2021

FLUID MANAGEMENT GUIDE

ONE EYE INDUSTRIES

SOLVING TOMORROW'S CHALLENGES TODAY.

PROTECTING YOUR EQUIPMENT

FLUID CONTAMINATION CAUSES EQUIPMENT FAILURE

To protect equipment and extend operating life, operators must employ new filtration technologies capable of removing the wear contamination that damages critical systems down to 4 microns and below. The primary sources of fluid contamination are the formations where the oil was produced, the machining and manufacturing processes of system components, air intake, and the initial break-in of equipment.

- Today's material quality, design and machinery function at a high level; the tolerances for rotating equipment components are precise. Quality bearings and servo valves for pneumatic and hydraulic systems have a 1µ tolerance. Magnetic filtration must accommodate these new tolerances; One Eye radial field, rare-earth magnetic technology meets this new standard.
- Traditional filtration is challenged to clean wear contamination <10µ because custom filtration for this capability is expensive and requires frequent changeout. The alternative, bypass filtration, is helpful on many applications however is expensive and requires a full flow rate to be effective.
- Standard analysis programs such as Spectographic, Millipore and Ferrographic Analysis do not identify contamination <4µ.

82%

of mechanical wear
is due to wear contamination

ISOCLEAN™ CERTIFIED LUBRICANTS

*Source: Noria Corporation

UNSEEN DAMAGE IS THE MOST EXPENSIVE

Contaminants in oil are typically measured in microns (one millionth of a meter) which is equal to 0.000039 inches. Since the human eye cannot detect wear particles less than 40 microns, almost all of the damage caused in equipment comes from contaminants in the fluid that we can't even see. Research has proven that the wear particles that damage the most are under 4 microns. Conventional filters rarely catch contaminants less than 30 microns.

GRAIN OF SALT
~ 100 μ

HAIR FOLLICLE
~ 80 μ

CIGARETTE SMOKE
< 40 μ

MOST HARMFUL
< 1 μ

THE CHAIN REACTION OF BROKEN-DOWN EQUIPMENT

Interrupting and restarting production consumes more energy and profit due to inefficient operations. The initial purchase of an OEI filter is quickly recovered when accounting for extended maintenance intervals, extended operating life, reduced labour, and prevented downtime.

WITH PROACTIVE MAINTENANCE

- **PRODUCTION**
- **EFFICIENCY**
- **MORALE**
- **PROFIT**
- **TRUST**

WITHOUT PROACTIVE MAINTENANCE

- **UNPLANNED MAINTENANCE**
- **LOST PRODUCTION**
- **LABOUR**
- **SAFETY RISKS**
- **POTENTIAL FAILURE**

WHY ISO STANDARDS ARE NOT ENOUGH

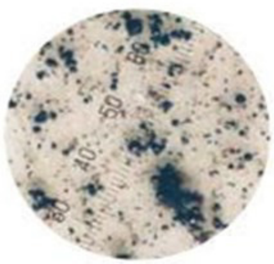
ISO fluid cleanliness standards are no longer relevant because of advances in the machining and manufacturing of equipment components. ISO recommended fluid cleanliness ratings do not account for the most damaging wear particles under 4 microns. ISO standards are communicated with a three-number coding system. In 1987, the clean fluid standard for responsible heavy equipment maintenance and operation was set at 18/16/13. Heavy equipment manufacturing has advanced considerably since 1987.

ISO STANDARD: 18/16/13

In a 1 ml sample of oil:

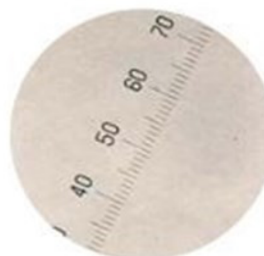
- 18 represents 1300 - 2500 particles between 4 and 6 μ
- 16 represents 320 - 640 particles between 6 and 16 μ
- 13 represents 40 - 80 particles over 16 μ

ISO standard cleanliness does not account for the most damaging wear particles under 4 microns.



ISO 22/20/17

ISO 18/16/13



ISO 12/9/6

REAL-WORLD REQUIREMENTS

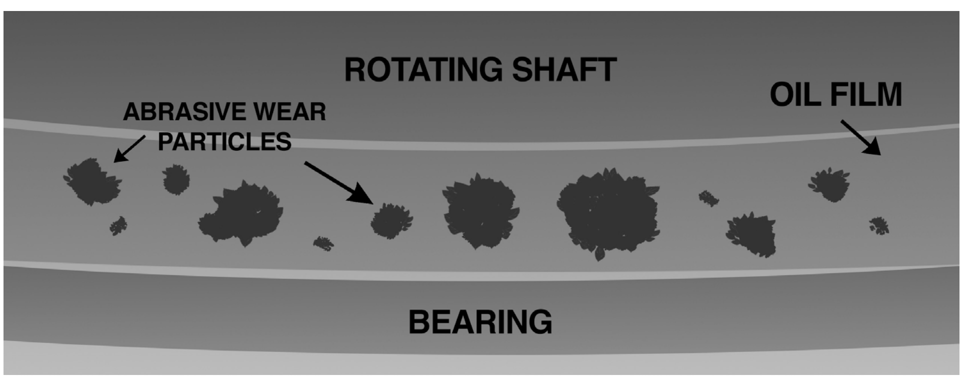
EQUIPMENT REQUIRES FLUIDS TO BE 4X CLEANER THAN ISO STANDARDS

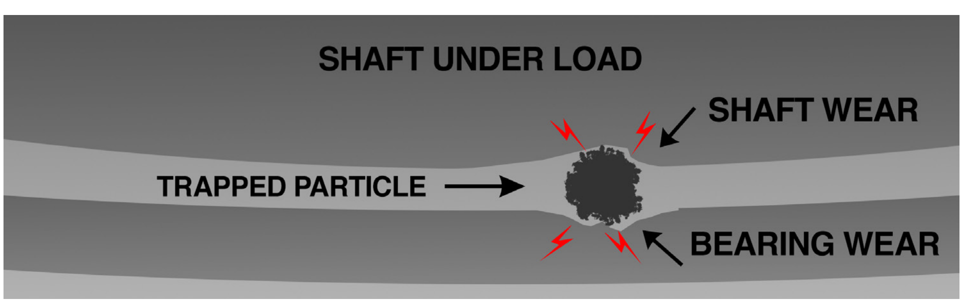
Industry mining leaders require fluid cleanliness specifications for their heavy-duty equipment not to exceed 16/13/8.

ISO FLUID CLEANLINESS STANDARD
particles per 1 ml of fluid

UNKNOWN Particles under 4 μ	1300-2500 Particles between 4-6 μ	320-640 Particles between 6-16 μ	40-80 Particles over 16 μ

THE MOST DAMAGING WEAR PARTICLES





BENEFITS OF CONSISTENT FLUID MONITORING

ANALYSIS ALLOWS DETECTION OF DESTRUCTIVE CONTAMINANTS

This form of oil analysis determines the presence and identification of wear particles produced as a result of mechanical wear, corrosion, or other machine surface degradation. It answers questions relating to wear, including:

- Is the machine degrading abnormally?
- Is wear debris produced?
- From which internal component is the wear likely originating?
- What is the wear mode and cause?
- How severe is the wear condition?

OEI core technology protects equipment by not only removing large contamination from worn components, but effectively collecting the wear contamination down to 4 microns and below before it can degrade components.

Figure 1.
Elemental Iron (ICP) = 0
Ferrous Density: High

Figure 2.
Elemental Iron (ICP) = High
Ferrous Density: High

Figure 3.
Elemental Iron (ICP) = Low
Ferrous Density: Low

Figure 4.
Elemental Iron (ICP) = High
Ferrous Density: Medium/Low

Figure 5.
Elemental Iron (ICP) = Low
Ferrous Density: High

BEST PRACTICES FOR ANALYZING FLUID

PROPER ANALYSIS ENSURES ACCURACY

Dirt particulates, moisture, varnish, and gases are the primary contaminants that can cause damage to the equipment the lubricant is intended to protect. These contaminants can also reduce the performance and shorten the intended life of the lubricant. Mobile construction, waste collection equipment, and fixed equipment that depends on the reliable operation of heavy-duty machinery in manufacturing and power generation plants requires a systematic approach to maintaining lubricant cleanliness at levels specified by the equipment's manufacturers.

Best practices monitoring involves pulling oil samples at regular intervals and sending them to a lab for testing. Label the sample with the date and time, type of oil, and specific equipment in order to monitor changes in particle count over time. A simple patch test can be performed at your facility. With this test, an oil sample is run through a filter membrane and then observed through a microscope. Commercial patch test kits are widely available.

1 CONSISTENCY IS KEY

Sample from an active stream in the system while the equipment is running and the oil is warm. Sample from the same place each time to ensure consistent results.

2 REGULAR INTERVALS

Waiting too long between samples (1,000 hours vs 100) may lead to abnormal signs of wear. Regular sample intervals will ensure the lab can establish a reliable baseline to monitor any changes.

3 BE CAREFUL WHERE YOU SAMPLE

Although the easiest place to take a sample is from the drain pan, this area is full of contaminants from earlier drains and debris around the drain plug. If the application allows, take a sample from the flow.

4 USE A CLEAN, DRY BOTTLE

Only open the bottle when you're ready to take the sample. Seal it quickly. Take approximately 4 oz. to represent a reservoir holding hundreds of gallons of oil. The lab uses a fraction for each of the many tests it performs.

5 DON'T FILL THE BOTTLE

Leave room in the bottle so the technician can shake it to disperse wear particles that may have collected at the bottom.

6 LABEL THE SAMPLE

Identify the exact oil viscosity, or SAE grade, in addition to the brand and fluid name. Label the type of equipment, number of hours on the unit, and date of last oil change. Use the same nomenclature each time. The more accurate information you give the lab, the more accurate the analysis.

7 ACCOUNTABILITY

Assign someone to become familiar with the process to ensure consistencyeach time samples are taken.

FERROUS DENSITY TEST

WEAR PARTICLE CONCENTRATION
(consistent Monitoring)

PARTICLE COUNTING OR PARTICLE QUANTIFICATION INDEX (PQI)

What it analyzes	On-site wear particle concentration (Wear particles are primarily iron. This test is often considered a ferrous density test).
Why it matters	PQI detects the total concentration of wear particles in a sample. By monitoring the level of ferrous (iron) wear particles over a period of time, you can predict accelerated component wear.
How it works	Each sample is passed over a sensor which measures the bulk magnetic content of the oil.
Limitations	Does not differentiate particle sizes or element types.

PATCH TEST

PARTICLE TYPE, SIZE, AND CONCENTRATION
(On-site)

What it analyzes	On-site visual analysis of particle concentration, type, and size.
Why it matters	Comparing the patch to reference slides provides an ISO code. The types of wear particles can be examined on-site for immediate understanding of fluid conditions.
How it works	Pass the oil through a filter membrane, and with the aid of microscope, count the deposited wear particles or compare the patch to reference slides to determine an ISO Rating.
Limitations	This method is insensitive to air bubbles and water droplets, which can interfere with the readings of the instrumental particle counters.

ANALYTICAL FERROGRAPHY

PARTICLE TYPE, SIZE, AND CONCENTRATION
(Best in class)

What it analyzes	Particle size, concentration, and shape.
Why it matters	The detail in this best-in-class, off-site analysis pinpoints component wear, how (and how often) it was generated, and its root cause.
How it works	The solid debris suspended in a lubricant is separated and systematically deposited onto a glass slide for microscopic examination. The microscope uses both reflected (top) and transmitted (bottom) light to distinguish the size, shape, composition, and surface condition of ferrous and non-ferrous wear particles.
Limitations	This method is costly but effective in identifying all aspects of wear particles down to 4 microns and below.

SPECTROSCOPY* PARTICLE SIZE

SCANNING ELECTRON MICROSCOPE (SEM)

What it analyzes	Identifies the sizes and structures of wear particles in a fluid sample that are under 10 microns.
Why it matters	When the particles' metallurgy, size, and shape are known with high accuracy, it's easier to determine their type, origin, and root cause.
How it works	The SEM scans the sample with an electron beam to produce a magnified image for analysis. Electron microscopy is performed at high magnifications to generate high resolution images that precisely measure particles under 10 microns.
Limitations	This analysis must be done with other tests because it is blind to particles in excess of 10 microns and does not identify particle concentrations.

SPECTROSCOPY ELEMENT CONCENTRATIONS

ENERGY-DISPERSIVE X-RAY SPECTROSCOPY (EDS)

What it analyzes	Identifies the concentrations of each element in a sample.
Why it matters	Understanding the elements in a fluid sample will identify the fluid condition and sources of wear.
How it works	The sample is stimulated by electrons or high-energy photons. Each atom absorbs, then emits, that energy in varying spectrums of light. The varying light energy is measured to determine concentrations of each element.
Limitations	This test is blind to particles larger than 10 microns and must be done with additional tests that identify the particle density, size, and element.

SPECTROSCOPY PARTICLE CHARACTERISTICS

X-RAY DIFFRACTOMETER (XRD)

What it analyzes	Once particle composition has been determined, XRD will show it's phase, grain size, texture, crystallinity, and stress.
Why it matters	Data about wear particle structure gives insight into which conditions are causing component stress.
How it works	XRD uses diffraction patterns to detect crystalline structure.
Limitations	SEM or EDS is required to determine the elemental composition. Approaching an unknown sample with XRD alone may be confusing.

*Spectroscopy is an off-site analysis that requires additional tests

MAGNETIC FILTRATION BENEFITS

CLEAN AND REUSE

OEI products are reusable for 18+ years, and require minimal consumables. Conventional filters require frequent, costly changeouts, and disposal.

PREDICTIVE MAINTENANCE

OEI Magnetic Filter Elements are effective predictive maintenance tools when used for condition monitoring. When removed for inspection, magnetic filter elements will have varying quantities of contamination. Abnormally high quantities of contamination indicate component failure. The composition of contamination will identify which components are stressed, worn, or failing.

Visual analysis of the quantities of wear contamination collected on magnetic filter plugs can determine component failure. Analysis of wear particle compositions and sizes will determine early component wear.

GOES WHERE NO CONVENTIONAL FILTER HAS GONE BEFORE

OEI magnetic filters can be installed on suction lines to protect pumps without risk of cavitation. Unlike conventional filters, they accommodate space restrictions and unique applications such as splash oil gearboxes, reservoirs, and small coolant lines.

CAPTURES NON-FERROUS CONTAMINATION

Non-ferrous particles are magnetically captured because of cross-contamination. Particles become statically charged from flow velocity. This charge is a principal force of particle adhesion; iron particles contaminate non-ferrous particles by adhering to their statically charged surface. Another form of cross-contamination occurs when sub-micron iron particles embed in softer non-ferrous particles after abrasive impact.

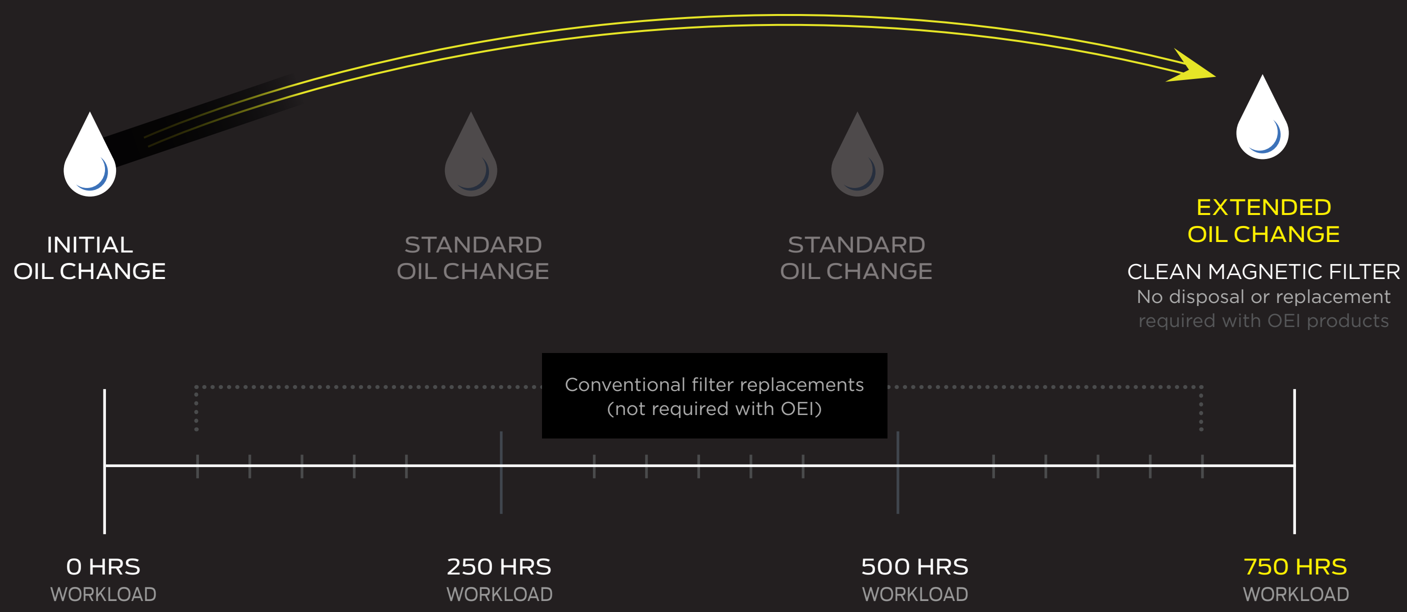
PREVENT OXIDIZATION AND VARNISH

OEI effectively removes iron and steel particles under 10 microns that are known to promote oil oxidation because of their catalytic properties. Oxidation can deplete additives that protect against wear, corrosion, sludge, varnish, and viscosity changes that affect the thickness of films between bearing surfaces, friction, control of temperature, and energy consumption.

NO WORMHOLING OR CHANNELING

OEI filters eliminate the opportunity for wormholing and channeling that conventional paper, fiberglass, and polymer media filter elements are subject to.
Wormholing: when wear contamination punctures the filter media.
Channeling: when fluid flows through punctured holes because it takes the path of least resistance.

The core technology in all One Eye Industries magnetic filtration products is a magnetic filter element designed with a patented radial magnetic field configuration to remove wear particles down to 4 microns and below. The magnetic filter element is utilized in various housings with calculated dwell times for optimal filtration.



EXTENDED FLUID LIFE ➡ PROTECTED EQUIPMENT ➡ EXTENDED EQUIPMENT LIFE

*Source: Noria Corporation

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