

**ZIEGLER****ZIEGLER S-O-S ANALYSIS LAB**

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**S-O-S<sup>SM</sup> Services**

**Sample For:** USED AGCHEM PRIME  
PAT MCCAULLEY  
INTERNAL ACCOUNT

**Serial #:** AGCA1100CDNSL1117  
**Compartment:** Left Rear Planetary  
**Unit #:** 1100RG  
**Model #:** RG1100  
**WO #:** WN30266

**Sample #:** 160203408  
**Date Received:** 2/10/16  
**Oil Brand:** Pennzoil  
**Oil Blend:**  
**Oil Weight** 75W140

**USED AGCHEM PRIME**

| CURRENT SAMPLE INFORMATION |         |       |                  |       |              | WEAR METALS ANALYSIS |             |                 |                 |                |             |               |                   |            | PARTICLE COUNT |       |       |       | PHYSICAL TESTS    |           |             |       |
|----------------------------|---------|-------|------------------|-------|--------------|----------------------|-------------|-----------------|-----------------|----------------|-------------|---------------|-------------------|------------|----------------|-------|-------|-------|-------------------|-----------|-------------|-------|
| Date Taken                 | Changed |       | Quarts Oil Added | Meter | Meter on Oil | CU Copper PPM        | FE Iron PPM | CR Chromium PPM | AL Aluminum PPM | SI Silicon PPM | PB Lead PPM | NA Sodium PPM | MO Molybdenum PPM | SN Tin PPM | ISO Code       | µm 5  | µm 15 | µm 20 | PQ-Ferrous Debris | Viscosity | Anti-Freeze | Water |
|                            | Oil     | Filtr |                  |       |              |                      |             |                 |                 |                |             |               |                   |            |                |       |       |       |                   |           |             |       |
| 2/02/16                    | U       |       |                  | 1214  | 708          | 8                    | 43          | 0               | 0               | 1              | 0           | 2             | 2                 | 0          | 23/17          | 51864 | 742   | 95    | 18                | 23.1      | N           | N     |

**Interpretation**

Results of latest sample indicate elements tested didn't exceed normal specifications for this compartment. No excessive wear is indicated at this time.

**Recommendation**

Continue sampling at recommended intervals.

| TRENDING SAMPLE INFORMATION            |         |       |                  |       |              | WEAR METALS ANALYSIS |             |                 |                 |                |                                        |               |                   |            | PARTICLE COUNT |       |       |       | PHYSICAL TESTS    |           |             |       |
|----------------------------------------|---------|-------|------------------|-------|--------------|----------------------|-------------|-----------------|-----------------|----------------|----------------------------------------|---------------|-------------------|------------|----------------|-------|-------|-------|-------------------|-----------|-------------|-------|
| Date Taken                             | Changed |       | Quarts Oil Added | Meter | Meter on Oil | CU Copper PPM        | FE Iron PPM | CR Chromium PPM | AL Aluminum PPM | SI Silicon PPM | PB Lead PPM                            | NA Sodium PPM | MO Molybdenum PPM | SN Tin PPM | ISO Code       | µm 5  | µm 15 | µm 20 | PQ-Ferrous Debris | Viscosity | Anti-Freeze | Water |
|                                        | Oil     | Filtr |                  |       |              |                      |             |                 |                 |                |                                        |               |                   |            |                |       |       |       |                   |           |             |       |
| 2/02/16                                | U       |       |                  | 1214  | 708          | 8                    | 43          | 0               | 0               | 1              | 0                                      | 2             | 2                 | 0          | 23/17          | 51864 | 742   | 95    | 18                | 23.1      | N           | N     |
| 3/10/14                                | U       |       |                  | 506   |              | 57                   | 108         | 1               | 1               | 3              | 1                                      | 16            | 1                 | 2          | 23/21          | 62386 | 17214 | 3803  | 68                | 21.5      | N           | N     |
| 5/08/13                                | U       |       |                  | 50    |              | 9                    | 63          | 4               | 1               | 2              | 0                                      | 40            | 2                 | 1          | 23/22          | 59724 | 35353 | 20592 | 73                | 21.0      | N           | N     |
| 3/01/13                                | Y       |       |                  | 495   |              | 16                   | 55          | 1               | 0               | 1              | 0                                      | 22            | 1                 | 1          | 23/20          | 56031 | 8650  | 1284  | 18                | 24.0      | N           | N     |
| CURRENT SAMPLE IS INCLUDED IN TRENDING |         |       |                  |       |              |                      |             |                 |                 |                | SEE REVERSE SIDE FOR TEST EXPLANATIONS |               |                   |            |                |       |       |       |                   |           |             |       |

To realize the full benefits of the diagnostic capabilities of the oil analysis program, the user should do the following:

1. Provide complete and accurate information on the sample label.
2. Adhere to proper sampling procedures.
3. Be on a regular and continuous sampling program.
4. Cut oil filters open and inspect (particles in the oil large enough to be seen by the naked eye are too large for analysis and may indicate imminent failure).

Metals are shown in parts per million (PPM) and are evaluated according to hours or miles the oil has been in use, amount of oil added, recent component repairs, type of operation and other conditions that might affect the concentration.

Caterpillar Inc. has established "normal" wear rates for their products. Interpretation of oil samples from other brands of machines is based on other manufacturer recommendations or general guidelines established for similar components. Elevated readings indicate excessive wear and shortened component life, but may not indicate an imminent failure.

#### TEST EXPLANATION

| WEAR METALS | Possible sources of high readings in Caterpillar product.                                                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COPPER:     | Air compressor bushings; oil cooler tubes; thrust washers; wrist pin bushings; oil pump bushings; anti-seize compounds after a repair; additives in the new oil; condensation (water). In transmissions, discs and thrust plates. |
| IRON:       | Cylinder walls; oil pump; crankshafts, gear teeth.                                                                                                                                                                                |
| CHROMIUM:   | Piston rings, valve stems, new engine break-in, ball and roller bearings.                                                                                                                                                         |
| ALUMINUM:   | Main and rod bearings; pistons; rocker shaft in some engines. Transmission pump bushings, torque converter impeller or turbine.                                                                                                   |
| SILICON:    | Dirt; anti-foam additives in new oil. (Dirt is an abrasive and normally elevates all readings to indicate excessive wear and shortened component life).                                                                           |
| LEAD:       | Overlay on main and rod bearings; fuel contaminated with gasoline (tetraethyl lead).                                                                                                                                              |
| SODIUM:     | Produced when engine coolant contacts a hot surface and the water evaporates leaving a residue; oil additive.                                                                                                                     |
| POTASSIUM:  | Element used to detect coolant.                                                                                                                                                                                                   |
| TIN:        | Piston plate coating; overlay on main and rod bearings.                                                                                                                                                                           |

| PHYSICAL TEST     |                                                                                                                                                                                                                                                                                                                                                            |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PQ                | Measurement of ferrous debris.                                                                                                                                                                                                                                                                                                                             |
| VISCOSITY:        | A bath viscometer is used to measure viscosity at 100 C., and readings are reported in centistokes. Viscosity results are used to detect possible fuel dilution; oil thickening from high soot and /or oxidation or use of the wrong oil, and in some cases, oil transfer. Viscosity should trend within 2 centistokes.                                    |
| ANTIFREEZE:       | Water pump seal; oil coolers; liner seals; head gaskets. Test for more than .1% by volume ethylene glycol antifreeze in engine oil. Ethylene glycol causes serious sludge and varnish formation.                                                                                                                                                           |
| FUEL DILUTION:    | Failed nozzles; fuel transfer pump seals; under valve cover fuel lines. Test for more than .4% diesel fuel in engine oil. (Invalid test results can be produced by volatile liquids if used to clean sample gun or container).                                                                                                                             |
| WATER:            | Coolant leaks; condensation (due to low operation temp.); contaminated new oil. Test for more than .1% by volume. Can rust components, promote oil oxidation and forms acid with combustion products.                                                                                                                                                      |
| PARTICLE COUNT    | A method of reporting the number and size (in microns) of particles in a volume of fluid. Cannot be performed if water is present or if oil is too dark in color.                                                                                                                                                                                          |
| INFRARED ANALYSIS | Will be run on oil samples when additional information is necessary for interpretation.                                                                                                                                                                                                                                                                    |
| SOOT:             | Indication of lugging; over fueling; air inlet restriction; filter plugging. Reported in terms of absorbance X 100 (The maximum normally allowed is 60).                                                                                                                                                                                                   |
| OXIDATION:        | Oxidation occurs in all compartments. It is accelerated by heat and contaminants such as water. Oxidized oil allows a buildup of sludge and varnish. Reported in terms of absorbance X 100 (The maximum normally allowed is 34 for engine and 17 for non-engine).                                                                                          |
| SULFATION:        | Sulfur products caused by combustion of diesel fuel which contains sulphur. Sulphur products cause corrosion and may lead to piston ring sticking. Reported in terms of absorbance X 100 (The maximum normally allowed is 34).                                                                                                                             |
| NITRATION:        | Nitrogen products resulting from the combustion process occur in all engines but only reach problem levels in natural gas engines. Nitrogen compounds cause the oil to thicken, lose it lubricating capabilities, and leads to filter plugging, heavy deposits and lacquering. Reported in terms of absorbance X 100 (The maximum normally allowed is 16). |

NOTE: Prior to performing any major repairs based solely on SOS test results, consult your Caterpillar SOS Supervisor.