

Lubricant Sampling Techniques for Wear Particle Analysis

Wear Particle Analysis is a method of detecting abnormal wear trends in machinery. Its effectiveness depends on proper sampling techniques. Valid samples must contain a representative selection of wear particles.

Since wear particles and contaminants in a lubricating system are seldom uniformly distributed, proper sample taking procedures are critical. Considerations for sampling are addressed in this document. They include:

- Life of a particle
- Sampling from pipes
- Sampling from tanks
- Effects of in-line filters
- Grease samples
- Sampling frequency
- Sample bottles and caps
- Sampling accessories
- Training

Familiarity with these considerations is essential for an accurate application of Wear Particle Analysis.

Life of a Particle

To establish the operating conditions and health of machines by Wear Particle Analysis, it is essential that the lubricant sample contain a representative selection of particles. Since particulate matter exists as a separate phase in the fluid, it cannot be assumed that a uniform distribution exists throughout the lubricant. Consequently, careful attention must be paid to the method of sample extraction.

During normal operation of lubrication and hydraulic systems, wear particle concentration achieves an equilibrium level for each set of operating parameters. Since wear debris is continually generated in

any operating mechanical system, the achievement of an equilibrium level implies that particles are removed from the fluid at the same rate they are generated.

Factors which influence the operating time to equilibrium are:

- Filtration: i.e., The average number of times a particle of a given size and composition passes through the filter.
- Oil pump cycle rate: Pumping rate expressed in volume per unit time, divided by the volume of lubricant in the system.
- Dispersive qualities of the lubricant: A fluid may contain detergent additives which will prevent agglomeration of particles and discourage surface adhesion.
- Physical traps: Particles may settle out or adhere to the surfaces semi-permanently. Examples include the bottom of sumps, oil tanks, etc.

To obtain a representative sample of lubricant for Wear Particle Analysis, the following guidelines should be followed:

- Samples should be taken from a single location in a system. Since large particles are so important in Wear Particle Analysis, every effort should be made to take a sample before an in-line filter.
- Samples should be taken during normal operating conditions.
- If samples cannot be taken while the machine is in operation, sample **no more than 15 minutes after shutdown.**

A further consideration is the effect of an oil change. Since a complete lubricant change removes the majority of particles from the system, the operational period needed to return to normal equilibrium must be considered. This rarely exceeds 24 hours.

Each machine has a characteristic time it returns to equilibrium. Large particles will regain their equilibrium level sooner than small particles.

Sampling from Pipes

Dynamic sampling during operation yields the most representative sample. For best results, the sample should be taken before filtering from a pipe that carries oil scavenged from the wearing parts.

The sample must represent the complete system; i.e., the scavenged oil must pass through all wearing parts.

If the pipe is large and the flow velocity is low, sampling from the bottom of the pipe should be avoided.

Sample valves should always be flushed before taking a sample.

Sampling from Tanks

There are two principal sources of error in oil tank sampling, both related to the natural tendency of the particles to settle:

1. If the sample is removed from the bottom of a tank, a high particulate volume may be obtained as a result of sedimentation.
2. If a sample is taken from the reservoir too long after machine shutdown (more than 15 minutes), a low particulate volume may be obtained due to settling of debris.

These are recommendations for sampling tanks.

- Preferably remove a sample while the system is operating. If this is not possible, the sample should be obtained within 15 minutes after machine shutdown.

- If the system contains a permanently installed sampling line, it should be flushed prior to sample removal. The dead volume of oil in the sample line should be estimated and approximately twice that volume extracted before the actual sample is taken.
- Sample from the center of the tank or halfway through the fluid level. Maintain sufficient clearance above the sludge line.
- If a standpipe is used for sampling, it should be designed so that the particles will not settle directly into the pipe.
- The user should make a sampling rod to retrieve samples from a tank. The polyethylene tube is attached to the rod and the rod is inserted through an opening in the tank. The rod should be designed with a "stand-off" feature to prevent the end of the tube from touching the sides and bottom of the tank.

Effects of In-Line Filters

Filters change the particle population in two ways. First, they lower the number of particles in the oil.

Second, filters remove large particles more effectively than small ones, so that the number of larger particles is reduced.

Consequently, samples should be taken upstream of a filter to ensure the most representative sample of a system.

Grease Samples

Taking grease samples poses a special problem since greases do not circulate like oils. Wear particles will concentrate in certain areas depending on bearing design. Consult your local PREDICT Sales Representative about the appropriate sampling techniques for the bearings you want to monitor.

Sampling Frequency

Sampling frequency is determined by the nature of the machine, its usage, and how important early warning is to the user.

Failures can result from operation beyond the machine's design specifications or from effects of the operating environment.

Experience has shown that taking a monthly sample ensures that the onset of abnormal wear is detected in time to minimize the consequences. Longer intervals increase the possibility of failure.

Sample Bottles and Caps

PREDICT provides bottles and caps to ensure the integrity of Wear Particle Analysis.

Sampling Accessories

The following accessories are available for taking samples.



Sample Pump

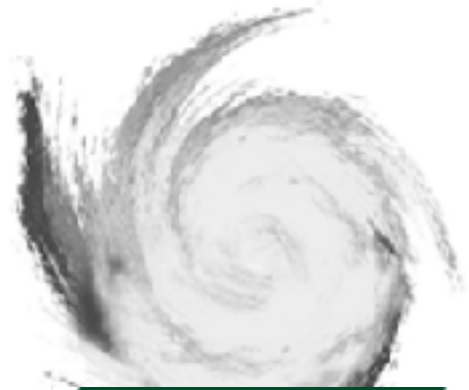
The manual suction pump draws an oil sample from a sump. Contamination is eliminated because the oil comes in contact with a disposable plastic tube.

Polyethylene Tube

One-quarter inch (1/4") OD tubing is used with the sample pump. Provided in reels of 500 ft., the tubing is cut in the field to suit the application and to avoid contamination. The used section of tubing is discarded after each sample is taken.

Training

A one hour lecture on the contents of this document, followed by on-site demonstrations and discussions should adequately train an operator or technician in proper sampling techniques.



PREDICT

9555 Rockside Road
Cleveland, OH 44125
Ph: 216-642-3223
Fax: 216-642-1484
Toll Free: 800-543-8786
email: info@predictusa.com
www.predictusa.com

ISO 17025:2005 Accredited
ISO 9001:2000 Certified