suit both the requirements of the ATEX standards (maximum coating thickness) and very high anti-corrosion levels. Even the laser labels affixed to the coating were still existent and still legible after the test period. A slight contact corrosion could only be ascertained on the devices comprising several metals with different solution potentials, but not even here had the corrosion led to inoperability. This weakpoint has already been specifically addressed, and devices with a new improved alloy have now returned to Helgoland for further testing.

Editor's note:

P. Plagemann, S. Buchbach. Auf einem Auge blind. In: JOT Journal für Oberflächentechnik, special issue Korrosionsschutz 2018, Springer VDI Verlag, p. 36 ff.

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