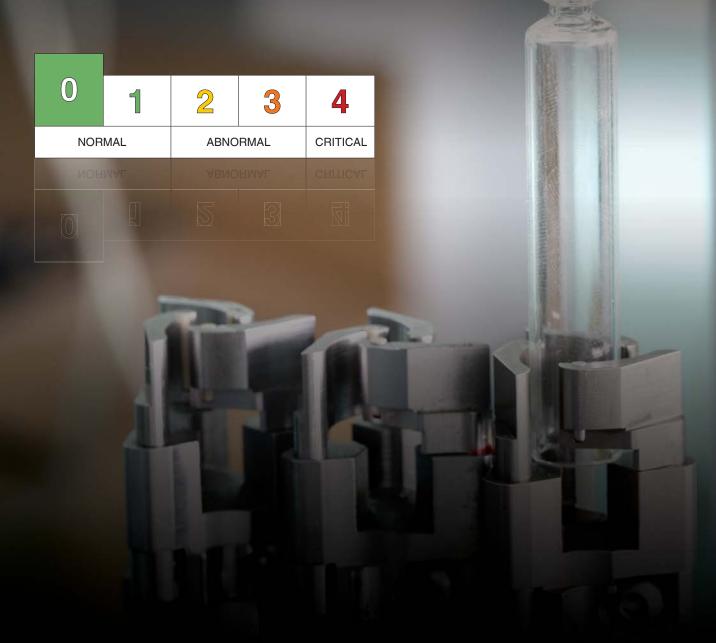
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# Oil Analyzers

## Fluid Analysis Program



www.oaitesting.com

## **About Fluid Analysis**

Fluid analysis is a preventive maintenance tool that provides diagnostic testing designed to evaluate lubricant condition, component wear and contamination in mobile and industrial applications. Routine fluid analysis can detect lubricant or equipment issues before major problems develop.

## Fluid Analysis Helps You Save Money

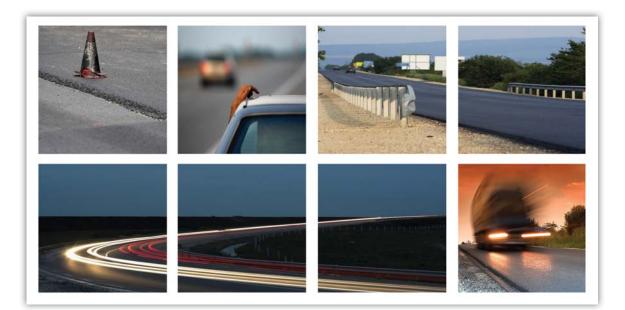
Because fluid analysis provides a comprehensive look at the condition of lubricants and internal component wear, tracking sample results over a period of time can help save money.

- **Maximize oil drain intervals.** Monitoring the condition of the oil allows you to optimize drain intervals so that you capitalize on the fluid's full service life. Performing fewer oil changes minimizes maintenance costs and maximizes uptime.
- **Extend equipment life.** Monitoring system cleanliness and filtration efficiency can help you keep your equipment longer and significantly reduce replacement costs.
- **Prevent major problems.** State-of-the-art fluid analysis identifies dirt, wear particles, fuel dilution, coolant and other contaminants that can cause catastrophic failure or significantly shorten equipment life.
- **Maximize asset reliability.** Testing and analysis ensure that equipment is up, running and making money.
- **Increase resale value.** Analysis results provide valuable sampling history documentation that justifies higher equipment resale values.

## **Oil Analyzers Fluid Analysis**

The Oil Analyzers Fluid Analysis Program protects valuable equipment by providing solutions for lubrication concerns through accurate and easy-tounderstand fluid analysis, timely reporting and an unparalleled commitment to personal, friendly customer service. Oil Analyzers works with fully equipped laboratories staffed by highly trained analysts and offers a complete line of oil analysis services to help you get the most from your lubricants and extend the life of your equipment.

- **Personalized Service.** Oil Analyzers provides personalized customer service. Reports are easy to understand and recommendations are included so you know exactly what you should do to provide the best care for your equipment. In addition, Oil Analyzers customer service representatives are available by phone and email to answer questions.
- **High-Quality Testing.** Oil Analyzers Fluid Analysis is performed at independent ISO 17025 A2LA accredited testing laboratories. This is the highest level of quality attainable by a testing laboratory backed by the most stringent accrediting body in the industry. You can be confident that the results you receive are accurate, repeatable and traceable to a standard.
- Innovative Information Technology Solutions. Oil Analyzers online reporting software, HORIZON®, delivers your results almost immediately after sample processing is complete. The software's management reports take your fluid-analysis program to the next level by helping you manage your data and your program efficiently and effectively.



## **Sampling and Trend Analysis**

The first step in any fluid analysis program is obtaining a sample. Regular sampling and trend analysis – monitoring test data over an extended period of time – provides the information you need to continually maximize asset reliability and increase profits. Comparing a component's most recent samples to its historical data is instrumental in identifying trends that can indicate potential problems or possible failure.

#### **Best Practices**

Fluid analysis is most effective when samples are representative of typical operating conditions. Dirt, system debris, water and light fuels tend to separate from lubricants and coolants when system temperatures cool. For optimum results:

- Take samples while systems are operating under normal conditions or immediately after shutdown while they are still at operating temperature.
- Take samples at regularly scheduled intervals.
- Take samples from the same sampling point each time.

#### **Suggested Sampling Intervals and Methods**

Although an equipment manufacturer's recommendations provide a good starting point for developing preventative maintenance practices, sampling intervals can easily vary. A piece of equipment's importance to production is a major consideration for determining sampling frequency, as are environmental factors such as hot, dirty operating conditions, short trips with heavy loads and excessive idle times. See the chart below for suggested sampling intervals and methods.\*



COMPONENT	INTERVAL	<b>SUGGESTED METHOD &amp; LOCATION</b>
MOTOR VEHICLE		
Gas Engines	125 Hours/7,500 miles	By vacuum pump through dipstick retaining tube or sampling
Diesel Engines	250 Hours/15,000 miles	valve installed in filter return
Gears, Differentials & Final Drives	250 hours	By vacuum pump through oil level plug or dipstick retaining tube
Planetaries	250 hours	By vacuum pump through oil fill port of system reservoir at mid-level
Cooling Systems	1000 hours	By vacuum pump through radiator cap or fill port of system reservoir at mid-level
INDUSTRIAL EQUI	PMENT	
Hydraulics	250-500 hours	By vacuum pump through oil fill port of system reservoir at mid-level
Gas Turbines	Monthly or every 500 hours	Through sample valve installed upstream of the filter on the return line or out of the system reservoir
Steam Turbines	Bi-monthly or monthly/quarterly	Through sample valve installed upstream of the filter on the return line or out of the system reservoir
Gas/Air Compressors	Monthly or at 500 hours/quarterly	Through sample valve installed upstream of the filter on the return line or out of the system reservoir

\*The suggested sampling intervals in the chart above are for conventional (non-synthetic) oils only. When using synthetic motor oil, the lubricant manufacturer's recommended interval should be followed. To extend the service of synthetic motor oil beyond the lubricant manufacturer's recommendation, oil analysis should be conducted.

## **Obtaining an Oil Sample**

Obtaining fluid samples is relatively simple, regardless of the application. Sampling methods may vary according to the type of equipment from which the sample is taken. Mobile vehicles typically require a vacuum pump while common industrial applications may give direct access through a sample valve or system reservoir. Some industrial equipment may require a vacuum pump.

To ensure accurate fluid analysis and reporting, appropriate procedures must be observed. All kits and materials necessary for obtaining an oil sample are outlined on pages 14 and 15.

#### Sampling with a Vacuum Pump

A vacuum pump is used to take samples from a dipstick or non-pressurized system.

To use a vacuum pump, securely attach a sample bottle to the pump. Attach a clean tube to the top of the pump and tighten the lock ring. Place the free end of the tube into the dipstick retaining tube or oil fill port, making sure not to allow contact between tubing and bottom of reservoir. Pump the plunger until oil flow is consistent and then pump only as needed to maintain consistent flow. The sample bottle should be filled about 3/4 full or to its shoulder. Remove the sample bottle from the vacuum pump and tighten the lid securely.

#### Sampling through a Sample Valve

Some industrial applications have a sampling port through which a sample can be obtained. This sampling method requires the equipment be in operation. Open the sampling valve and allow a small amount of oil to flush contaminants from the valve. Place the sampling bottle under the valve and obtain the sample. The sample bottle should be filled about 3/4 full or to its shoulder. Ensure the sampling valve is securely closed once the sampling process is complete.

#### Sampling from a System Reservoir

If collecting a sample through a sample valve is not possible, the equipment's system reservoir can be used.

The oil must be drained from the plug for a few moments before the sample is taken so contaminants that have settled around the drain are flushed out. Once the drain has been flushed, place the sample bottle in the oil stream and collect the sample. Using the reservoir drain plug is the least desirable method for obtaining an oil sample because the bottom of the reservoir contains elevated amounts of contaminants. It should be used only when the other options are unavailable.

#### **Mobile Sampling Locations**

Appropriate sampling locations for automobiles; light-duty, heavy-duty and over-the-road trucks include the oil dipstick tube, the reservoir drain plug or petcock valve if one has been installed.

#### **Industrial Sampling Locations**

Common sampling locations include the oil reservoir, oil filter, sampling port and filtration mount. If excess wear is detected in industrial applications, samples can be taken immediately before or after particular components, such as pumps or valves, to help isolate which component is producing excess wear elements.

## Submitting an Oil Sample

Accurately filling out a registration form, affixing a barcode label to the sample bottle and sending the oil sample to the appropriate lab for analysis are the final steps in submitting an oil sample.

#### **Component Registration Form**

Accurate, thorough and complete lube and equipment information not only allows for in-depth analysis, but can eliminate confusion and difficulties that can occur when interpreting results.

A component registration form is included with every sample kit. Always complete the Sample Information section of the form. Fill out the Component Registration section of the form when sampling a component for the first time or to notify the laboratory of a change for a previously registered component or fluid. The Component Registration section of the form does not need to be completed if a previous sample has been analyzed for that specific Component ID and no information has changed. The laboratory will request additional information if the registration form is incomplete and there is no information on record from the last sample that was analyzed.

#### **Barcode Label**

The Component Registration Form includes a barcode that corresponds to the sample information you recorded on the form. Identical barcode labels are included on the bottom of the Component Registration Form.

- The barcode labeled "APPLY TO SAMPLE JAR" should be applied vertically to the oil sample bottle.
- The barcode labeled "FOR YOUR RECORDS" should be maintained for your files.



Note: Prepaid shipping labels are already addressed. Do not alter shipping labels.



#### **Shipping Information**

Small return-address labels are provided on the Component Registration Form for non-postage-paid kits. Choose the label for the laboratory nearest you.

- Adhere the correct return-address label located on the Component Registration Form to the provided mailer.
- Place the Component Registration Form in the clear pocket on the front of the mailer.
- Place the oil sample bottle inside the mailer and seal.
- Apply the appropriate postage. Use a trackable shipping service such as FedEx, UPS or the USPS for mailing samples.

#### **Test Reports and Data Management**

Oil Analyzers Inc. and HORIZON® provide your test results almost immediately after processing your oil sample. Analysis reports are available via fax, email or online. To view your oil analysis test results online, go to www.eoilreports.com and click Test Results.

Fast access to oil analysis reports allows you to affect positive changes in your daily maintenance practices.

- Keep sampling schedules on track.
- Identify bottlenecks in turnaround time that are costing you money.
- Summarize unit problems that could influence future purchasing decisions.



Lubricant Analysis Report

North America: 1-877-458-3315



Overal report severity based on comments.

Ассо	unt Information	Component Information	Sample Information		
Account Number:	OILANA-1234-5678	Component ID: John's Truck	Tracking Number: 12345A67890		
Company Name:		Secondary ID: 2014 Suburban	Lab Number: I-123456		
Contact:	JOHN Q. CUSTOMER	Component Type: Unleaded Gasoline Engine	Lab Location: Indianapolis		
	1234 MAIN STREET	Manufacturer: Chevrolet	Data Analyst: AKB		
Address.	ANYTOWN, WI 54555 US	Model: 5.3L	Sampled: 04-Jul-2015		
Phone Number:		Application: Transportation	Received: 07-Jul-2015		
	/10-000-0000	Sump Capacity: 7 qts	Completed: 09-Jul-2015		
Filt	er Information	Miscellaneous Information	Product Information		
Filter Type:	Full-Flow		Product Manufacturer: AMSOIL		
Micron Rating:	20		Product Name: ASL SIG SIGNATURE SERIES Viscosity Grade: SAE 5W30		
Comments NE	W LUBE REFERENCE - Data u	sed for baseline reference only;	· · · · ·		
	Wear Metals (ppm)	Contaminant Metals (ppm) Multi-Source	e Metals (ppm) Additive Metals (ppm)		

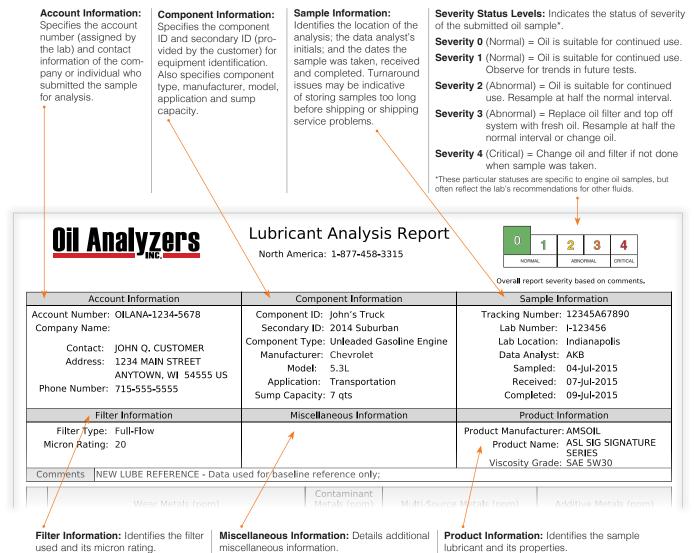
## **Reading the Oil Analyzers Fluid Analysis Report**

Once the oil sample is processed, Oil Analyzers provides a complete fluid analysis report detailing customer and equipment information, recommendations, elemental analysis, sample information, contaminants and fluid properties. This information is critical in determining the integrity of both the lubricant and the equipment.

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		Ac	count	Infor	natio	า				(	Compoi	nent Ir	nform	ation					Sam	np <b>l</b> e Ir	nforma	ation		
		y Nan ontac	ne: t: JO	HN Q.	CUST	OMER			S Comj	mpone econda ponent	nt <b>I</b> D: ry <b>I</b> D: Type: turer:	John's 2014 Un <b>l</b> ea	: Trucl Subur ded G	< ban	e Eng	gine	Т	Lal Lab	ng Nur o Nurr o Loca	nber: ber: tion:	1234  -123  ndia	5A67 456		
Ph	Ad Ione N			IYTOV	VN, W	545		S		Applica	odel: ition: bacity:		portat	ion			Data Analyst: AKB Sampled: 04-Jul-2015 Received: 07-Jul-2015 Completed: 09-Jul-2015							
	Filte licron mmer	er Typ Ratir	5	ll-Flov	v	ENCE	- Dat	ta us	ed for		isce <b>ll</b> ar ne refe			nation			Prod	Prod	anufac uct Na	turer: ame:	AMSC AMSC ASL SERII SAE	Dil Sig Si Es	GNATU	JRE
				Wea	ar Met	als (p	pm)	-	-1	1		ntamir als (p		м	ulti-S	Source	Metal	s (ppn	า)	A	dditive	e Met	als (pp	m)
Sample #	Iron	Chromium	Nicke	Aluminum	Copper	Lead	Tin	Cadmium	-		Silicon	Sodium	Potassium	Titanium	Molybdenum	Antimony	Manganese	Lithium	Boron	Magnesium	Calcium	Barium	Phosphorous	Zinc
1	1	0	0	0	0	0	0	0		-	2	0	0	0	0	0	0	0	0	9	3043	_	999	106
2	1	0		1			, v			0	3	2	1	Ů	•	0	0		1	7	3649	1	1174	1268
sample #	e Samp <b>l</b> ed	-	-	Samp	Lube Time			e Change	Lube Added	er Change	Fue	Dilution		amina Soot		Water		Viscosity	Viscosity		Number	Base Number	Oxidation	Nitration
1 (	Date Date 15-Feb	-2012	09-No		-	00 13		Property of the second	gal	Yes Yes	% \	/ol		% Vol		% \ <.1 - <.1 -	FTIR	cSt	cS	it K0		mg OH/g 10.7 10.9	abs/cm 39 52	abs/c 9 8
		-011			-				ticles/							-14		Ado	litiona			- 515	52	0

#### **Customer and Equipment Information**

This section of the report includes the severity status of the sample and information regarding the account, component and sample, as well as information regarding the filter and product. It also includes a miscellaneous information section for any additional information recorded by the lab.



Note: Missing or incomplete information is printed in red.

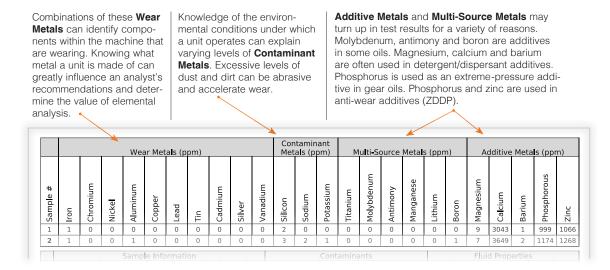
#### Comments

A data analyst's job is to explain and, if necessary, recommend actions for rectifying significant changes in the lubricant or the unit's condition. Reviewing comments before looking at the actual test results will provide a road map to the report's most important information. Any actions that need to be taken are listed in order of severity. Justifications for recommending those actions immediately follow.

											Cor	ntamir	nant											
			r	Wea	ar Meta	als (p	pm)	-			Me	tals (p	pm)	М	ulti-So	ource	Meta	s (ppn	n)	A	dditi	ve Met	als (pp	m)
Sample #	ron	Chromium	Nicke	Aluminum	Copper	Lead	Tin	Cadmium	Silver	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Antimony	Manganese	Lithium	Boron	Magnesium	Calcium	Barium	Phosphorous	Zinc
1	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	9	304	3 1	999	106
2	1	0	0	1	0	0	0	0	0	0	3	2	1	0	0	0	0	0	1	7	364	9 2	1174	126
				Samp	le Info	rmati	on						Cont	amina	ants					Flui	id Pro	pertie	s	
ole #	Sampled		-	Kecelved	Lube Time	Linit Timo		Change	Lube Added	- Change	Fue	Dilution		Soot		Water	2	Viscosity	Viscosity	100 °C	Number	Base Number	Oxidation	Nitration
sample	Date			Date	h	ł		Lube	gal	Filter	% \	/ol		% Vol		%\		cSt		St KO	mg DH/g	-	abs/cm	
1	01-Nov 15-Eeb		09-No 21-Fe	v-2012				Yes		Yes						<.1 -			14	.2		10.7	39 52	9

#### **Elemental Analysis**

Elemental analysis, or spectroscopy, identifies the type and amount of wear particles, contamination and oil additives. Determining metal content can alert you to the type and severity of wear occurring in the unit. Measurements are expressed in parts per million (ppm).



#### Sample Information, Contaminants and Fluid Properties

Test results are listed according to age of the sample oldest to most recent, top to bottom - so that trends are apparent. Significant changes are flagged and printed in the gray areas of the report. For lubricant lower and upper limitations, see pages 12 and 13.

specified.

Samples are listed by Date Received. They are also assigned a Lab Number for easy internal tracking. It is important to note whether or not the Lube has been Changed since the last sample was taken.

Fuel and Soot (only on engine oil samples) are reported in % of volume. High fuel dilution decreases unit load capacity. Excessive soot is a sign of reduced combustion efficiency.

Water in oil decreases lubricity, prevents additives from working and furthers oxidation. Its presence can be determined by crackle or FTIR and is reported in % of volume. Water by Karl Fischer ASTM D1744 determines the amount of water present.

Viscosity measures a lubricant's resistance to flow at temperature and is considered its most important physical property. Depending on the product, it is tested at 40 or 100 degrees Centigrade and reported in Centistokes.

Nitration

bs/cr

9

8

e Informatior Contaminants id Propertie Time Unit Time Viscosity 100 °C Viscosity 40°C Oxidation Received Acid Number Base Number Sampled Change Change Lube Added Fuel Dilution Water -ube Soot Sample # Lube ( Filter Date Date **∮**mg KOH/g % Vo % Vo % Vo h h ga cSt cSt KOH/d abs/c 13.000 01-Nov-2012 09-Nov-2012 10,000 <.1 - FTIR 10.7 1 Yes 14.2 39/ Yes The ISO Code is an index num-2 15-Feb-2014 21-Feb-2014 10,000 23,000 Yes Yes <.1 - FTIR 14.3 10.9/ 52 ber that represents a range of Particle Count (particles/mL) Additional Testing particles within a specific micron range, (e.g. 4, 6, 14). Each class designates a range of measured particles per one ml of sample. This test is valuable in determin-SO Code Sample ing large particle wear in filtered > 10 > 14 > 21 > 38 > 70 > 100 Based On > 4 > 6 Test systems. This section is only 4/6/14 Method μm μm μm μm μm μm μm μm used when a particle count is 1 // 2 11 Comments are advisory only and are based on the assumption that the sample and data submitted are valid. Missing fluid or compo expressed or implies on limits the evaluation. No warranty is Historical 1 NEW LURE REFERENCE

Acid and Base Numbers are measured to determine if the lubricant is becoming acidic. A lubricant that becomes too acidic can cause corrosion to internal engine components. Note that acid and base numbers do not begin at zero.

Oxidation measures the breakdown of the lubricant due to age and operating conditions. Nitration occurs when nitrogen oxides react with the lubricant, causing deposit formation and an increase in viscosity. Note that oxidation and nitration readings do not begin at zero.

## **Typical Lubricant Guidelines**

The charts below describe the properties typical of various lubricants. Consulting these charts while reading the fluid analysis report may help you understand the indicated severity level and recommendations.

		Gasoline Engine operties, contamir	Oil Guidelines	on)
	Normal	Elevated	Abnormal	Critical
Water	0.10%	0.30%	0.40%	0.50%
Fuel Dilution (Gasoline)	<2.4%	2.5% - 3.4%	3.5% - 4.9%	>5.0%
Fuel Dilution (Diesel)	<3.4%	3.5% - 4.9%	5.0% - 6.9%	>7.0%
Viscosity	In grade	+/- one SAE/ISO viscosity grade change	+/- one SAE/ISO viscosity grade change	+/- two SAE/ISO viscosity grade changes
Soot (Diesel Only)	<3.4%	3.5% - 4.9%	5.0% - 6.9%	>7.0%
Oxidation	Baseline + 17	Baseline + 20	Baseline + 23	Baseline + 27
Nitration	Baseline + 17	Baseline + 20	Baseline + 23	Baseline + 27
Base Number TBN	50% depletion	57% depletion	65% depletion	80% depletion
Acid Number TBN	1 x new-oil baseline	2 x new-oil baseline	3 x new-oil baseline	4 x new-oil baseline

#### SAE Engine & Gear Oil Viscosity Grade @ 100°C (Automotive Fluids)

SAE Engine Oil Grade @ 100°	Min cST.	Max cST.
16	6.1	<8.2
20	6.9	<9.3
30	9.3	<12.5
40	12.5	<16.3
50	16.3	<21.9
60	21.9	<26
SAE Gear Oil	Min cST.	Max cST.
90	13.5	<24.0
140	24.0	<41.0
250	41.0	No Reg.



### ISO Viscosity Grade @ 40°C (Industrial Fluids)

ISO Viscosity Grade @ 40°C	Min cST.	Max cST.
2	1.98	2.42
3	2.88	3.52
5	4.14	5.06
7	6.12	7.48
10	9.00	11.0
15	13.5	16.5
22	19.8	24.2
32	28.8	35.2
46 (AGMA 1)	41.4	50.6
68 (AGMA 2)	61.2	74.8
100 (AGMA 3)	90.0	110
150 (AGMA 4)	135	165
220 (AGMA 5)	198	242
320 (AGMA 6)	288	352
460 (AGMA 7)	414	506
680 (AGMA 8)	612	748
1000 (AGMA 8A)	900	1100
1500	1350	1650

## **Oil Analyzers Fluid Analysis Test Packages**

Oil Analyzers fluid analysis provides diagnostic testing designed to evaluate lubricant condition, component wear and contamination in mobile and industrial applications with a test report provided by an independent laboratory for each sample submitted. Refer to the chart below to determine which combination of tests each component will receive.

To order **Oil Analyzers** fluid analysis kits, visit www.oaitesting.com or call Oil Analyzers at **800-777-7094**. If you have questions regarding the Oil Analyzers Fluid Analysis Program or need help understanding your test reports, call **877-458-3315**.

Full-Service	Kits (KIT01, KI	F02, KIT06)	Value K	(it (KIT14)
Applications	Engines	Non-Engines	Engines	Non-Engines
Purpose	Monitors wear	& contamination		
24 Metals by ICP	•	•	•	•
% Fuel Dilution	•			
% Soot	•			
Water % by Crackle	•	•		
Viscosity @ 40°C		(if ISO grade fluid)	•	• (if ISO grade fluid)
Viscosity @ 100°C	•	• (if ISO grade fluid)	٠	• (if ISO grade fluid)
Oxidation/Nitration By FTIR	•	•		
Total Base Number	•		•	
Total Acid Number		•		•

KIT01	Oil Analyzers Test Kit, US Postal Service Pre-Paid
KIT02	Oil Analyzers Test Kit, UPS Pre-Paid
KIT06	Oil Analyzers Test Kit, Non Postage Paid
KIT14	Oil Analyzers Sample Value Kit, Non Postage Paid (do not use for first oil sample)

Note: Oil analysis kits cannot be used for coolant or diesel fuel samples. See page 15 for additional sampling kits.



#### Coolant Kit (KIT09)

17 Metals by ICP
pH
Glycol % (Ethylene or Propylene Glycol)
Freeze Point
Boil Point
Nitrite
SCA Number
Total Dissolved Solids
Specific Conductance
Total Hardness
Visuals (color, oil, fuel, magnetic precipitate, non-magnetic precipitate, odor & foam)

## Basic Fuel Kit – Fuel Contamination (KIT10)

Water & Sediments

Aerobic Bacteria

#### Basic Fuel Kit (KIT11)

24 Metals by ICP
Viscosity @ 40°C
Calculated Cetane Index
Distillation
API Gravity

#### Basic Winter Fuel Kit (KIT12)

Cloud Point

Pour Point

#### Premium Winter Kit (KIT13)

Cloud Point

Pour Point

Cold-Filter-Plugging Point

\* Cold-Filter-Plugging Point can be added to any fuel test package.

#### Sampling Equipment and Supplies

Oil Analysis Pump (G1206) Replacement Hose, 25' ft. (G1571)

To order OIL ANALYZERS Fluid Analysis kits, visit www.oaitesting.com or call 800-777-7094.

## <u>Oil Analyzers</u>

### LAB LOCATIONS

#### INDIANAPOLIS

7451 Winton Drive Indianapolis, IN 46268 Phone: 877.808.3750

#### HOUSTON

10910 West Sam Houston Parkway North Suite 700 Houston, TX 77064-6314 Phone: 877.808.3750

#### SALT LAKE CITY

3060 West California Avenue Suite B Salt Lake City, UT 84104 Phone: 877.808.3750

#### EDMONTON

5140 75th Street Edmonton, Alberta Canada T6E 6W2 Phone: 877.808.3750

To order Oil Analyzers fluid analysis kits, please call **800.777.7094** or visit www.oaitesting.com

Order by Phone 1-800-956-5695 - Give Operator Reference #1685293