

How to Select the Right Oil Analysis Tests

Loren Green

Oil analysis is an excellent tool that can be used to direct maintenance decisions. However, if you have not chosen the proper test slate, it is wasted time and money. Therefore, one of the first steps toward a successful oil analysis program is determining the right tests to perform.

Test slate selection can be a bit daunting. Some mistakenly believe that it is too technical or too involved for an untrained individual. It may help to break the selection into smaller segments. For example, first decide whether you want to examine the fluid properties, the contamination or the wear debris.

	1. Fluid Properties Physical and chemical properties of used oil (aging process)	2. Contamination Fluid and machine destructive contaminants	3. Wear Debris Presence and identification of wear particles
What is analyzed			
Possible Tests:			
Particle counting	○	●	◐
Moisture analysis	○	●	○
Viscosity analysis	●	◐	○
Ferrous density	○	○	●
Analytical ferrography	○	◐	●
AN/BN	●	◐	◐
FTIR	●	◐	○
Patch test	○	●	◐
Flash point	◐	●	○
Elemental analysis	●	◐	●
	Proactive	Proactive	Predictive

As shown in the chart above, particle counting can be a great indicator of the

● Primary benefit ◐ Minor benefit ○ No benefit

effectiveness of your contamination control program, but if you are looking for a test to tell you about the health of your lubricant, the acid/base number and viscosity tests would be much better. You can narrow your focus even further by considering tests based on equipment type.

Qualification testing, quality assurance testing, user acceptance testing and monitoring of new oils in storage are some of the other important categories of oil analysis.

Typically, lubricant manufacturers or blenders will use qualification testing to make sure the lubricant blend meets the stated minimum criteria. Among the tests usually conducted include:

- Oil viscosity and lubricity
- Oxidation stability
- Acidity and/or alkalinity
- Pour, flash and fire point
- Soluble and insoluble contaminants
- Air release and foaming characteristics
- Anti-corrosion and anti-rust characteristics
- Anti-wear and extreme-pressure characteristics
- Water separability and emulsibility characteristics
- Relative cold-weather operating characteristics

A number of other organizations may conduct additional testing to verify performance for specific machine classes. For example, the Society of Automotive Engineers (SAE) and the American Petroleum Institute (API) perform tests for gasoline and diesel engine oils, while the International Organization for Standardization (ISO) and the American Gear Manufacturers Association (AGMA) run tests on gear oils and for viscosity, anti-wear, extreme-pressure and other performance specifications.

SELECTING OIL ANALYSIS TESTS BY APPLICATION

Test or Procedure	Paper Machine Oils	Motor and Pump Bearings	Diesel and Gas Engine	Hydraulics	Air and Gas Compressors	Chillers and Refrigeration	Transmissions, Final Drives and Differentials	Industrial Gear Oils	Steam Turbine Oils	Gas Turbine Oils	EHC Fluids***
1. Particle Count	R	R	R	R	R	R	R	R	R	R	R
2. Viscosity											
a. 40°C	R	R	-	R	R	R	R	R	R	R	R
b. 100°C	-	-	R	-	-	-	-	-	-	-	-
3. AN	R	E(5a)	-	R	R	R	R	R	R	R	R
4. BN	-	-	R	-	-	-	-	-	-	-	-
5. FTIR											
a. Ox./Nit./Sul.	R	R	R	R	R	R	R	R	R	R	-
b. Hindered Phen.	-	R	-	R	R	-	-	R	R	-	-
c. ZDDP	-	R	-	R	R	-	R	R	-	-	-
d. Fuel Dil./Soot	-	-	R	-	-	-	-	-	-	-	-
6. Flash Point	-	-	R	-	R*	-	-	-	-	E(2b,5d)	-
7. Glycol	-	-	E(14b)	-	-	-	-	-	-	-	-
8. Ferrous Density	E(1)	E(1)	R	R	R	R	R	R	E(1)	E(1)	R
9. Analytical Ferrography	E(8,14a)	E(8,14a)	E(8,14a)	E(8,14a)	E(8,14a)	E(8,14a)	E(8,14a)	E(8,14a)	E(8,14a)	E(8,14a)	E(8,14a)
10. RPVOT	-	-	-	-	R	-	-	-	R	R	-
11. Crackle	R	R	R	R	R**	R	R	R	R	-	R
12. Water by KF	E(11)	E(11)	E(11)	E(11)	E(11)**	E(11)	E(11)	E(11)	E(11)	-	E(11)
13. Water Separability	R	-	-	-	R**	-	-	-	R	-	-
14. Elemental Analysis											
a. Wear Metals	R,E(1)	R,E(1)	R	R,E(1)	R,E(1)	R,E(1)	R	R,E(1)	R,E(1)	R,E(1)	R,E(1)
b. K, Na, B, Si	R	R	R	R	R	R	R	R	R	R	R
c. Additives	R	R	R	R	R	R	R	R	R	R	R

* Gas compressors only ** Air compressors only *** For phosphate ester fluids, consult your fluid supplier and/or turbine manufacturer

R = Routine testing

E = Exception test keyed to a positive result from the test in parenthesis

Component-specific routine and exception test slates

Quality assurance testing is conducted by lubricant manufacturers during refining and blending to confirm product quality and consistency. These tests are generally limited to oil viscosity and/or viscosity index, sulfated ash, acidity and/or alkalinity, and additive concentration.

Acceptance testing is often some of the first testing performed by end users. It helps ensure that the lubricants delivered match those that were ordered and that deliveries meet acceptance quality standards.

Typical tests include oil viscosity, viscosity index, atomic emission spectroscopy, Fourier transform infrared (FTIR) spectroscopy, water contamination and particle counts.

Finally, there is testing used to monitor new oils in storage. Many are unaware that lubricants in storage have a shelf life. Over time, lubricants suffer the effects of contamination, biological growth, oxidation and degradation byproducts.

If oils are stored for an extended period of time, they should be tested to verify that they have not deteriorated to the point of becoming useless.

The table above provides component-specific routine and exception test slates for the majority of equipment used in plants today. Several of the tests listed as routine are fairly simple and can be performed in-house.

At minimum, I would recommend that you have a particle counter and viscosity comparator to make certain that the lubricants you are receiving are labeled correctly. Having the ability to conduct onsite particle counts can save you money

by providing quick information on the effectiveness of your contamination control program.

46% of lubrication professionals use onsite oil analysis testing at their plant, based on a recent poll at MachineryLubrication.com

Of course, there are many reputable oil analysis laboratories that will work with you to select test slates targeted to your equipment and processes, but you must educate yourself to guarantee that you are getting your money's worth and that your oil analysis program is aligned with your reliability goals.

Besides the name of the test, be sure to ask which test method is utilized. If the lab is not able to identify the ASTM method being used, this would be a good indication to terminate the partnership.