What Can the Donaldson Fluid Analysis Program Do For You?

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 so that you can:

- 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

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 about the fluid sampling kits available.

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>Sampling 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>
Fluid Analysis Products

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

Benefits of the Fluid Analysis Program

- 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.

Sending Samples to your Donaldson Laboratory

**Step 1**
Fill out the Component Registration Form and include it with your sample in the shipping container provided. Use this form only when sampling a component for the first time or when submitting changes in component or fluid information already submitted to the laboratory.

**Step 2**
Fill out the sample jar label completely and accurately, including unit ID, time on both the fluid and the unit and whether or not fluid has been added or changed.

**Step 3**
Complete the return address shipping label and apply it to the shipping container. Use only a trackable shipping service such as UPS or FedEx to send samples to the laboratory at:

Donaldson Fluid Analysis Laboratory
7898 Zionsville Road
Indianapolis, IN 46268-2177

**Step 4**
Set up your account and receive your username and password for easy access to your test results by calling the laboratory’s Customer Service at 877-458-3313. Go to www.donaldson.com, click on Industrial Hydraulics, and locate View Fluid Analysis Reports. Log in with your assigned username and password given to you by the laboratory.

### Fluid Sampling Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Analysis Service</td>
<td>X009330</td>
</tr>
<tr>
<td>- 24 Metals by ICP</td>
<td></td>
</tr>
<tr>
<td>- Water by Karl Fischer, ppm</td>
<td></td>
</tr>
<tr>
<td>- Viscosity at 40°C or 100°C</td>
<td></td>
</tr>
<tr>
<td>- Oxidation/Nitration by FTIR</td>
<td></td>
</tr>
<tr>
<td>- Total Acid Number</td>
<td></td>
</tr>
<tr>
<td>- ISO Particle Count/Particle Quantifier</td>
<td></td>
</tr>
<tr>
<td>Sample Extraction Pump</td>
<td>P176431</td>
</tr>
<tr>
<td>Sample Extraction Tubing</td>
<td>P176433</td>
</tr>
</tbody>
</table>
Test Results / Reports from Your Sample

Your Donaldson test report color codes 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 change 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

Test Points, Adapter and Hose Assemblies

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

See the Accessories Section to view extensive offering!
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.

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

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.

Fluid Added is how much oil has been added since the last sample was taken.

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

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

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.

Severities are 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.

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.

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

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

Data Analyst Initials

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.
**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.

<table>
<thead>
<tr>
<th>COMMENTS</th>
<th>Data flagged for observation only; Particle Count is at a MODERATE LEVEL (LEVEL 3); AIR BUBBLES is MODERATELY HIGH; Aluminium is at a MINOR LEVEL; Is this system filtered? If so, please inform us of the filter micron rating. This will assist us in trending Particle Count;</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>WEAR METALS PPB</th>
<th>CONTAMINANT METALS PPB</th>
<th>MULTI-SOURCE METALS PPB</th>
<th>ADDITIVE METALS PPB</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLE #</td>
<td>IRON</td>
<td>CHROMIUM</td>
<td>NICKEL</td>
</tr>
<tr>
<td>30</td>
<td>0 0 0</td>
<td>0 0 0</td>
<td>0</td>
</tr>
<tr>
<td>31</td>
<td>2 0 0</td>
<td>0 0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>32</td>
<td>1 0 0</td>
<td>0 0 0</td>
<td>0 0</td>
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<tr>
<td>33</td>
<td>4 4 0</td>
<td>0 0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>34</td>
<td>3 0 0</td>
<td>0 0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>35</td>
<td>3 0 0</td>
<td>3 0 0</td>
<td>0 0</td>
</tr>
</tbody>
</table>

“Highlighted” numbers denote test results the analyst has flagged because they exceed pre-set warning parameters and warrant closer examination or require action. Individual results are flagged by severity color to better explain the overall severity assigned to the sample.

**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.
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.

**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.

**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.

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 8 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.

**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 determines the amount of water present in the sample. These results appear in the Special Testing section of your report.

**TAN: Total Acid Number** is the amount of acid present in the lubricant. Numbers higher than that of new lube is an indication of oxidation or some type of contamination. **Total Base Number (TBN)** measures the lube’s alkalinity, or ability to neutralize acid. When TAN and TBN approach the same number, the lube should be changed or “sweetened,” meaning more lube could be added.

**Online Tip:** When reviewing your report online, you can click on the test name to see its definition, the ASTM test method used, how the results are reported, the amount of sample needed to perform the test and an illustration of the test equipment.

**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.

Particle count results are reported in particles per milliliter or particles per 100 milliliters at a given size (microns) and ISO Cleanliness Code. When sampling units for the first time, you must include on the Component Registration Form the target ISO Cleanliness Codes specific to each of your applications. These unit-specific codes will then pre-fill on each test report. If target ISO codes are not provided, the target ISO field will be determined by the type of hydraulics and pressure rating listed on the Component Registration Form. The 4, 6 and 14 micron particle ranges are then graphed for each sample tested.

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 content details on the next page.

The Donaldson Portable Fluid Analysis Kit includes enough supplies for 100 fluid samples. All apparatus is securely packaged and well-protected with laser-etched foam in a sturdy carrying case.

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

**Kit Content and Physical Size:**

**Case Size:**
- **Height:** 14.5”/368.3mm
- **Width:** 19.25”/489mm
- **Depth:** 7.75”/197mm

**Case Weight:** 9.95 lbs./4.51 kg

**Kit Part Number** X009329

**120 ml Sample Bottles (8)**

**P567861**

**Membrane Filter**

**Forceps**

**P567864**

**Pen Light & Batteries**

**100 ml Solvent Dispensing Bottle**

**P567862**

**Membrane Holder & Funnel Assembly**

**P567863**

**Sampling Pump**

**P176431**

**Filter for Solvent Dispensing Bottle**

**P567860 (ea.)**

**Plastic Tubing**

**P176433**

**Analysis Cards (3”x5”)**

**P567865 (set of 50)**

**Beaker**

**P567866**

**0.8 micron Membrane Filters**

**P567869 (set of 100)**

**5 micron Membrane Filters**

**P567868 (set of 100)**

**Basic Steps for Use**

Kit includes detailed operating instructions and visual comparison guide.

1. Assemble the pump and funnel assembly and screw on empty sample bottle.

2. Place solvent dispensing bottle filter on spout of solvent dispensing bottle.

3. Wash funnel with solvent* and pull solvent through assembly with hand-operated vacuum pump.

4. Place a patch membrane in the funnel assembly.

5. Pour the fluid sample into the funnel and fill to the 25 ml level.

6. Pull sample through patch membrane with hand-operated vacuum pump.

7. Wash funnel with solvent and pull through patch membrane with hand-operated vacuum pump.

8. When sample passes completely through patch membrane, remove membrane with forceps, place on clean index card and immediately cover with adhesive analysis lamination cover.

9. View patch membrane through microscope and compare sight screen from 100x microscope to various pictures shown in the Fluid Cleanliness Comparison Guide (included in kit) to assign the appropriate ISO cleanliness code.

*Odorless mineral spirits
Portable Oil Diagnostic System (PODS)

Donaldson Part Number: P567843

Intelligent and robust, the Portable Oil Diagnostic System measures, stores and reports oil condition parameters essential for reliable hydraulic systems operation. The unit analyzes fluids and lubricants in online or bottle sampling modes to determine the machine’s operating condition immediately. This instant analysis is as accurate and precise as traditional laboratory analysis that normally takes weeks. Thus, providing a real-time assessment of the oil under operating conditions.

The PODS monitors the dirtiest of fluids due to its concentration limit of 30,000 particles/ml. Superior optics and design provide eight channels for particle counting, as well as measurement of viscosity and temperature to assess fluid conditions. Versatile in operation, the PODS offers compatibility with standard hydraulic fluids, oils and phosphate esters. A rugged carrying case ensures durability and the convenience of portability. The PODS contains a buffer for 500 records. The control analysis software provides real-time data download and visualization, as well as data analysis, formatting and reporting.

The PODS features a wide array of reporting formats, including ISO 4406, NAS 1638 and SAE AS 4059. The PODS can report to both the new MTD μm(c) sizes (4/6/14) or to the previous ACFTD μm sizes (2/5/15). Unlike other portable particle counters on the market, the PODS unit fully supports the ISO 11171 standard. Whether calibrated to the new ISO 11171 standard or the optional ISO 4402 standard, the PODS meets industry demands.

Features

- Efficient and intuitive to use
- Immediate laboratory-quality on site results
- Reports SAE and ISO cleanliness classifications, 4/6/14 μm(c)
- Harmonizes NAS 1638 to new MTD calibration
- Full ISO 11171 calibration options
- Standard bottle and online modes
- Multiple language support

Applications

- Allows for proactive maintenance
- Monitor system operations
- Extend system reliability
- Certify manufacturing “roll off”
- Identify maintenance cycles
- Schedule repair periods
- Track online system cleanliness

This unit is available only in North America. Not available for export through Donaldson.
# Technical Specifications

**Donaldson Part Number: P567843**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Channels</td>
<td>8</td>
</tr>
<tr>
<td>Size Channels</td>
<td>ISO-MTD (standard): 4, 4.6, 6, 9.8, 14, 21.2, 38, 68 μm</td>
</tr>
<tr>
<td></td>
<td>ACFTD (optional): –1, 2, 5, 10, 15, 25, 50, 100 μm</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>50 ml/min standard (consult factory for optional offerings down to 15 mL/min)</td>
</tr>
<tr>
<td>Light Source</td>
<td>Laser diode</td>
</tr>
<tr>
<td>Calibration</td>
<td>ISO MTD (based on ISO 11171)</td>
</tr>
<tr>
<td></td>
<td>Full ISO 11171 or ISO 4402 optional</td>
</tr>
<tr>
<td>Counting Efficiency</td>
<td>Meets JIS B9925:1997</td>
</tr>
<tr>
<td>Concentration Limit</td>
<td>20,000 particles/ml at 5% coincidence loss (per ISO 11171)</td>
</tr>
<tr>
<td></td>
<td>30,000 particles/ml at 10% coincidence</td>
</tr>
<tr>
<td>Sample Volume</td>
<td>3 runs (averaged) of 5, 10 or 20 ml (programmable)</td>
</tr>
<tr>
<td>Fluid Temp Range</td>
<td>0 to 90°C at 25°C ambient (32 to 194°F at 77°F ambient)</td>
</tr>
<tr>
<td>Measured Fluid Temperature</td>
<td>0 to 100°C, ±0.5°C (32 to 212°F, ±0.9°F)</td>
</tr>
<tr>
<td>Viscosity Range</td>
<td>10 to 424 cSt</td>
</tr>
<tr>
<td>Measurement</td>
<td>10 to 424 cSt ±20% at value</td>
</tr>
<tr>
<td>Wetted Materials</td>
<td>Aluminum, stainless steel, sapphire, PTFE and Aflast®</td>
</tr>
<tr>
<td>Data Storage</td>
<td>500 Sample Records</td>
</tr>
<tr>
<td>Dimensions</td>
<td>17.8 D x 33.0 W x 35.6 H cm (7 x 12.5 x 14 inches)</td>
</tr>
<tr>
<td>Weight</td>
<td>9.5 kg (21 lbs)</td>
</tr>
<tr>
<td>Input/Output</td>
<td>Serial Communication RS-232</td>
</tr>
<tr>
<td>Bottle Operation</td>
<td>Purge Volume 15 to 30 ml programmable</td>
</tr>
<tr>
<td></td>
<td>Cartridge: CO2, replaceable, rechargeable</td>
</tr>
<tr>
<td></td>
<td>Operating Capacity: 60 samples per cartridge (120 ml sample bottle)</td>
</tr>
<tr>
<td></td>
<td>Shop Air : 60 to 110 psi (4.1 to 7.6 bar) clean, dry</td>
</tr>
<tr>
<td>Online Operation</td>
<td>Fluid Pressure: 40 to 6000 psi (2.75 to 413.7 bar)</td>
</tr>
<tr>
<td></td>
<td>Purge Volume: 15 to 999 ml programmable</td>
</tr>
<tr>
<td>Power</td>
<td>DC Input: +24 VDC, 2A</td>
</tr>
<tr>
<td></td>
<td>AC/Battery Adapter: Universal 100 to 240 VAC, 50 to 60 Hz, 60 W</td>
</tr>
<tr>
<td></td>
<td>Rechargeable Battery: Nickel-Metal Hydride</td>
</tr>
<tr>
<td></td>
<td>Operating Time: 100 samples or 4 hours continuous</td>
</tr>
<tr>
<td></td>
<td>Recharge Time: 2.5 Hours</td>
</tr>
<tr>
<td>Environment</td>
<td>Ambient Temperature: 0 to 50°C (32 to 122°F), 20 to 85% relative humidity, non-condensing</td>
</tr>
<tr>
<td></td>
<td>Storage: -40 to 70°C (-40 to 150°F), up to 98% relative humidity, non-condensing</td>
</tr>
<tr>
<td>Accessories Included</td>
<td>Carrying Case, High Pressure Hose Adapter, CO2 Bottles, Sample Bottles, PODS Control Software</td>
</tr>
<tr>
<td>Optional Accessories</td>
<td>Ultrasonic Bath, Additional Sample Bottles and CO2 Bottles</td>
</tr>
</tbody>
</table>