

## Introduction

The 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 : 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 <sup>TM</sup>"



**Double Wear Check**<sup>TM</sup>  $\sqrt{\sqrt{}}$  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 and coarse wear particles - metal elements .

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



## Wear Metal Detection Limit due to particle size

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

**Double Wear Check**<sup>TM</sup>  $\sqrt{\sqrt{}}$  are named for this dual spectrometric analysis (RDE + RFS).

**Double WearCheck**<sup>TM</sup>  $\sqrt{\sqrt{}}$  will give more advanced warning than traditional or conventional spectrometric analysis in used oil analysis –conditioning monitoring .

If **Double WearCheck**<sup>TM</sup>  $\sqrt{\sqrt{}}$  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 Spectrometric (Course Wear Particles ) RDE Spectrometric (Fine Wear Particles )					LubeCheck Mail Oil Analysis for Predictive Maintenance   Page 1 of 3   Setters: 1993 Image: 1995 Satisfies Check   Answer: 1993 1997 Satisfies Check Satisfies Check   Answer: 1993 1997 Satisfies Check Satisfies Check   Main: 1995 Satisfies Check Unit Type : Digste Check Satisfies Check   Text ander : 004 Satisfies Check Satisfies Check Satisfies Check   Satisfies Check Satisfies Check Satisfies Check Satisfies Check   Lubits System Chack Satisfies Check Satisfies Check Satisfies Check   Bate Array Satisfies Check Satisfies Check Satisfies Check   Bate Array Satisfies Check Satisfies Check Satisfies Check						
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Wear Element	Method	Unit	RDE fine	RFS coarse	FocusLab 10 Date campled	in the second	1	71125 17-Fab-07	1125 70677 70001 Fab-07 10-Fab-07 25-Jan-07		15/040
Iron	D-6595	PPM	37.5 C	9.6 A	Hours on Unit	Ĵ.	a	404 11064 436267	277 10997 055252	547 10900 630070	
Chromium	D-6595	PPM	4.4	1.0 C	Wear Condition	Magaod	STR.	ROE SIN RED CONT	ROE THE RPS CONTR	ROESON RFE CONTRA	
Lead	D-6595	PPM	14.4	0.0	kan Chranikan	D.RNR	101	57.5 C 8.6 A 4.4 1.0 C	26.6 27.5 A 26 23 A	570 C 24.1 A 50 C 0.9	0 125 126 15 19
Copper	D-6595	PPM	4.0	0.4	Copper Te	D.0500	994 994	49 04 09 43	6.1 1.0 0.0 16.7 A	45 07 1.1 0 25 0	
Tin	D-6595	PPM	0.8	4.3 A	Aluminum Hickel	D.0500 D.0500	HU HU	47 0.0 0.5 0.0	54 100 A 0.0 0.8	6.5 60 A 0.5 0.0	
Aluminum	D-6595	PPM	4.7	0.0	Marybolena m Titanisam	D.4595 D.4595	990 990	235.0 42.5 0.0 0.0	1904 074 00 05	2081 267 0.0 0.0	100
Nickel	D-6595	PPM	0.3	0.0	Dil Condition Viscolly @ 48*0	D.445	eis.				BUR LINE Lints Lints Risks
Silver	D-6595	PPM	0.0	0.0	Macoulty @ 100*0 Oxidation Hittorice	P.445 FTR	10	17.2 A 25.1 A 14.1 C	192 A 193 A	12.2 A	03 145 145 71 145 145
Molybdenum	D-6595	PPM	235.0	42.5	TAN TEN	0.876 10.4752	-	59	78	6.0	71 2 4
Titanium	D-6595	PPM	0.0	0.0	Contaminatio	FTR	5.051	0.065	658	0.062	0635 01 010
					Giyool Sett	FTR	- A64 9-0403	0 0.07	0.48	0 0.52	000 16
					Sedem Silicon	D.0500 D.0500	-1714 1714	15 120 1.4	9 78 75	11 13.7 5.3	3
					Additive Element Boron	I to star	1 Hear	1 12 A	50 🔥	47 A	1 40 40
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#### Abbreviation :

> ICP – Atomic Emission Spectrometer **RFS** Spectrometer PPM

- RDE Atomic Emission Spectrometer : Rotating Disk Electrode Atomic Emission Spectrometer
  - : Inductively Coupled Plasma Atomic Emission Spectrometer
    - : Rotrode Filter Spectroscopy Atomic Emission Spectrometer

#### : part per million