HIAC PODS *Portable Oil Diagnostic System*

Intelligent and robust, the HIAC Portable Oil Diagnostic System (PODS) measures, stores and reports oil condition parameters essential for reliable hydraulic systems operation. The PODS 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.

HACH ULTRA™
EXCELLENCE IN PROCESS ANALYTICS

The HIAC 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 HIAC PODS contains a buffer for 500 records. The PODSControl analysis software provides real-time data download and visualization, as well as data analysis, formatting and reporting.

The HIAC 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 onsite 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**

Donaldson®

Performance Specifications

Product Part Number	P567843	
Number of Channels	8	
Size Channels	ISO-MTD (standard)	4, 4.6, 6, 9.8, 14, 21.2, 38, 68 µm
	ACFTD (optional)	~1, 2, 5, 10, 15, 25, 50, 100 µm
Flow Rate	50 mL/min standard (consult factory for optional offerings down to 15 mL/min)	
Light Source	Laser diode	
Calibration	ISO MTD (based on ISO 11171) Full ISO 11171 or ISO 4402 optional	
Counting Efficiency	Meets JIS B9925:1997	
Concentration Limit	20,000 particles/mL at 5% coincidence loss (per ISO 11171) 30,000 particles/mL at 10% coincidence	
Sample Volume	3 runs (averaged) of 5, 10 or 20 mL (programmable)	
Fluid Temp Range	0 to 90°C at 25°C ambient (32 to 194°F at 77°F ambient)	
Measured Fluid Temperature	0 to 100°C, ±0.5°C (32 to 212°F, ±0.9°F)	
Viscosity Range	10 to 424 cSt	
Measurement	10 to 424 cSt ±20% at value	
Wetted Materials	Aluminum, stainless steel, sapphire, PTFE and Aflas®	
Cleanliness Classification	ISO 4406-1991, ISO 4406.2-1999, NAS 1638, MIL-STD-1246C, NAVAIR 01-1A-1, SAE AS 4059	
Data Storage	500 Sample Records	
Dimensions	17.8 D x 33.0 W x 35.6 H cm (7 x 12.5 x 14 inches)	
Weight	9.5 kg (21 lbs)	
Input/Output	Serial Communication RS-232	
Bottle Operation	Purge Volume	15 to 30 mL programmable
	Cartridge	CO_2, replaceable, rechargeable
	Operating Capacity	60 samples per cartridge (120 mL sample bottle)
	Shop Air	60 to 110 psi (4.1 to 7.6 bar) clean, dry
Online Operation	Fluid Pressure	40 to 6000 psi (2.75 to 413.7 bar)
	Purge Volume	15 to 999 mL programmable
Power DC Input	+24 VDC, 2A	
	AC/Battery Adapter	Universal 100 to 240 VAC, 50 to 60 Hz, 60 W
	Rechargeable Battery	Nickel-Metal Hydride
	Operating Time	100 samples or 4 hours continuous
	Recharge Time	2.5 hours
Environment	Ambient Temperature	0 to 50°C (32 to 122°F); 20 to 85% relative humidity, non-condensing
	Storage	-40 to 70°C (-40 to 158°F), up to 98% relative humidity, non-condensing
Accessories Included	Carrying Case, High Pressure Hose Adapter, CO_2 Bottles, Hand Pump, Sample Bottles, PODSControl Software	
Optional Accessories	Ultrasonic Bath Additional Sample Bottles Additional CO_2 Bottles	

For technical support call 800-866-7889.

Donaldson
Filtration Solutions

Donaldson Company, Inc.
PO Box 1299
Minneapolis MN
55440-1299 USA

Tel 800.846.1846
Fax 952.703.4913
hydraulicfilters@mail.donaldson.com
www.donaldson.com

Bulletin No. HYD-214

Portable Fluid Analysis Kit

The **Donaldson Portable Fluid Analysis Kit** allows you to conduct immediate on-site particulate and water 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.

Also included is a water test kit that can be used to determine the percentage of water in hydraulic and lubrication oils. The water test kit has five ranges from .005% to 12% water. Measurements can be in parts per million or as a percentage of volume.

• 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.

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 and water contamination levels
- Provides reliable results

Donaldson®
Filtration Solutions

Donaldson®

Donaldson

Portable Fluid Analysis Kit

Donaldson

Kit Part Number X009329 Height: 14.5" Width: 19.25" Depth: 7.75" Weight: 9.95 lbs

Replacement part numbers listed below

Filter for Solvent Dispensing Bottle **P567860** (ea)

120 ml Sample Bottle **P567861**

Membrane Filter Forceps

Pen Light

100X Microscope **P567864**

1000 ml Solvent Dispensing Bottle **P567862**

Membrane Holder & Funnel Assembly **P567863**

Sampling Pump **P176431**

Plastic Tubing **P176433**

Analysis Cards (3"x5") **P567865** (set of 50)

Beaker **P567866**

Water Test Vessel **P567855**

Syringe **P567858**

0.8 micron membrane filters **P567869** (set of 50)

5 micron membrane filters **P567868** (set of 50)

Reagent A for Water Analysis **P567851** (set of 50)

Operation Instructions

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 Comparison Guide (included in kit) to assign the appropriate ISO cleanliness code.

Donaldson Filtration Solutions

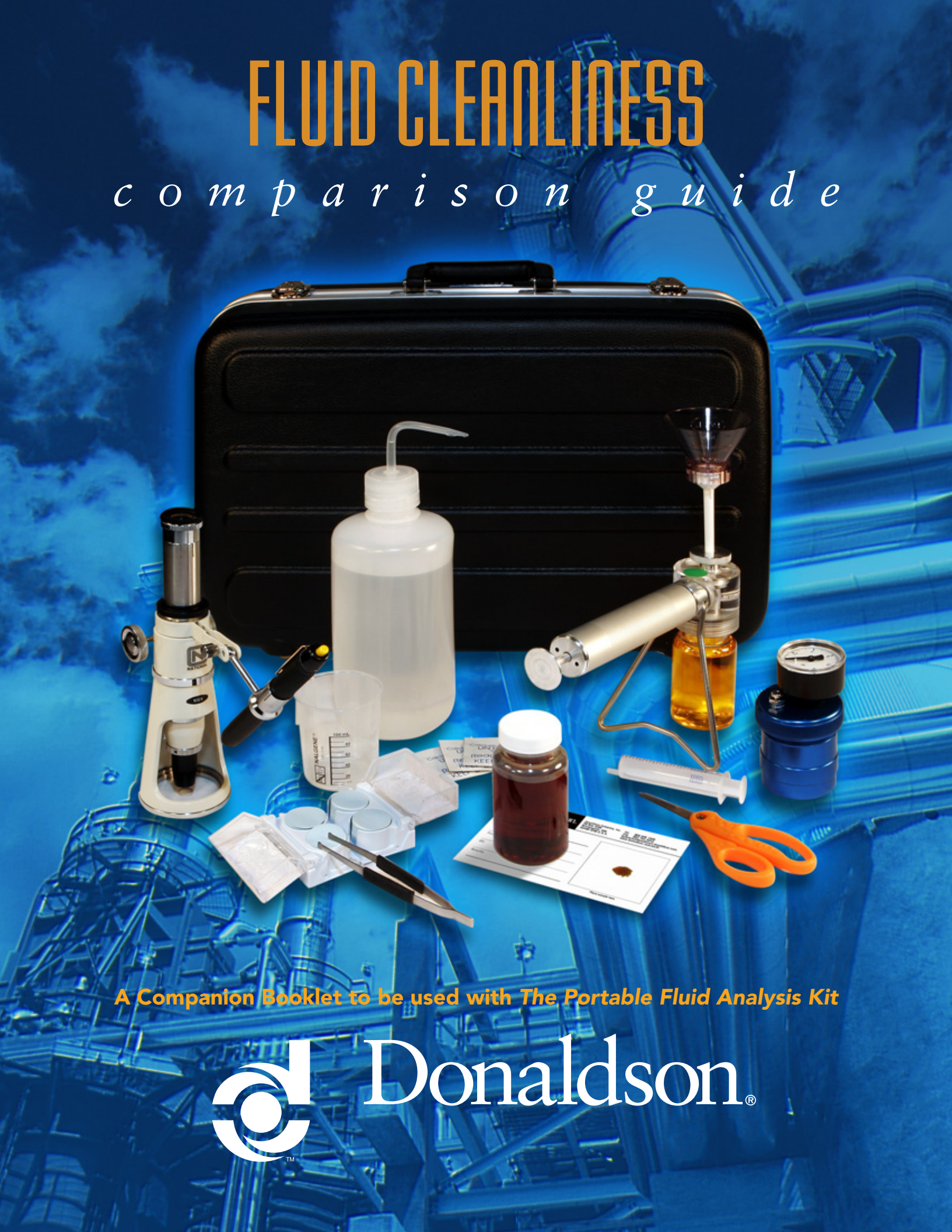
Donaldson Company, Inc.
PO Box 1299
Minneapolis MN
55440-1299 USA

Tel 800.846.1846
Fax 952.703.4913
hydraulicfilters@mail.donaldson.com
www.donaldson.com

Bulletin No. HYD-215

FLUID CLEANLINESS

comparison guide



A Companion Booklet to be used with *The Portable Fluid Analysis Kit*

Donaldson®

Introduction

Portable Fluid Analysis Kit

The Donaldson - *Portable Fluid Analysis Kit* was developed to enable a person to conduct immediate on-site oil analysis in as little as 10 minutes.

Using the Patch Test Method, a user can reliably assign a three-digit cleanliness code to any given sample based on photomicrograph comparisons of known samples. These known samples are the results of particle counts achieved by standards as set forth in ISO 4406-1999.

The kit effectively monitors particulate contamination in all hydrocarbon-based hydraulic fluids, bulk chemicals, and lubrication fluids.

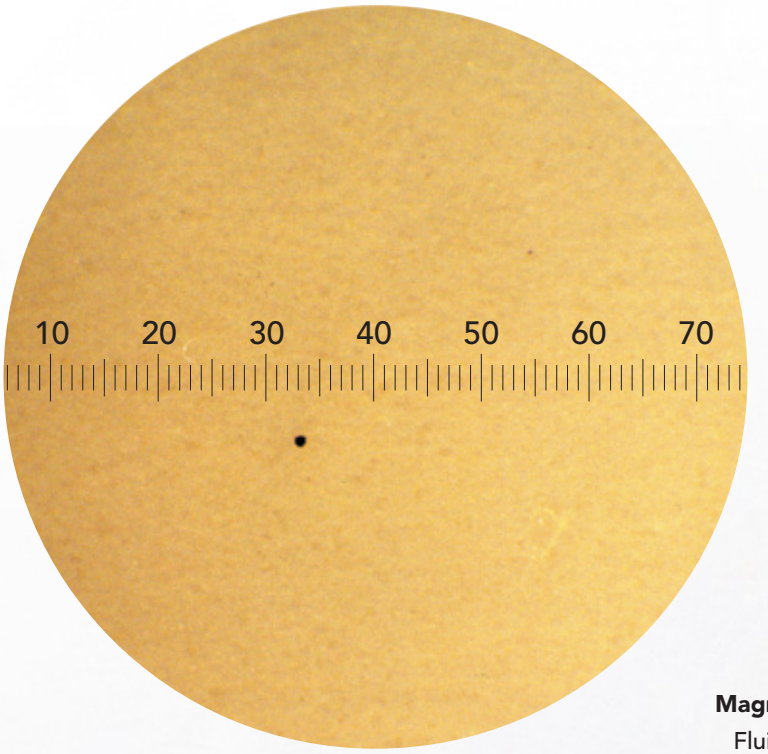
Simply pull a 25 ml fluid sample through a Patch Membrane Filter and compare oil sample particle distribution with the Fluid Cleanliness Comparison Guide to assign an ISO Cleanliness Code.

For complete Operating Instructions, see page 18 (operating manual).

Particle Count Range can be determined in as little as 10 minutes.

CLEANLINESS CODE

13•12•9



Magnification: 100 x
Fluid Volume: 25 ml
Scale: 1 Division = 14 µm

PARTICLE COUNT SUMMARY

Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	56	40-80	13
6	37	20-40	12
10	25		
14	3	2.5-5	9
25	3		

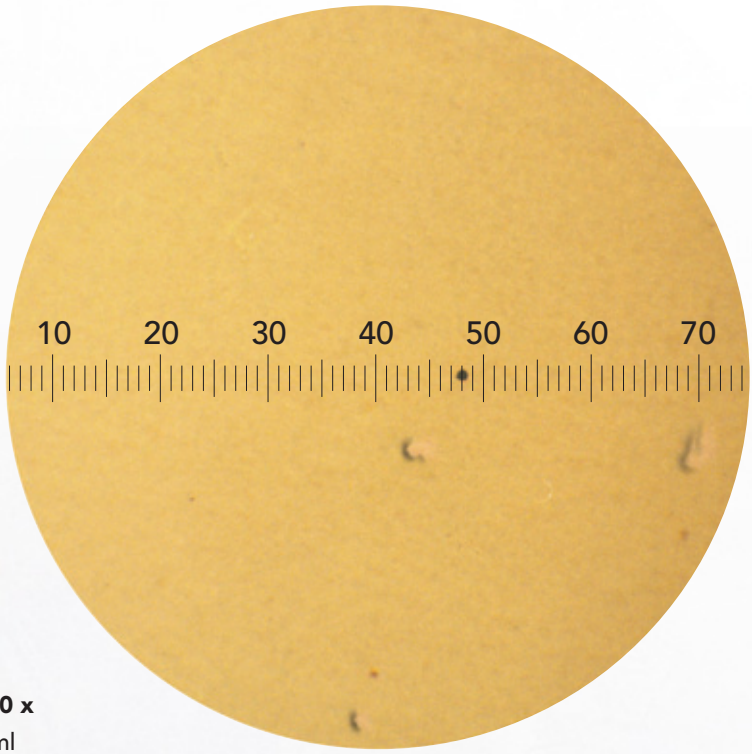
Photo Analysis

Very little contamination is present.
The visible particle is an oxidized ferrous particle.

Donaldson

CLEANLINESS CODE

15•14•11



Magnification: 100 x
Fluid Volume: 25 ml
Scale: 1 Division = 14 µm

PARTICLE COUNT SUMMARY

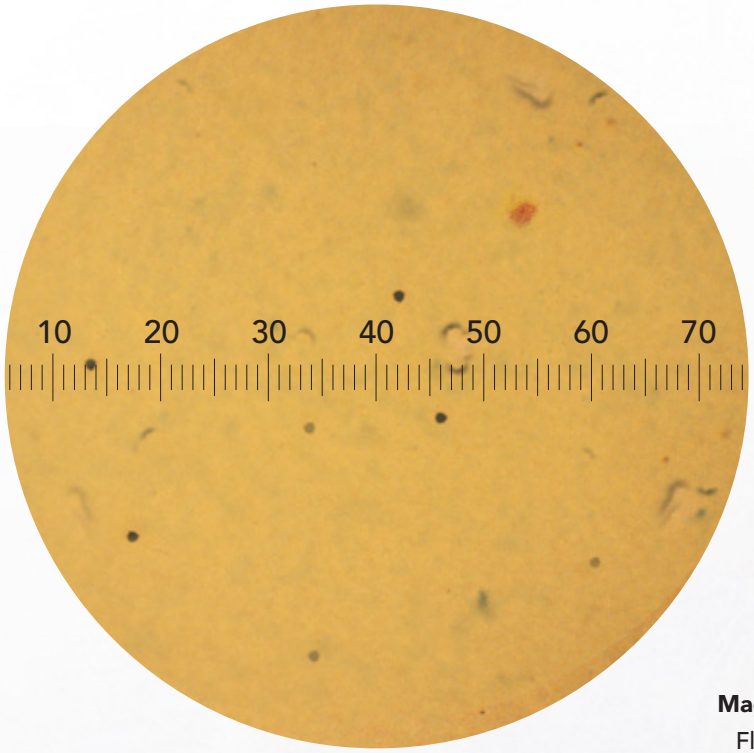
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	221	160-320	15
6	154	80-160	14
10	66		
14	15	10-20	11
25	10		

Photo Analysis

The visible contaminate is silica.

CLEANLINESS CODE

16•15•12



Magnification: 100 x
Fluid Volume: 25 ml
Scale: 1 Division = 14 µm

PARTICLE COUNT SUMMARY

Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	587	320-640	16
6	222	160-320	15
10	104		
14	30	20-40	12
25	13		

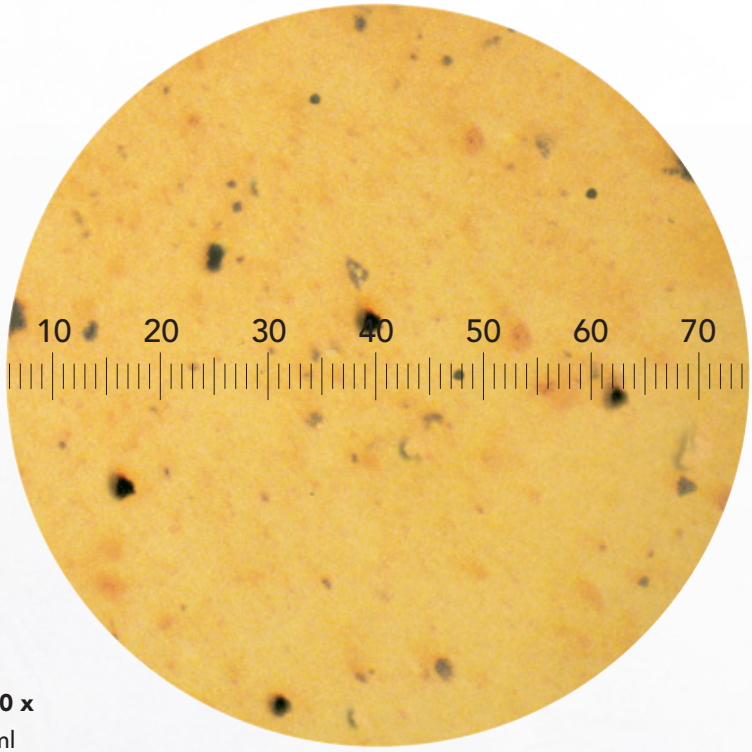
Photo Analysis

The visible contamination is primarily metallic with some silica and fiber particles.

Donaldson

CLEANLINESS CODE

18•16•13



Magnification: 100 x
Fluid Volume: 25 ml
Scale: 1 Division = 14 µm

PARTICLE COUNT SUMMARY

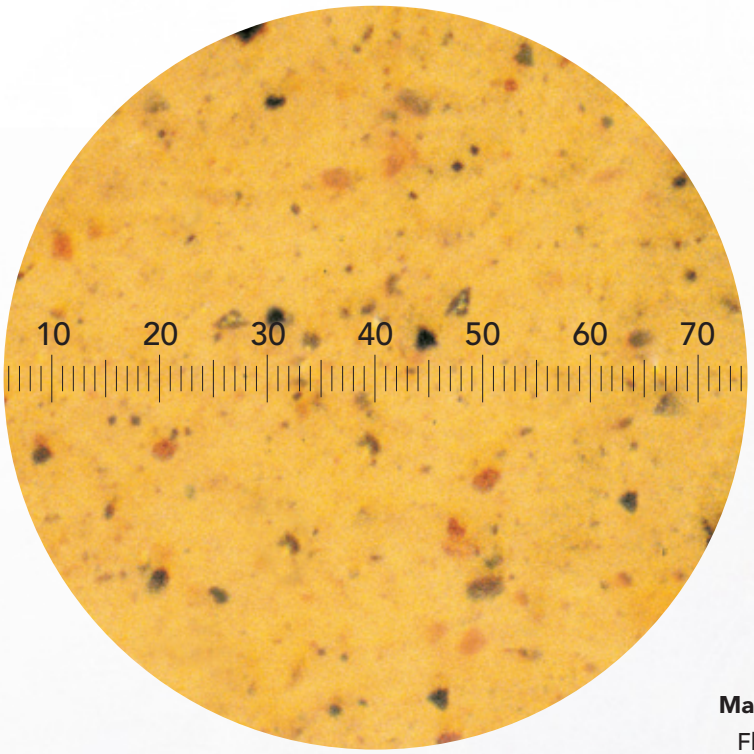
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	1,978	1,300-2,500	18
6	396	320-640	16
10	230		
14	60	40-80	13
25	24		

Photo Analysis

The visible contamination is primarily silica with some metallic, oxidized ferrous and rust particles.

CLEANLINESS CODE

19•17•14



Magnification: 100 x
Fluid Volume: 25 ml
Scale: 1 Division = 14 µm

PARTICLE COUNT SUMMARY

Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	3,548	2,500-5,000	19
6	892	640-1,300	17
10	456		
14	120	80-160	14
25	46		

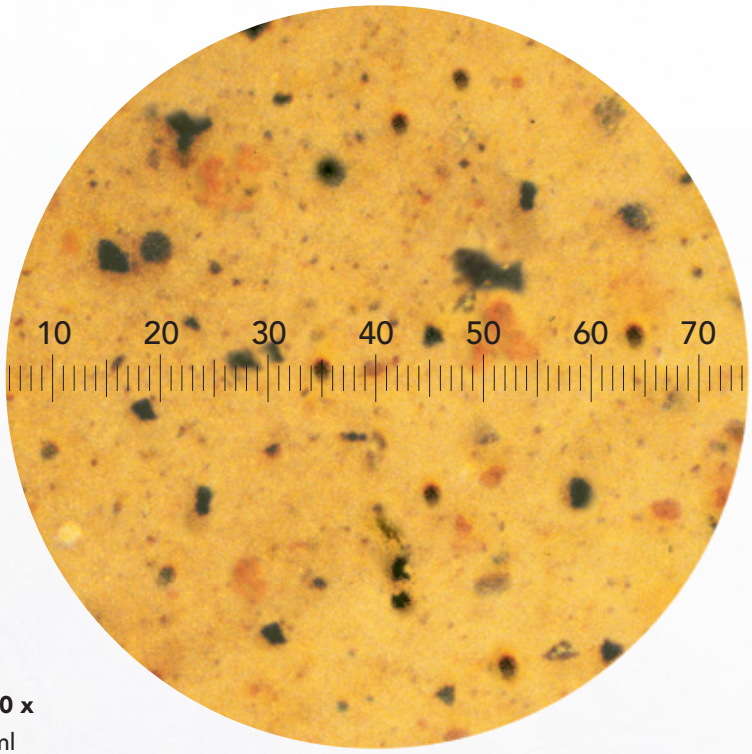
Photo Analysis

The visible contamination includes silica with metallic and rust particles.

Donaldson

CLEANLINESS CODE

20•19•16



Magnification: 100 x
Fluid Volume: 25 ml
Scale: 1 Division = 14 µm

PARTICLE COUNT SUMMARY

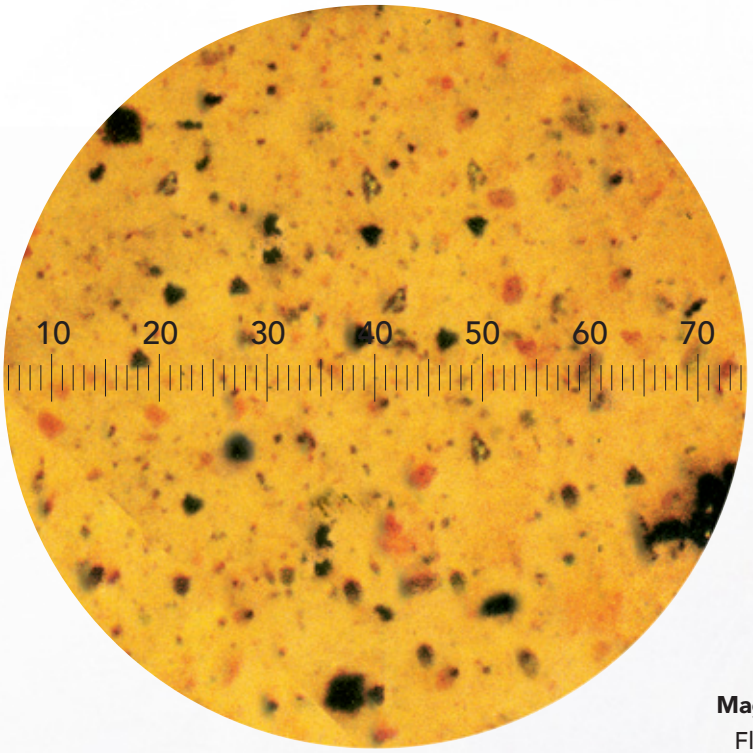
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	7,514	5,000-10,000	20
6	3,431	2,500-5,000	19
10	1,514		
14	480	360-640	16
25	84		

Photo Analysis

The visible contamination includes silica, metallic and rust particles.

CLEANLINESS CODE

21•20•17



Magnification: 100 x
Fluid Volume: 25 ml
Scale: 1 Division = 14 µm

PARTICLE COUNT SUMMARY

Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	14,992	10,000-20,000	21
6	8,688	5,000-10,000	20
10	3,570		
14	900	640-1,300	17
25	437		

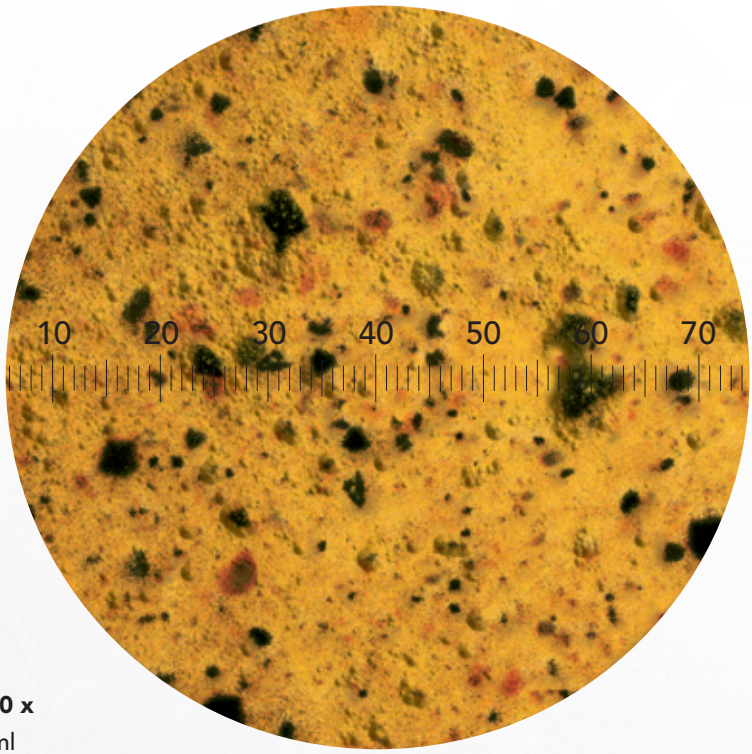
Photo Analysis

The contamination is primarily silica with some metallic and rust particles. A slight degree of oxidized ferrous particles are also present.

Donaldson

CLEANLINESS CODE

23•22•19



Magnification: 100 x
Fluid Volume: 25 ml
Scale: 1 Division = 14 µm

PARTICLE COUNT SUMMARY

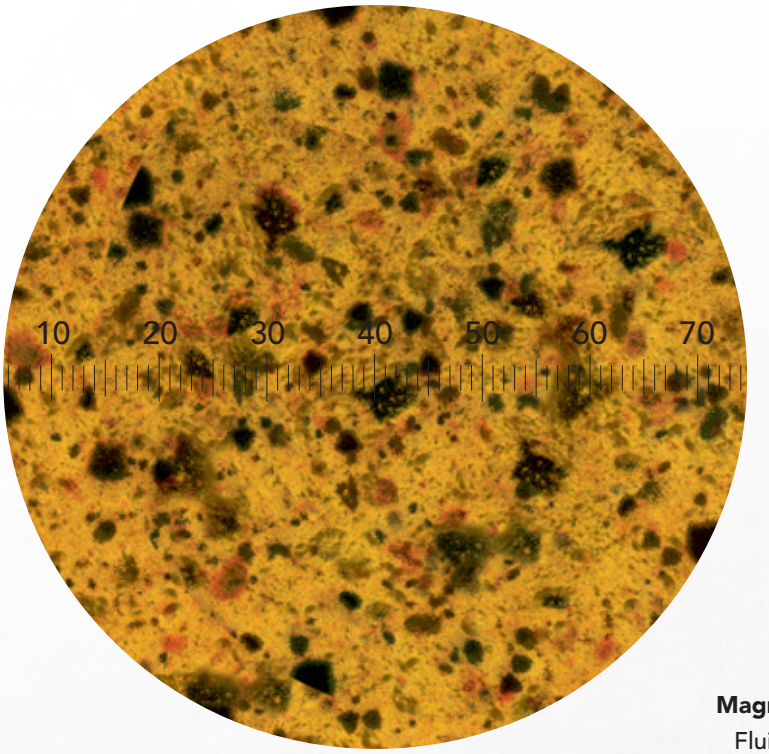
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	57,030	40,000-80,000	23
6	31,964	20,000-40,000	22
10	14,400		
14	3,750	2,500-5,000	19
25	811		

Photo Analysis

The contamination is primarily metallic with additional silica contaminants, and a few rust particles and oxidized ferrous metal particles.

CLEANLINESS CODE

26•24•21



Magnification: 100 x
Fluid Volume: 25 ml
Scale: 1 Division = 14 µm

PARTICLE COUNT SUMMARY

Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	373,430	320,000-640,000	26
6	155,635	80,000-160,000	24
10	59,999		
14	15,000	10,000-20,000	21
25	1,160		

Photo Analysis

This sample is highly contaminated with silica,metallic, rust and carbon (such as coal) particles.

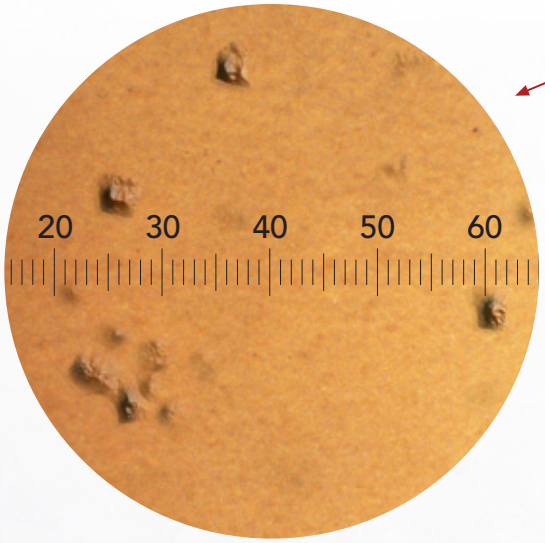
Donaldson

Types of Contamination

Silica

Photo Analysis

Most commonly sand or dust associated with airborne contamination containing hard, translucent particles.

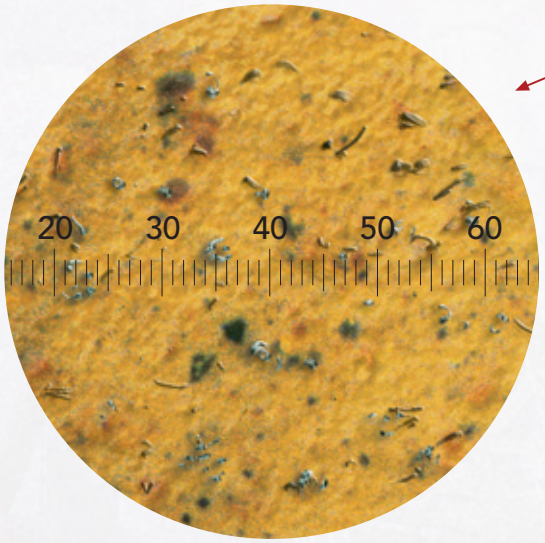


Magnification: 100 x
Scale: 1 Division = 14 µm

Bright Metal

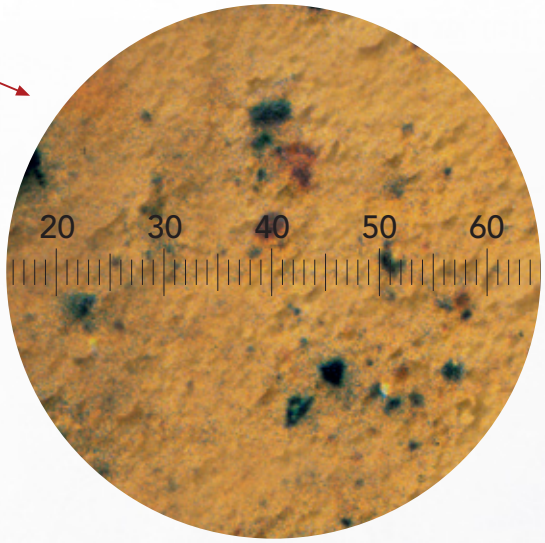
Photo Analysis

Most commonly products of component wear and fluid breakdown within the system. Visible contaminant will usually appear to contain shiny metallic particles of various colors.



Types of Contamination

continued

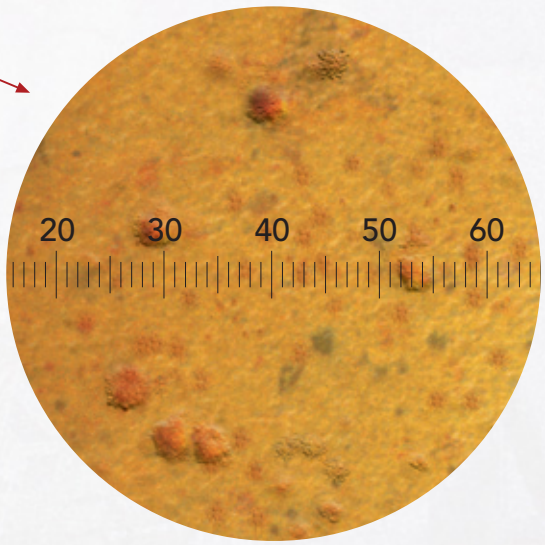


Black Metal

Photo Analysis

Most commonly products of component wear within the system. Contaminants are primarily oxidized ferrous metal particles.

Magnification: 100 x
Scale: 1 Division = 14 µm



Rust

Photo Analysis

Most commonly seen when water is present in the system. Contaminants contain dull orange or brown particles.

Donaldson.

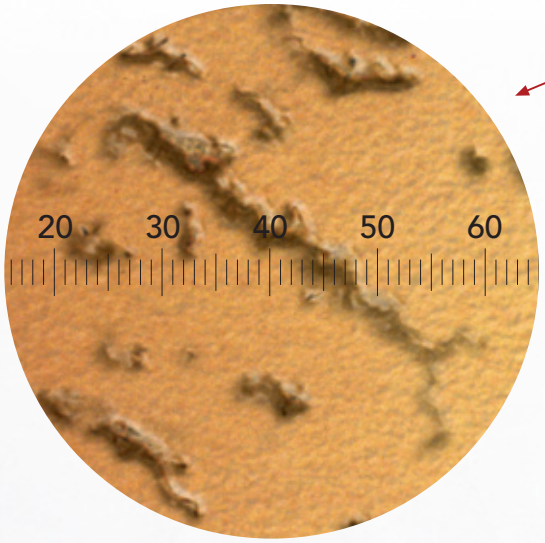
Types of Contamination

continued

Fibers

Photo Analysis

Most commonly generated by paper products and fabrics. Sources of contamination also include cellulose filter media and shop rags.

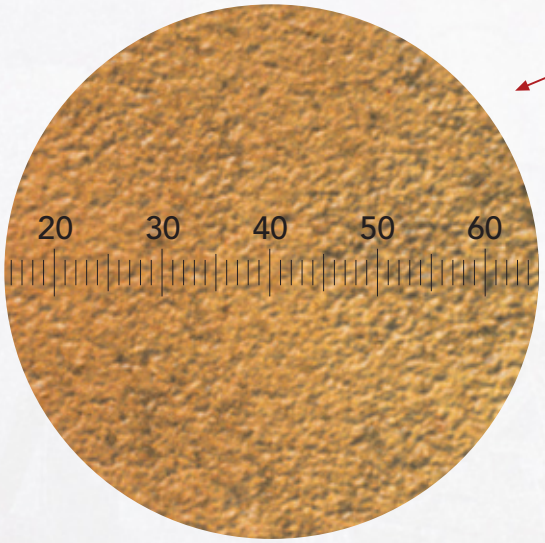


Magnification: 100 x
Scale: 1 Division = 14 µm

Cake of Fines/ Precipitate

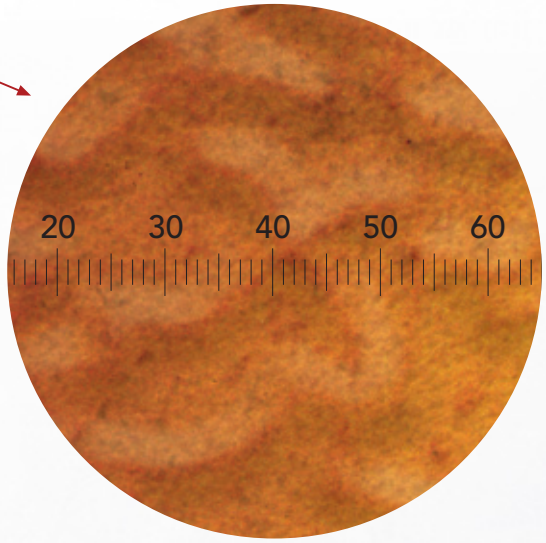
Photo Analysis

A very high concentration of silt-size particles and/or additive package ingredients will build up on the patch membrane obscuring all other contaminants. If the additive package breaks down in this way and drops out of solution (uniform size and color), it is no longer performing its intended function.



Types of Contamination

continued



Gel Cake

Photo Analysis

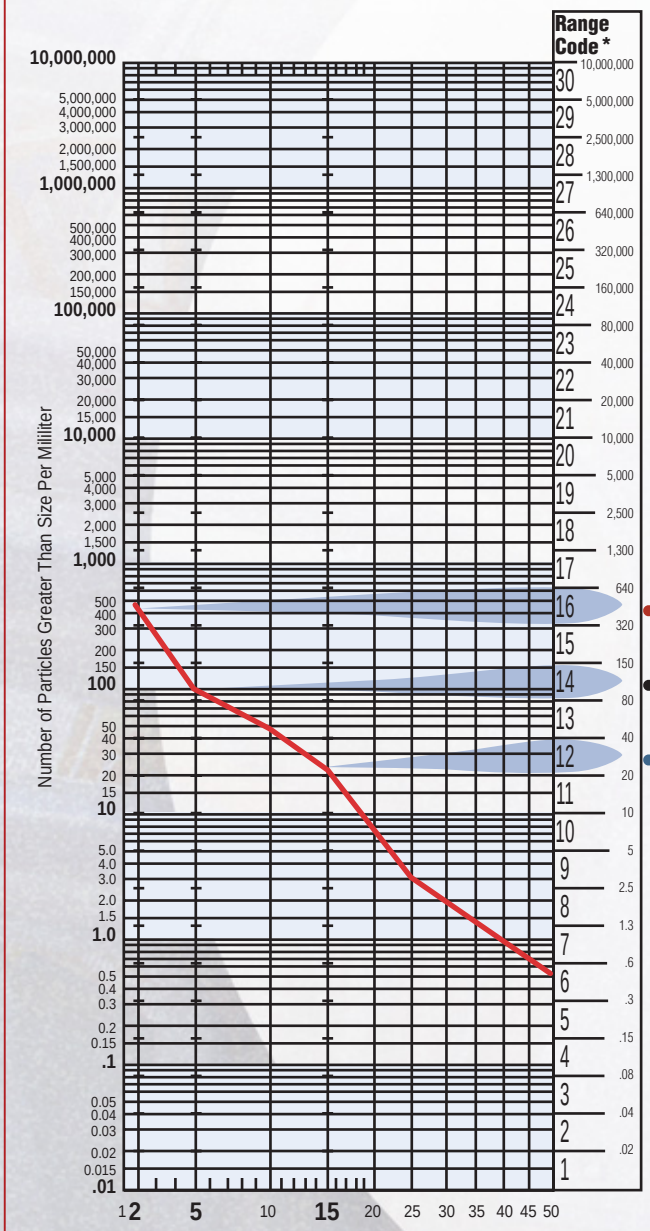
A dense accumulation on the analysis membrane that makes particle contamination evaluation an impossibility.

Magnification: 100 x
Scale: 1 Division = 14 µm

Note:
All images contained in this guide are for comparison and evaluation purposes only. Actual results will vary depending upon specific conditions and levels of contaminants.

Donaldson®

Understanding ISO Cleanliness Codes



16•14•12

PARTICLE COUNT SUMMARY

Particle Size (in microns)	Number per ML. Greater Than Size	Range Code
4	430.0	16
6	90.0	14
10	44.0	
14	21.0	12
25	3.0	
50	9.5	

*Note: each increase in range number represents a doubling of the contamination level.

The ISO Cleanliness Code references the number of particles greater than 4, 6, & 14 microns in one milliliter of fluid. The results of particle counting are plotted on the adjacent logarithmic graph. The corresponding ISO Range Code, shown above, gives the cleanliness code number for each of the three particle sizes.

ISO/NAS/SAE

Oil Filtration Systems

Comparison Chart

The comparisons at right...

...relate to particle count data only.

To conform to any particular standard, reference should be made to the recommended experimental procedure.

BS 5540/4 ISO/DIS 4406 CODE	NAS 1638 CLASS	SAE 749 CLASS
11/8	2	—
12/9	3	0
13/10	4	1
14/9	—	—
14/11	5	2
15/9	—	—
15/10	—	—
15/12	6	3
16/10	—	—
16/11	—	—
16/13	7	4
17/11	—	—
17/14	8	5
18/12	—	—
18/13	—	—
18/15	9	6
19/13	—	—
19/16	10	—
20/13	—	—
20/17	11	—
21/14	—	—
21/18	12	—
22/15	—	—
22/17	—	—

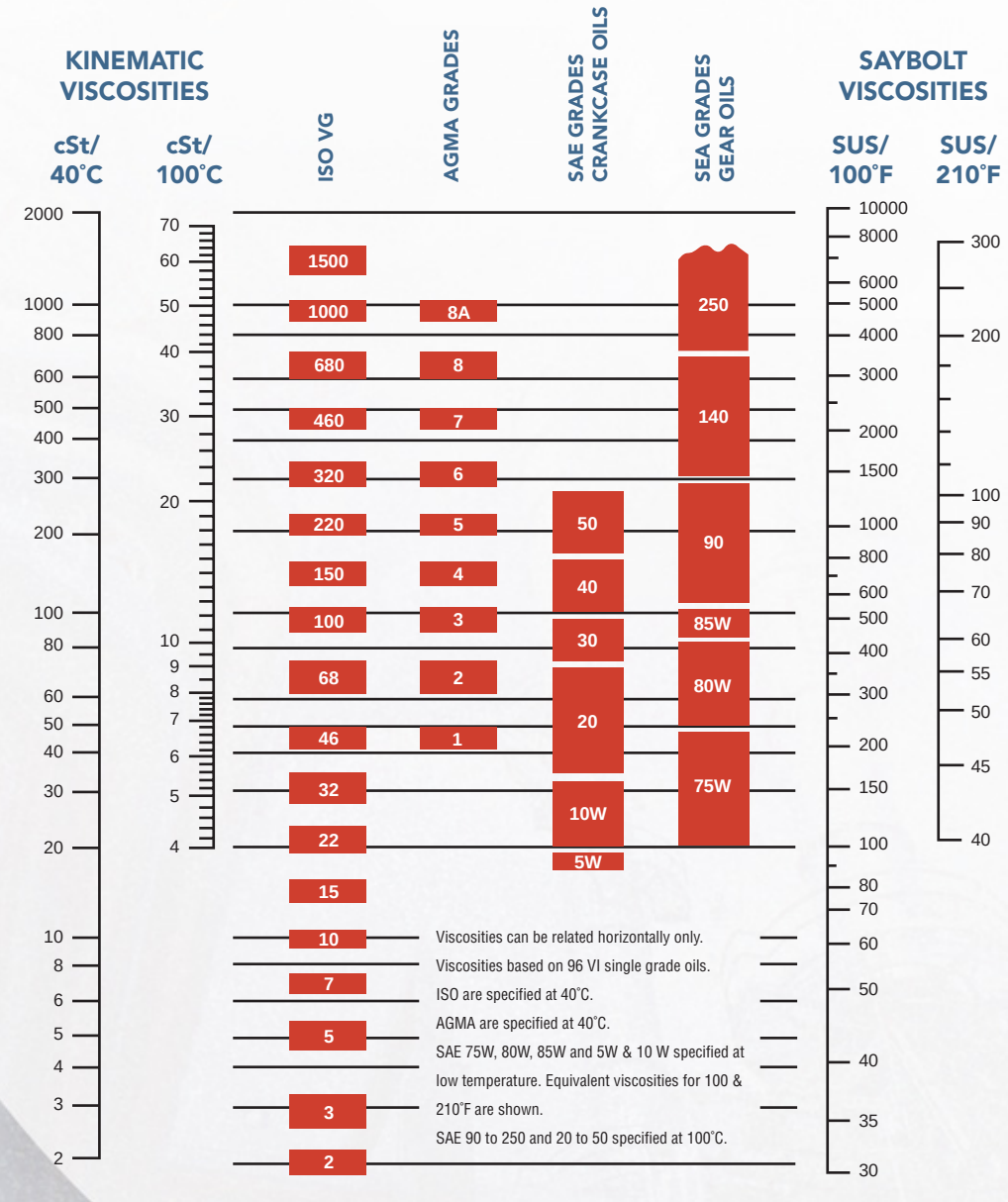
Viscosity

Classification Equivalents

Many petroleum products are graded according to the ISO Viscosity Classification System, approved by the International Standards organization (ISO).

Each ISO viscosity grade number corresponds to the mid-point of a viscosity range expressed in centistokes (cSt) at 40°C.
For example, a lubricant with an ISO grade of 32 has a viscosity within the range of 28.8 - 35.2, the midpoint of which is 32.

Rule-of-Thumb:
The comparable ISO grade of a given product whose viscosity in SUS at 100°F is known can be determined by using the following conversion formula: SUS @ 100° F÷5≅ cSt @ 40°C.



Portable Fluid Analysis KIT

Manual

This booklet is designed to be a quick and easy reference guide to be used along with our Portable Fluid Analysis Kit. Using the Patch Test Method, a user can reliably assign a three-digit cleanliness code to any given sample based on photomicrograph comparisons of known samples. These known samples are the results of particle counts achieved by standards as set forth in ISO 4406-1999.

Instructions

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 this Comparison Guide to assign the appropriate ISO cleanliness code.

Portable Fluid Analysis Kit

The Kit includes the following components:

Manual

page 2 (of 2)

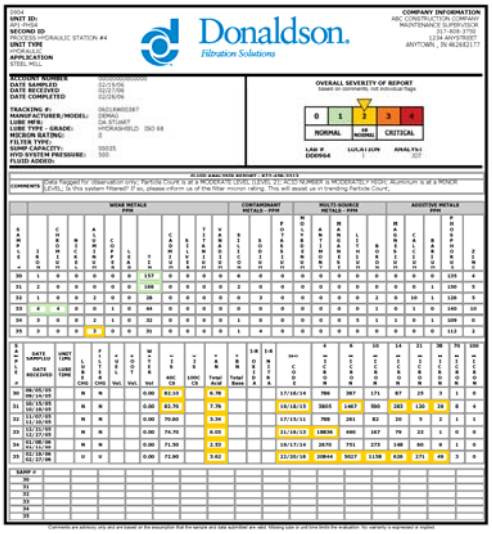
Item#	Description	Qty
1	Solvent dispensing bottle filters	4
2	120 ml sample bottles	8
3	Membrane filter forceps	1
4	Microscope pen light	1
5	1000 ml solvent dispensing bottle	1
6	Membrane holder & funnel assembly	1
7	100X microscope	1
8	Heavy-duty carrying case	1
9	Easy-vac hose	1

Item#	Description	Qty
10	Scissors (for opening packets)	1
11	3"x 5" analysis cards	100
12	Beaker	1
13	Keys for case	2
14	Syringes	3
15	Water Test Kit	1
16	0.8 & 5.0 micron membrane filters	50 ea.
17	Reagent A for water analysis	50
18	Hand-actuated vacuum pump	1

Donaldson
Filtration Solutions

Technical Bulletin

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.

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

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.

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 lease 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.

0904
UNIT ID: AP1-PHS4
SECOND ID PROCESS HYDRAULIC STATION #4
UNIT TYPE HYDRAULIC
APPLICATION STEEL MILL

Donaldson. Filtration Solutions

COMPANY INFORMATION
ABC CONSTRUCTION COMPANY
MAINTENANCE SUPERVISOR
317-808-3750
1234 ANYSTREET
ANYTOWN , IN 462682177

ACCOUNT NUMBER	0000000000000
DATE SAMPLED	02/19/06
DATE RECEIVED	02/27/06
DATE COMPLETED	02/28/06
TRACKING #:	06018W00387
MANUFACTURER/MODEL:	DEMAG
LUBE MFR:	DA STUART
LUBE TYPE - GRADE:	HYDRASHIELD ISO 68
MICRON RATING:	0
FILTER TYPE:	
SUMP CAPACITY:	00035
HYD SYSTEM PRESSURE:	500
FLUID ADDED:	

OVERALL SEVERITY OF REPORT
based on comments, not individual flags

0	1	2	3	4
NORMAL		AB NORMAL	CRITICAL	

LAB #	LOCATION	ANALYST
DD0964	I	JDT

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.

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

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.

FLUID ANALYSIS REPORT - 877-458-3313	
COMMENTS	Data flagged for observation only; Particle Count is at a MODERATE LEVEL (LEVEL 2); ACID NUMBER is MODERATELY HIGH; Aluminum 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;

4

"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.

	WEAR METALS PPM											CONTAMINANT METALS - PPM			MULTI-SOURCE METALS - PPM					ADDITIVE METALS PPM				
SAMPLE #	IRON	CHROMIUM	NICKEL	ALUMINUM	COPPER	LEAD	TIN	CADMIUM	SILVER	TITANIUM	VANADIUM	SILICON	SODIUM	POTASSIUM	MOLYBDENUM	ANTIMONY	MANGANESE	LITHIUM	BORON	MAGNESIUM	CALCIUM	BARIUM	PHOSPHORUS	ZINC
30	1	0	0	0	0	0	157	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	135	4
31	2	0	0	0	0	0	166	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	150	5
32	1	0	0	2	0	0	28	0	0	0	0	0	3	0	0	0	0	0	2	0	10	1	126	5
33	4	4	0	0	1	0	44	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	140	10
34	3	0	0	2	1	0	32	0	0	0	0	1	0	0	0	0	0	5	1	1	0	1	109	0
35	3	0	0	3	0	0	31	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	112	2

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). Consult the POLARIS Wear Metals Guide at www.polarislabs.com for a quick reference to possible wear metal sources.

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).

	WEAR METALS PPM											CONTAMINANT METALS - PPM			MULTI-SOURCE METALS - PPM					ADDITIVE METALS PPM				
SAMPLE #	IRON	CHROMIUM	NICKEL	ALUMINUM	COPPER	LEAD	T	CADM	SILV	TITAN	VANAD	SILICON	SODIUM	POTASSIUM	MOLYBDENUM	ANTIMONY	MANGANESE	LITHIUM	BORON	MAGNESIUM	CALCIUM	BARIUM	PHOSPHORUS	ZINC
30	1	0	0	0	0	0						6	0	0	0	0	0	0	0	0	0	0	135	4
31	2	0	0	0	0	0						2	0	0	0	0	0	0	0	0	0	1	150	5
32	1	0	0	2	0	0						0	3	0	0	0	0	0	2	0	10	1	126	5
33	4	4	0	0	1	0						0	0	0	0	0	0	0	1	0	1	0	140	10
34	3	0	0	2	1	0						1	0	0	0	0	0	5	1	1	0	1	109	0
35	3	0	0	3	0	0						1	4	0	0	0	0	0	0	0	0	0	112	2

Iron (Fe)

Definition
Iron is a wear metal detected with Elemental Analysis by ICP (inductively-coupled plasma), which detects up to 24 metals, measuring less than 5µ in size, that can be present in used oil due to wear, contamination or additives. Wear Metals include iron, chromium, nickel, aluminum, copper, lead, tin, cadmium, silver, titanium and vanadium. Contaminant Metals include silicon, sodium, and potassium. Multi-Source Metals include molybdenum, antimony, manganese, and lithium. Additive Metals include boron, magnesium, calcium, barium, phosphorous and zinc. Elemental Analysis is instrumental in determining the type and severity of wear occurring within a unit.

Standard Test Method Used
ASTM D5185

Reporting Measurement
ppm

Amount of Sample Needed
2 mL

Test Limitation

Possible Sources
Reciprocating Compressors
Shafts, Pistons, Crosshead, Packing Glands, Gears, Housing Casting, Valves
Rotary Compressors
Gears, Shafts, Bearings, Casting
Turbines / Centrifugal Compressors
Shafts, Gears, Bearings, Valves
Hydraulics
Rods, Cylinder, Gears, Shafts, Pistons
Reciprocating Engines
Cylinder Levers, Rings, Gears, Crankshaft, Camshaft, Rods, Valve Train, Oil Pump Gear,

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.

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 6 microns. This test is valuable in determining large particle wear in filtered systems.

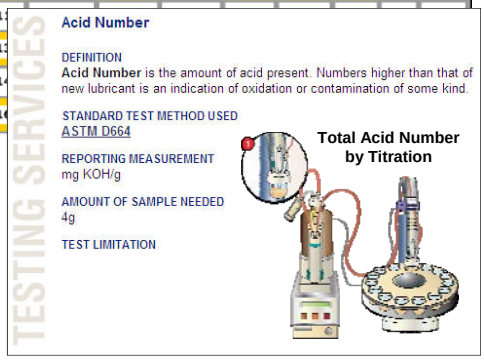
Providing your lab with a New Lube sample allows the analyst to verify product integrity and establishes a guideline for analyzing subsequent used oil samples. It will appear first on all reports for the unit.

SAMPLE #	DATE SAMPLED / DATE RECEIVED	UNIT TIME / LUBE TIME	LUBE CHG	FILTER CHG	FUEL Vol.	SOOT Vol.	WATER Vol	VIS 40C CS	VIS 100C CS	TAN Total Acid	TBN Total Base	I-R OXIDA	I-R NITRA	ISO CODE	4 MICRON	6 MICRON	10 MICRON	14 MICRON	21 MICRON	38 MICRON	70 MICRON	100 MICRON
30	09/05/05 09/14/05		N	N			0.00	82.10		6.78				17/16/14	786	387	171	87	25	3	1	0
31	10/15/05 10/19/05		N	N			0.00	82.70		7.79				19/18/15	3805	1467	590	283	120	29	8	4
32	11/07/05 11/10/05		N	N			0.00	70.60		3.34				17/15/1								
33	12/21/05 12/27/05		N	N			0.00	74.70		6.05				21/16/1								
34	01/08/06 01/11/06		N	N			0.00	71.50		2.53				19/17/1								
35	02/19/06 02/27/06		U	U			0.00	72.90		3.62				22/20/1								

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

Total Acid Number is the amount of acid present in the lubricant. Numbers higher than that of new lube indicate oxidation or some type of contamination. Total Base Number 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.



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).

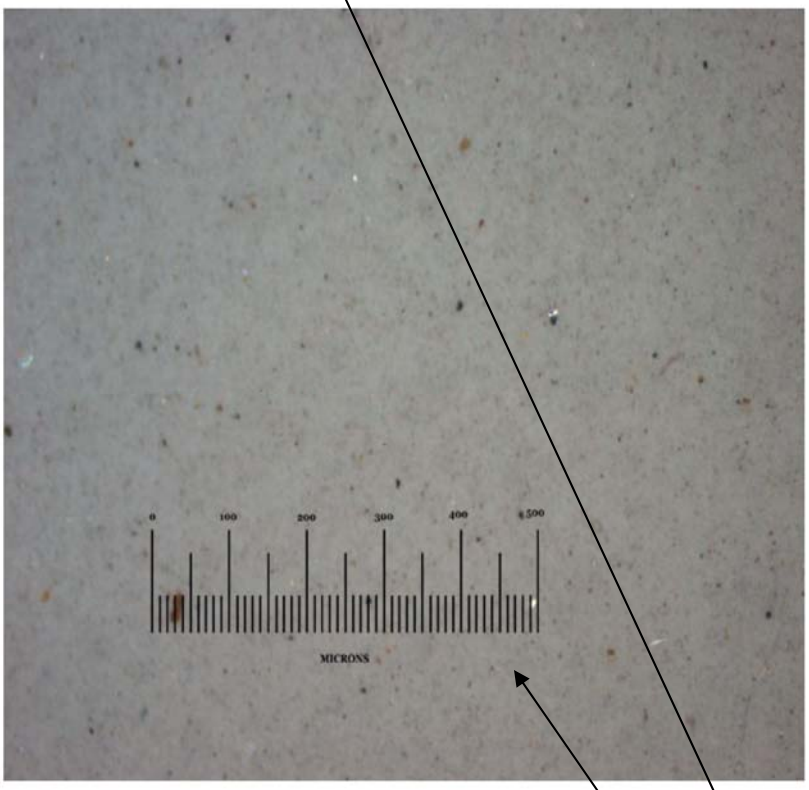
0904
UNIT ID:
AP1-PHS4
SECOND ID
PROCESS HYDRAULIC STATION #4
UNIT TYPE
HYDRAULIC
APPLICATION
STEEL MILL

Donaldson. Filtration Solutions

COMPANY INFORMATION
ABC CONSTRUCTION COMPANY
MAINTENANCE SUPERVISOR
317-808-3750
1234 ANYSTREET
ANYTOWN , IN 462682177

MICROPATCH

ISO CODE: **22/20/16**
Magnification: **100 X**
Volume: **25mL**
Scale: **10 micrometers per division**



A Photomicropatch 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.

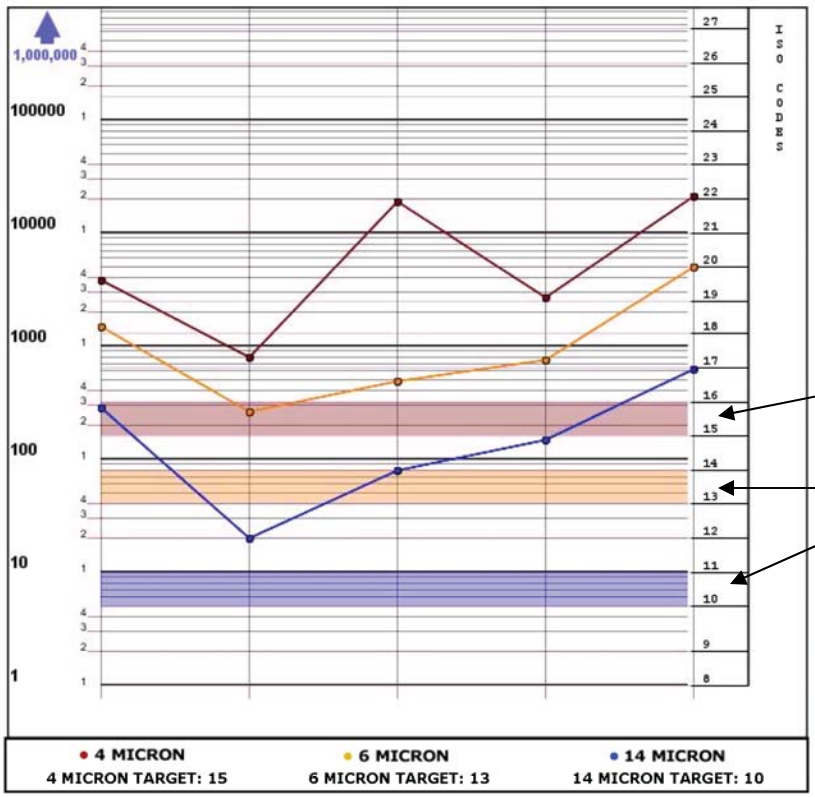
CUSTOMER SERVICE PHONE: 877-458-3313

0904
UNIT ID:
AP1-PHS4
SECOND ID
PROCESS HYDRAULIC STATION #4
UNIT TYPE
HYDRAULIC
APPLICATION
STEEL MILL

Donaldson. Filtration Solutions

COMPANY INFORMATION
ABC CONSTRUCTION COMPANY
MAINTENANCE SUPERVISOR
317-808-3750
1234 ANYSTREET
ANYTOWN , IN 462682177

TARGET ISO CHART



DATE	10/19/05	11/10/05	12/27/05	01/11/06	02/27/06
4 MICRON	3805	788	18836	2670	20844
6 MICRON	1467	261	490	751	5027
14 MICRON	283	20	79	148	626
ISO CODE	19/18/15	17/15/11	21/16/13	19/17/14	22/20/16
LAB NUMBER	DD3139	DD3615	DD2063	DD7243	DD0964

CUSTOMER SERVICE PHONE: 877-458-3313

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 4µm. The second represents particles greater than 6µm and the third represents those greater than 14µm.

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 (see ISO code ranges chart on next page). 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 14µm particles is between 160 and 320, the corresponding ISO code is 15.

ISO Cleanliness Code

ISO/Range Code	Min particles /ml	Max particles /ml
1	0	0.02
2	0.02	0.04
3	0.04	0.08
4	0.08	0.15
5	0.15	0.3
6	0.3	0.6
7	0.6	1.3
8	1.3	2.5
9	2.5	5
10	5	10
11	10	20
12	20	40
13	40	80
14	80	160
15	160	320
16	320	640
17	640	1,300
18	1,300	2,500
19	2,500	5,000
20	5,000	10,000
21	10,000	20,000
22	20,000	40,000
23	40,000	80,000
24	80,000	160,000
25	160,000	320,000
26	320,000	640,000
27	640,000	1,300,000
28	1,300,000	2,500,000
29	2,500,000	5,000,000
30	5,000,000	10,000,000

Donaldson®
Filtration Solutions

Industrial Fluid Analysis

donaldson.com

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 industrial 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

Benefits of Using the Donaldson 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.

Test Kits and Sampling Supplies

To order test kits, sampling equipment or supplies, contact your local Donaldson Industrial Hydraulics distributor. Refer to the chart at right for recommended sampling intervals by component.

Donaldson Fluid Analysis Products	
The Advanced Industrial Fluid Analysis Kit is designed to monitor component wear, contamination and fluid condition.	
Product	**Part #**
Industrial Fluid Analysis Service	Part #X009330
24 Metals by ICP	
Water by Karl Fischer, ppm	
Viscosity at 40°C or 100°C	
Oxidation/Nitration by FTIR	
Total Acid Number	
ISO Particle Count/ Particle Quantifier	
Sample Extraction Pump	Part #P176431
Sample Extraction Tubing	Part #P176433

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.

	Component Interval	Suggested Method & Location
Hydraulics	250 – 500 hours	By vacuum pump through oil fill port of system reservoir at mid-level
Gearboxes	750 hours	By vacuum pump through oil level plug or dipstick retaining tube
Compressors	Monthly or at least every 500 hours	By vacuum pump through oil fill port of system reservoir at mid-level
Turbines	Monthly or at least every 500 hours	By vacuum pump through oil level plug or dipstick retaining tube

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:

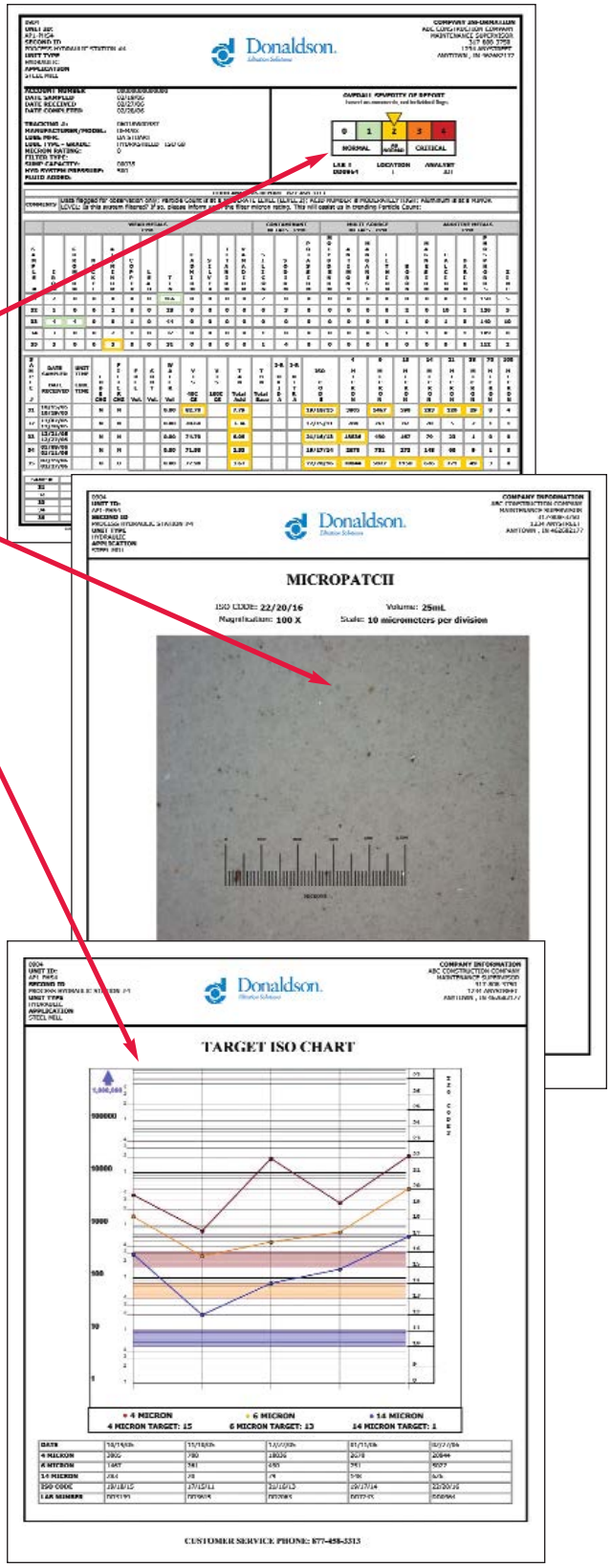
Donaldson Fluid Analysis Laboratory
7898 Zionsville Road
Indianapolis, IN 46268

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 Fluid Analysis. Log in with your assigned username and password.

Data Management Solutions That Save You Time and Money

Donaldson's data management solutions make it fast and easy to maximize the value of your test results. 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 photomicropatch 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

Go to www.donaldson.com and click on Industrial Hydraulics for a reference guide on how to read a fluid analysis report.

Donaldson
Filtration Solutions

Donaldson Company, Inc.
P.O. Box 1299
Minneapolis, MN
55440-1299 U.S.A.

Order Line: 800.846.1846
Lab Assistance Line: 877.458.3313
Fax: 952.703.4913
grphydfilters@donaldson.com
donaldson.com

Bulletin No. HYD-216 01-09

Water Test Kit

INSTRUCTIONS

– to be used for determining the percentage of water in most lube and/or hydraulic oils.

Donaldson®

Water Test Kit

Instructions

The WATER TEST KIT can be used to determine the percentage of water in various fluids. Typically these fluids are hydraulic and lubrication oils; however, other fluids can also be tested. The WATER TEST KIT has five ranges from .005% to 12% water.

Table of Contents:

Donaldson

Water Test Kit

Instructions

Caution:

Using the water test kit can be dangerous!

You must read and understand the following precautions before you begin to use the water test kit!

WARNING:

The packets of Reagent A in this kit contain Calcium Hydride which can cause eye and skin burns. Calcium hydride, in contact with water, will produce hydrogen gas which is highly flammable.

Avoid getting the chemical on your skin or in your eyes. Keep the kit and Reagent A away from water and water vapor. DO NOT use the kit near an open flame or sparks. DO NOT permit smoking when the kit is being used.

Never use more than one packet of Reagent A per test. Excessive hydrogen gas could be produced causing injury to you or damage to the test vessel.

FIRST AID:

In case of contact with Reagent A powder, immediately flush eyes or skin with water for at least 15 minutes. Remove contaminated clothing. Wash skin contact area with soap and water. Call a physician.

Donaldson

Water Test Kit

Instructions

Water Test Kit can be used to test for water content measured as Parts Per Million or as a % of volume. The test can be performed on any liquid which is not based on water. On the lower two ranges, the direct reading gauge displays from 50 to 15000 Parts Per Million (.005% to 1.5%), with a resolution of 20 PPM (.005%) water. Any fluid can be tested as long as the two following requisites are met: A, the water MUST be in the form of free molecules or droplets and not be chemically or physically bound as in emulsions; B, the fluid should not attack the water vessel components which are anodized aluminum, fluorocarbon gasket, brass, and the epoxy used to mount the Reagent Chamber.

Principle of Operation

Reagent A reacts with water and produces hydrogen gas. When a sample and a dry solvent (Reagent B) are placed in the vessel in the proper ratio, the pressure produced is proportional to the amount of water present. A sample with .1% (1000 PPM) water content will produce 10 pounds per square inch (PSI) @ 25° C. Since the pressure gauge has a full scale value of 15 PSI, a maximum reading of 0.15% (1500 PPM) water is possible on the low range. The smallest division of the gauge on the PSI scale is 0.2 PSI or .002% (20 PPM). The gauge's pointer can easily point to the space between the smallest divisions, thus providing the ability to read a result down to the nearest 0.001% (0.1 PSI) or 10 PPM of water. There are a total of five ranges with the following full scale values: 0.15%, 1.5%, 3.0%, 6.0%, and 12.0%.

When using the test vessel, the operator should make sure the pressure does not exceed 15 PSI, since over-pressurizing the gauge will damage it. Should you encounter a sample with a water content which will produce a pressure equal to or greater than 14 PSI, release the pressure immediately. The preferred procedure is to watch the gauge as the reaction takes place, observing the pressure. When the pressure reaches 14 PSI, intervene and stop the test by pressing the relief valve or loosening the lid.

CAUTION:
When releasing pressure from the vessel via the "Pressure Relief Button," DO NOT aim the discharge spray at your face or eyes!

Kit Contents:
Each Water Test Kit contains the following items:

Water Test Vessel consisting of cup, cap, gauge and gasket	1 ea
Box of Reagent A containing 50 packets	1 ea
Syringe 10 ml for sample	1 ea
Syringe 30 ml for Reagent B	1 ea
Instructions	1 ea

Physical Data:
P567855
Size: 4.25 H x 2.5 Dia.
Weight: 9.8 oz.
Material:
anodized aluminum,
chrome plated brass,
fluorocarbon gasket,
teflon tape, epoxy

Donaldson

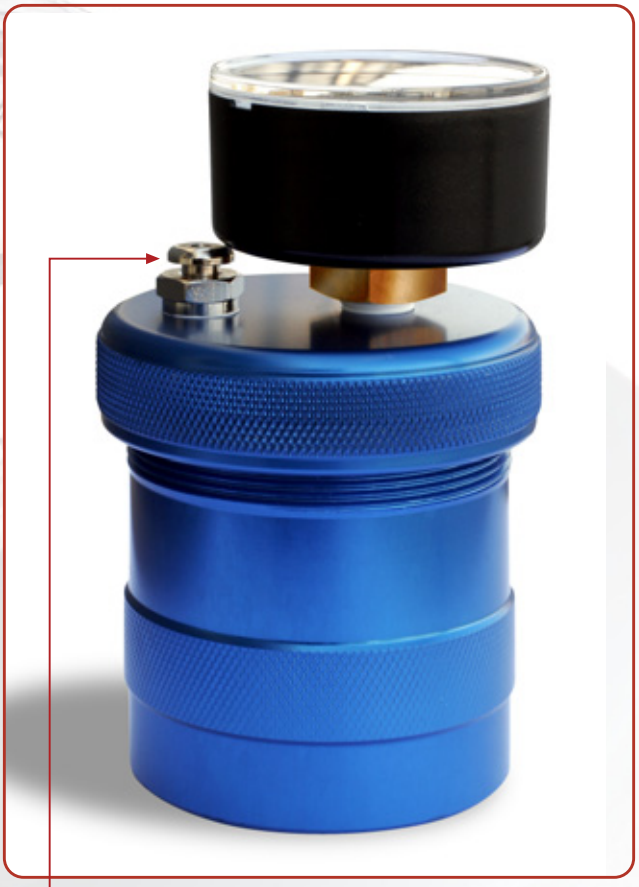
Instructions

Nomenclature & Part Numbers:

The illustrations on this page identify the parts of the WATER TEST KIT

Water Test Kit Contains:

ITEM	PART#
Reagent A, Box 50 packets	P567851
Test Vessel (Complete)	P567854
Vessel (Cap & Cups)	P567855
15 PSI Gauge	P567856
Fluorocarbon Gasket	P567857
Syringe 10 ml	P567858
Syringe 30 ml	P567859
Reagent B 500 ml	



Donaldson

Instructions

Low Range Test Procedure .15% Full Scale

1. Using the 30 ml syringe, measure 30 ml of sample oil and inject it into the Oil-Reagent B Chamber. Be careful not to spill any fluids into the Reagent A Chamber.
2. Using the 10 ml syringe, measure 10 ml of Reagent B and inject it into the Oil-Reagent B Chamber.
3. Prepare a packet of Reagent A (according to the Reagent A Instruction sheet). Empty the rolled-up packet of Reagent A into the Reagent A Chamber, being careful not to spill any powder into the Oil Solvent Chamber. Place the rolled-up packet with the open end facing down, into the Reagent A Chamber and flick the bottom of the packet a few times with your finger.
4. Keeping the cup vertical so as not to spill or mix the contents, tightly screw the cap onto the cup making sure there is a very tight seal on the gasket.
5. Shake the vessel vigorously for 20 seconds, then observe the pressure gauge to insure that the pressure has not exceeded 14 PSI. If the pressure has reached 14 PSI, STOP the test by pressing the relief valve or loosening the cap. Go to the next section titled "1.5% Full Scale" for instructions on testing samples with water content greater than .14%.
6. Shake the vessel vigorously for another 20 seconds, and then observe the pressure gauge to insure that the pressure has not exceeded 14 PSI.
7. Shake the vessel vigorously AGAIN for another twenty seconds, observing the pressure gauge to insure that the pressure has not exceeded 14 PSI.
8. Set the vessel down and wait one minute. Shake the vessel for 10 seconds once every minute and take the final reading 5 minutes after you have started the test.
9. Measure the temperature of the oil-Reagent B mixture and refer to the temperature compensation chart to correct the reading due to the effects of temperature.

Reading the Gauge

Correlation of Data: Low Range –
Multiply the Gauge Reading by 0.01

10.0 PSI =	0.100%	water content or	1,000 PPM
1.0 PSI =	0.010%	water content or	100 PPM
0.2 PSI =	0.002%	water content or	20 PPM
0.1 PSI =	0.001%	water content or	10 PPM

The scale is from 0 to 15 PSI (pounds per square inch) with the smallest scale division being 0.2 PSI.

(See Page 8 - Cleaning Vessel)

See Page 9 for Pressure Conversion Charts for the .15 % range

Donaldson

Instructions

High Range Test Procedure

1.5% Full Scale

1. Using the 10 ml syringe, measure 4 ml of sample oil and inject it into the Oil-Reagent B Chamber. Be careful not to spill any fluids into the Reagent A Chamber.
2. Using the 30 ml syringe, measure 16 ml of Reagent B and inject it into the Oil-Reagent B Chamber.
3. Prepare a packet of Reagent A according to the Reagent A Instruction sheet. Empty the rolled-up packet of Reagent A into the Reagent A Chamber, being careful not to spill any powder into the Oil-Reagent B Chamber. Place the rolled-up packet with the open end facing down, into the Reagent A Chamber and flick the bottom of the packet and flick the bottom of the packet a few times with your finger.
4. Keeping the cup vertical so as not to spill or mix the contents, tightly screw the cap onto the cup making sure there is a very tight seal on the gasket.
5. Shake the vessel vigorously for twenty seconds, then observe the pressure gauge to insure that the pressure has not exceeded 14 PSI. If the pressure has reached 14 PSI, STOP the test by pressing the relief valve or loosening the cap. Go to the next section titled "3.0% Range" for instructions on testing samples with water content greater than 1.4%.
6. Shake the vessel vigorously for another twenty seconds, and then observe the pressure gauge to insure that the pressure has not exceeded 14 PSI.
7. Shake the vessel vigorously AGAIN for another twenty seconds, observing the pressure gauge to insure that the pressure has not exceeded 14 PSI.
8. Set the vessel down and wait one minute. Shake the vessel for 10 seconds once every minute and take the final reading 5 minutes after you have started the test.
9. Measure the temperature of the oil-Reagent B mixture and refer to the temperature compensation chart to correct the reading due to the effects of temperature.

Correlation of Data: High Range –
Multiply the Gauge Reading by 0.1

Reading the Gauge

10.0 PSI =	1.00% water content or	10,000 PPM
1.0 PSI =	0.10% water content or	1,000 PPM
0.2 PSI =	0.02% water content or	200 PPM
0.1 PSI =	0.01% water content or	100 PPM

The scale is from 0 to 15 PSI (pounds per square inch) with the smallest scale division being 0.2 PSI.

(See Page 8 - Cleaning Vessel)

See Page 9 for Pressure Conversion Charts for the 1.5 % range

Donaldson

Instructions

Should the fluid sample have greater than 1.4 % water content, the concentration can still be determined by using the following procedures:

Test Procedure (Normal): 1.5 % Range

Sample	4	ml
Reagent B	16	ml
Total Volume	20	ml

Test Procedure: 3.0 % Range

For example, let's say that after using 2 ml of sample and 18 ml of Reagent B, the test produces a reading of 12.0 PSI on the gauge. To convert this reading to the actual % of water, use the following calculation:

Water % = Gauge Reading x .2

Use Sample Volume	2	ml
Reagent B Volume	18	ml
Total Volume	20	ml

Water % = 12.0 x .2 = 2.4%

See page 9 for pressure Conversion Charts for the 3.0% range

Test Procedure: 6.0 % Range

Should the reading on the gauge exceed 14 PSI again, stop the test and prepare a new test using 1 ml of sample and 19 ml of Reagent B. Using the following equation, determine the percentage of water:

Water % = Gauge Reading x .4

Example: gauge reads 11.5 PSI
Water % = 11.5 x .4 = 4.6%

See page 9 for pressure Conversion Charts for the 6.0% range

Donaldson

Instructions

12 % Range

Should the reading on the gauge exceed 14 PSI again, stop the test and prepare a new test using 1/2 ml of sample and 19-1/2 ml of Reagent B. Using the following equation, determine the percent water:

Water % = Gauge Reading x .8

Example: gauge reads 10.0 PSI
Water % = 10 x .8 = 8.0%

See page 9 for pressure Conversion Charts for the 12% range

Cleaning the Vessel

After each use, be sure to rinse out the cap and vessel thoroughly before storing the Water Test Kit. You can use any petroleum solvent to clean the vessel. Remove all traces of Reagent A (undissolved particles).

Conversion Charts: Gauge Reading to % Water

Gauge Reading = GR

Range 0.15%
GR x .01

GR	% Water
1	0.01%
2	0.02%
3	0.03%
4	0.04%
5	0.05%
6	0.06%
7	0.07%
8	0.08%
9	0.09%
10	0.10%
11	0.11%
12	0.12%
13	0.13%
14	0.14%
15	0.15%

Range 1.5%
GR x .1

GR	% Water
1	0.1%
2	0.2%
3	0.3%
4	0.4%
5	0.5%
6	0.6%
7	0.7%
8	0.8%
9	0.9%
10	1.0%
11	1.1%
12	1.2%
13	1.3%
14	1.4%
15	1.5%

Range 3%
GR x .2

GR	% Water
1	0.2%
2	0.4%
3	0.6%
4	0.8%
5	1.0%
6	1.2%
7	1.4%
8	1.6%
9	1.8%
10	2.0%
11	2.2%
12	2.4%
13	2.6%
14	2.8%
15	3.0%

Range 6%
GR x .4

GR	% Water
1	0.4%
2	0.8%
3	1.2%
4	1.6%
5	2.0%
6	2.4%
7	2.8%
8	3.2%
9	3.6%
10	4.0%
11	4.4%
12	4.8%
13	5.2%
14	5.6%
15	6.0%

Range 12%
GR x .8

GR	% Water
1	0.8%
2	1.6%
3	2.4%
4	3.2%
5	4.0%
6	4.8%
7	5.6%
8	6.4%
9	7.2%
10	8.0%
11	8.8%
12	9.6%
13	10.4%
14	11.2%
15	12.0%

Beyond 12% Water Content

It is possible to measure water content above 12%. The accuracy will depend on your laboratory technique and should be within 5 to 10% of reading. The technique used to prepare the sample is known as serial dilution. The process involves taking a sample with high water content and diluting it with a dry solvent. The resulting mixture is a sample with water content in the range of the Water Test Kit (WTK). This diluted sample mixture is tested using the WTK and the results are multiplied by a known factor to arrive at the original sample's water content.

The chart below shows how to take a high water content sample and make an approximate 2% sample for testing on the WTK's 3 % range. The chart also shows the multiplication factor needed to convert the results of the 3% range test back to the original sample's water content. The following is an example of the process.

Process Example

For this example, we use an oil sample with an assumed water content of 35%. In the chart below, go down the first column labeled "% Water in Sample" to 35%. In the second column labeled "Sample", you will see that it directs you to take 2.9 ml of the high water content sample and mix it with 47.1 ml of dry solvent. Mix the diluted sample (DS) well and then perform the 3 % range test which is found on page 7 (i.e. Take 2 ml of DS and 18 ml of Reagent B). In this example the gauge reading will be 10 PSI.

Water % = gauge reading x .2 (10 PSI x .2 = 2.0%). To convert the results of the 3% range test back to the original sample's water content, multiply 2% x 17.5 (the factor listed below at 35 % level). 2 x 17.5 = 35%

% Water in Sample	Sample	Solvent	Factor
100	1.0 ml	49.0 ml	50.0
90	1.1 ml	48.9 ml	45.0
80	1.3 ml	48.8 ml	40.0
70	1.4 ml	48.6 ml	35.0
60	1.7 ml	48.3 ml	30.0
50	2.0 ml	48.0 ml	25.0
40	2.5 ml	47.5 ml	20.0
35	2.9 ml	47.1 ml	17.5
30	3.3 ml	46.7 ml	15.0
25	4.0 ml	46.0 ml	12.5
20	5.0 ml	45.0 ml	10.0
15	6.7 ml	43.3 ml	7.5
10	10.0 ml	40.0 ml	5.0

Instructions

Temperature Compensation Factors

°F	Factors	°F	Factors	°F	Factors	°F	Factors
32	1.0916	54	1.0448	76	1.0019	98	0.9623
33	1.0894	55	1.0428	77	1.0000	99	0.9606
34	1.0872	56	1.0407	78	0.9981	100	0.9589
35	1.0850	57	1.0387	79	0.9963	101	0.9572
36	1.0828	58	1.0367	80	0.9944	102	0.9555
37	1.0806	59	1.0347	81	0.9926	103	0.9538
38	1.0784	60	1.0327	82	0.9908	104	0.9521
39	1.0762	61	1.0307	83	0.9889	105	0.9504
40	1.0741	62	1.0288	84	0.9871	106	0.9487
41	1.0719	63	1.0268	85	0.9853	107	0.9470
42	1.0698	64	1.0248	86	0.9835	108	0.9454
43	1.0677	65	1.0229	87	0.9817	109	0.9437
44	1.0656	66	1.0209	88	0.9799	110	0.9420
45	1.0634	67	1.0190	89	0.9781	111	0.4040
46	1.0613	68	1.0171	90	0.9763	112	0.9387
47	1.0592	69	1.0151	91	0.9746	113	0.9371
48	1.0572	70	1.0132	92	0.9728	114	0.9355
49	1.0551	71	1.0113	93	0.9710	115	0.9338
50	1.0530	72	1.0094	94	0.9693	116	0.9322
51	1.0509	73	1.0075	95	0.9675	117	0.9306
52	1.0489	74	1.0056	96	0.9658	118	0.9290
53	1.0468	75	1.0037	97	0.9641	119	0.9274
						120	0.9258

°C	Factors	°C	Factors	°C	Factors	°C	Factors	°C	Factors
0	1.0916	10	1.0530	20	1.0171	30	0.9835	40	0.9521
1	1.0876	11	1.0493	21	1.0136	31	0.9803	41	0.9490
2	1.0836	12	1.0456	22	1.0102	32	0.9770	42	0.9460
3	1.0797	13	1.0420	23	1.0068	33	0.9739	43	0.9430
4	1.0758	14	1.0383	24	1.0034	34	0.9707	44	0.9401
5	1.0719	15	1.0347	25	1.0000	35	0.9675	45	0.9371
6	1.0681	16	1.0311	26	0.9967	36	0.9644	46	0.9342
7	1.0643	17	1.0276	27	0.9933	37	0.9613	47	0.9313
8	1.0605	18	1.0241	28	0.9900	38	0.9582	48	0.9283
9	1.0567	19	1.0205	29	0.9868	39	0.9551	49	0.9255

Instructions: For temperature compensation, multiply the above factor times the gauge reading for the temperature of the sample in the test vessel. The product is the corrected percent water.

Donaldson

Donaldson.

Portable Fluid Analysis Kit

reorder component information

Part Number	Description
P567860	Solvent dispensing bottle filters
P567861	Sample bottles (50/carton)
P567862	1000 ml solvent dispensing bottle
P567863	Membrane holder & funnel assembly
P567864	100X Microscope
P176433	Easy-vac Hose
P567865	3x5 analysis cards (50/pack)
P567866	Beaker
P567858	Syringe 10 ml
P567859	Syringe 30 ml
P567854	Test Vessel (complete) cap & cup, 15 PSI gauge, fluorocarbon gasket.
P567869	0.8 Micron membrane filters (100/pack)
P567868	5.0 Micron membrane filters (100/pack)
P567851	Reagent A Powder (50 packets per kit)
P176431	Hand-actuated vacuum pump
P567863	Filter funnel
P567855	Vessel (cap & cups)
P567856	15 PSI Gauge
P567857	Fluorocarbon gasket
P567912	Laminate sheets (100/pack)

Donaldson
Filtration Solutions

Donaldson Company, Inc.
PO Box 1299
Minneapolis, MN
55440-1299 U.S.A.

Tel 800.846.1846
Fax 952.703.4652
hydraulicfilters@mail.donaldson.com
www.donaldson.com/en/ih

Systems

Innovative Solutions for all Your Filtration Needs

Systems for Sale and/or Rent

Contact us for information regarding our Rental Fleet & Pricing

High Flow Flushing Skids

Low Flow Filter Carts

Vacuum Dehydrators

INDUSTRIAL FLUID PURIFICATION

Coalescers

LTC Transformer Filtration

Rental Fleet

Turnkey Flushing Services at your jobsite, performed by qualified factory trained technicians.

Filter Elements: For Oil, Air, Fuel and Water applications.

Donaldson
Filtration Solutions

Donaldson Company, Inc.
PO Box 1299
Minneapolis, MN
55440-1299 U.S.A.

Tel 800.846.1846
Fax 952.703.4652
hydraulicfilters@mail.donaldson.com
www.donaldson.com/en/ih