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SERVICE LETTER

Service Letter No. L171

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TO: All owners and operators of Avco Lycoming Aircraft Engines.

SUBJECT: General Aspects of Spectrometric Oil Analysis.

As the use of spectrometric lubricating oil analysis has become more widespread in the field of general aviation, the problems of methods, procedures, schedules and interpretation of data have become prevalent. This service letter is an attempt to clarify the subject and to define how lubricating oil analysis can be used as another tool in the maintenance of modern reciprocating aircraft piston engines.

First of all, it must be remembered that oil analysis does not replace other maintenance techniques as differential cylinder pressure checks, boroscopic examination, and filter content inspection. However, oil analysis can be used to estimate wear rate values as illustrated by the examples shown herein. These examples are actual instances taken from analysis reports submitted from a single laboratory.

PRINCIPLE OF SPECTROGRAPH OIL ANALYSIS:

The various parts of any engine are comprised of different metals or alloys and in the case of the Avco Lycoming aircraft engines these essentially consist of aluminum pistons, chrome plated or steel piston rings, steel or chrome cylinders, aluminum or aluminum bronze piston pin plugs, etc. These parts are subject to wear and they normally deposit minute particles of metal in the oil. If a part is wearing abnormally, excessively high concentrations of the metal of which it is made will be deposited in the oil and this wear can increase over a period of time until premature failure results. By analyzing the oil spectrochemically for this metal content, the increasing concentrations can be detected and corrective action taken.

The most important aspect of monitoring engine wear by oil analysis is safety. As long as the wear rates of the various elements do not show a sharp rise, the operator can be assured that his engine is in good "health" at the time of the analysis. Oil analysis will very quickly detect dirty induction systems and it is

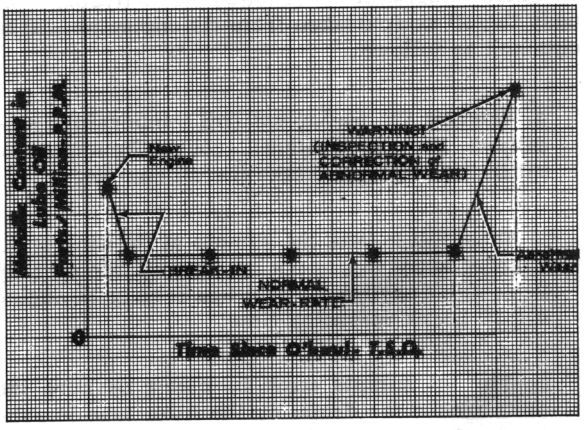

Figure 1. Typical Metallic Concentration in Engine Lube Oil Relative to Time - Since Overhaul

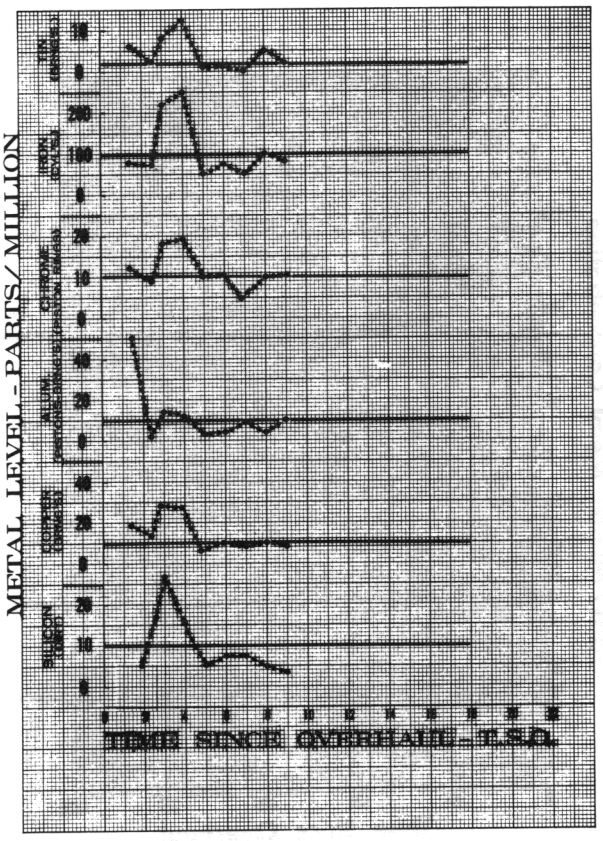

Figure 2. Typical Spectrometric Oil Analysis Showing Abnormal Wear Due to High Silicon Content - 300 Hours

most important that clean air be provided to engines to obtain recommended "TBO's". Worn, dirty, misaligned, etc. air filters are often in use and this condition is frequently ignored by operators.

PRACTICAL APPLICATION OF OIL ANALYSIS:

Referring to Figure 1, the amount of metal carried in the engine oil is most often high in a new engine or an overhauled engine during its break-in period because of new parts mating together. After about 25 hours of operating time the metal content decreases rapidly to a level that essentially remains constant unless abnormal wear occurs due to dirt in the induction system or for other causes. Abnormal wear will be quickly indicated by a "break" in the curve also shown in Figure 1. It should be emphasized that this "break" in the normal wear rate does not necessarily mean that failure is imminent; but it does mean that an investigation (filters checked, boro-scope examination, compression pressure check, etc.) should be undertaken to determine the cause for abnormal wear as illustrated by the following examples:

NOTE

Avco Lycoming claims no responsibility for engines remaining in service or removed from service solely on the basis of a spectrometric oil analysis report.

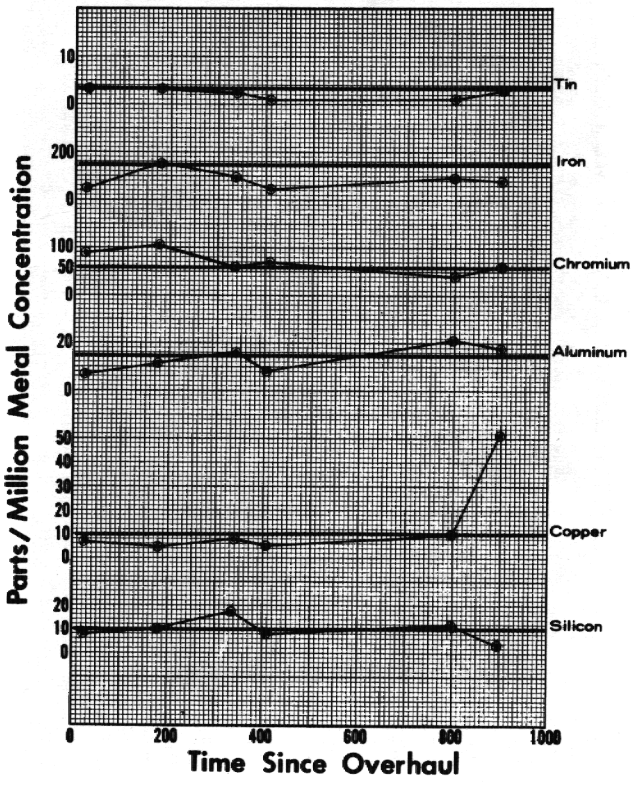

Figure 3. Typical Spectrometric Oil Analysis Showing Serious Bearing Wear (Cu) at 900 Hours

1. In Figure 2, it is noted that the dirt ingested by the engine (silicon content) increased rapidly from about 5 PPM (parts per million) to about 30 PPM resulting in increased wear to the rings and cylinders as shown by the sharp rise in chrome and iron content. Corrective action in this case by the operator (filter change and better fit) quickly resulted in normal wear again with resultant good health to the engine.

2. Figure 3 illustrates how spectrometric oil analysis can aid in the prevention of a major failure. At 900 hours, the wear rate for copper content in this engine increased from 10 PPM to 50 PPM, indicating serious bearing wear. Subsequent inspection proved this to be the case and a major failure was prevented.

It should be noted in Figure 3 that the metallic content of the various elements in the lube oil sampled at each check point are plotted against a "normal-wear-rate" expected for these elements.

CAUTION

These values are published as a guide and may or may not be directly applicable to all engines or laboratories providing this service.

Each of the organizations specializing in oil analysis has its own specifications for sampling oil to be analyzed; but, in general the following procedure is typical and acceptable by the major companies.

1. An oil sample may be submitted for analysis at any time during the life of the engine, preferably, a sample should be submitted at specified intervals and a running log maintained, somewhat like the chart, Figure 2. The sample should be taken from the engine in the manner specified by the analyzing company.

2. Unless otherwise specified by the analyzing company the oil sample taken from the engine should be obtained as follows:

a. Operate the engine until oil temperature stabilizes, then shut it down, check the amount of oil in the engine and take the oil sample.

b. It is best to take the sample at the time of oil change; but if this is not convenient, the oil may be sampled anytime after it has been in the engine for 10 hours operating time.

c. The oil sample must be clean; be sure the area around the drain, or the filler tube is perfectly clean before the sample is taken.

d. If the sample is taken when the oil is drained, let half the oil run out, then take the sample by holding the sample bottle in the oil stream.

e. If desired, the sample may be taken from the oil filler tube by means of a rubber bulb and a suction hose. If this method is used be sure the hose and bulb are cleaned with petroleum solvent before and after the sample is taken and that the solvent has evaporated.

3. There are certain items of information that must accompany the oil sample which are as follows: Engine model number, engine serial number, aircraft manufacturer, aircraft model, aircraft registration number, total hours on engine, hours since overhaul, brand of fuel, octane rating of fuel, brand of oil, viscosity of oil; type of oil - straight mineral, or ashless dispersant; oil consumption, hours since last oil change, date sampled, and oil level at sampling time. Also, indicate if cylinders are chrome plated at overhaul; describe any major repair or top overhaul.

NOTE

Avco Lycoming does not recommend any particular company to provide spectrometric oil analysis service for aircraft maintenance. However, at the present time only those companies affiliated with the Spectrometric Oil Analysis Laboratory Association (SOALA) are considered to be adequately qualified.