

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.

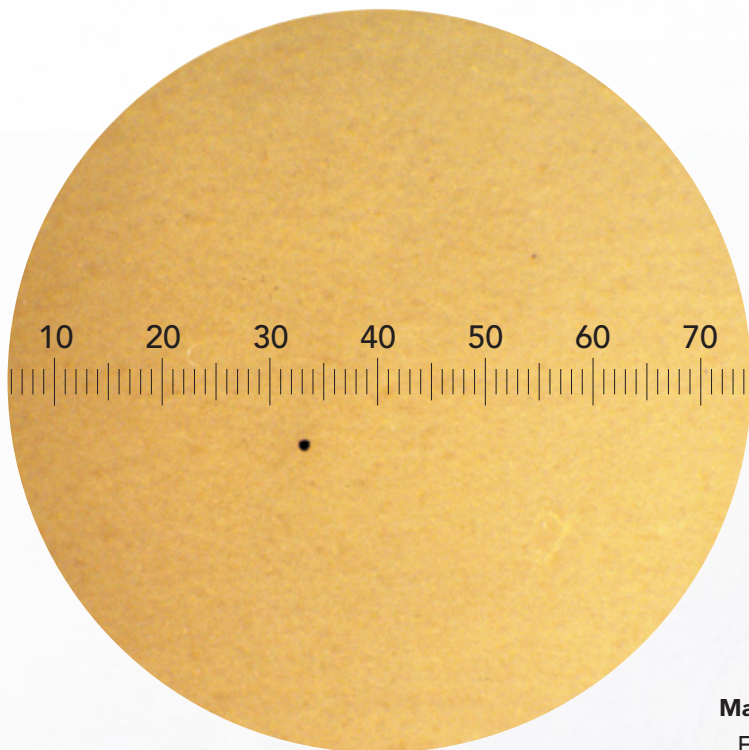
For complete Operating Instructions, see page 18 (operating manual).

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

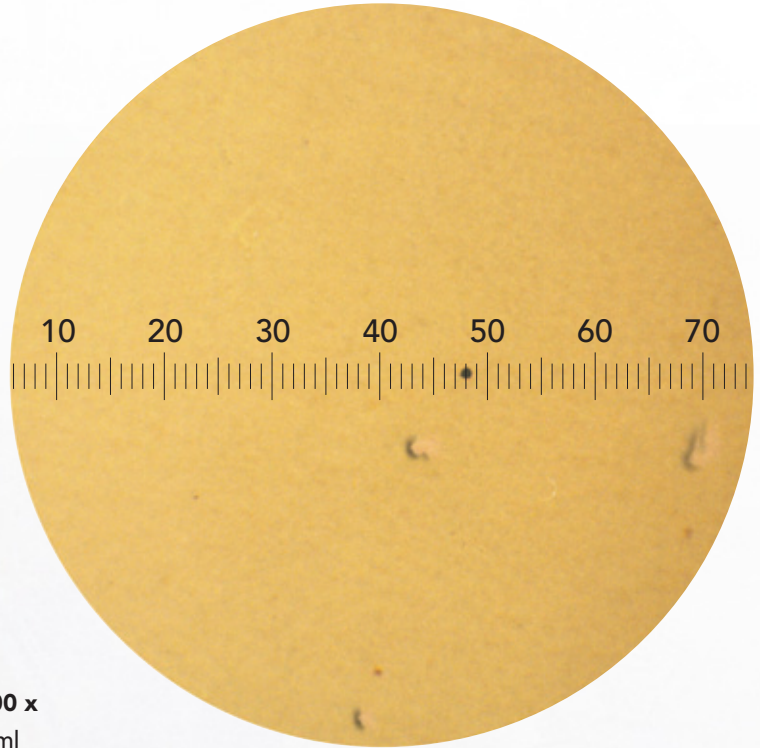
PARTICLE COUNT SUMMARY			
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	56	40-80	13
6	37	20-40	12
10	25		
14	3	2.5-5	9
25	3		

Photo Analysis

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

CLEANLINESS CODE

15•14•11



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

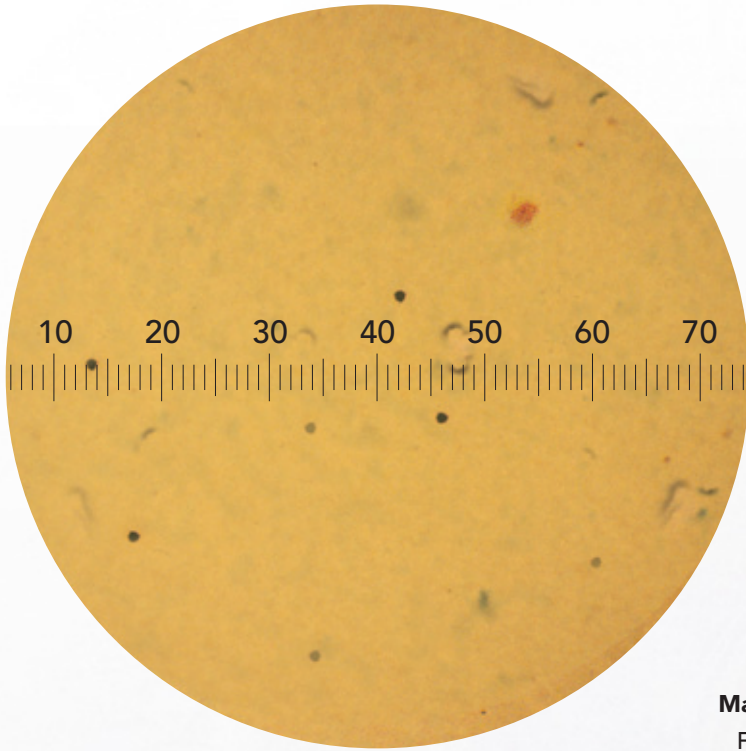
PARTICLE COUNT SUMMARY			
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	221	160-320	15
6	154	80-160	14
10	66		
14	15	10-20	11
25	10		

Photo Analysis

The visible contaminate is silica.

CLEANLINESS CODE

16•15•12



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

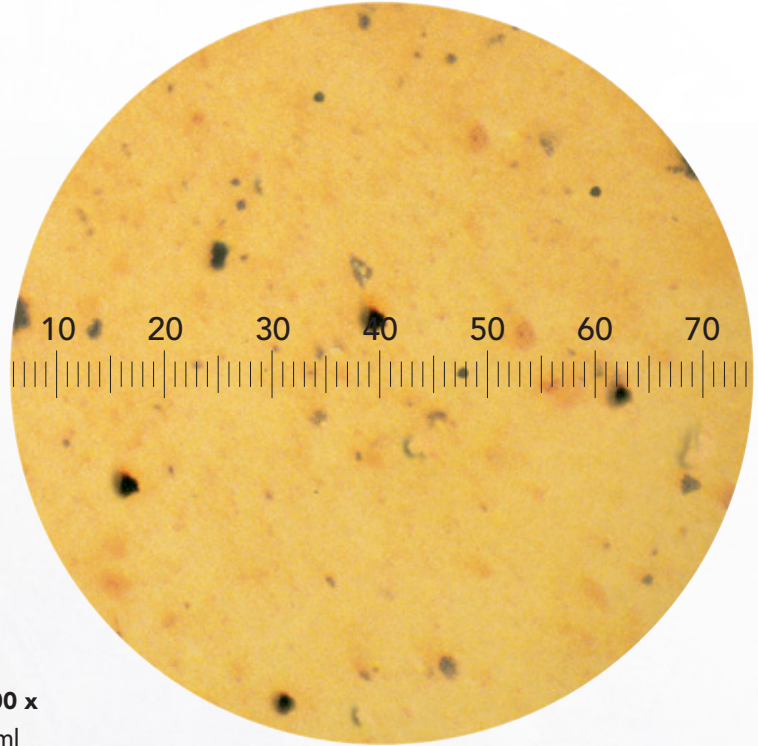
PARTICLE COUNT SUMMARY			
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	587	320-640	16
6	222	160-320	15
10	104		
14	30	20-40	12
25	13		

Photo Analysis

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

CLEANLINESS CODE

18•16•13



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

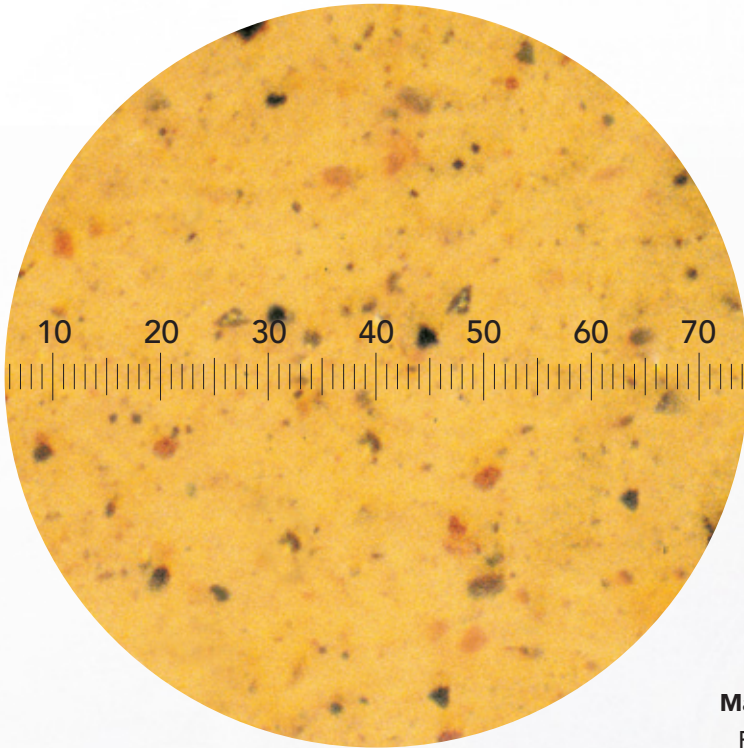
PARTICLE COUNT SUMMARY			
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	1,978	1,300-2,500	18
6	396	320-640	16
10	230		
14	60	40-80	13
25	24		

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

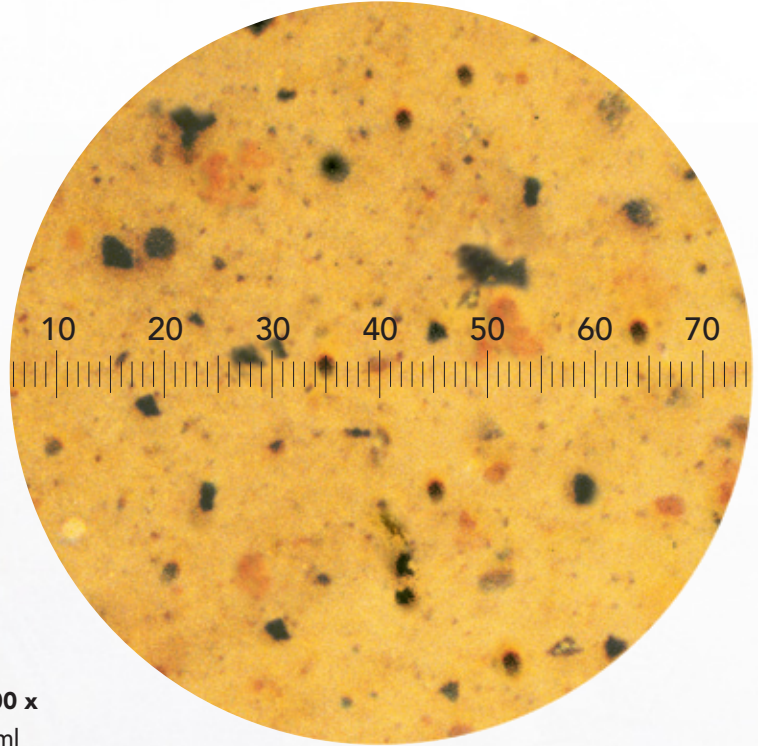
PARTICLE COUNT SUMMARY			
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	3,548	2,500-5,000	19
6	892	640-1,300	17
10	456		
14	120	80-160	14
25	46		

Photo Analysis

The visible contamination includes silica with metallic and rust particles.

CLEANLINESS CODE

20•19•16



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

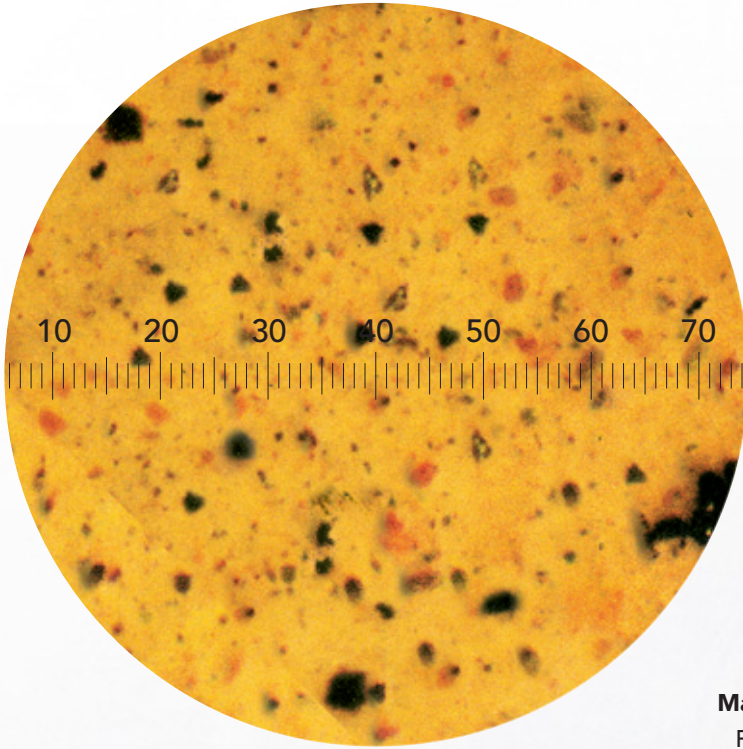
PARTICLE COUNT SUMMARY			
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	7,514	5,000-10,000	20
6	3,431	2,500-5,000	19
10	1,514		
14	480	360-640	16
25	84		

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

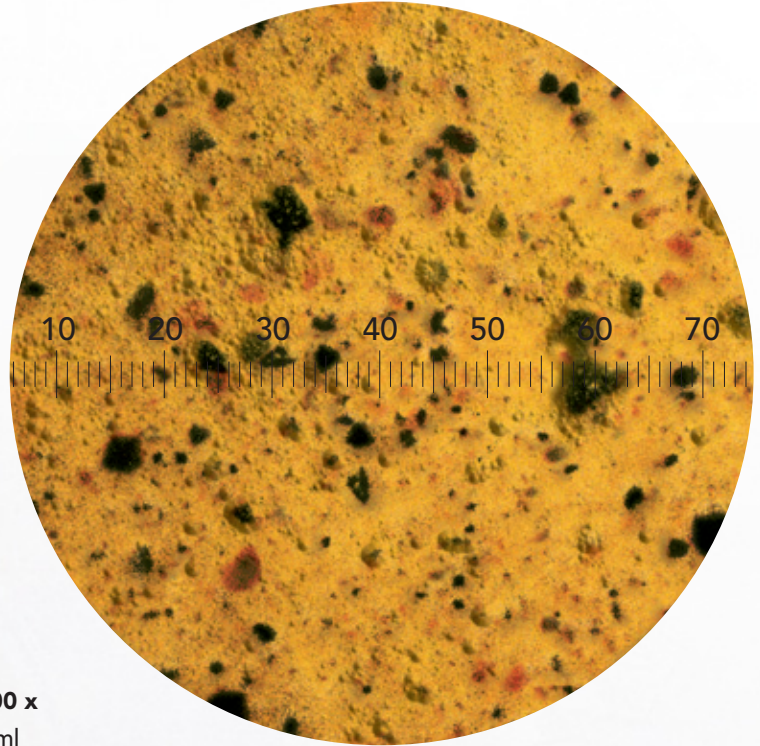
PARTICLE COUNT SUMMARY			
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	14,992	10,000-20,000	21
6	8,688	5,000-10,000	20
10	3,570		
14	900	640-1,300	17
25	437		

Photo Analysis

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

CLEANLINESS CODE

23•22•19



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

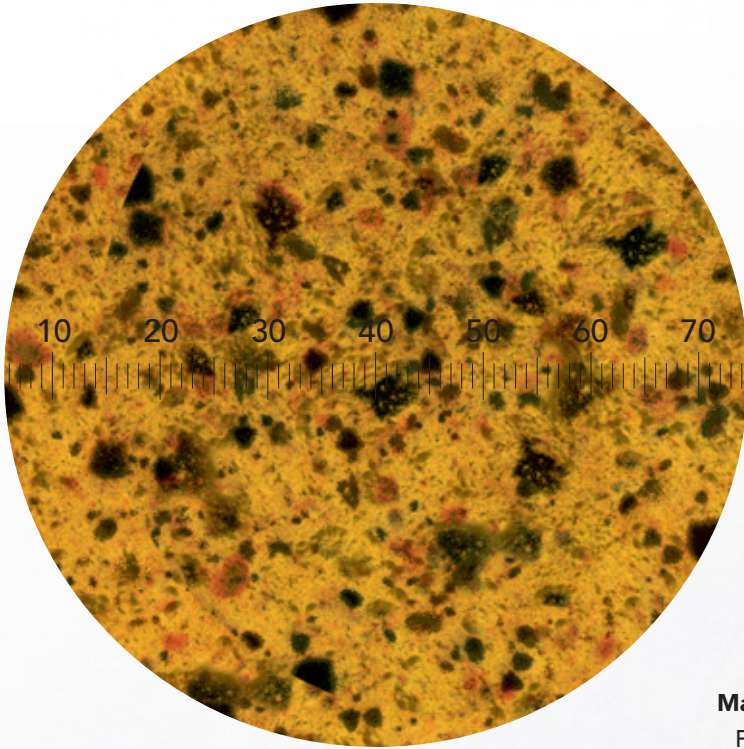
PARTICLE COUNT SUMMARY			
Particle Size (in microns)	Number per ML. Greater Than Size	Particle Count Range	Range Code
4	57,030	40,000-80,000	23
6	31,964	20,000-40,000	22
10	14,400		
14	3,750	2,500-5,000	19
25	811		

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

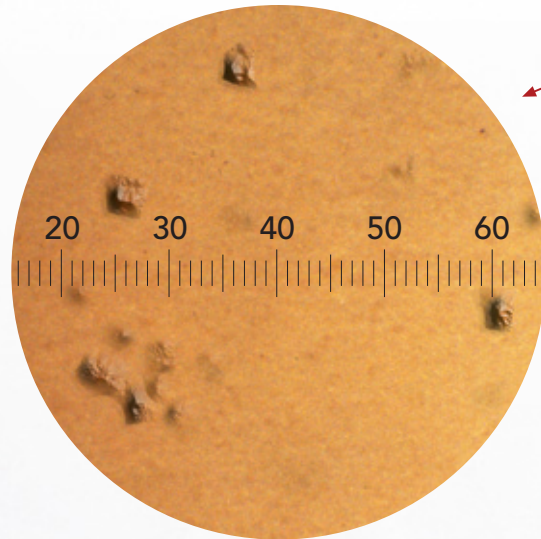
This sample is highly contaminated with silica, metallic, rust and carbon (such as coal) particles.

Types of Contamination

Silica

Photo Analysis

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

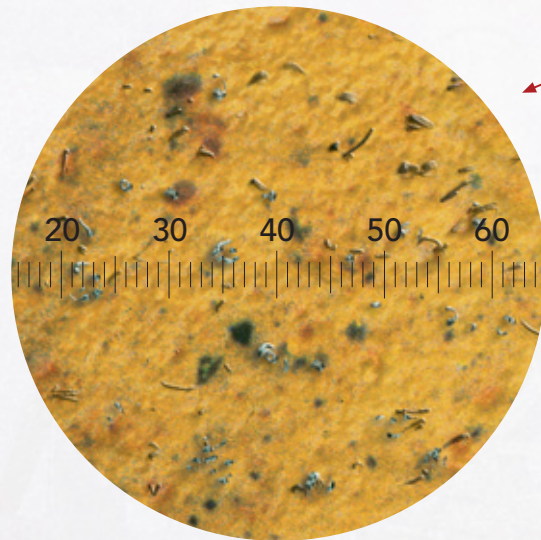


Magnification: 100 x
Scale: 1 Division = 14 μm

Bright Metal

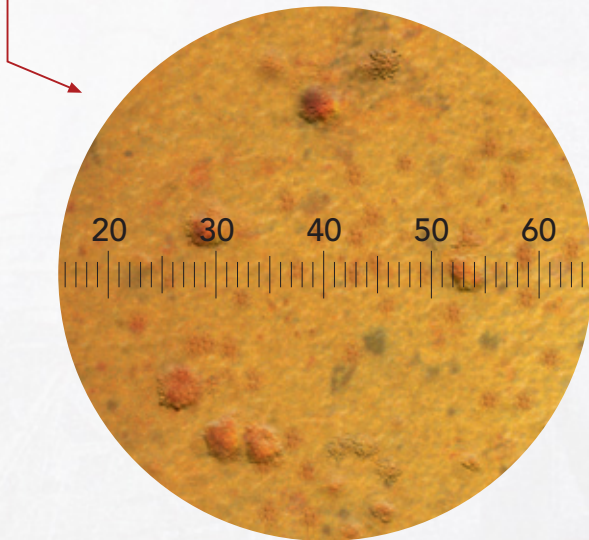
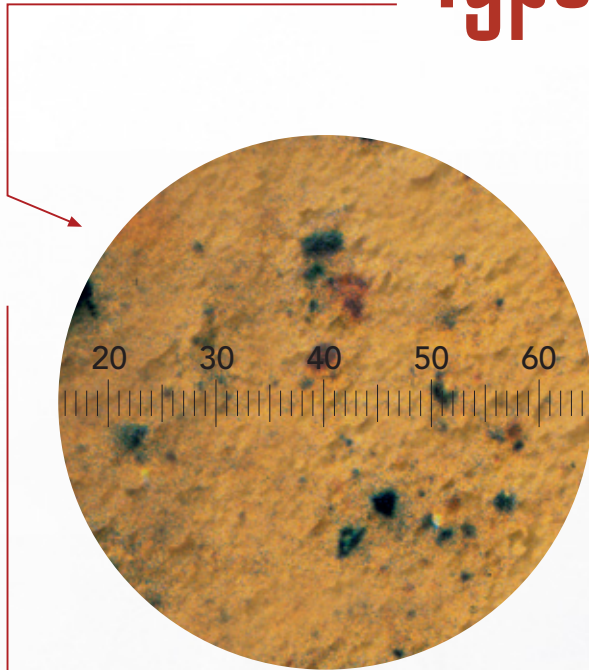
Photo Analysis

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 μ m

Rust

Photo Analysis

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

Types of Contamination

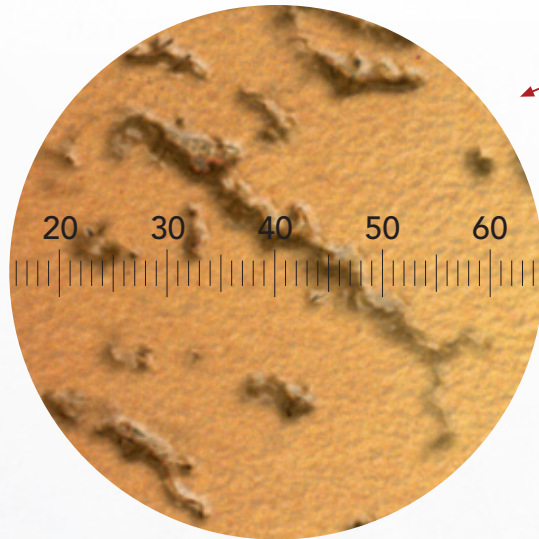
continued

Fibers

Photo Analysis

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

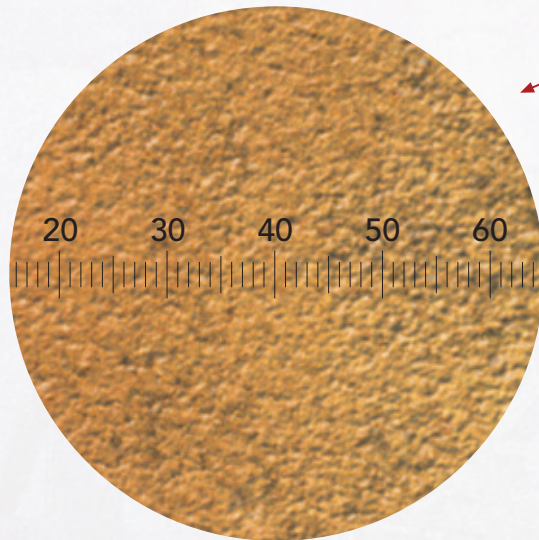
Magnification: 100 x
Scale: 1 Division = 14 μ m



Cake of Fines/ Precipitate

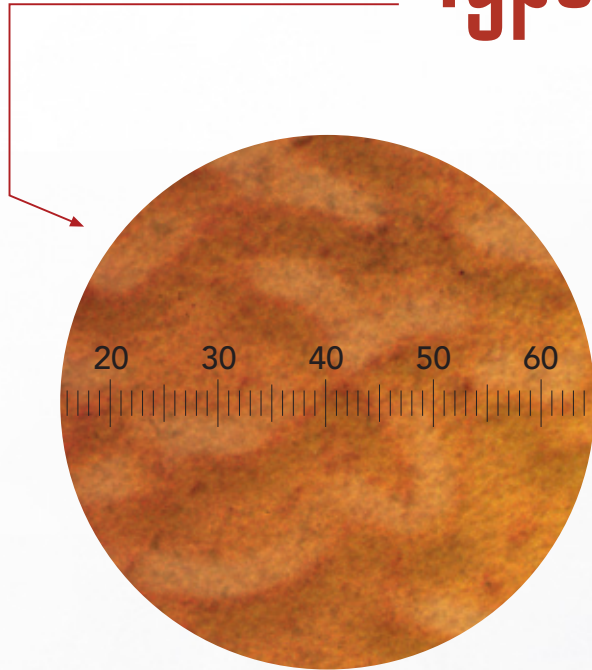
Photo Analysis

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

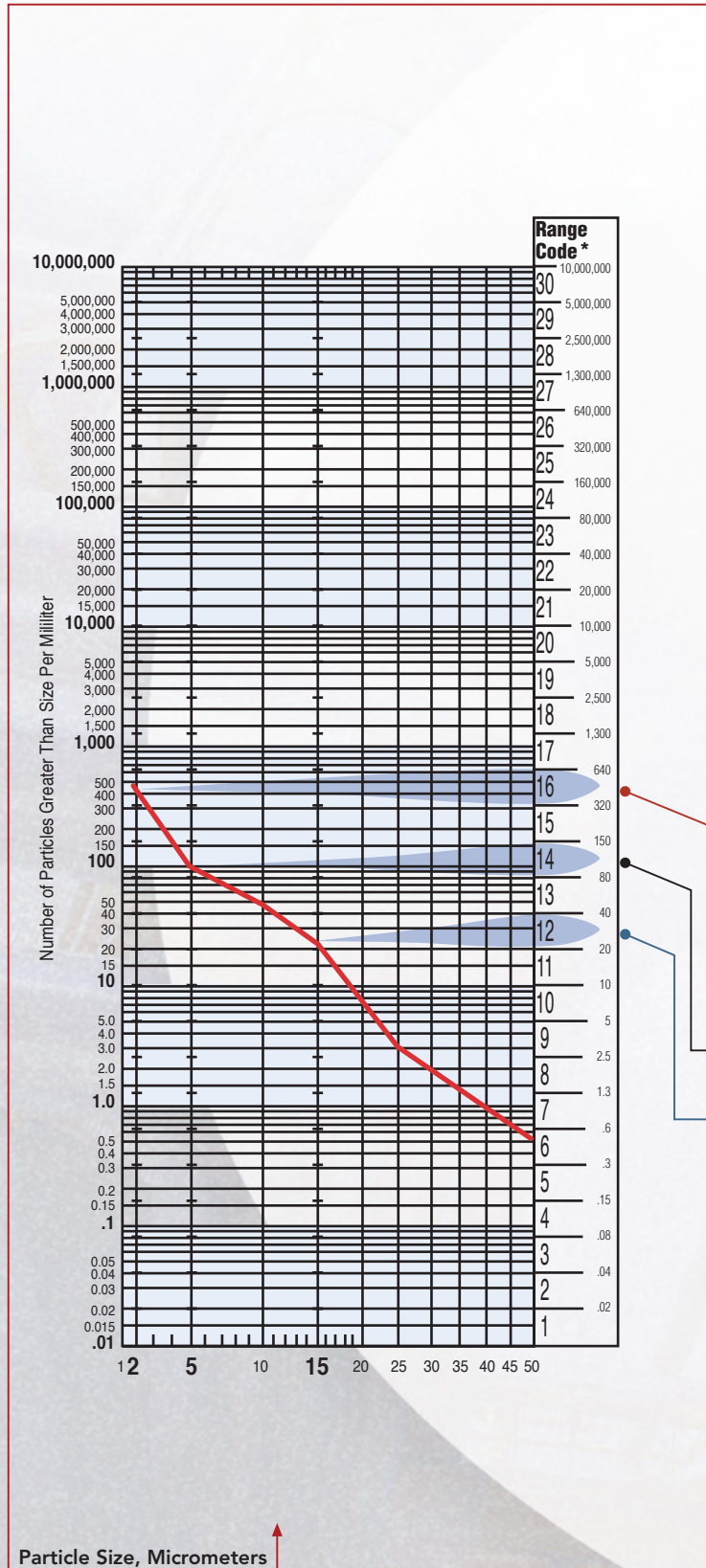
Photo Analysis

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

Magnification: 100 x
Scale: 1 Division = 14 μ m

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.

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

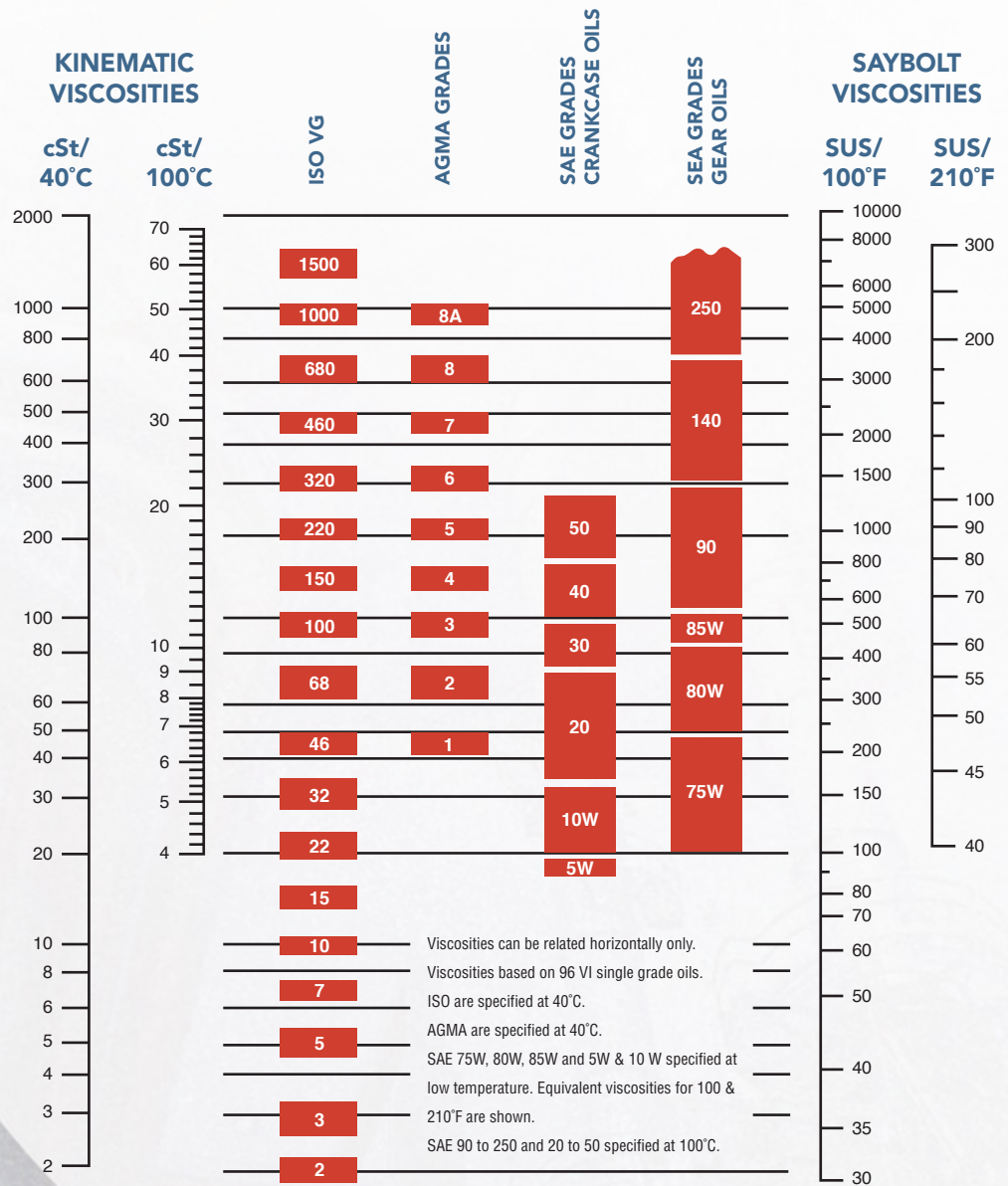
Many petroleum products are graded according to the ISO Viscosity Classification System, approved by the International Standards organization (ISO).

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:
 $SUS @ 100^\circ F \div 5 \cong cSt @ 40^\circ C$



Portable Fluid Analysis KIT

Manual

page 1 (of 2)

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