



# The Role of Sensor Technology for Condition Monitoring of EALs (Environmentally Acceptable Lubricants)

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Internationally recognized standards on protection of marine environment and the corresponding legislation adopted by the US Environmental Protection Agency (EPA) in 2013 “Vessel General Permit” (VGP) limit the application of traditional mineral based oils for vessels entering the US waters and establish instead the necessity of use of environmentally acceptable lubricants for machinery parts below the waterline (e.g. stern tube bearing, thruster gearboxes and horizontal stabilizers). The main reason of change is the adverse impacts of the conventional lubricants on aquatic life due to continuous low-level oil pollution, i.e. the so-called operational discharges in ports (e.g. stern tubes oil leakages).

Owing to the distinctive general characteristics of EALs, namely biodegradability, low toxicity to aquatic organisms and non-bioaccumulative nature, they are considered environmentally friendly especially taking into account their significantly reduced environmental consequences.

Regarding the European standards, although there are no obligatory unified requirements on application of EALs across Europe similar to the US, numerous labeling programs have been developed that set the methods of determining the principal parameters of lubricants enabling their categorization under “environmentally acceptable” (e.g. the German “Blue Angel” label, “Swedish Standard”, “Eco-label” of the European Union, OSPAR for the area of the North Sea etc.).

The growing meaning of these lubricants for shipping industry in the framework of environmental protection as well as their increased use in vessels’ daily operation pose a problem of regular assessment of their condition for ensuring smooth and efficient continuous functioning of various engine components. In view of the fact that high humidity conditions of marine environments or, for instance, undetected water ingress can cause gradual degradation of lubricant condition as well as potential corrosion problems in the long run, it is essential to regularly check such crucial oil parameter as the presence of water and the degree of its concentration in the lubricant under examination.

With respect to the EALs, it is necessary to note that they differ in accordance with the base oil in their formulation: vegetable oils, synthetic esters and polyalkylene glycols. In the context of synthetic ester-based environmentally acceptable lubricants the conventional water-in-oil measuring devices such as WIO Check and TWIN Check of Martechnic® cannot be employed for quick on-site lubricant condition verification. As portable devices are designed for measuring the content of water in oil with the help of the reagent (based on calcium hydrid), this method is not suitable for EALs because of the occurring chemical reaction between the reagent and parts of the lubricant itself.

Accordingly, it is advisable to install advanced sensor technology in order to conduct continuous real-time monitoring of water-in-oil concentration. Depending on the specific case, either sudden seawater ingress or lubricant contamination as a result of high humidity from the air, Martechnic® offers two different sensor systems developed with account of a particular case: the Humidity Sensor and the infrared water in-line sensor AHHOI. In both cases the importance of continuous measurement can be explained by the fact that contact of environmentally acceptable lubricant with water leads to increased biodegradability of oil. This means that the lubricant's life (initially longer than the life expectancy of the conventional mineral based oil) can get decreased if water is not detected in due time.

The Humidity Sensor was developed for assessment of machinery components where lubricant is not supposed to contain any water per se, but due to the increased humidity factor of marine environment, the oil might contain a certain degree of water.

In order to always stay confident about the current lubricant condition and in particular the degree of water content, it is possible to measure the saturation degree of oil with water.



The Humidity Sensor can be installed into different parts of the engine system, for instance, bow thruster, stern tube bearing, horizontal stabilizers and continuously transmit information on relative oil humidity in % ranging from 0 % (no water detected) to 100 % (complete saturation/ existence of free water). The obtained data are constantly processed to the special display unit Datalogger and saved. The early warning system of the Humidity Sensor provides immediate notification of the increased water content and enables detection at the pre-alarm level.

The upgraded version of the Humidity Sensor – Humidity Sensor Plus enables also additional measurement of further lubricant parameters such as relative permittivity and conductivity. Based on the combined calculation of the measured values the semi-intelligent sensor provides information on the remaining useful lifetime of the oil under inspection.



Another sensor system – AHHOI – is applicable for continuous monitoring of various engine systems (e.g. main engine, gearboxes, hydraulic systems etc.) and is

recommended to install for early detection of sudden seawater ingress and offers vessel operators and engineers the possibility to early identify any abnormal water concentration. Due to the infrared technology, the AHHOI Sensor enables determination of water in all three states: saturated, emulsified and free measured in

molecular form in the range of up to 10000 ppm / 1.0 vol. %. All the measured values will be transferred to the Datalogger and saved.



The sensor is installed in the bypass and if equipped with the manifold enables simultaneous monitoring of up to four different oil systems. Each oil system gets pre-calibrated for the particular oil grade in use. Due to this advantageous feature of the AHHOI, it is possible to monitor different oil types including the engine systems employing environmentally acceptable lubricants.

Similarly to the Humidity Sensor, the AHHOI is fitted with the alarm system which enables early detection of irregularities at the pre-alarm level.

Consequently, taking into account the benefits of the sensor technology and the above-specified limitations of EALs, the sensor systems of Martechnic® play a critical role in terms of accurate lubricants condition assessment. More information on sensors can be found on our website: [www.martechnic.com](http://www.martechnic.com)