FA-ST Filtration Analysis Services Technology Ltd

OIL FILTRATION SOLUTIONS FOR

Oil Analysis – Diesel Fuel

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FA-ST provides analysis of diesel fuel allowing our customers to make informed decisions on the quality, and usability of the fuel. A comprehensive range of standard tests covering Cleanliness, FW, Density, Flash point, Water content, Diesel bug and bacterial growth. Additional tests (additional costs apply) are provided such as sulphur content can also be carried out. This document is to help customers to fully understand the reports, tests, alarm limits (on our reports), and what the results actually mean.

Wear Analysis

FA-ST diesel fuel wear analysis tests are:

- **FW Idx –** Stands for Ferrous Wear Index. It is a measure of the amount of the ferrous (magnetic iron-containing) material in your sample. Samples containing a lot of fine ferrous particles or several large ferrous particles will generate a high FW index. Since this number is an index it has no unit – it is used for comparative purposes only.

Contamination Analysis

Our lab carries out ISO Particle count for cleanliness levels, Water by Karl Fisher Water count and Flash Point analysis to determine mis-fueling/solvent contamination.

- **Particle Count (ISO) –** Particle counting is actually a test for particle contaminant levels and not specifically wear debris. It does not distinguish between wear and dirt particles, but if it can be determined that nonferrous contamination has remained stable, then an increase in the particle count must be attributable to wear.

  A magnet can be used to modify the particle count to count ferrous debris only. There are various ways of doing this, but essentially a magnet holds back the ferrous debris while the nonferrous debris is flushed from the sample, after which a ferrous debris particle count is performed.
  Particle counts are invariably reported according to ISO 4406:99. Other standards do exist, but they are not as commonly used. ISO 4406:99 returns a three-digit (ISO) solid contamination code.
  The method of particle counting is not as important as performing the test properly. It is important to note that only results from the same method should be compared.

- **ISO 4406 Standard –** The ISO 4406/2000 classification of particle contents was introduced to facilitate comparisons in particle counting. Sudden breakdown in a fuel system is often caused by large particles (>14 micron) in the fuel while slower, progressive faults, e.g. wear and tear, are caused by the smaller particles (4-6 micron).This is one of the explanations why the particle reference sizes were set to 4 micron, 6 micron and 14 micron in ISO 4406/2000. Cleanliness Particulates have mass and can be removed by mechanicalfiltration.

  A typical sample contains in every 100 ml of oil:

  50,000 particles >4 micron
  120,000 particles >6 micron
  14,000 particles >14 micron

  Introduced in the ISO classification table (next page), this oil sample has a contamination class of 19/17/14.

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O 4406 Standard Classification table		
Particles From	Particles To	ISO Number
80,000	160,000	24
40,000	80,000	23
20,000	40,000	22
10,000	20,000	21
5,000	10,000	20
2,500	5,000	19
1,300	2,500	18
640	1,300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2.5	5	9
1.3	2.5	8
0.64	1.3	7
0.32	0.64	6
0.16	0.32	5
0.08	0.16	4
0.04	0.08	3
0.02	0.04	2
0.01	0.02	1

- **Water K.Fischer** – The Karl Fischer test measures the exact amount of free and dissolved water molecules contained in the oil sample. This is reported in Parts Per Million (PPM) until 2% water is detected then reported as a percentage from then. Specification is less than 200ppm but seldom should be above 20 ppm. Water can only be fully removed by chemically absorption filtration; coalescing will not remove all emulsified and dissolved water.

- **Flashpoint** – 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.

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Chemistry tests include:

- **Density/specific gravity/API –** How heavy the fuel is and has a relationship with Cetane rating, this can 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 0.87 g/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.

- **FAME testing –** FAME testing tests for the amount of biodiesel in your fuel. Current EU levels are at 7% and anything above this could cause issues for injectors, pumps, filters etc. Marine Diesel should be0%

- **Bug Bactria –** 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.

Diesel Bug Treatment

Diesel Bug Treatment is exactly what the product says. Our diesel bug treatment is a biocide blend formulated especially for preventing or eradicating the fuel spoilage organisms known collectively as diesel bug. A 100ml bottle is sufficient to prevent diesel bug growth in 2000 ltrs of fuel. For serious contamination addition rates of 100ml to 100 ltrs may be required. Very rarely over 15 years of selling the product have we had to clean out a tank but for severe contamination several doses may be required to break up and remove the biological sludge that forms. Our diesel bug treatment disperses into both the water and fuel phases in your tank and will remain sufficiently active for over a year at both high and low temperatures. Marine 16 Diesel Bug Treatment is the fuel treatment of choice for the RNLI, The Royal Marines, Sea Start and River Canal Rescue as well as being number 1 in the Practical Boat Owner magazine review.

Diesel Bug Test Kit

The individually packed Marine 16 diesel bug test-kit can be used to check for microbial contamination of diesel fuels in boats, storage tanks, home heating fuels etc. Contains full instructions of use, results in approx 3-4 days

One test per kit.

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Understanding your Report

Understanding oil reports is vital to ensure the correct actions are taken and your oil is maintained in working order. The following is a breakdown of the FA-ST diesel analysis report and guidance on our alarm levels. Please note that due to the many factors regarding storage of oil unique site conditions and previous trend lines these are for guidance only and report results could vary.

Units & Alarm limits

The table below shows the main points of analysis of a FA-ST diesel report and the units measured in. These should be referred to as **GUIDANCE ONLY** as many factors can affect results and due to this faults may be reported differently. Also these only relate to diesel analysis carried out at FA-ST and other analysis labs may vary.

Diesel Fuel Analysis Reporting Limits					
Standard Diesel Analysis Tests					
Parameter	**Units**	**High Fault**	**Low Fault**	**High Alert**	**Low Alert**
ISO 4	**Parts Per Million (PPM)**	**23**	**22**	**20**	
ISO 6	**Parts Per Million (PPM)**	**21**	**20**	**18**	
ISO 14	**Parts Per Million (PPM)**	**18**	**17**	**15**	
FW Index	**Index**	**5**	**4**	**2**	
Specific Gravity	**Specific Gravity**	A pass between 0.815-0.870 otherwise a red high fault fail			
Flash Point	**˚C**	**< 55**	**N/A**	**N/A**	**N/A**
Density					
Water	**PPM**	**1000**	**500**	**200**	*
FAME	**%**	**7.1**			
Diesel Bug/Yeast	**Cfu/ml**	**10000**	**1000**	**100**	**10**
Additional Diesel Analysis Test					
Sulphur	**Parts Per Million (PPM)**	**3000**	**2000**	**1001**	**500**

*Discretion of the operator to highlight a trend or to illustrate a point – less than 200ppm Acceptable.

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FA-ST UK
Filtration Analysis Services Technology
How clean is your oil ?

Oil Analysis Report

Standard oil report is broken into 6 sections

IDENTIFICATION & EQUIPMENT

UNIT/OIL USAGE REFERENCE OIL

RESULTS TABLE

REULTS TABLE SHOWING CURRENT AND HISTORICAL DATA.
EACH CATEGORY AND ELEMENT IS ALARM COLOUR CODED.

COMMENTS AND RECOMMENDATIONS BOX

COMMENTS FOR CURRENT SAMPLE BASED ON EXPERIENCE OF SIMILAR EQUIPMENT AND BUILT IT ALARM LIMITS SPECIFIC TO INDIVIDUAL ASSETTS.

TRIVECTOR

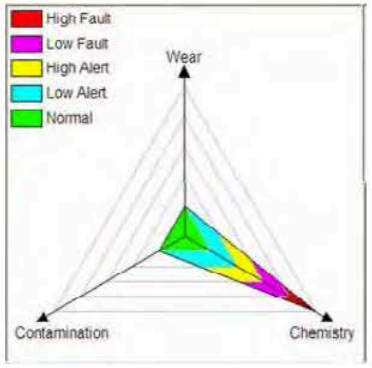
TRIVECTOR: IS AN AT A GLANCE INTERPRETATION OF THE WHOLE REPORT.

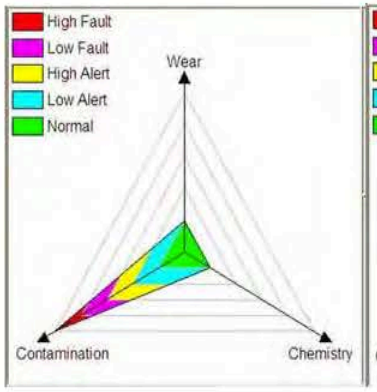
1) WEAR
2) CONTAMINATION
3) OIL CONDITION/CHEMISTRY

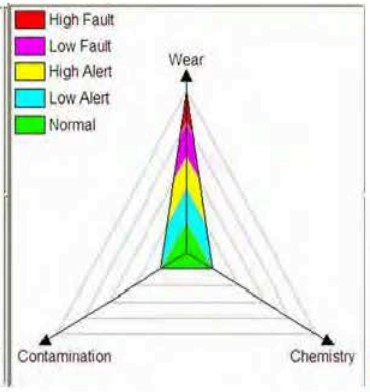
ALL OR ONE BRANCH CAN SHOW THE ALARM STATUS FOR THAT CATEGORY.
THIS REPORT SHOWS HIGH LEVELS OF PARTICULATE CONTAMINATION.

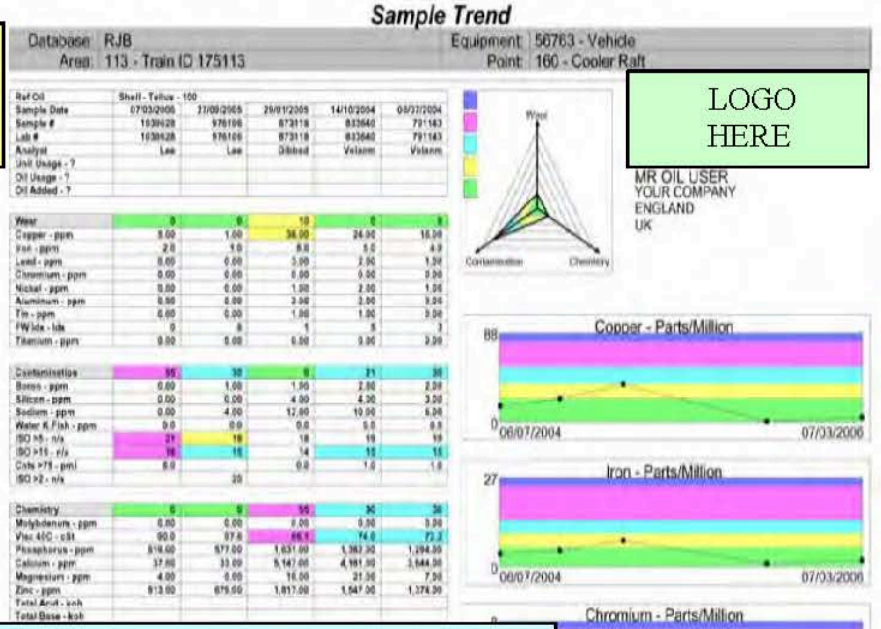
TREND GRAPHS

ELEMENTAL PLOTS SHOWING TRENDS AND HISTORICAL DATA









LOGO HERE

MR OIL USER
YOUR COMPANY
ENGLAND
UK

THE WEAR RATE IS STABLE BUT THE OIL COUNTED VERY DIRTY. CHANGE THE OIL AND FILTER(S) AND RESAMPLE EARLY TO MONITOR.

HISTORICAL DATA USING TREND ANALYSIS

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If you contact FA-ST regarding a sample the sample number will be vital to ensure the correct sample is found

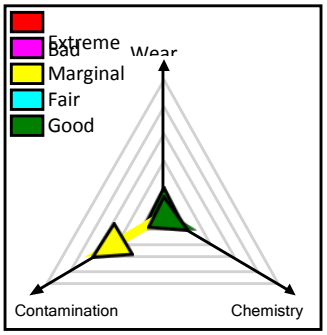
Database:	Company Data Base	Equipment:	Type of equipment i.e. bulk tank
Area:	Area in database & Customer Name	Point:	Sample point i.e. Draw off Point

Sample Date	01/02/2017	01/01/2017	Date Sample was taken
Sample #	1770740	1770739	Unique Sample Number
Unit Usage	2000	1000	Total Equipment Usage
Oil Usage	1000	1000	Equipment usage since last analysis
Oil Added	20	N/A	Amount of oil added litres

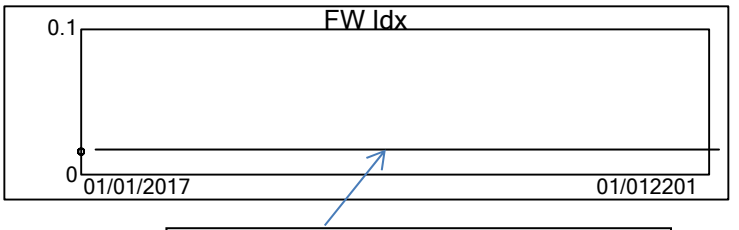
Wear	0	0	Meaningless value(s)
FW Idx	0	0	Ferreous Wear Index

Contamination	30	0	Meaningless value(s)
Cnts >4	12,424	3,358	Number of particles above 4 micron
Cnts >6	3,411	535	Number of particles above 6 micron
Cnts >14	454	48	Number of particles above 14 micron
Cnts >18	103	11	Number of particles above 18 micron
Cnts >22	45	6	Number of particles above 22 micron
Cnts >32	22	4	Number of particles above 32 micron
Cnts >38	7	2	Number of particles above 38 micron
Cnts >56	2.0	1.0	Number of particles above 56 micron
ISO >4	21	19	ISO Cleanliness rating
ISO >6	19	16	ISO Cleanliness rating
ISO >14	16	13	ISO Cleanliness rating
Water K.Fish	260.00	39.00	Water count in ppm or %
Flash Point	56.0	56.0	Degress Celcius Flashpoint

Chemistry	0	0	Meaningless value(s)
Specific Gravity	.8410	.8400	We use a general limit of 0.815-0.870



Trivector: is an at a glance interpretation of the whole report.
1) Wear
2) Contamination
3) Oil condition/chemistry
All or one branch can show the alarm status for that category. This report shows high levels of particulate contamination.



Trend line referring to previous sample(s)

Oil Report write up. The technicians will report their findings and may give recommendations for actions. The FAME count is reported in % and Diesel Bug counts may also be found here. Example below:

THE FUEL HAS COUNTED DIRTY AND IS SLIGHTLY WET CONSIDER USING AN EXTERNAL FILTRATION UNIT TO RETURN CLEANLINESS LEVELS. NO PETROL CONTAMINATION WAS DETECTED. FAME CONTENT 3.1%. BACTERIA COUNT = NEGATIVE. FUNGUS COUNT = NEGATIVE. RESAMPLE AS NORMAL

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