

# factsheet

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## How to Read the Results Report

### Overview

When your wear metal oil analysis values are determined by our laboratory, we uniquely provide guidance in two crucial areas of concern: comparison of each indicator with similar engines, as well as noticing any trends in wear. In addition, a trained analyst reviews every oil analysis result to finalize any recommendations before you receive it and sets the overall report severity level.

1. **Matching Engine Population Statistics (MEPS)** - First, a subset of the extensive Aviation Laboratories database is created by matching your engine and cylinders type, oil hours, and Time-In-Service (TIS) as yours. Either "Time Since Overhaul" or "Time Since New" determine TIS. This controlled population of other historical sample results is then statistically compared against your own sample result values. If this comparison exceeds ranking limits, then the border of the box in which that value is displayed will change color to indicate statistical severity. Visit AvLab's [KnowledgeBox](http://www.avlab.com) via <http://www.avlab.com> to read fact sheet "[Engine Statistics - MEPS](#)" for details on how MEPS is applied to properly analyze your engine.
2. **Trend Monitoring** - Your current analysis values are compared against your previous ones. If an excessive trend increase occurs, the new value will be shown in **red**. The border color is unaffected.
3. The **Aviation Laboratories Analysis Results Meter**, or **ALARM** - is manually set for each individual report by our analyst to reflect the overall severity of the current result based on the above two results and criteria, and the expertise of our Laboratory Analysts. The Comments section is also set as needed by our technical staff to suggest any recommended actions to be taken.

### MEPS Generated Colored Borders



**NOTICE:** *If your report does not have colored borders around your oil analysis wear metal values, then a statistical analysis was not done. This can be due to a number of reasons including: unknown engine type, unknown engine hours since overhaul (or new), unknown oil hours, or unknown cylinder type (for reciprocating engines). If you can later provide these values to us, we will happily apply them and you can see how your engine statistically compares against the thousands of similar engines within our database. Your analysis will always be reviewed by a trained technician before sending results to you.*

*If your engine has more than one cylinder type indicated, then no filtering by cylinder type will be done. It will be statistically compared against all same type engines with similar engine hours and oil hours as it is impossible to determine cylinder type nor wear population distribution.*

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*There may be traces of metals such as silver and titanium in some oil samples. If these are not meaningful wear metals for your engine type, then no values will be provided. This varies between engine types although you may find these metals reported by other oil analysis companies. Our reports do not show them to avoid your confusion with the meaningful wear metals vs. elements that are part of oil or fuel additives. Contact us if you are concerned about any specific elements.*

The row of small boxes that contain your individual oil analysis wear metal values on the result page have colored borders of Green, Yellow, and Red to indicate the severity of each value. This severity is determined statistically by comparing your results to a matching engine population. These engines are: 1) the exact engine model and cylinder type as yours; AND 2) within the same range of engine hours, AND 3) within the same range of oil hours. In other words we are comparing your data to our database in a very precise way, and to a very precise subset of the entire database. This is very important because engines like yours can have very different rates of metal wear and those corresponding results would not apply to all other engines.

Either the Normal (Green Border), Elevated (Yellow Border) or High (Red Border) will be presented when your values fall into a ranking of values for similar engines to yours (e.g. same type and cylinders, similar TIS, and similar oil hours). Each rank is statistically calculated from within that subset for your engine and the color border is determined based on those results. .

## GREEN BORDER OR NORMAL

75.00

Above example shows that this value is statistically in the NORMAL range for your engine, TIS and cylinder type (if applicable).

The green border color indicates that these values are within a normal range compared to other engines like yours. They are below the Caution level settings for your engine model, engine hours, and cylinder type. No corrective action is indicated based on these values.

## YELLOW BORDER OR ELEVATED

75.00

Above example shows that this value is statistically in the ELEVATED range for your engine, TIS and cylinder type (if applicable).

The yellow-orange border color indicates that this value is closer to the borderline range. The **Comments** box of your results will indicate the recommended next step that should be taken

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## RED BORDER OR HIGH

75.00

Above example shows that this value is statistically in the HIGH range for your engine, TIS and cylinder type (if applicable).

The red border color indicates that this wear metal value is in a range that is well above both the average and caution levels for that wear metal for your engine and therefore corrective action should be taken. The suggested locations for excessive wear and recommendation for a course of action will be listed in the Comments box of your results.

## Trending Results, Red Numbers

75.00

The red characters in the above example shows that a SIGNIFICANT value change occurred from the previous sample, although this value is statistically in the CAUTION range for your engine, TIS and cylinder type (if applicable).

Your results are always being compared to the previous sample's results as we look for significant increases in particular wear metal values. Any numeric wear metal value may be presented in **RED** showing a significant upward change. That change is independent of that value's rank within similar engines, TIS and cylinder type (if applicable) which determines the border color. A bold **RED** value indicates that this **current value has changed** and **increased** by a **critical amount** when compared to previous results and since your last sample. Keep in mind that the border may be any of the three colors at this time and may not be an indicator for immediate action based upon the current measured value. The **Comments** box of your results will indicate overall recommendations.

## Historical Averages Explained

Historical Averages will shown in parenthesis along with your actual values in your most current results, these are the average wear metal values for all engine samples in our extensive database that we have analyzed matching your specific engine type, cylinder type, TIS and oil hours. This allows you to quickly compare your values to the average values for engines similar to

yours. Although these average values are interesting, there can be some fairly large deviation from the average for a particular engine. This means your value can still reside either within, or outside, the acceptable operating range.

## ALARM Explained



The **Aviation Laboratories Analysis Results Meter**, or **ALARM** for short, is manually set for each analysis result by our analyst. It reflects the overall severity of the current result based on the absolute wear metal values, and increases compared to previous values, and taking into account our most recent experiences with this engine type. If your ALARM indicates Elevated or High, suggested excessive wear locations will be indicated in the **Comments** box of your results. Due to the complexities and experience required, the ALARM meter is manually set by our highly trained analyst. Therefore earlier analysis results will not have this set.

There are other variables which should be considered when determining the overall severity of the results, including but not limited to, maintenance, oil consumption, how the aircraft has been flown, if the aircraft has been sitting, and other reports from the operator.

## Most Common Sources of Wear Metal Elements in Oil

<b>Iron</b>	Cylinders, rotating shafts, valve train and any steel part sharing the oil.
<b>Copper</b>	Brass or bronze parts, bushings, bearings, oil coolers, sacrificial coatings.
<b>Nickel</b>	Valve guides, trace element in steel, some cylinder types.
<b>Chromium</b>	Rings, cylinders, a trace element in steel.
<b>Silver</b>	Sacrificial coatings, a trace element in some types of bearings, bearing cage plating
<b>Magnesium</b>	Engine casings, additives
<b>Aluminum</b>	Pistons, piston pin plugs, bearing overlay, casings.
<b>Lead</b>	Primarily leaded gas blow-by, traces from bearings
<b>Silicon</b>	Abrasive dirt from intake air, silicone sealers and gaskets, sample contamination.
<b>Tin</b>	Bearings, bronze parts (with copper), anti-wear coatings.
<b>Molybdenum</b>	Traces of anti-wear coatings, some cylinder types, and bearings.

**Acknowledgement:**  
Contributing author, Rob Duncan of **Airbase 1** ([www.airbase1.com](http://www.airbase1.com))

## ANALYSIS RESULTS

AVIATION LABORATORIES  
Attn: QC Department  
910 Maria St.

Aircraft: PA12RT-345  
S/N: 38R1234567  
Tail No.: N910LA

Date: 6/28/2013  
Engine S/N: 123456  
Engine Model: CONT. T360

Kenner LA 70062  
United States

Values in (parenthesis) below your results are average values from all our analysis data for the same engine model with similar engine hours and oil hours. See [www.avlab.com/explain](http://www.avlab.com/explain) for detailed explanation of the statistical analysis used with your laboratory results.

CURRENT SAMPLE		** SEE LAB COMMENTS **										Normal	Elevated	High
<b>Sample Date:</b> 3/20/2013 <b>Analysis Date:</b> 3/28/2013 <b>Sample Number:</b> P42 <b>Cylinder Type:</b> steel  <b>TSN/TSO:</b> 441.4 <b>Oil Hours:</b> 30.6 <b>Filter Hours:</b> 30.6 <b>Oil Added:</b> 1 <b>Filter Wt. (mgs):</b> 496 <b>Flashpoint(deg. F):</b> <b>H2O (ppm):</b> <b>Total Acid No.:</b>	<b>*** OIL ANALYSIS RESULTS IN PARTS PER MILLION ***</b>													
	Iron	Copper	Nickel	Chromium	Silver	Magnesium	Aluminum	Lead	Silicon	Titanium	Tin	Moly.		
	141.7 (72.2)	11.7 (5.1)	20.8 (12.1)	20.4 (9.4)	N/A	N/A	20.2 (7.0)	4615 (3473)	4.6 (5.3)	N/A	< 0.1 (0.2)	N/A		
	<b>*** FILTER ANALYSIS RESULTS ***</b>													
	<b>Material:</b>	Stainless Steel	Carbon Steel	Alloy Steel	Bearing Alloy	Copper	Silver	Magn.	Alum.	Grit	Misc.			
	<b>Amount:</b>	Minor		10-40%				Trace		Major				
	<b>Type:</b>	5040 or 7225						0-10%		40-100%				
	<b>Form:</b>	Flakes												
	<b>Comments:</b> A MINOR AMOUNT OF DARK COLORED FLAKES WERE REMOVED FROM THE FILTER, CLOSEST MATCH AMS# 5040 OR 7225, RANGING IN SIZE FROM 834 X 683 TO 78 X 66 MICRONS. THESE EASILY BREAKABLE FLAKES CAN POSSIBLY BE RUST/CORROSION. NOTE INCREASES IN OIL VALUES. THIS CAN ALSO BE FROM CORROSION DUE TO INACTIVITY (57.1 HOURS SINCE LAST SAMPLE TAKEN 13 MONTHS PRIOR) OR CYLINDER/PISTON AREA WEAR. A COMPRESSION CHECK AND BORESCOPE MAY BE USEFUL IN DETERMINING AND MONITORING CYLINDER AND PISTON AREA CONDITION. WE WILL CONTINUE TO MONITOR THIS ENGINE ON YOUR NEXT SAMPLE. PLEASE CONTACT THE ENGINE MANUFACTURER'S SERVICE REP IF FURTHER ASSISTANCE IS NEEDED.													
	PREVIOUS SAMPLE 1		SAMPLE APPEARS NORMAL. Send next sample at normal interval.										Normal	Elevated
<b>Sample Date:</b> 2/10/2012 <b>Analysis Date:</b> 3/28/2012 <b>Sample Number:</b> P43 <b>Cylinder Type:</b> steel  <b>TSN/TSO:</b> 384.3 <b>Oil Hours:</b> 23.3 <b>Filter Hours:</b> 23.3 <b>Oil Added:</b> 1 <b>Filter Wt. (mgs):</b> 210 <b>Flashpoint(deg. F):</b> <b>H2O (ppm):</b> <b>Total Acid No.:</b>	<b>*** OIL ANALYSIS RESULTS IN PARTS PER MILLION ***</b>													
	Iron	Copper	Nickel	Chromium	Silver	Magnesium	Aluminum	Lead	Silicon	Titanium	Tin	Moly.		
	56.7 (62.7)	7.7 (4.4)	5.3 (8.4)	4.6 (8.4)	N/A	N/A	8.1 (5.9)	2425 (3034)	3.3 (5.5)	N/A	< 0.1 (0.2)	N/A		
	<b>*** FILTER ANALYSIS RESULTS ***</b>													
	<b>Material:</b>	Stainless Steel	Carbon Steel	Alloy Steel	Bearing Alloy	Copper	Silver	Magn.	Alum.	Grit	Misc.			
	<b>Amount:</b>	Trace		0-10%				Trace		Major				
	<b>Type:</b>							0-10%		40-100%				
	<b>Form:</b>													
	<b>Comments:</b>													
	PREVIOUS SAMPLE 2		SAMPLE APPEARS NORMAL. Send next sample at normal interval.										Normal	Elevated
<b>Sample Date:</b> 12/29/2010 <b>Analysis Date:</b> 1/21/2011 <b>Sample Number:</b> P34 <b>Cylinder Type:</b> steel  <b>TSN/TSO:</b> 341 <b>Oil Hours:</b> 32 <b>Filter Hours:</b> 32 <b>Oil Added:</b> 1 <b>Filter Wt. (mgs):</b> 164 <b>Flashpoint(deg. F):</b> <b>H2O (ppm):</b> <b>Total Acid No.:</b>	<b>*** OIL ANALYSIS RESULTS IN PARTS PER MILLION ***</b>													
	Iron	Copper	Nickel	Chromium	Silver	Magnesium	Aluminum	Lead	Silicon	Titanium	Tin	Moly.		
	74.7 (74.9)	5.1 (5.7)	6.2 (11.0)	7.3 (11.2)	N/A	N/A	6.4 (6.4)	3156 (3783)	3.7 (7.7)	N/A	0.1 (0.3)	N/A		
	<b>*** FILTER ANALYSIS RESULTS ***</b>													
	<b>Material:</b>	Stainless Steel	Carbon Steel	Alloy Steel	Bearing Alloy	Copper	Silver	Magn.	Alum.	Grit	Misc.			
	<b>Amount:</b>	Trace		0-10%				Trace		Major				
	<b>Type:</b>							0-10%		40-100%				
	<b>Form:</b>													
	<b>Comments:</b>													