# INTERPRETING THE NUMBERS: SOLUBLE OILS

## BACKGROUND:

This Technical Bulletin is designed to reveal the value of the data generated on routine Used Oil Analysis (UOA) reports and nonroutine reports through a Laboratory Service Request (LSR) for Castrol's Soluble oils Metal Working Fluids. The following tests are broken down into two categories: routine and non-routine. Routine tests are those performed on UOA samples. Non-routine tests are those that are used to troubleshoot various system problems. Listed below are concentration control measures:

Total Oil (via Acid Split or via FTIR, %)

In an ideal system these concentration controls should be in a 1:1 relationship. For example, if the concentration by Acid Split is 5%, the concentration by total oil should be 5%, etc. The key to interpreting data is to assess the overall trend of the data instead of focusing on individual data points. Proper interpretation requires a comprehensive view of the all the data points in relation to one another and the system environment to establish an overall view of the condition of the metalworking fluid.

## ROUTINE TESTS:

**Total Oil (%):**

- Total oil by FTIR is a concentration control that measures the oil content of the sample.
- The oil content functions as a lubricant, corrosion preventive, and a carrier for additives. This test does not distinguish between free oil, emulsified oil, product oil, and non-product oil.

**Bacteria (cfu/mL):**

- The bacteria test measures the number of bacteria in a system sample after 24 hours of incubation, reported in colony forming units/mL.
- Bacteria may enter a system from the air, water, and contamination and grow rapidly once they inhabit a system.
- Bacteria consume vital product components such as fatty acids and secrete acidic by-products causing a drop in system pH.
- Bacterial contamination can be prevented by maintaining adequate concentration, good filtration, limiting tramp oil and contamination, using quality make-up water, and regular product additions
- A tankside biocide addition of a plant approved biocide may be recommended for bacteria levels >10^5cfu/mL.



Castrol Technology Deployment, 150 W Warrenville Rd., Naperville IL 60563

**Dirt 8um (PPM):**

- The dirt test is performed by filtering the sample through an 8um filter patch. The weight of particulate is then reported in parts per million (PPM).
- Dirt levels below 20PPM are acceptable. For precision operations where tolerance and surface finish are critical, maintaining lower dirt levels is critical.
- High dirt levels contribute to decreased tool life, poor surface finish, residues, dermal irritation, and increase the potential for corrosion.
- Various filtration methods are available to help maintain a clean system.
- The addition of a settling agents can be used to help settle fines and swarf and break up smut deposits. Contact Technical Support for assistance.
- This test can also be performed on a non-routine basis at 1um, 3um, 5um, and 20um to establish a particulate size/weight distribution.

**Hardness (gpg):**

- The Hardness test is a measure of calcium and magnesium ions that contribute to hardness in solution.
- Calcium, magnesium, and other minerals come from the water source used for product dilution and vary widely by source and region.
- Over time, these minerals build in a system due to the distillation effect.
- High hardness levels contribute to increased potential for corrosion, residue formation, and fatty acid soap formation.
- Very soft water (<2gpg) may contribute to foaming with some products. Non silicone defoamers can be added to increase water hardness.

**pH:**

- pH is a measure of how acidic or basic a product is with the scale ranging from 0-14.
- Severe fluctuations in pH are often the result of contamination.
- When foaming occurs, an increase in pH may indicate that the system has been contaminated with an alkaline cleaner.
- Maintaining a proper pH aids in the biostability of the fluid.
- High bacteria levels may contribute to a decrease in pH.
- Low pH can contribute to corrosion on ferrous metals and product instability.
- pH can be increased with product addition or the addition of a pH adjuster

## NON-ROUTINE TESTS

**Chloride (PPM):**

- This test measures the level of chloride ions in solution.
- Chloride levels <200ppm are acceptable, however studies have shown that levels >350ppm are extremely detrimental.
- This test can be used to troubleshoot corrosion issues.
- No additives are available to remove chlorides from a system. A full or partial dump-and-recharge may be necessary.

**CIC (Cast Iron Chip) Rust**:

- This test determines if a coolant sample will cause corrosion of cast iron chips.
- The CIC rust test (or the more severe 50% CIC rust test) is a good indication of the corrosion protection offered by the product and can be used to trouble shoot corrosion issues.
- If rust is exhibited, ensure that the system concentration is adequate.
- If corrosion is exhibited, a good preventive measure is to add SYNLUBE L4

**Dissolved Metals (ppm):**

- This test measures the level of individual metals dissolved in a coolant sample by Inductively Coupled Plasma (ICP) reported as parts per million (PPM)
- The most common reason for metals analysis is to troubleshoot dermal irritation and contamination.
- High levels of dissolved metals can increase the potential for corrosion and contribute to residue and soap formation.

**Inhibitor BZT/TTZ (ppm) :**

- This test measures the level of BZT or TTZ in a product detected by HPLC.
- These components are formulated into several of our products to provide bi-metallic corrosion inhibition and increased corrosion protection.
- The components also prevent cobalt leaching and are used in our various carbide grinding fluids.
- This test would be performed if corrosion or staining is being experienced.
- Products containing bi-metallic corrosion inhibitors should be used in situations where contact occurs between dissimilar metals. For example, these products should be used when machining aluminum parts that are fixtured with steel components.
- INHIBITOR 3 can be added sump-side to replenish depleted inhibitor levels.