



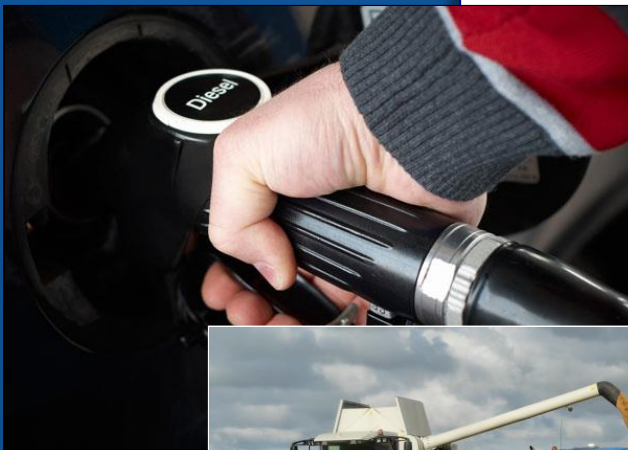
www.FA-ST.co.uk

Filtration Analysis Services Technology Ltd

How clean is your oil ?

Diesel Fuel Analysis Service

How Clean is your Oil?



Certificate Number 22484

Email: info@fa-st.co.uk

Tel: +44(0)1246268900

Visit: www.oilsampling.co.uk

www.fa-st.co.uk



Contents

Wear Analysis Testing of Diesel Fuels	3
Ferrous Wear / PQ Index.....	3
Contamination Testing on Diesel Fuels	3
Particle Counting (ISO 4406 Standard).....	3
Understanding the ISO 4406:2017 Standard	3
Water Count	4
Flash Point	5
Fatty Acids Methyl Esters (FAME) count	5
Testing Chemical Make-up of Diesel Oils	5
Specific Gravity	5
Diesel Bug, Mould & Fungus detection	5
Sulphur.....	6



Certificate Number 22484



Wear Analysis Testing of Diesel Fuels

Ferrous Wear / PQ Index

Using the 51FW meter

As the ICP analysis only covers particles up to 15 micron without becoming blocked then a method of detecting larger particles is required. This is carried out via the ferrous wear Index (FW Idx). Ferrous particles are selected for this as in most common equipment ferrous metal tend to represent the most common metals in components, also the FW Idx can be quickly, and cost effectively measured.

No matter the test, trending is always the most useful method for identifying impending issues, however one additional correlation may be made between ferrous content and iron by elemental spectroscopy. If the iron by elemental spectroscopy is elevated, but ferrous wear concentration remains low, it may be surmised that the wear particles are small (<10 microns) and therefore from normal wear modes. When results from both tests are elevated, then the wear mode is likely transitioning from normal to abnormal; and if iron by elemental spectroscopy is low or consistent, but ferrous wear concentration is elevated or increasing, then the wear particles are likely large (>10 microns) and considered to be due to abnormal or severe wear modes.

Pros: Provides a count on total number of magnetic particles irrelevant of size.

When used in correlation with ICP analysis allows users to see if normal or abnormal wear is occurring.

Cons: Not all methods of calculating the FW Idx are the same.

Contamination Testing on Diesel Fuels

Particle Counting (ISO 4406 Standard)

The ISO particle count determines the cleanliness level of an oil. With oils main function being to provide lubrication to components, having dirt trapped within the oil will lessen the lubricity and cause scouring to components increasing wear levels are reducing component life span. To allow us to determine the cleanliness levels then we use the ISO 4406:2017 standard. When used to gauge cleanliness levels this standard will count particles at 4-micron, 6-micron, and 14-micron in size. Once this has been done the total number of particles in of each size can be correlated with the ISO classification table and the cleanliness can be determined. Particle counting does not distinguish between wear and dirt particles and provides at total number of particles within the oil.

Understanding the ISO 4406:2017 Standard

As stated, the ISO counts look at particles that are 14 micron and above, 6 micron and above and 4 micron and above. **The following is for example purposes only** if we look at a typical 100ml sample of oil, then we would expect to see:

450,000 particles within the oil that are **14 micron and above**

120,000 particles within the oil that are **6 micron and above**

14,000 particles within the oil that are **4 micron and above**



Certificate Number 22484



The table below shows how to convert the number of particles into ISO classification numbers.

ISO 4406 Standard Classification table		
Number of Particles From	Number of Particles To	ISO classification number
8,000,000	16,000,000	24
4,000,000	8,000,000	23
2,000,000	4,000,000	22
1,000,000	2,000,000	21
500,000	1,000,000	20
250,000	500,000	19
130,000	250,000	18
64,000	130,000	17
32,000	64,000	16
16,000	32,000	15
8,000	16,000	14
4,000	8,000	13
2,000	4,000	12
1,000	2,000	11
500	1,000	10
250	500	9
130	250	8
64	130	7
32	64	6
16	32	5
8	16	4
4	8	3
2	4	2
1	2	1

If we take our example then we would have the **ISO code of 19/17/14** this is due to:

The number of particles is between 250,000 and 450,000 per 100ml of oil then the Classification number would be 19.

As we can see from the table if the number of particles is between 64,000 and 130,000 per 100ml of oil then the Classification number would be 17.

As we can see from the table if the number of particles is between 8,000 and 16,000 per 100ml of oil then the Classification number would be 14.

Water Count

Using Karl Fisher ASTM D1744

Water Counts conducted using the Karl Fisher method are determined by, having a reagent that reacts with water and then converts the water into a non-conductive chemical. Samples analysed in our independent laboratory the coulometric Karl Fisher approach is used. In this method the reagent and solvent (normally Methanol or ethanol) are combined in the titration cell. Once a sample is added to the cell an electrical current is passed through, the total water count is calculated by measuring the current required to make the water in the sample react with the reagent.

Pros: Able to detect water content from 1ppm to 100%

Cons: Additives that contain elements like phosphorus can provide erroneous water counts.





Flash Point

Via closed cup method

All flammable liquids have a flashpoint. It is defined as the lowest temperature at which the liquid can form an ignitable mixture in air. All flammable liquids have a vapour pressure. The vapour pressure is closely related to the liquid's temperature. So, as the temperature increases, so does the vapour pressure. When the vapour pressure increases, the concentration of evaporated flammable liquid in the air increases. It is therefore clear that the temperature determines the concentration of evaporated liquid at equilibrium. In essence, **the flashpoint is the lowest temperature at which enough fuel vapour exists that it will ignite.**

For standard Diesel Fuel (cars, bulk tanks etc) must not be positive below 56°C.

For Marine Diesel Fuel must not be positive below 61°C.

Fatty Acids Methyl Esters (FAME) count

Value given as a percentage

The FAME test is to detect the level of bio-acids that are in biodiesel. Biodiesel is now the standard road diesel used in the UK, EU and most other places. Instead of just having standard diesel from the refinery an allowance of biodiesel can be blended with the fuel to provide a cleaner green fuel for consumers. This issue is that biodiesel contain by nature of what they are fatty acids that build up and can cause damage to engine components. Due to this there is a current level of 7% FAME allowable in the fuel, above this and current engine components such as injectors, pumps, filters etc in standard road cars not converted to run on biofuels with develop issues.

FAME levels should only be detected in road diesel samples as **Marine Diesel should be 0%**

Testing Chemical Make-up of Diesel Oils

Specific Gravity

How heavy the fuel is and has a relationship with Cetane rating, this indirectly can point to other sources of contamination. Density of diesel fuel varies slightly depending on the ambient temperature. Diesel fuel varies between 0.815 g/cm³ and about 0.87g/cm³ between 15 degrees Celsius and about 25 degrees Celsius (Can vary depending on diesel type). The specific gravity of a liquid is basically the ratio of the density of a substance when compared to a standard. In most cases that standard is water.

Diesel Bug, Mould & Fungus detection

This is microbiological growth that forms in diesel fuels and can block filters causing engines to cut out. It tends to develop in dirty wet fuel however once a tank is infected will need treating with biocide to remove the growth (see below for further details).

Bugs/ Yeast - These are reported in **cfu/ml (Colony forming units per ml)**.

10⁻² = 100 cfu

10⁻⁴ = 10000 cfu

10⁻⁷ = 10000000 cfu

Fungus is reported as **slight, moderate or heavy**, because it doesn't form cfu's in the same way as bacteria.

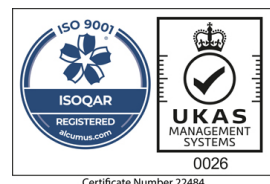




Sulphur

Measured by parts per million (ppm)

Sulphur was a common additive in diesel fuel with allowable levels up to 3000 parts per million. However, in 2007 these levels were dropped to 500 ppm for marine fuel and removed from road diesel due to the environmental impact of sulphur oxide emissions that are created. We test all diesel fuel for sulphur as an additional test in our FUELKIT2 ONLY as this test these days is only relevant for marine diesel, old diesel users or suspected sulphur in the diesel fuel.



Certificate Number 22484



www.FA-ST.co.uk
Filtration Analysis Services Technology Ltd

How clean is your oil ?

Oil & Fuel Sampling

With our wide range of sample bottles and containers our customers can take a wide range of samples including oils, diesel fuel, coolants, glycols and a selection of chemicals and other fluids. Supplying our customers with:

- Vacuum Sampling Pumps
- Sample Bottles
- Sample Tubing
- Complete Oil & Fuel Sampling Kits



Oil Analysis

FA-ST provide a comprehensive range of oil testing allowing you to determine the cleanliness, contamination, chemistry and identify wear particles in lubrication oils, diesel fuel, coolants, and greases etc. at our independent oil analysis laboratory.

With the support of the FA-ST oil analysis program you can consistently monitor the quality of the fluids used on your machinery & equipment, detect potential component failure, reduce maintenance costs and help decide the correct oil change intervals.



Oil Filtration

FA-ST have an extensive range of oil filtration equipment especially designed to remove particulate, water and magnetic particles from oils, diesel fuel, coolants & glycols. Working with some of the industries leading businesses we aim to bring you the finest filtration equipment on the market including:

- Oil, Diesel & Glycol Filtration Systems
- Filter Cartridges for a wide range of fluids
- Magnetic Pre-Filters
- Bypass Filter Systems



How Clean is your Oil?



For all your oil sampling, filtration & Analysis needs contact FA-ST:

Phone +(0)1246268900
Email: sales@fa-st.co.uk
Visit: www.oilsampling.co.uk

