IRON CHECK E

Digital Test for Chemical Determination of Iron Content (Patent Number: 2982974)

Martechnic®'s Remark: Fundamental Differences of IRON CHECK E Measuring Method

Measurement of iron concentration in cylinder drain oil (CDO) can be applied with various analysis methods by means of laboratory equipment or on-site test devices. Each measurement method may differ remarkably in terms of iron definition, sample preparation, determination of measuring range and measuring unit. Depending on the measuring method, the obtained tests results can also differ. It is important to understand crucial differences between various measurement methods and as per CIMAC recommendation "…to ensure that the data are generated by the same laboratory, the same apparatus and the same method…" before any comparison of analysis results can be made.[1]

When conducting CDO analysis, **total iron** concentration in CDO samples should usually be measured beside the remaining base number in accordance with recommendations and practices of major engine manufactures of two-stroke diesel engines. **Total iron** is an indication of wear and tear of the components surrounding the engine combustion chamber as a result of mechanical friction (**ferromagnetic iron/ abrasive wear**) and acid corrosion due to chemical reaction from combustion residues and sulphur present in the fuel oil (**non-magnetic iron /corrosive wear**).

Among different laboratory methods, **ICP analysis (Inductively Coupled Plasma Mass Spectrometry)** is mostly used for iron content determination. This measurement method enables detection of iron particles (**ferromagnetic and non-magnetic**) only up to a certain size, usually up to 5-8 µm (microns), as larger particles cannot be vaporized. When using this methodology alone, large iron particles that are typically generated as a result of engine components wear and tear (e.g., pistons, pistons rings and cylinder liners) cannot be detected and measured. Therefore, low measured iron values trends should be carefully examined and critically evaluated.

In case of assumption of increasing or abnormal wear, a **ferromagnetic PQ (Particle Quantifier) Index** may be used to complement the test results obtained through ICP methodology. The PQ Index does not have limitations of particles size and can detect the presence of larger ferrous particles which are not identified by the ICP analysis. However, the PQ Index is a unitless number, a "score" to provide **a relative quantitative assessment** of total ferromagnetic particles accumulation in a CDO sample. The bigger the "score", the more iron particles have been detected. Their exact size cannot be interpreted as a value in mg/kg (ppm).

[1] CIMAC „Used Oil Engine Analysis – User Interpretation Guide", p.11. 30 November, 2011. / https://www.cimac.com/cms/upload/Publication_Press/Recommendations/Recommendation_30.pdf (10.07.2021)

Laboratory reports of the CDO analysis often indicate a combination of the ICP measured value with additional determination of the PQ Index. The provided data can be assessed in the form of a **relative concept of total iron concentration** as no final value of total iron (in mg/kg/ ppm) can be calculated. To estimate a cylinder condition and a wear degree of the engine system components a comparative configuration is rather used: low ICP / low PQ, high ICP / low PQ, low ICP / high PQ, high ICP / high PQ. Interpretations may vary accordingly from normal to serious and critical engine wear condition.

In contrast to the above-mentioned laboratory analyses, the test device **"IRON CHECK E"** offers a different testing method specifically elaborated for regular application by engineers and users directly on site and is based on **chemical determination** of **total iron** content in **mg/kg (ppm)**. An entire CDO sample without any prior treatment is required in order to provide representative and accurate test results.

The test device **"IRON CHECK E"** detects and measures **all** iron particles present in the CDO sample irrespective of their size and the reason of iron accumulation (abrasive wear or acid corrosion). Accordingly, also large iron particles will be identified, measured and displayed by the test device.

The presence of iron particles can be also clearly visually observed after a test. If any iron is contained in the CDO sample, the chemical reaction between the special reaction liquid and the iron will result in a blue color change of the liquid. The intensity of the blue color may vary from light to dark blue and directly depends on actual **total iron** concentration in the CDO sample.

If the measured value of **total iron** concentration is significantly higher than the limits established by the engine manufacturer and a repeated measurement with the test device **"IRON CHECK E"** displays the same result, inspections of the engine by the ship's crew has to take place in order to identify the problem. To narrow down the scope of the probable cause, it is possible to measure **corroded iron** with the **"IRON CHECK E"** almost in a similar manner as total iron and/or to assess **abrasive iron**. Any further actions should be taken in accordance with the instructions of the engine manufacturer.

The test device **"IRON CHECK E"** is generally intended for preventive routine monitoring of CDOs to follow the trends in total iron content in order to recognize unusual measured values (high amount of total iron concentration) in due time which may be an indication of impending damages in the engine system before serious engine wear occurs.

Please contact Martechnic® GmbH for any further information on the test device **"IRON CHECK E":** info@martechnic.com