

Hydraulic & Lube Oil Contamination Reference Chart



hyprofiltration.com/



Filter Element Upgrades
Deliver lower ISO Codes, longer element life, and lower total cost of ownership



FC Off-line Filter Carts
Heavy duty off-line Filter Carts for reservoir and gearbox conditioning



SVR Soluble Varnish Removal Systems
Complete recovery and maintenance solution for mineral oil based turbine oil lubricants



VUD Vacuum Dehydration Systems
Complete oil conditioning systems for removal of particulate and all forms of water



FCLCOD Diesel Conditioning Filter Carts
Heavy duty water and particulate removal filter carts for diesel fuels

New Updated App



Available on the App Store and on Google Play™



NSD Non-Spark Discharge Filter Elements
Elements designed to prevent spark discharge in bearing lube and hydraulic control systems



FSL High Viscosity Filtration Systems
Oversized filter systems for off-line gearbox and reservoir conditioning



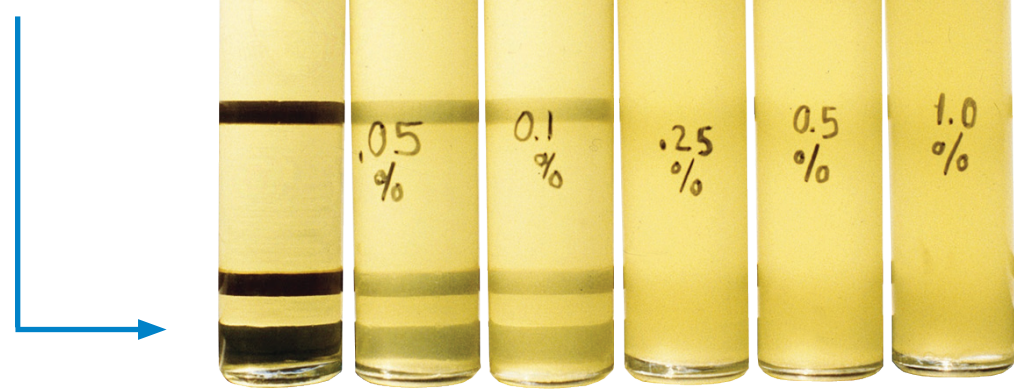
FSAPE Phosphate Ester Conditioning Systems
Complete conditioning systems to remove acid, increase resistivity and lower ISO Codes

Donaldson Hy-Pro Product Catalog



Appearance of Water in Oil

Dissolved Water:
Oil appears bright and clear. Water can only be removed by vacuum dehydration.



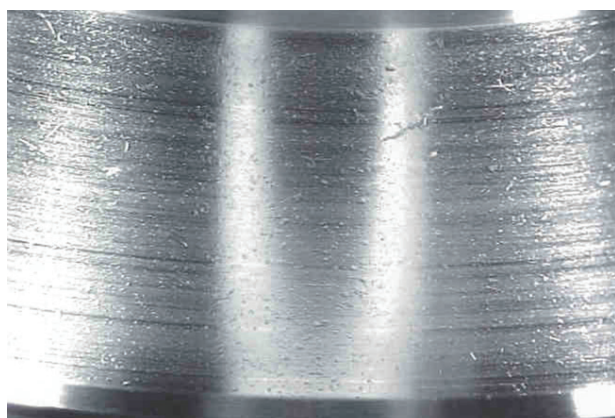
500 ppm 1000 ppm 2500 ppm 5000 ppm 10000 ppm

Emulsified Water:
Very small droplets dispersed in oil. Oil viscosity may go up and appear cloudy and milky. Tiny amounts of detergent engine oil can contaminate industrial oils.

Harmful Effects of Water in Oil

Water is one of the most common and most damaging contaminants found in a lube or hydraulic system. Continuous or periodic high water levels can result in damage such as:

- Metal Etching (Corrosion)
- Abrasive Wear in Hydraulic Components
- Dielectric Strength Loss
- Fluid Breakdown
- Additive Precipitation and Oil Oxidation
- Reduction in Lubricating Properties



Contamination Related Failure

Component Life Extension by Removing Water*

Current Moisture Level PPM	New Moisture Level PPM (%)									
	1000 (0.1%)		500 (0.05%)		250 (0.025%)		100 (0.01%)		50 (0.005%)	
	Rolling Element	Journal Bearing	Rolling Element	Journal Bearing	Rolling Element	Journal Bearing	Rolling Element	Journal Bearing	Rolling Element	Journal Bearing
5000	2.3	1.6	3.3	1.9	4.8	2.3	7.8	2.9	11.2	3.5
2500	1.6	1.3	2.3	1.6	3.3	1.9	5.4	2.4	7.8	2.9
1000	-	-	1.4	1.2	2	1.5	3.3	1.9	4.8	2.3
500	-	-	-	-	1.4	1.2	2.3	1.6	3.3	1.9
250	-	-	-	-	-	-	1.5	1.3	2.3	1.6
100	-	-	-	-	-	-	-	-	1.4	1.2

*Courtesy of Noria

Before



After

Fluid Analysis Reference Guide

Below are contaminants found on fluid analysis test reports listed according to their chemical symbol (often how they'll be listed on the reports) and the various sources from which they are known to occur.

Oil Analysis Test Categories

Wear Metals **Additives** **Contaminants**

Al Aluminum	Bearings Blocks Blowers Bushings Clutches Cylinders Housings Pistons Pump Bearings Motor Housings Rotors Thrust Bearings Thrust Washers	Alumina Bauxite Catalyst Coal Fly Ash Foundry Dust Granite Grease Thickener Paint Road Dust
Sb Antimony	Alloy Steel	Ceramic Products Paint

Ba Barium	Fuel Additive Grease Thickener Oil Additive: Detergent	Oil Additive: Detergent
---------------------	--	-------------------------

Be Beryllium	Alloy Steel	
------------------------	-------------	--

B Boron	Coolant Inhibitor Oil Additive: Anti Wear	Oil Additive: Ext Pressure Oil Additive: Detergent
-------------------	--	---

Cd Cadmium	Journal Bearings Plating	
----------------------	-----------------------------	--

Ca Calcium	Cement Dust Fuller's Earth Grease Thickener	Hard Rock Dust Oil Additive: Detergent Oil Additive: Rust Inhibitor Road Dust Rubber Salt Water Slag
----------------------	---	--

Cr Chromium	Exhaust Valves Sieve Liners Low Alloy Steel Oil Coolers Rings Rods	Roller Bearings Stainless Steel Taper Bearings Water Treatment Paint
-----------------------	---	--

Cu Copper	Babbitt Bearings (Underlay) Bearing Cage Brass Bronze Cam Bushings Clutches Governors Guides Oil Coolers	Oil Pumps Pump Piston & Thrust Plate Steering Disc Valve Train Bushings Wear Plates Wrist Pin Bushings
---------------------	--	---

Fe Iron	Bearings Blocks Brake Pads Cam Shaft Cast Iron Crankshafts Cylinders Disks Gears Housings	Hydraulic Pump Vanes Gears Pistons Liners Oil Pump Power/Take Off (PTO) Rings Screws Shafts
-------------------	--	--

Predictor Source of Spectrometry Metals

Wear Metals **Contaminants & Abrasives**

Pb Lead	Babbitt Journal Bearing (Overlay) Bronze Alloy Solder Balancing Weights	Gasoline Additives Paint Road Dust
-------------------	---	--

Mg Magnesium	Turbine Metallurgy	Hard Water Oil Additive: Detergent Road Dust Sea Water Fuller's Earth
------------------------	--------------------	---

Mo Molybdenum	Alloy Steel Ring	Oil Additive: Ext Pressure Grease
-------------------------	---------------------	--------------------------------------

Ni Nickel	Hardened Steels Stainless Steel Plating	
---------------------	---	--

P Phosphorus		Oil Additive: Anti Wear Oil Additive: Ext Pressure
------------------------	--	---

K Potassium	Coolant Inhibitor Fly Ash Fuel Element	Granite Paper Dust Road Dust
-----------------------	--	------------------------------------

Si Silicon	Alloy Steel	Granite Grease Limestone Oil Additive: Antifoam Synthetic Lubricant Sealant
----------------------	-------------	--

Ag Silver	Bearing (Overlay) Needle Bearings	Oil Cooler (Solder) Wrist Pin Bushings
---------------------	--------------------------------------	---

Na Sodium	Activated Alumina Coolant Inhibitor Dirt Fly Ash	Grease Oil Additives Paper Mill Dust Road Salt
---------------------	---	---

Sn Tin	Bearing Cage Babbitt Bearing Flashing	Piston Overlay Solder
------------------	---	--------------------------

Ti Titanium	Gas Turbine Bearings Turbine Blades	Paint
-----------------------	--	-------

V Vanadium	Turbine Blades Valves	
----------------------	--------------------------	--

Zn Zinc	Brass Plating	Bunker Oil Cathodic Protection Galvanizing Grease Oil Additive: Anti Wear
-------------------	------------------	---

Oil Analysis Patch Test Kits

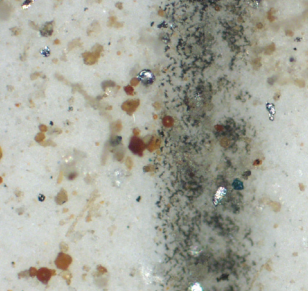
Lowering Your ISO Codes: Oil Analyses Filter Patches

Understanding the condition of your fluid is the first step toward improving your system cleanliness. Establish your current ISO code, set a target and a plan of action, and finally trend your progress to your goal.

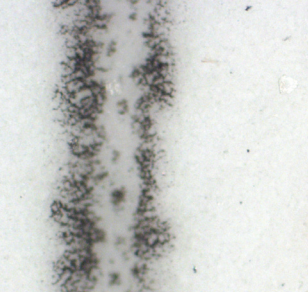


PTK1 Patch Test Kit

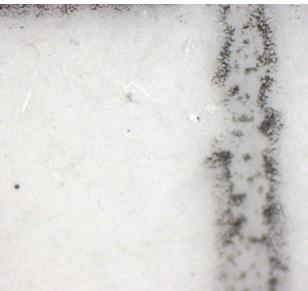
ISO Code: 24/22/19



ISO Code: 20/17/13



ISO Code: 16/14/11



Understanding ISO Codes

The ISO Cleanliness Code (per ISO4406-1999) is used to quantify particulate contamination levels per milliliter of fluid at 3 sizes - 4µm, 6µm, and 14µm. It is expressed in 3 numbers (example 19/17/14) where each number represents a contaminant level code for the correlating particle size. The code includes all particles of the specified size and larger.

It is important to note that each time a code increases, the quantity range of particles is doubling. Inversely, as a code decreases by one the contaminant level is cut in half.

ISO 4406:1999 Code Chart

ISO Code	Particles per Milliliter (PPM)		Sample Values Before Filtration			
	Lower Limit	Upper Limit	Particle Size	PPM	ISO 4406 Code Range	ISO Code
24	80,000	160,000	4µm	151773	80,000-160,000	24
23	40,000	80,000	4.6µm	87210		
22	20,000	40,000	6µm	38363	20,000-40,000	22
21	10,000	20,000	10µm	8229		
20	5,000	10,000	14µm	3339	2,500-5,000	19
19	2,500	5,000	21µm	1048		
18	1,300	2,500	38µm	112		
17	640	1,300	68µm	2		
16	320	640				
15	160	320				
14	80	160				
13	40	80	Particle Size	PPM	ISO 4406 Code Range	ISO Code
12	20	40	4.6µm	35		
11	10	20	6µm	7	5-10	10
10	5	10	10µm	5		
9	2.5	5	14µm	0.4	0.32-0.64	6
8	1.3	2.5	21µm	0.1		
7	0.64	1.3	38µm	0.0		
6	0.32	0.64	68µm	0.0		

Component Life Extension Tables

Develop a Fluid Cleanliness Target

Donaldson Hy-Pro will help you develop a plan to achieve and maintain target fluid cleanliness. Arm yourself with the support, training, tools and practices to operate more efficiently, maximize uptime and save money.

Laboratory and field tests prove time and again that Donaldson Hy-Pro filters consistently deliver lower ISO fluid cleanliness codes.

Improving fluid cleanliness means reduced downtime, more reliable equipment, longer fluid life, fewer maintenance hours, and reduces costly component replacement or repair expenses.

Hydraulic Component Life Extension

Current ISO Code	New ISO Code	New ISO Code	New ISO Code	New ISO Code
	2 x Life	3 x Life	4 x Life	5 x Life
28/26/23	25/23/21	25/22/19	23/21/18	22/20/17
27/25/22	25/23/19	23/21/18	22/20/17	21/19/16
26/24/21	23/21/18	22/20/17	21/19/16	21/19/15
25/23/20	22/20/17	21/19/16	20/18/15	19/17/14
24/22/19	21/19/16	20/18/15	19/17/14	18/16/13
23/21/18	20/18/15	19/17/14	18/16/13	17/15/12
22/20/17	19/17/14	18/16/13	17/15/12	16/14/11
21/19/16	18/16/13	17/15/12	16/14/11	15/13/10
20/18/15	17/15/12	16/14/11	15/13/10	14/12/9
19/17/14	16/14/11	15/13/10	14/12/9	13/11/8
18/16/13	15/13/10	14/12/9	13/11/8	-
17/15/12	14/12/9	13/11/8	-	-
16/14/11	13/11/8	-	-	-
15/13/10	13/11/8	-	-	-
14/12/9	13/11/8	-	-	-



DPE Rated Filter Elements Lower ISO Codes and Improve Reliability

Roller Contact Bearing Life Extension

Current ISO Code	New ISO Code	New ISO Code	New ISO Code	New ISO Code
	2 x Life	3 x Life	4 x Life	5 x Life
28/26/23	25/23/19	22/20/17	20/18/15	19/17/14
27/25/22	23/21/18	21/19/16	19/17/14	18/16/13
26/24/21	22/20/17	20/18/15	18/16/13	17/15/12
25/23/20	21/19/16	19/17/14	17/15/12	16/14/11
24/22/19	20/18/15	18/16/13	16/14/11	15/13/10
23/21/18	19/17/14	17/15/12	15/13/10	14/12/9
22/20/17	18/16/13	16/14/11	14/12/9	13/11/8
21/19/16	17/15/12	15/13/10	13/11/8	-
20/18/15	16/14/11	14/12/9	-	-
19/17/14	15/13/10	13/11/8	-	-
18/16/13	14/12/9	-	-	-
17/15/12	13/11/8	-	-	-
16/14/11	13/11/8	-	-	-
15/13/10	13/11/8	-	-	-
14/12/9	13/11/8	-	-	-