What Can Fluid Analysis Do For You?

Fluid analysis is a snapshot of what is happening inside your equipment. It summarizes the condition of your oil and identifies component wear and contamination in virtually any application.

- Identify opportunities for optimizing filtration performance
- Safely extend drain intervals
- Minimize downtime by identifying minor problems before they become major failures
- Maximize asset reliability
- Extend equipment life

Suggested Sampling Intervals and Methods

Fluid analysis is most effective when samples are representative of typical operating conditions. Always take samples at regularly scheduled intervals and from the same sampling point each time. How critical a piece of equipment is to production should be a major consideration for determining sampling frequency.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Sampling Interval</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic</td>
<td>250-500 hours</td>
<td>By vacuum pump through oil fill port of system reservoir at mid-level</td>
</tr>
<tr>
<td>Gearboxes</td>
<td>750 hours</td>
<td>By vacuum pump through oil level plug or dipstick retaining tube</td>
</tr>
<tr>
<td>Compressors</td>
<td>Monthly or at least every 500 hours</td>
<td>By vacuum pump through oil fill port of system reservoir at mid-level</td>
</tr>
<tr>
<td>Turbines</td>
<td>Monthly or at least every 500 hours</td>
<td>By vacuum pump through oil level plug or dipstick retaining tube</td>
</tr>
</tbody>
</table>

Test Kits and Sampling Products Outside of North America: The fluid sampling program featured in this section is used by North American customers. If you’re located outside of North America, we recommend you contact your local Donaldson distributor to discuss availability.
Fluid Analysis Program

The Donaldson Advanced Fluid Analysis Kit is designed to monitor component wear, contamination and fluid condition.

Benefits

- Partnership with a total filtration solutions provider
- High quality testing by an ISO 17025 A2LA accredited laboratory
- Results available immediately upon sample processing completion
- Innovative data management tools that will help you affect change in daily maintenance practices.

How Send Samples to the Laboratory

STEP A | Sample Information

First-time users need to establish a Horizon® account, and new components (sample point) need to be added to your account. Go to this address: www.eoilreports.com/login

Next, fill out the QR code label with the corresponding Component ID and Sample Date. Attach the label to the sample jar and retain the other label for your records.

To improve accuracy and ensure faster processing, use the Sample Submission feature in Horizon to send the sample information to the laboratory. Once the information is submitted online, the QR code will contain all required sample information needed for processing.

NOTE: Provide the laboratory with as much detailed equipment and fluid information as possible. More in-depth analysis is possible when the analyst knows the time on both the unit and fluid and whether the fluid and/or filter have been changed since last sampled.

STEP B | Laboratory Locations

A list of available laboratory locations is included on the form. Label your package with the laboratory address of your choice and ship it using a trackable shipping service, such as UPS or FedEx.

STEP C | Online Access

If the sample information cannot be submitted online, complete the simple form on the right, detach the form and submit it to the laboratory with the sample.

IMPORTANT: Samples will be placed on hold if the component ID does not match an ID in your account and no component information is included on the paper form. Components can be added to your account online via Horizon or by contacting Customer Service. Samples placed on hold for more than 30 days will be disposed.

Test Points, Adapters and Hose Assemblies

If you have filters installed in hard-to-access locations, test points, adapters and hose assemblies can be used to plumb up a bulkhead to read pressure differentials.

See Accessories Section for complete offering!
Test Results / Reports from Your Sample

Your Donaldson test report colors code individual results by severity for a better understanding of the overall severity of the report. It also provides a graphical representation of the cleanliness level of the fluid with a photo micropatch accompanied by the Target ISO Chart done on each sample.

With Donaldson, you’re also on track for total program management with problem summary reports, sample processing turnaround tracking and data mining capabilities that allow you to affect positive changes in your daily maintenance practices.

- Get test results almost immediately – online
- Identify significant trends in fluid cleanliness
- Use management reports to pinpoint problems with critical units
- Identify bottlenecks in sample turnaround time
- Influence equipment purchasing decisions
- Access your information from anywhere there is an internet connection
How to Read the Donaldson Fluid Analysis Report

Reading a fluid analysis report can be an overwhelming and sometimes seemingly impossible task without an understanding of the basic fundamentals for interpreting laboratory results and recommendations. Referring to the report descriptions and explanations below will help you better understand your results and, ultimately, better manage a productive, cost-saving reliability program.

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. Know your equipment and share this information with your laboratory. 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.

Unit, Lube, Turnaround Time and Account information are listed on the left side of the report emphasizing the data most critical to laboratory processing and data interpretation. Details such as what kind of compressor, gearbox, engine, etc., influences flagging parameters and depth of analysis.

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

Severity is represented on a sliding scale and is color-coded so that critical units are more apparent at first glance. Overall severity is based on report Comments—not individually flagged results.

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 not performed. Occasionally, a test result can violate the S4 excursion level. But, if there is no supporting data or a clear indicator of what is actually happening within the unit, maintenance action may not be recommended.

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

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

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

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 Manufacturer, Type and Grade identifies a lube’s properties and its viscosity and is critical in determining if the right lube is being used.

The laboratory at which testing was completed is denoted by an I for Indianapolis and an H for Houston. The following Lab # is assigned to the sample upon entry for processing and should be the reference number used when notifying the lab with questions or concerns.

Data Analyst Initials

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.
**Recommendations**

A data analyst’s job is to explain and, if necessary, recommend actions for rectifying significant changes in a unit’s condition. Reviewing comments before looking at the actual test results will provide a roadmap 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.

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### Elemental Analysis

Elemental Analysis, or Spectroscopy, identifies the type and amount of wear particles, contamination and 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 metals 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 (ZDP).

When reviewing your report online, you can click on the metal to see its definition, the ASTM test method used, how the results are reported, the amount of sample needed to perform the test, possible sources as to where the metal is coming from, and an illustration of the test equipment.

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**Sample Information**

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Date Sampled</th>
<th>Date Received</th>
<th>Oil Change</th>
<th>Tube Change</th>
<th>Filter Change</th>
<th>Unit Type</th>
<th>Oil Type</th>
<th>Oil Grade</th>
<th>Oil Temperature</th>
<th>Viscosity 40°C</th>
<th>Viscosity 100°C</th>
<th>Water</th>
<th>Acid Number</th>
<th>Base Number</th>
<th>Soot</th>
<th>Viscosity Reduction</th>
<th>Dilution</th>
<th>Water</th>
<th>Acid</th>
<th>Base</th>
<th>Nitro</th>
<th>KCl/mg</th>
<th>K2O/mg</th>
<th>CaCO3</th>
<th>MgCO3</th>
<th>Si</th>
<th>Mn</th>
<th>Fe</th>
<th>Cr</th>
<th>Al</th>
<th>Ni</th>
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<tr>
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<td>22-Nov-2016</td>
<td>30-Nov-2016</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Unit Type</td>
<td>Oil Type</td>
<td>Oil Grade</td>
<td>Oil Temperature</td>
<td>Viscosity 40°C</td>
<td>Viscosity 100°C</td>
<td>Water</td>
<td>Acid Number</td>
<td>Base Number</td>
<td>Soot</td>
<td>Viscosity Reduction</td>
<td>Dilution</td>
<td>Water</td>
<td>Acid</td>
<td>Base</td>
<td>Nitro</td>
<td>KCl/mg</td>
<td>K2O/mg</td>
<td>CaCO3</td>
<td>MgCO3</td>
<td>Si</td>
<td>Mn</td>
<td>Fe</td>
<td>Cr</td>
<td>Al</td>
<td>Ni</td>
<td>Cu</td>
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**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* appear in an oldest to newest numbered sequence so that results are easily associated with them throughout the report and depth of analysis. **Water** in oil decreases lubricity, prevents additives from working and further oxidation. Its presence can be determined by crackle or FTIR and is reported in % of volume. Water by Karl Fischer determines the amount of water present. These results appear in the Special Testing section of your report. **Viscosity** measures a lubricant’s resistance to flow at temperature and is considered its most important physical property. Depending on lube grade, it is tested at 40 and/or 100 degrees Centigrade and reported in centistokes.

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Date Sampled</th>
<th>Date Received</th>
<th>Lube Time</th>
<th>Unit Time</th>
<th>Lube Change</th>
<th>Lube Added</th>
<th>Filter Change</th>
<th>Fuel Dilution</th>
<th>Water</th>
<th>Viscosity 40°C</th>
<th>Viscosity 100°C</th>
<th>Acid Number</th>
<th>Base Number</th>
<th>Oxidation</th>
<th>Nitration</th>
<th>Abrs/Dm²</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22-Nov-2016</td>
<td>30-Nov-2016</td>
<td>0</td>
<td>0</td>
<td>Unk</td>
<td>0</td>
<td>Unk</td>
<td>0</td>
<td>44.4</td>
<td>0.02</td>
<td>102</td>
<td>3.46</td>
<td>5.50</td>
<td>0.16</td>
<td>1.2</td>
<td>abs/12</td>
<td>1.64</td>
</tr>
</tbody>
</table>

**Additional Testing**

**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.

**Fuel and Soot** results are all reported in % of volume. High fuel dilution decreases unit load capacity. Excessive soot is a sign of reduced combustion efficiency.

**Oxidation** measures the breakdown of a lubricant due to age and operating conditions. Oxidation prevents additives from working and therefore promotes increased acid content, as well as increased viscosity. **Nitration** is an indication of excessive “blow-by” from cylinder walls and/or compression rings and indicates the presence of nitric acid, which speeds up oxidation. Too much disparity between oxidation and nitration can indicate air to fuel ratio problems. As Oxidation/Nitration increases, TAN will also increase and TBN will begin to decrease.

**Special Testing**

Special testing is often done when additional, or more specific, information is needed. For example, an Analytical Ferrograph might be requested when a ferrous metal larger than 5 microns has been detected by Direct Read Ferrography. The AF can determine actual size of the particle, its composition—iron, copper, etc.—and the type of wear it’s creating—rubbing, sliding, cutting, etc. Additional special testing could include, Water by Karl Fischer and RPVOT (Rotating Pressure Vessel Oxidation Test).
**Photo Micropatch**

A photo Micropatch is included with each test report and provides digital imagery of the wear debris, contamination and/or filter media particles found in each fluid sample. It is taken at a 100x magnification and includes the sample’s ISO code and a 10 micrometer scale for particle size comparison.
If target ISO codes are provided on the Component Registration Form, it will appear above the unit ID.

The ISO 4406 standard utilizes a three number system to classify system cleanliness — The first number represents the number of particles present measuring greater than 4 μm. The second represents particles greater than 6 μm and the third represents those greater than 14 μm.

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<table>
<thead>
<tr>
<th>#</th>
<th>Date</th>
<th>4 micron</th>
<th>6 micron</th>
<th>14 micron</th>
<th>ISO Code</th>
<th>Lab Number</th>
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<tbody>
<tr>
<td>1</td>
<td>22-Nov-2019</td>
<td>WAT</td>
<td>WAT</td>
<td>WAT</td>
<td>WA/WA/WA</td>
<td>1-794768</td>
</tr>
</tbody>
</table>

Each of the ISO Code’s three numbers represents an ISO range. For example, the ISO Cleanliness Code for the most recent sample in this report is 19/18/15. Because the number of 4μm particles is between 2,500 and 5,000, the corresponding ISO code is 19. Because the number of 6μm particles is between 1,300 and 2,500, the corresponding ISO code is 18. Because the number of 14 μm particles is between 160 and 320, the corresponding ISO code is 15.
Portable Fluid Analysis Kit

Fluid analysis is a snapshot of what is happening inside your equipment. It tells you the condition of the lubricant and identifies component wear and contamination in virtually any application. The Donaldson Portable Fluid Analysis Kit (Part No. X009329) allows you to conduct immediate on-site particulate analysis in as little as ten minutes.

Using the patch test method, you can quickly and reliably assign a three-digit cleanliness code per ISO 4406-1999 to a given fluid sample. Simply pull a 25 ml fluid sample through a patch membrane filter and compare oil sample particle distribution with the Fluid Cleanliness Comparison Guide (included) to assign an ISO Cleanliness Code.

- Use this kit to determine which systems need improved filtration.
- When improvements are made, use it to monitor the cleanliness status of the system.
- A great alternative to expensive, portable electronic devices.

Kit Contents

- Membrane Filter Forceps
- Microscope P567864
- Filter for Solvent Dispensing Bottle P567860 (Qty. 3)
- 120 ml Sample Bottles (Qty. 6) P567861
- 500 ml Solvent Dispensing Bottle
- Zip Drive with Reference Information (under Plastic Tubing)
- 5 micron Membrane Filters P567868 (Qty. 50)
- 1.2 micron Membrane Filters P567869 (Qty. 100)
- Sharpie Marker
- Analysis Cards (3"x5") P567865 (Qty. 50)
- Patch Covers P567912 (Qty. 150)
- Membrane Holder & Funnel Assembly P567863
- Plastic Tubing (5 Feet)
- Sampling Pump P176431

Case Size:
- Height: 14.5”/368.3mm
- Width: 19.25”/489mm
- Depth: 7.75”/197mm
- Case Weight: 9.95 lbs./4.51 kg

Benefits
- Easy to use
- Results in as little as 10 minutes
- Measures particulate levels
- Provides reliable results

The Donaldson Portable Fluid Analysis Kit includes enough supplies for 200 fluid samples. All apparatus is securely packaged and well-protected with laser-etched foam in a sturdy carrying case.
**Basic Steps for Use**

Kit includes detailed operating instructions and visual comparison guide.

1. Assemble waste bottle, funnel-patch assembly, and vacuum pump to form the sample processing assembly. Tighten the vacuum pump o-ring on the funnel-patch assembly tube by turning the aluminum locking device.

2. Install solvent* dispensing tube and install solvent filter on end of the dispensing tube.

3. Rinse the funnel-patch assembly with the filtered solvent to remove background contamination. The patch should not be in place for this process.

4. Separate the funnel from the patch supporter and install a filter patch with ink grid up. (If the patch has an ink grid).

5. Reattach the funnel to the filter patch base with filter patch. Twist lock the funnel to the base.

6. Agitate the sample fluid bottle and pour 25ml into the funnel. 25ml is denoted by the first line on the funnel (closest to the patch).

7. Draw the sample fluid through the patch by pulling on the vacuum pump handle.

8. Once the entire sample has passed through the patch rinse the funnel with filtered solvent and draw through the patch. Continue to pull air through until the patch starts to dry. Then separate the funnel from the patch supporter and remove the patch with forceps.

9. Place the sample (ink/dirty side up) on a clean index card and cover it immediately with a plastic laminate patch cover.

10. Analyze the sample with the 100x magnification field microscope.

11. For best results, stand the microscope (without the lens cap or base) directly over the sample.

12. Use the reference photos at the back of the manual to make approximate ISO code correlation and identify contaminant types.

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* Mineral spirits are the most commonly used solvent

* Odorless mineral spirits