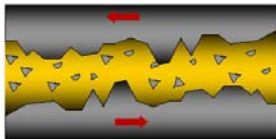


PPM (parts per million wt/wt) result of several metal elements (e.g. iron, copper ,tin ,aluminum ,ect) in used oil sample is usually analyzed by an Atomic Emission Spectrometer (AES) or Spectrometric Oil Analysis technique . PPM (parts per million) unit is the concentration of wear metal elements .
Unfortunately , Spectrometric Oil Analysis technique is unable to detect all wear metal element debris -particle

size . Each Atomic Emission Spectrometer have its limited range detection –sensitivity .(see picture 1) . Spectrometric Oil Analysis technique have been known to have decreasing sensitivity as particle size increased.

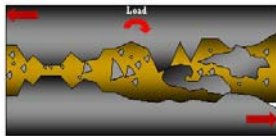
During machinery in operations , wear metal debris particles are generated by rubbing motion of mechanical component parts , are either normal wear or abnormal wear .

Normal wear particles will tend to have particle size in fine wear particles or small wear particles or less than 5 micron in size .



Normal Wear

Abnormal wear mechanism (high load ; high speed) , often tend to proceed gradually with many fine wear particles together with coarse or large wear particles (larger than 5 micron) .



Abnormal Wear

Particle Size Limitation of Spectrometric Analysis

Traditional Spectrometric Analysis that are widely used for measuring concentration (in PPM units) of wear metal elements ,additives and contaminants in used oil analysis are “RDE-AES Spectrometer” or “ICP AES

Spectrometer” . Those spectrometer methods (RDE spectrometric and ICP Spectrometric) are blinded or unable to detect large wear debris particles indicating abnormal wear .

Most widely understanding and accepting , that

ICP – AES Spectrometers **can not** detect wear metal particles more than 3 micron in size .

RDE – AES Spectrometer **can not** detect wear metal particles large than 8 microns in size.

“Spectrometric oil analysis measures only very small particles and dissolved metal elements in oil ”

“ Spectrometric oil analysis , as they are routinely applied today , are blind to large debris wear particles”

Abbreviation :

RDE – Atomic Emission Spectrometer : Rotating Disk Electrode - Atomic Emission Spectrometer

ICP – Atomic Emission Spectrometer : Inductively Coupled Plasma - Atomic Emission Spectrometer

Method of detecting large wear particles.

Focuslab have been introducing RFS Spectrometric Analysis (RFS Coarse Wear Spectrometric Analysis) combined with RDE Spectrometric Analysis (RDE Fine

Wear Spectrometric Analysis) , the combined 2 test method is called “ **Double WearCheck™** ”



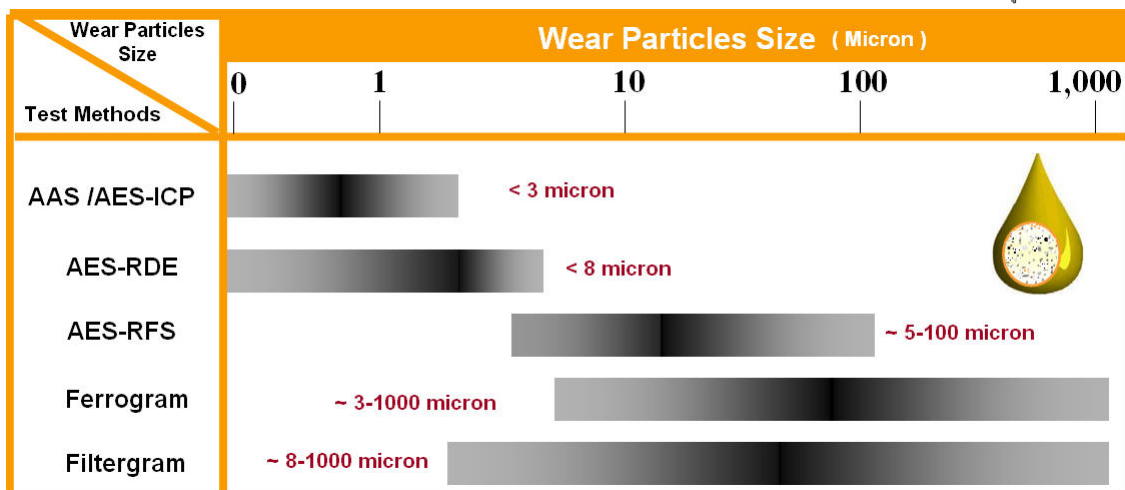
Double WearCheck™ √√ is a special Spectrometric Analysis that combining RDE Spectrometric Analysis together with RFS Spectrometric Analysis in order to detecting metal element concentration (in ppm unit) of both

- fine wear debris particles -metal elements
- coarse wear particles - metal elements .

RFS Spectrometer technology was developed specifically to detect large particles of wear metals and contaminants particles in used oil.

Limit Detection of Each Instrument

รูปที่ 1



Focuslab has been integrating the RFS method with RDE spectrometer (for fine wear metals ,additives and contaminants) to provide an excellent Spectrometric Analysis .

Double WearCheck™ √√ are named for this dual spectrometric analysis (RDE + RFS).

Double WearCheck™ √√ will give more advanced warning than traditional or conventional spectrometric analysis in used oil analysis –conditioning monitoring .

If **Double WearCheck™** √√ detects any abnormal or severe wear , then we can perform further analytical testing such as **Ferrographic Analysis** to find out Root Cause.

Abbreviation :

RFS Spectrometer : Rotrode Filter Spectroscopy - Atomic Emission Spectrometer

RFS Coarse Spectrometric
(ขนาดหยาบ ประมาณ 8-100 ไมครอน)

RDE Fine Spectrometric
(ขนาดละเอียด < 8 ไมครอน)

Wear Element	Method	Unit	RDE fine	RFS coarse
Iron	D-6595	PPM	8.8 C	2444.3 W
Chromium	D-6595	PPM	0.0	9.6 W
Lead	D-6595	PPM	0.0	4.6
Copper	D-6595	PPM	0.0	20.6 C
Tin	D-6595	PPM	0.0	0.0
Aluminum	D-6595	PPM	0.0	136.2 W
Nickel	D-6595	PPM	0.0	1.2 C
Silver	D-6595	PPM	0.0	0.0
Molybdenum	D-6595	PPM	0.0	0.8
Titanium	D-6595	PPM	0.0	0.0

FOCUSLAB Fluid & Oil Analysis Technology

ISO 9001:2008 Certified

FocusLab Ltd. Page 1 / 6

Code : 25038 Unit ID : 291 HW 101 WFE Preflash

Name : Unit Type : Geosox Generel

Address : 4th Industrial Estate, No.3 Moo2 T.Bangtoeng, A.Bangcoeng Rayong 21130 Unit Make : NORD

Site : Unit Model : SK 103F REC 225-225 8/4

Oil type / Viscosity : Shell Casello OL200

Test code : 884 Oil System Capacity : 27.5 Liters

Overall Condition Rating

WARNING CAUTION OK

Notes (Finding, Evaluation, Interpretation, Suggestion and Recommendation)

Sediment particles found in bottom of sample bottle.
Note the significant increase in ferrous particles since the last sampling. This is cause for concern.
Heavy amount of dirt and abrasive wear noted.
Recommend check for other abnormal operating parameters, i.e., vibration, noise, heat etc. If abnormal condition exists, please inform laboratory with next sample.
Recommend change oil and flush system with clean oil to remove contamination, if the oil from this sample is still in use in this component.

Condition History	Current Sample			Previous Sample			Baseline and Alarm Limit		
	Wear	Oil	Cont.	Wear	Oil	Cont.	Wear	Oil	Cont.
Lab ID	149610	146401	145491						
Bottle ID	924883	924288	916208						
Date Sampled	05-Dec-10	18-Oct-10	30-Sep-10						
Oil Hours (Kims)	1272	562	192						
Unit Hours (Kims)	1272	562	192						
Oil Added (Liters)									
Filtere Hours (Kims)									

Wear Condition

Wear Element	Method	Unit	RDE fine	RFS coarse
Iron	D-6595	PPM	8.8 C	2444.3 W
Chromium	D-6595	PPM	0.0	9.6 W
Lead	D-6595	PPM	0.0	4.6
Copper	D-6595	PPM	0.0	20.6 C
Tin	D-6595	PPM	0.0	0.0
Aluminum	D-6595	PPM	0.0	136.2 W
Nickel	D-6595	PPM	0.0	1.2 C
Silver	D-6595	PPM	0.0	0.0
Molybdenum	D-6595	PPM	0.0	0.8
Titanium	D-6595	PPM	0.0	0.0

Oil Condition

Parameter	Unit	Value	Limit
Viscosity @ 40°C	cSt	216.8	217.0
Viscosity @ 100°C	cSt	216.2	<150.4
Cloud Point	°C	3.4	3.2
Nitration	FTIR Abs	2.5	2.7
TAN	mg/Kg	0.27	0.33
TBN	mg/Kg	0.26	0.33

Contamination

Parameter	Unit	Value	Limit
Water	% (Wt)	0.031	0.019
Sodium	PPM	1	3
Silicon	PPM	2.3	11.3

Additive Element

Parameter	Unit	Value	Limit
Boron	PPM	0	0
Magnesium	PPM	1	5
Calcium	PPM	7	21
Barium	PPM	0	0
Phosphorus	PPM	316	333
Zinc	PPM	7	21

Additional Test

Parameter	Unit	Value	Limit
Flash Point	°C		
Viscosity Index			

Note: Alarm Limits are variable and dependent upon dataset size and to be used as general guideline.
No Sign or (N) : NORMAL, (C) or (A) : CAUTION (first level warning limit), (W) or (M) : Warning (second level warning limit)
(U) : Upper CAUTION Level, (L) : Lower CAUTION Level, (U) : Upper WARNING Level, (L) : Lower WARNING Level
Results will be date of value "The new oil" or "Reference oil" or "Oil specification".
Accuracy of interpretation and recommendation are based on representative sample and information supplied.
No warranty is expressed or implied for this report.

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