

Used Oil Analysis

Do's and Don'ts



Who Am I?

Lake Speed, Jr.



- Member of Society of Tribologists and Lubrication Engineers

- Certified Lubrication Specialist

- Oil Monitoring Analyst

- Son of Lake Speed, NASCAR driver and 1978 World Karting Champion (Scott Speed is not by brother)



DRIVEN
DRIVEN TO WIN **RACING OIL**®

How is Dad?



Race Date 08/25/18

Kart #	First Name	Last Name	Best Time
e 135cc Sidewinder --			
000	LAKE	SPEED	35.633
6	LAKE	SPEED, JR.	35.823
1	RICK	GILMORE	38.589
51	LARRY	PIKE	37.474
9	MARK	STORY	39.707
3	DEAN	SAUDER	00.000
33	MARC	NAGEL	00.000
11	BUTCH	STEWART	00.000

HISTORY



1999 Season

- Joe Gibbs Racing begins to lose 1 in 10 new camshafts on break-in
- 2 lifter failures during competition
- Pinpoints change in Zinc level as a factor

Lubrizol

- World leader in oil and fuel additive technology – One of 4 companies that mfg.
- Purchased by Warren Buffet for \$9 Billion
- Invented Zinc DialkyDithioPhosphate in 1941

2000

- Lubrizol develops BR for camshaft break-in
- Synthetic race oil developed (OS#166666)
- Bobby Labonte wins NASCAR championship with no DNF's

2005

- JGR begins to market Driven Racing Oil
- Tony Stewart wins JGR's 3rd Championship



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What is Used Oil Analysis?

Just like a doctor samples your blood to check your health, used oil analysis can determine the health of the equipment and the health of the oil itself.

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Used Oil Analysis Kits

Typical Kit Includes Everything Needed To Take & Ship The Sample.



Used Oil Analysis Process

Collect The Sample



**Drain Sample
Sample**

Vacuum Pump

Used Oil Analysis Process

Complete The Form & Mail The Sample

Sample Form

PLEASE FILL OUT FORM FOR SUBMISSION TO LAB

Please only enter one sample per form.

Sample ID *
Please enter the sample ID number on the sample bottle. For example, kit ID number AAA-0001.

Sample Unit *
Please select the sample application.
Fuel Type *
What type of Fuel

- Unleaded Gasoline
- AV Gas
- Leaded Race Fuel
- Methanol/ER3
- Diesel
- Not Applicable

Unit Description *
Type of racing sample was taken from

Hours or Miles *
Please select measure of time or distance on sample. If for Hours and M for Miles.

Used Oil Analysis Process

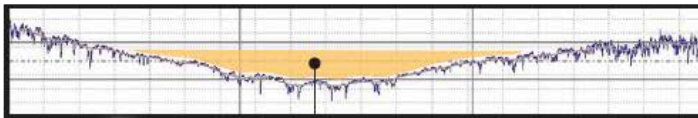
Receive The Report

SPEEDiagnostix		Results Color Codes			
How To Know You're Good To Go		Results outside the normal range are highlighted red		[Red]	
		Results with borderline values are highlighted yellow		[Yellow]	
		Results within the normal range are highlighted green		[Green]	
Oil Analysis Report					
Name:	Driven Racing Oil		Sample Type:	Engine	
Unit ID:	1999 Boxster		Condition:	Good	
Sample Information			Previous Samples		
Sample ID #:	Post Parade		Pre Parade	Post Break-In	
Sample Date:	8/5/17		3/3/17	1/6/17	
Oil Brand:	DT40		DT40	DT40	
Viscosity Grade:	5W-40		5W-40	5W-40	
Mileage:	7,809		4,600	3,472	
Oil Health	Test Results	Legend	Previous Sample Results		
Viscosity @ 100C:	✓ 12.5	cSt Flow Measurement	✓ 12.5	✓ 12.5	
Oxidation Value:	✓ 0.0	Oil Life	✓ 0.0	✓ 0.0	
Fuel Dilution:	Negative	Contamination	Negative	Negative	
Water:	Negative	Contamination	Negative	Negative	
Glycol:	Negative	Contamination	Negative	Negative	
Potassium:	✓ 0	Contamination	✓ 2	✓ 3	
Silicon:	✓ 9	Anti-Foam, Dirt	✓ 11	⚠ 19	
Additives (ppm):					
Calcium	1603	Detergent	1617	1768	
Sodium	4	Detergent	7	14	
Magnesium	8	Detergent	7	9	
Phosphorus	1071	Anti-Wear	1078	1622	
Zinc	1209	Anti-Wear	1184	1648	
Molybdenum	403	Friction Reducer	415	450	
Boron	54	Friction Reducer	125	130	
Equipment Health	Test Results	Legend	Previous Sample Results		
Wear Trend:					
✓ Iron	✓ 5	Valvetrain, Cylinder Bore Wear	✓ 6	✓ 8	
✓ Chromium	✓ 0	Piston Ring Wear	✓ 0	✓ 0	
✓ Copper	✓ 1	Bushing, Bearing Wear	✓ 2	✓ 3	
✓ Tin	✓ 0	Bearing Wear	✓ 0	✓ 2	
✓ Lead	✓ 0	Bearing Wear	✓ 0	✓ 0	
✓ Aluminum	✓ 3	Piston, Aluminum Bore Wear	✓ 1	✓ 2	
✓ Manganese	✓ 0	Valve Guide Wear	✓ 0	✓ 0	
✓ Titanium	✓ 0	Wrist Pin, Retainer Wear	✓ 0	✓ 0	
✓ Vanadium	✓ 0	Gear, Crank Wear	✓ 0	✓ 0	
⚠ Total Metals:	✓ 9	Total Wear Metals	✓ 9	✓ 15	
✓ Wear / 1,000 miles:	✓ 1.2	Wear Metals / 1,000 Miles	✓ 2.0	✓ 4.3	
Comments / Recommendations					
All wear metals within normal ranges. The initial silicon levels were elevated, but that was likely from engine seals breaking-in. The trend analysis shows overall wear rate decreasing, which indicates excellent engine health.					

Used Oil Analysis

Direct Correlation To Measured Engine Wear

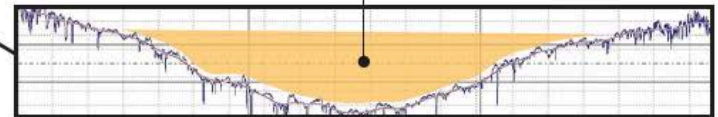
UOA = IRON 5 ppm



CAMSHAFT WEAR AREA



CAMSHAFT WEAR AREA



UOA = IRON 10 ppm

Insight Into Engines

Used Oil Analysis Measures Engine Wear



Bearing Wear

Lead: 16 ppm

Copper: 9 ppm

Tin: 2 ppm

Lead: 11 ppm

Copper: 4 ppm

Tin: 1 ppm

Used Oil Analysis

Do's and Don'ts...

- *Do Take Samples On A Regular Basis*
- *Do Take A Fresh Sample Of The Oil You Use*
- *Do Use The Sample Bottle Provided*
- *Do Follow The Instructions Provided In The Kit*
- *Don't Vary Your Sampling Procedure*
- *Don't Rely On TBN*
- *Don't Read Too Much Into A Single Sample*
- *Don't Expect CSI*

Used Oil Analysis

Take Samples On A Regular Basis

LAB CONTROL NUMBER	SAMPLE DATE	PROCESS DATE	EQUIPMENT METER	METER ON FLUID	FLUID CHANGED	MAKE UP FLUID	MAKE UP FLUID UNITS
D090-46166-3501	09-Jun-2016	14-Jun-2016			Unknown		
<div style="border: 2px solid green; padding: 2px; display: inline-block;">No Action Required</div> UNKNOWN HOURS ON THE OIL. ALL TESTS APPEAR NORMAL. CONTINUE SAMPLING AT NORMAL INTERVAL.							
D090-45350-3412	18-Nov-2015	16-Dec-2015	865 HR		Unknown		
<div style="border: 2px solid green; padding: 2px; display: inline-block;">No Action Required</div> UNKNOWN HOURS ON THE OIL. ALL TESTS APPEAR NORMAL. CONTINUE SAMPLING AT NORMAL INTERVAL.							
D090-45252-3024	13-Aug-2015	09-Sep-2015	459 HR	459 HR	Unknown		
<div style="border: 2px solid green; padding: 2px; display: inline-block;">No Action Required</div> NORMAL BREAK IN WEAR. MORE SAMPLES ARE NEEDED TO ESTABLISH A TREND. CONTINUE SAMPLING AT NORMAL INTERVAL.							

Wear Metals (ppm)	Cu Fe Cr Al				Sn Si Na K Mo Ni Ca Mg Zn P Ba										
	D090-46166-3501	3	4		5	0	14	1	1	0	1	2546	8	1085	1022
D090-45350-3412	5	7		11	0	23	2	1	1	1	2036	9	1258	1121	0
D090-45252-3024	13	11		17	0	54	1	3	2	2	1421	10	2688	2357	0

Oil Condition / Particle Count (ct/ml)	ST	OXI	NIT	SUL	W	A	F	PFC	V100
D090-46166-3501	0	17	4	20	N	N	N	2.34	11.9
D090-45350-3412	0	37	5	38	N	N	N	2.66	12.8
D090-45252-3024	0	10	4	18	N	N	N	3.94	12.2

Trend Analysis

DATE SAMPLED	19-Sep-16
DATE RECEIVED	07-Oct-16
DATE REPORTED	11-Oct-16

LAB NO.	40010470472	
SIF NO.	30538809	
TIME ON UNIT	135	135
TIME ON OIL		
OIL BRAND	Unidentified	
OIL TYPE	Unknown	
OIL GRADE		
OIL ADDED	gal	
FILTER	Not Applicable	
OIL CHANGED	Changed	
WO NUMBER		

Metals (ppm)		
Iron (Fe)	10	10
Chromium (Cr)		
Lead (Pb)	1160	
Copper (Cu)		
Tin (Sn)		
Aluminium (Al)	10	10
Nickel (Ni)	<1	
Silver (Ag)	<1	
Titanium (Ti)	<1	
Vanadium (V)	<1	

Contaminants (ppm)	
Silicon (Si)	8
Sodium (Na)	6
Potassium (K)	7

Additives (ppm)	
Magnesium (Mg)	3
Calcium (Ca)	825
Barium (Ba)	<1
Phosphorus (P)	1617
Zinc (Zn)	1727
Molybdenum (Mo)	16
Boron (B)	<5

Contaminants	
Water (%)	<0.05
Coolant	No

Physical Tests	
Viscosity (cSt 100C)	16.2
Solids (%)	<0.1

DATE SAMPLED	20-Oct-16
DATE RECEIVED	07-Nov-16
DATE REPORTED	08-Nov-16

LAB NO.	40010475145	
SIF NO.	30538811	
TIME ON UNIT	251	251
TIME ON OIL		
OIL BRAND	Unidentified	
OIL TYPE	SAE 20W50	
OIL GRADE		
OIL ADDED	qt	
FILTER	Not Applicable	
OIL CHANGED	Changed	
WO NUMBER		

Metals (ppm)		
Iron (Fe)	21	21
Chromium (Cr)		
Lead (Pb)	2080	
Copper (Cu)		
Tin (Sn)		
Aluminium (Al)	22	22
Nickel (Ni)	<1	
Silver (Ag)	<1	
Titanium (Ti)	<1	
Vanadium (V)	<1	

Contaminants (ppm)	
Silicon (Si)	17
Sodium (Na)	2
Potassium (K)	<1

Additives (ppm)	
Magnesium (Mg)	4
Calcium (Ca)	536
Barium (Ba)	<1
Phosphorus (P)	1412
Zinc (Zn)	1568
Molybdenum (Mo)	6
Boron (B)	<5

Contaminants	
Water (%)	<0.05
Coolant	No

Physical Tests	
Viscosity (cSt 100C)	16.2
Solids (%)	0.2

Trend Analysis

	7809	3869	721	4600	3472	1183
TIME ON OIL	Unidentified	Unidentified	Unidentified	Joe Gibbs Driven	Unidentified	Unidentified
OIL BRAND	Unidentified	Unidentified	Unidentified	DT40	Unidentified	Unidentified
OIL TYPE	SAE 15W40	SAE 15W40	SAE 15W40	SAE 5W40	SAE 10W40	SAE 10W40
OIL GRADE						
OIL ADDED	Ltrs					
FILTER	Not Applicable					
OIL CHANGED	Changed	Changed	Changed	Changed		Changed
WO NUMBER						
Metals (ppm)						
Iron (Fe)	5	8	4	6	8	8
Chromium (Cr)	<1	<1	<1	<1	<1	<1
Lead (Pb)	<1	<1	<1	<1	<1	5
Copper (Cu)	1	1	<1	2	3	2
Tin (Sn)	<1	<1	<1	<1	2	4
Aluminium (Al)	3	2	1	1	2	2
Nickel (Ni)	<1	<1	<1	<1	1	1
Silver (Ag)	<1	<1	<1	<1	<1	<1
Titanium (Ti)	<1	<1	<1	<1	<1	<1
Vanadium (V)	<1	<1	<1	<1	<1	<1
Contaminants (ppm)						
Silicon (Si)	9	9	7	11	19	23
Sodium (Na)	4	3	4	7	14	6
Potassium (K)	<1	<1	<1	2	3	7
Additives (ppm)						
Magnesium (Mg)	8	7	6	7	9	2
Calcium (Ca)	1603	1783	1007	1617	1768	533
Barium (Ba)	<1	<1	<1	<1	<1	<1
Phosphorus (P)	1071	899	1689	1078	1622	2570
Zinc (Zn)	1209	1043	1753	1184	1648	2730
Molybdenum (Mo)	403	26	138	415	450	3
Boron (B)	54	8	40	125	130	<5
Contaminants						
Water (%)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Coolant	No	No	No	No	No	No
Physical Tests						
Viscosity (cSt 100C)	12.3	16.1	11.5	12.3	12.2	12.1
Solids (%)	0.1	0.1	<0.1	<0.1	<0.1	<0.1

Total Wear Metals	9	11	5	9	16	22
Wear Metals/1,000	1.1	2.8	6.9	1.9	4.6	18.6

Used Oil Analysis

Take A Fresh Sample Of Your Oil

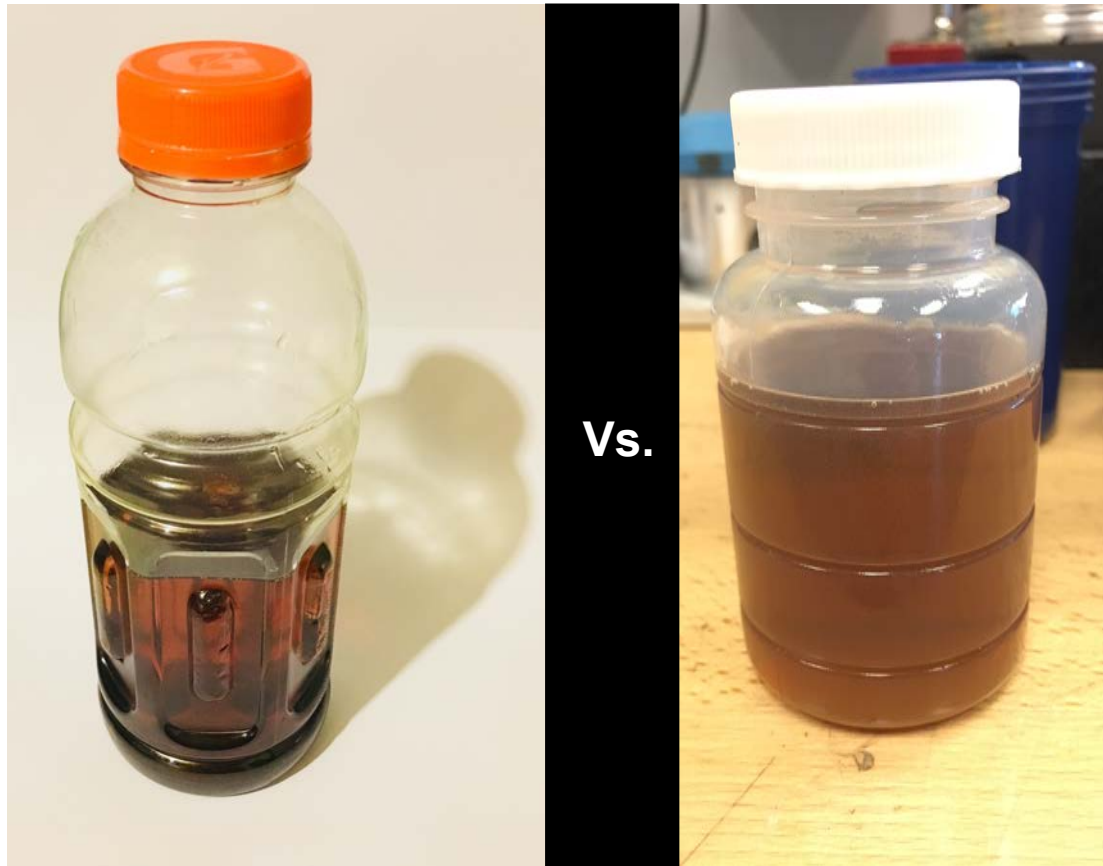
- *This Provides A Great Baseline For Interpreting The Used Oil*

SPEEDiagnostix How To Know You're Good To Go.		
Sample Date:	6/21/18	
Oil Brand:	Liqui Moly	
Viscosity Grade:	5W-40	
New Oil Analysis Report		Legend
Viscosity @ 40C:	84.7	cSt Flow Measurement
Viscosity @ 100C:	14.1	cSt Flow Measurement
Viscosity Index:	172.1	
Oxidation Value:	8.7	>30 = Ester
Additives (ppm):		
Calcium	2975	Detergent
Sodium	2	Detergent
Magnesium	14	Detergent
Phosphorus	1201	Anti-Wear
Zinc	1006	Anti-Wear
Molybdenum	29	Friction Reducer
Boron	2	Friction Reducer
Silicon	10	Anti-Foam

Used Oil Analysis

Use The Sample Bottle Provided

- *Why Did The Sample On The Left Contain Potassium?*



Used Oil Analysis

Follow The Instructions In The Kit

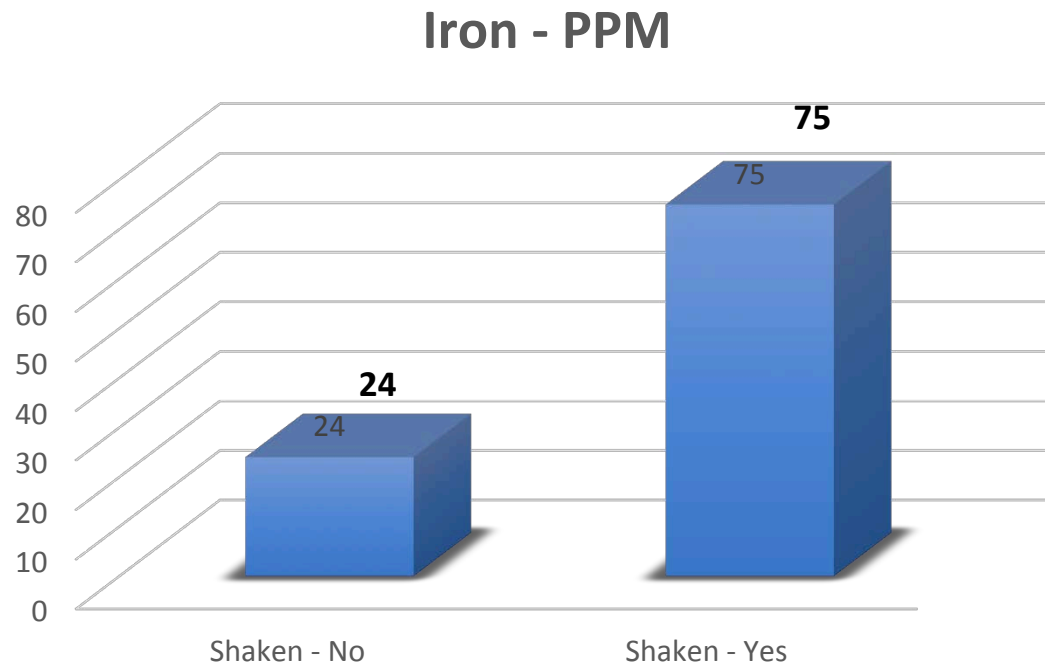
Used Oil Analysis Instruction Sheet

For best results:

- Take sample within 10 minutes of using the equipment. (i.e. shutting off the engine or coming off the track)
- If this is not possible, drain 1 quart of fluid into a quart or larger container, shake for 1 minute before filling the sample bottle.
- Always use the sample bottle provided in the kit.
- Clean the area around the drain plug to remove possible contamination before taking sample.
- Allow the oil to drain for 5 seconds before beginning to take the drain sample.
- Only fill the sample bottle 3/4 full. DO NOT fill beyond the top of the label on the bottle.
- Complete the sample ID Information Form
- Place the sample bottle in the plastic bag and seal.
- Place the bagged sample and Information Form in the pre-paid Priority Mail box and seal.
- Drop the completed package in the mail box. The report will be emailed as soon as the analysis is completed.

Used Oil Analysis

Don't Vary Your Sampling Procedure



Used Oil Analysis

Best Method...

Vacuum Sample Taken From A Warm Engine



Used Oil Analysis

Don't Rely On TBN

Total Base Number (TBN) has been rejected by both GM and Cummins as an accurate method for determining oil health in modern fuels.



Used Oil Analysis

Don't Read Too Much Into A Number

- *Re-Test If You Get A Surprising Result*
- *Look Beyond The Raw Numbers*

	Porsche Flat 6	Porsche Flat 6
Oil	DT40	Motul
Miles	4600	3200
Iron	6	6
Lead		
Copper	2	2
Tin		1
Aluminum	1	2
Total Wear Metals	9	11
Iron/1,000	1.30	1.88
Total Wear / 1,000	1.96	3.13

Used Oil Analysis

Don't Expect CSI

LAB CONTROL NUMBER	SAMPLE DATE	PROCESS DATE	EQUIPMENT METER	METER ON FLUID	FLUID CHANGED	MAKE UP FLUID	MAKE UP FLUID UNITS
D090-46153-3009	27-May-2016	01-Jun-2016			Yes		
Monitor Compartment	(2ND OIL CHANGE) POSITIVE WATER IN SAMPLE. CHECK SYSTEM FOR POSSIBLE SOURCES OF WATER ENTRY. ALUMINUM APPEARS ELEVATED. POSSIBLE BEARING WEAR. MORE SAMPLES ARE NEEDED TO ESTABLISH A TREND. RESAMPLE AT HALF NORMAL SERVICE INTERVAL TO MONITOR.						

Wear Metals (ppm)	Cu	Fe	Cr	Al	Pb	Sn	Si	Na	K	Mo	Ni	Ca	Mg	Zn	P	Ba
D090-46153-3009	8	21	0	62	0	0	15	3	2	0	2	3212	189	1335	1167	0

Oil Condition / Particle Count (ct/ml)	ST	OXI	NIT	SUL	W	A	F	PFC	V100
D090-46153-3009	0	14	9	21	P	N	N	4.35	11.7

Used Oil Analysis

LAB CONTROL NUMBER	SAMPLE DATE	PROCESS DATE	EQUIPMENT METER	METER ON FLUID	FLUID CHANGED	MAKE UP FLUID	MAKE UP FLUID UNITS
D090-46139-3201	16-May-2016	18-May-2016			Unknown		
Action Required		UNKNOWN MILES ON THE OIL. FUEL DILUTION IS HIGH. SCHEDULE UNIT FOR INSPECTION TO EVALUATE POSSIBLE SOURCES OF FUEL ENTRY. SODIUM IS ELEVATED INDICATING POSSIBLE COOLANT LEAK OR MAY BE DUE TO ADDITIVE IN THE OIL. CHANGE OIL/ INSTALL NEW FILTER(S) . RESAMPLE AT HALF NORMAL SERVICE INTERVAL TO MONITOR.					

Wear Metals (ppm)	Cu	Fe	Cr	Al	Pb	Sn	Si	Na	K	Mo	Ni	Ca	Mg	Zn	P	Ba
D090-46139-3201	6	6	0	3	3	0	13	32	12	580	0	1183	5	2057	2008	1

Oil Condition / Particle Count (ct/ml)	ST	OXI	NIT	SUL	W	A	F	PFC	V100
D090-46139-3201	0	106	7	95	N	N	P	8.7	8.6

Used Oil Analysis

Trend analysis identified problem for KBM #18 Truck



Results Color Codes	
Results outside the normal range are highlighted red	
Results with borderline values are highlighted yellow	
Results within the normal range are highlighted green	

Oil Analysis Report						
Name:	Daniel Brown		Sample Type:	Engine		
Unit ID:	KBM-128		Condition:	Warning		
Sample Information			Previous Samples			
Sample ID #:	AAA-0452		AAA-0433			
Sample Date:	9/18/18		8/24/18			
Oil Brand:	Mobil 1		Mobil 1			
Viscosity Grade:	0W-30		0W-30			
Mileage:	314		273			
Oil Health	Test Results	Legend	Previous Sample Results			
Viscosity @ 100C:	✓ 10.8	cSt Flow Measurement	✓ 11.0			
Oxidation Value:	✓ 7.1	Oil Life	✓ 7.3			
Fuel Dilution:	Negative	Contamination	Negative			
Water:	Negative	Contamination	Negative			
Glycol:	Negative	Contamination	Negative			
Potassium:	✓ 2	Contamination	✓ 3			
Silicon:	✗ 26	Anti-Foam, Dirt	✓ 13			
Additives (ppm):						
Calcium	973	Detergent	1095			
Sodium	3	Detergent	4			
Magnesium	488	Detergent	740			
Phosphorus	2049	Anti-Wear	2301			
Zinc	2056	Anti-Wear	2248			
Molybdenum	1450	Friction Reducer	1675			
Boron	51	Friction Reducer	57			
Equipment Health	Test Results	Legend	Previous Sample Results			
Wear Trend:	Wear Metals (ppm):					
✗	Iron ✗	Valvetrain, Cylinder Bore Wear	✓ 48			
✗	Chromium ✗	Piston Ring Wear	✓ 3			
✗	Copper ⚠	Bushing, Bearing Wear	✓ 4			
✓	Tin ✓	Bearing Wear	✓ 5			
✗	Lead ✓	Bearing Wear	✓ 13			
⚠	Aluminum ✓	Piston, Aluminum Bore Wear	✓ 6			
✓	Manganese ✓	Valve Guide Wear	✓ 0			
✓	Titanium ✓	Wrist Pin, Retainer Wear	✓ 0			
✓	Vanadium ✓	Gear, Crank Wear	✓ 4			
✗	Total Metals: ✗	Total Wear Metals	✓ 83			
✗	Wear / 100 Miles: ✗	Wear Metals / 100 Miles	✓ 30.4			
Comments / Recommendations						
Wear levels are severe! Silicon content is elevated and Iron levels are extremely high. Do not continue to use the engine.						



Used Oil Analysis

Limitations...

- *Wear metal test only "sees" particles 10 microns or less*
- *Wear metal test only sees metals – it won't tell you if your chain tensioner is worn out*
- *Particle counts can "see" particles larger than 10 micron, but it does not distinguish*
- *Particle counting only works with oils that are not dark*
- *Most of the tests won't run if the sample is saturated with water*

Thanks For Attending!

Any Questions?