

Oil Analyzers INC.



Fluid Analysis Program



What Can the OIL ANALYZERS Fluid Analysis Program Do For You?

Imagine being able to see exactly what's happening inside an engine, a gearbox or hydraulic system. **OIL ANALYZERS Fluid Analysis** is a preventive maintenance tool that provides a picture of both the fluid condition and the internal condition of a component or system without disassembly. OIL ANALYZERS Fluid Analysis will:

Extend oil drain intervals

Monitoring the condition of the oil optimizes drain intervals so that you get the most out of the fluid you're paying for. Fewer oil changes minimize maintenance costs and maximize uptime.

Extend equipment life

Monitoring system cleanliness and filtration efficiency allows you to keep your equipment longer and significantly reduce replacement costs.

Identify minor problems before they become major failures

State-of-the-art fluid analysis identifies dirt, wear particles, fuel dilution, and coolant – contaminants that can cause catastrophic failure or significantly shorten equipment life.

Maximize asset reliability

Testing and analysis ensures that units are up, running and making money.

Increase resale value

Analysis results provide valuable sampling history documentation that easily justifies higher equipment resale values.

Why OIL ANALYZERS?



HIGH-QUALITY TESTING

The **OIL ANALYZERS Fluid Analysis Program** utilizes 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 and that your fluid analysis program is supported by a documented quality system you can depend on to deliver superior testing and customer services.

INNOVATIVE INFORMATION TECHNOLOGY SOLUTIONS

The **OIL ANALYZERS Fluid Analysis Program's** online reporting software shows you how to get the most from your information. Using **HORIZON** online you receive results fast – almost immediately after sample processing is complete. The software's management reports can then take your fluid analysis program to the next level by helping you manage your data and your program efficiently and effectively.



Taking Samples

OIL ANALYZERS Fluid Analysis will show you how regular sampling and **TREND ANALYSIS** – monitoring test data over an extended period of time – will provide the information you need to continually maximize asset reliability, and, ultimately, increase company profits. Comparing a component’s most recent samples to its historical data is instrumental in identifying trends that can pinpoint potential problems.

Although an equipment manufacturer’s recommendations provide a good starting point for developing preventative maintenance practices, sampling intervals can easily vary. How critical a piece of equipment is 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.

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

- 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.

Whether you’re a seasoned veteran or a first-time sampler, a well-designed, quality fluid analysis program puts you on track for well-managed, cost-effective equipment maintenance programming.

Suggested Sampling Intervals & Methods

COMPONENT	INTERVAL	SUGGESTED METHOD & LOCATION
MOTOR VEHICLES		
Gas Engines	125 Hours/7,500 miles	By vacuum pump through dipstick retaining tube or sampling valve installed in filter return
Diesel Engines	250 Hours/15,000 miles	
Gears, Differentials & Final Drives	250 hours	By vacuum pump through oil level plug or dip stick retaining tube
Planetaries	250 hours	By vacuum pump through oil fill port of system reservoir at mid-level
Cooling System	1,000 hours	By vacuum pump through radiator cap or fill port of system reservoir at mid-level
INDUSTRIAL EQUIPMENT		
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



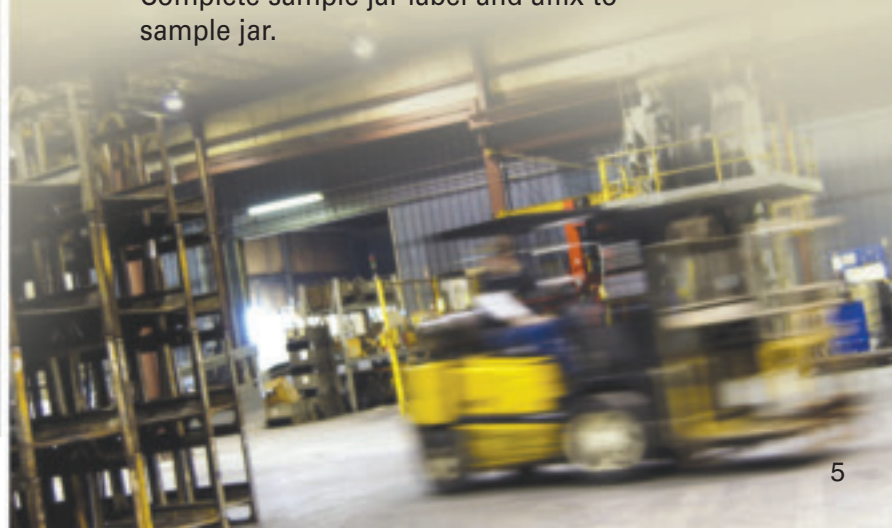


Sampling with a Vacuum Pump

A vacuum pump is used to take samples from a dipstick or non-pressurized system. The pump is attached to the sample jar, a tube is inserted into the pump and then into the dipstick retaining tube or oil fill port. Activating the pump handle, the sample jar should be filled about 3/4 full or to its shoulder.

When sampling engines:

- Measure length or depth of fill port tube, reservoir or dipstick.
- Add six (6) inches and mark the measurement on the tubing.
- Cut the tubing 12 inches beyond this mark.
- Insert tubing onto top of vacuum pump and tighten lock ring.
- Remove sample jar lid and attach jar to bottom of vacuum pump and tighten securely.
- Insert tubing into fill port, reservoir or dipstick retaining tube only to the mark on the tubing. To avoid drawing settled debris into the sample, do not allow contact between tubing and bottom of reservoir.
- Push and pull vacuum pump plunger until sample jar is 3/4 full.
- When sample reaches shoulder of jar, unscrew jar from pump, replace jar lid and tighten securely.
- Unscrew pump locking ring, remove tubing and drain excess oil back into reservoir.
- Discard tubing after each sample to avoid cross contamination.
- Complete sample jar label and affix to sample jar.



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.

Oil Kit		
Test Packages		
Applications	Engines	Non-Engines
Purpose	Monitors wear & contamination	
24 Metals by ICP	•	•
% Fuel Dilution	•	
% Soot	•	
Water % by Crackle	•	•
Viscosity @ 40°C	•	• (if ISO grade fluid)
Viscosity @ 100°C	•	• (if SAE grade fluid)
Oxidation/Nitration By FTIR	•	•
Total Base Number	•	
Total Acid Number		•

To order OIL ANALYZERS Fluid Analysis kits, please call OIL ANALYZERS at **800-777-7094**. For product information, if you have questions regarding the OIL ANALYZERS fluid analysis program, or for help in understanding your test reports, call **877-458-3315**.





Coolant Kit

- 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

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

Basic Winter Fuel Kit

- Cloud Point
- Pour Point

Premium Winter Fuel Kit

- Cloud Point
- Pour Point
- Cold Filter Plug Point

Basic Fuel Kit Fuel Contamination

- Water & Sediment
- Aerobic Bacteria

* Cold Filter Plug Point can be added to any fuel test package.

Sampling Equipment and Supplies

- Vacuum Pump
- Plastic Tubing (100 ft. roll)
- Plastic Tubing (56")



To order OIL ANALYZERS Fluid Analysis kits, please call 800-777-7094.

Component Registration Forms

A **Component Registration Form** is included with every sample kit. Fill it out only when sampling a component for the first time or to notify the laboratory of a change in component and/or fluid information already registered with the laboratory. **Complete, up-to-date information ensures that you receive the proper testing and an accurate analysis of the results.**

STEP 1

- Fill out the **Component Registration Form** completely and accurately.
- Use this form **only** for first-time samples or changes in unit **or** oil information previously submitted.
- Include it in the black mailer with the sample jar.

Sample Labels

Complete a **sample jar label** for **every** sample submitted to the laboratory. **Be sure to fill out all label information completely and accurately to ensure proper testing and accurate, in-depth analysis.** Once complete, attach the label to the sample bottle. Fill in the unit's ID on the removable tracking number sticker located to the right of the sample label and retain for your records.

STEP 2

- Fill out the **sample jar label** completely and accurately.
- Include **all** unit and fluid information requested including unit ID, type of component and position, time on both the fluid and the unit and whether or not fluid has been added or changed.
- Track sample processing at www.trackmysample.com.

NOTE: When you provide accurate and complete unit and oil information, your laboratory can deliver accurate and complete results and recommendations.



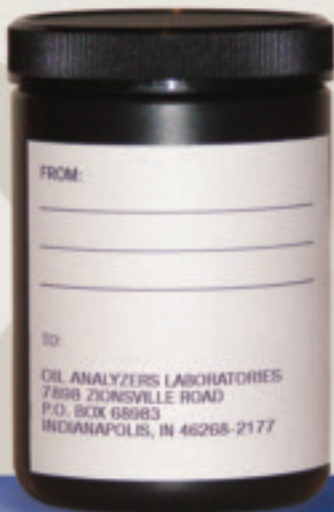
Shipping Information



Complete the mailer return address label for the laboratory nearest you and attach it to the shipping container, affix the appropriate postage and mail. Use a trackable shipping service for sending samples to the laboratory.

STEP 3

- Complete and attach the return mailer address label to the black shipping container.
- Ship by trackable mail service such as FedEx or UPS.



Test Reports and Data Management

Your **FREE**, online reporting option – **HORIZON** – is fast, bringing you test results almost immediately after processing is complete.

HORIZON Management Reports allow you to affect positive changes in your daily maintenance practices by:

- Keeping sampling schedules on track
- Identifying bottlenecks in turnaround time that are costing you money
- Summarizing unit problems that could influence future purchasing decisions.

Control over an extensive host of personal application settings and preferences also gives you the power to put the information you need most in front of you first.

STEP 4

Go to www.horizonsignup.com

NOTE: When you provide accurate and complete unit and fluid information, your laboratory can deliver accurate and complete results and recommendations.

Oil Analyzers

OVERALL HEALTHY OF REPORT: 0 1 2 3 4

LAB # 00000 LOCATION IN ANALYST 001

WEAR METALS	ANTIFEWAMOUNT METALS - ppm	MULTI-SOURCE METALS - ppm	ANALYTIC METALS ppm
Al
Ca
Fe
...



Diesel & Gasoline Engine Oil Guidelines

(for physical properties, contaminants & degradation)

	Normal	Abnormal	Excessive
Glycol	0	Trace	Trace
Water	<0.05%	0.05%	>1.0%
Fuel Dilution	<1.0%	2.0%	3.0%
Viscosity	in grade	+ or – one SAE/ISO viscosity grade change	+ or – two SAE/ISO viscosity grade change
Solids	<1.5%	2.0%	>4.0%
Soot (diesel only)	<2.0%	3.0%	>4.0%
Oxidation*	Expressed as absorption units per cm		50.0 synthetic 30.0 petroleum
Nitration*	Expressed as absorption units per cm		50.0 synthetic 30.0 petroleum
Total Base Number	Change oil when TBN strength diminishes to <2		
Total Acid Number (industrial)	1-3	3-4	>4

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

SAE Engine Oil Grade @ 100°	Min cSt.	Max cSt.
20	5.6	>9.3
30	9.3	>12.5
40	12.5	>16.3
50	16.3	>21.9
60	21.9	>26.0
SAE Gear Oil	Min cSt.	Max cSt.
90	13.5	>24.0
140	24.0	>41.0
250	41.0	No Req.

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 INC.		COMPANY INFORMATION UNIT ID: K205 A-1100 SECOND ID: F2 OILWELL UNIT TYPE: PUMP APPLICATION: ON-SHORE OILFIELD																																																																																																																																																																																											
ACCOUNT NUMBER: 813007 DATE SAMPLED: 08/21/07 DATE RECEIVED: 08/21/07 DATE COMPLETED: 08/21/07		OVERALL SEVERITY OF REPORT based on comments, not individual flags 0 1 2 3 4 NORMAL 40 INCRASING CRITICAL																																																																																																																																																																																											
TRACKING #: MANUFACTURER/HOURL: OILWELL A-1100 LUBE MFR: 76 LUBRICANTS LUBE TYPE - GRADE: GL 3 SAE 68D140 HICRON RATING: 800 FILTER TYPE: SUMP CAPACITY: 50000 HYD SYSTEM PRESSURE: 50000 FLUID ADDED:																																																																																																																																																																																													
FLUID ANALYSIS REPORT COMMENTS: Check for possible source of ABRASIVES entry (such as faulty filter elements, seal housing, smoothies, fit points etc.). Abrasives (Silica) are at a SEVERE LEVEL. Lubricant change is suggested if not done at sampling time. Water is at a MODERATE LEVEL. Gear and/or bearing metal is at a MODERATE LEVEL. Aluminum is most likely in the form of sludge/scale (Zinc). Petroleum is at a MODERATE LEVEL. SANGUIN IS COMMONLY FOUND IN OILWELL FLUID. Unit and/or tube TIME missing. N/A.																																																																																																																																																																																													
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How to Read the OIL ANALYZERS Fluid Analysis Report

Application identifies in what type of environment the equipment operates and is useful in determining exposure to possible contaminants.

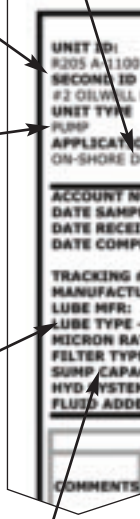
Equipment ID is each customer's opportunity to uniquely identify units being tested and their location.

Unit Type should give as much detail as possible. **What kind** of compressor, gearbox, engine, etc..., influences flagging parameters and depth of analysis. Different metallurgies require different lubrication and have great impact on how results are interpreted.

Lube Manufacturer, Type and Grade identify a lube's properties and its viscosity and are critical in determining if the right lube is being used.

Filter Types and their **Micron Ratings** are important in analyzing particle count-the higher the micron rating, the higher the particle count results.

Accurate, thorough, and complete fluid and equipment information allows for more in-depth analysis and can eliminate confusion when interpreting results.



Customer Equipment and Sample Information

The information submitted with a sample is as important to who is reading the report as it is to the analyst interpreting the test results and making recommendations. **Properly document your equipment and share this knowledge with your laboratory.** Implement a sampling process for every piece of equipment in your oil analysis program that can be followed consistently each time the unit is sampled. Accurate, thorough and complete lube and equipment information not only allows for in-depth analysis, but can eliminate confusion and the difficulties that can occur when interpreting results.

Make note of the difference between the **Date Sampled** and the **Date Received** by the lab. Turnaround issues may point to storing samples too long before shipping or shipping service problems. Also noted is testing **Date Completed**.

Manufacturer and Model can also identify metallurgies involved as well as the OEM's standard maintenance guidelines and possible wear patterns to expect.

Severity Status Levels:

- 0- Normal.
- 1- At least one or more items have violated initial flagging points yet are still considered minor.
- 2- A trend is developing.
- 3- Simple maintenance and/or diagnostics are recommended.
- 4- Failure is eminent if maintenance is not performed.

The image shows a sample report form from Oil Analyzers Inc. The form includes sections for 'COMPANY INFORMATION', 'FLUID ANALYSIS REPORT', and 'OVERALL SEVERITY OF REPORT'. The severity level is indicated by a red triangle pointing to the number '4' in a color-coded scale (0: Normal, 1: AB NORMAL, 2: CRITICAL, 3: CRITICAL, 4: CRITICAL). Callout boxes point to various fields: 'Date Sampled' (07/30/07), 'Date Received' (08/07/07), 'Date Completed' (08/06/07), 'Manufacturer/Model' (OIL WELL A-1100), 'Lube Grade' (GL 5 SAE 85W140), 'Sump Capacity' (0000), 'Lube Time' (0000), 'Lab #' (S36280), 'Location' (H), and 'Analyst' (EM).

The laboratory at which testing was completed is denoted by an **I** for **Indianapolis**, an **H** for **Houston** and an **S** for **Salt Lake City**. The **Lab #** is assigned to the sample upon entry for processing and should be the reference number used when contacting the lab with questions, concerns or feedback.

Sump Capacity identifies the total volume of oil (in gallons) in which wear metals are suspended and is critical to trending wear metal concentrations.

Lube Time is how long the oil has been used. **Unit Time** is the age of the equipment and **Lube Added** is how much oil has been added since the last sample was taken.

Data Analysts Initials

Recommendations

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 first in order of severity. Justifications for recommending those actions immediately follow.

FLUID ANALYSIS REPORT	
COMMENTS	Check for possible source of ABRASIVES entry (such as faulty filter elements, filter housing, breathers, fill points etc:). Abrasives (Silicon) are at a SEVERE LEVEL; Lubricant change is suggested if not done at sampling time; Water is at a MODERATE LEVEL; Gear and/or bearing metal is at a MODERATE LEVEL; Aluminum is most likely in the form of alumina/silica (Dirt); Potassium is at a MINOR LEVEL; BARIUM IS COMMONLY FOUND IN DRILLING MUD; Unit and/or lube TIME missing; N/A

FLUID ANALYSIS REPORT																								
COMMENTS	Check for possible source of ABRASIVES entry (such as faulty filter elements, filter housing, breathers, fill points etc:). Abrasives (Silicon) are at a SEVERE LEVEL; Lubricant change is suggested if not done at sampling time; Water is at a MODERATE LEVEL; Gear and/or bearing metal is at a MODERATE LEVEL; Aluminum is most likely in the form of alumina/silica (Dirt); Potassium is at a MINOR LEVEL; BARIUM IS COMMONLY FOUND IN DRILLING MUD; Unit and/or lube TIME missing; N/A																							
WEAR METALS - PPM				CONTAMINANT METALS - PPM				MULTI-SOURCE METALS - PPM				ADDITIVE METALS - PPM												
SAMPLE #	IRON	CHROMIUM	NICKEL	ALUMINUM	COPPER	LEAD	CADMIUM	SILICON	TITANIUM	VANADIUM	SILICON	SODIUM	POTASSIUM	MOLYBDENUM	ANTHRAcene	MANGANESE	LITHIUM	BORON	MAGNESIUM	CALCIUM	BARIUM	PHOSPHORUS	ZINC	
1	598	6	6	143	60	4	1	0	23	0	431	38	39	1	0	0	3	47	188	118	649	40		
2	172	1	0	35	23	1	0	0	10	0	137	21	8	0	0	0	0	6	46	208	91	716	182	
3	262	4	1	91	32	1	0	0	3	0	280	41	24	1	0	2	0	6	54	295	139	656	81	
SAMPLE #	DATE SAMPLED	UNIT TIME	DATE RECEIVED	LUBE	CHG	FILTER	FUEL	SOOT	WATER	45C	100C	Total Acid	Total Base	I-R	I-R	ISO	MICRON	MICRON	MICRON	MICRON	MICRON	MICRON	MICRON	
					CHG	CHG	Vol.	Vol.	Hot Plat		CE						4	6	10	14	21	38	70	100

Laboratory will request additional unit and lube information if incomplete on sample label



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).

Combinations of these **Wear Metals** can identify components within the machine that are wearing. Knowing what metal a unit is made of can greatly influence an analyst's recommendations and determine the value of elemental analysis.

Knowledge of the environmental conditions under which a unit operates can explain varying levels of **Contaminant Metals**. Excessive levels of dust and dirt can be abrasive and accelerate wear.

Additive and Multi-Source Metals may turn up in test results for a variety of reasons. Molybdenum, antimony and boron are additives in some oils. Magnesium, calcium and barium are often used in detergent/dispersant additives. Phosphorous is used as an extreme-pressure additive in gear oils. Phosphorous, along with zinc, are used in anti-wear additives (ZDDP).

SAMPLE #	WEAR METALS PPM										CONTAMINANT METALS - PPM				MULTI-SOURCE METALS - PPM				ADDITIVE METALS PPM				
	CHROMIUM	NICKEL	ALUMINUM	COPPER	LEAD	CADMIUM	SILVER	TITANIUM	VANADIUM	SILICON	SODIUM	POTASSIUM	MOLYBDENUM	ANTIMONY	BORON	MANGANESE	CALCIUM	BARIUM	PHOSPHORUS	ZINC			
1	598	6	143	60	4	1	0	0	23	0	431	38	39	1	0	5	0	3	47	188	118	649	40
2	172	1	35	23	1	0	0	0	10	0	137	21	8	0	0	1	0	6	46	208	91	716	102
3	262	4	91	32	1	0	0	0	3	0	280	41	24	1	0	2	0	6	54	295	139	656	81

Test Data

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.

Samples are listed by **Date Received** in the lab—oldest first. They are also assigned a **Lab Number** for easy internal tracking. Important to also note is whether or not the **Lube** has been **Changed** since the last sample was taken.

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

SAMPLE #	DATE SAMPLED	UNIT TIME	FUEL %	SOOT %	WATER %	VISC 40C	VISC 100C	TAN	TBN	I-R	I-R	ISO	4	6	10	14	21	35	70	100	
	DATE RECEIVED	LUBE TIME																			LUBE CHG
1	03/20/06	03/27/06	U	U	0.00	25.00	1.11														
2	06/20/07	06/27/07	U	U	0.20	27.30	1.12														
3	07/30/07	08/07/07	U	U	0.20	24.00	0.95														

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

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. These results appear in the Special Testing section of your report.

The **ISO Code** is an index number that represents a range of particles within a specific micron range, i.e., 4, 6, 14. Each class designates a range of measured particles per one ml of sample. The particle count is a cumulative range between 4 and 6 microns. This test is valuable in determining large particle wear in filtered systems.

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