National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594

CEN22FA317

AIRWORTHINESS

Group Chair's Factual Report – Attachment #3

T53 Engine S/N LE-23701RX Oil Samples Report
& Oil Analysis Maintenance Manual

December 8, 2023

OIL ANALYSIS REPORT

NORMAL

BERNALILLO COUNTY SHERIFF'S DEPARTMENT
7401 ATRISCO VISTA RD
ALBUQUERQUE
NM, USA
87120

For the Attention of	IAN DAY
Telephone	505-340-1587
Laboratory Report Reference	JC18474
Laboratory Report Date	17-Feb-22
Receipt Date	17-Feb-22
Sample Date §	-

Equipment Information

Registration §	N911SZ
Position §	1
Description §	ENGINE
Manufacturer §	LYCOMING
Model §	T53-L-703
Serial Number §	LE-23701RX
Customer Reference §	70-16431
Unique Code	BRNCOSRF1.0014
Oil Grade §	EASTMAN TURBO OIL 2380
Unit Life §	298.9
Oil/Fluid Life §	142.6

Comment

Sample Number			3	4	5	6	7	8	9	10	11	12
Analysis Date			10-Jun-19	01-Oct-19	01-Oct-19	20-May-20	10-Nov-20	09-Mar-21	06-Apr-21	08-Jul-21	17-Sep-21	17-Feb-22
Sample Date §			28-May-19	07-Aug-19	22-Sep-19	09-May-20	31-Oct-20	26-Feb-21	26-Mar-21	04-Jun-21	10-Sep-21	-
Lab Reference			JC19F606	JC19J37	JC19J39	JC4241	JC7918	JC10240	JC10901	JC13128	JC14837	JC18474
Unit Life §			50.2	75.4	107.6	143.8	181.8	209.4	232.6	261.4	287.4	298.9
Oil/Fluid Life §			50	75.4	107.6	-	25.5	211.4	232.6	105.1	131.1	142.6
Oil/Fluid Added §			0	0	-	-	1	-	1	-	-	-
Ticket Number §			8O-62487	8O-62485	8O-67705	8O-67691	8O-67690	8O-77594	8O-77603	8O-77611	8O-83185	8O-83184
Sampling Point §												
Physical Condition												
Viscosity at 40°C	(M002)	cSt | mm2/s	24.5	24.4	24.5	24.7	24.2	24.1	24.3	24.2	24.5	24.4
TAN	(M007)	mg KOH/g	0.39	0.36	0.28	0.26	0.46	0.36	0.34	0.26	0.22	0.25
Spectrographic Analysis												
Iron	(M019)	ppm	1.7	1.7	1.5	0.6	0.8	1.0	1.3	1.3	1.5	1.8
Aluminum	(M019)	ppm	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1
Chromium	(M019)	ppm	0.7	0.6	0.5	<0.1	0.1	0.1	0.1	0.1	0.1	0.1
Molybdenum	(M019)	ppm	0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1	0.1	<0.1	<0.1
Copper	(M019)	ppm	0.1	0.1	0.1	<0.1	0.1	0.1	<0.1	0.1	0.1	0.1
Lead	(M019)	ppm	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tin	(M019)	ppm	<0.1	0.2	0.1	0.2	<0.1	0.2	0.1	0.1	0.1	0.2
Nickel	(M019)	ppm	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Silver	(M019)	ppm	0.1	0.2	0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1
Vanadium	(M019)	ppm	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	(M019)	ppm	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Silicon	(M019)	ppm	<1	1	1	<1	<1	<1	<1	<1	<1	<1
Sodium	(M019)	ppm	<1	<1	<1	3	<1	<1	<1	<1	<1	2
Phosphorus	(M019)	ppm	2412.4	2450.8	2444.2	2362.7	2383.2	2481.6	2557.7	2337.5	2185.6	2319.5
Magnesium	(M019)	ppm	0.7	0.5	0.3	<0.1	0.1	0.1	0.1	0.2	0.2	0.2
Tungsten	(M019)	ppm	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Calcium	(M019)	ppm	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1	<0.1
Zinc	(M019)	ppm	0.9	1.1	1.0	0.7	0.4	0.3	0.4	0.3	0.4	0.3

SPECTRO | JET-CARE

Opinions and interpretations included in this report are outside the scope of UKAS accreditation.
The validity of this report may depend on the accuracy of the sample data supplied.
Caution, this is an extract from the complete test results.
Reports with the same laboratory reference may contain a different selection of tests.
All tests carried out in accordance with in house documented methods.
Results relate only to the item tested.
By authority of Pam Kaur, Laboratory Manager. A UKAS accredited testing laboratory No. 1961.

Key:
* early warning
** advanced warning
§ supplied by customer
N/A not UKAS/SAS accredited
^ subcontracted (1:UK,2:US,3:CH)
~ based on agreed or OEM specified limit values

APPROVED BY:
NILAY MEHTA
LABORATORY SUPERVISOR

Jet-Care International Inc. | 3 Saddle Road
Cedar Knolls | NJ 07927 | United States
T. +1 973 292 9597 | W. www.jet-care.com

G. Inlet Blockage Inspection

NOTE: Any time the aircraft is flown in a loose grass/foliage environment or if it is suspected that rags, paper or other debris could have been ingested, the engine shall be inspected for blockage around the inlet guide vanes. Failure to perform this inspection could result in loss of power.

(1) Inlet blockage inspection:

(a) Remove the particle separator (both halves) and aircraft inlet screen (if installed) and inspect the engine inlet area

(b) Inspect the inlet housing struts and each inlet guide vane for rags, paper, grass, foliage or other foreign material blockage or partial blockage.

(c) Completely remove any foreign material that may be lodged on the inlet strut or guide vanes. Special attention should be given to the lower (4 thru 8 o'clock) portion of the vane assembly.

(d) If blockage or partial blockage is evident or suspected, remove and scrap all the first and second stage compressor blades and replace with new blades. (See 75-20-01.)

(e) Reinstall particle separator and aircraft inlet screen.

(f) Perform standard engine vibration check with the engine installed in the aircraft. (See 71-00-00, paragraph 11.E.)

G1. Unanticipated Inspection Requirements

Engines that have experienced an incident not addressed elsewhere under Special Inspections, such as immersion in water, etc. should be handled in the following manner. Incidents of this type will be handled on a case by case basis. Inspection recommendations may currently be specified within the Special Inspection Section or can be modified to meet a unique inspection requirements.

(1) Contact Honeywell T53 Customer Support Engineering for inspection recommendations.

(2) Provide as much detailed information as possible describing the incident and current condition of the engine.

H. Oil Sample Analysis

The oil sample analysis program provides a procedure for taking samples, testing, and spectrometric analysis of engine lubricating oil. This program will minimize engine deterioration due to oil contamination, maximize time between oil changes and can provide an advance warning of an excessive wear condition of an engine component or components.

(1) Take oil sample as follows:

(a) On newly installed engines or modules, after engine has run approximately 1 hour.

(b) On engines which have bad oil changed, after engine has run 15 minutes minimum.

NOTE: Sample must be taken within 15 minutes of shut down and before addition of any new oil. Do not allow sample to become contaminated.

(c) Shut down engine and using a clean dry sample bottle, immediately take oil sample from oil tank to 1 to 1-1/2 inches (25.3 to 38.1 mm) from bottom of tank. Be careful not to touch sides or bottom of tank to prevent contamination.

(2) Perform oil sample test as follows:

NOTE: If Gerin test kit or equivalent is not available, analysis by a reputable oil laboratory is acceptable.

When an oil change has been completed, the engine shall be run for 15 minutes minimum and an oil sample shall be taken for analysis. Analysis results will establish baseline acidity, viscosity and flash point data for oil sample analysis program.

(a) Using Gerin Turbo-Lube test kit V-3A or equivalent, test oil sample using procedure provided by oil analysis equipment manufacturer.

(b) Change oil if limits are exceeded. Limits are as follows:

NOTE: If oil viscosity decreased by 2 centistokes or 10 percent of new oil value, check for fuel in oil by determining oil flash point.

1 Kinematic viscosity or Gerin viscosity at 100°F (38°C) shall be +25 percent to -10 percent that of new oil value.

2 Total Acid Number (TAN) shall be 1.0 milligram potassium hydroxide per gram (KOH/mg/g) of oil maximum.

3 Flash Point, Cleveland Open Cup (COC) shall be 400°F (205°C) minimum for Type I oil or 475°F (245°C) minimum for Type II oil.

(3) Perform spectrometric oil analysis as follows:

NOTE: To avoid analysis variations due to test equipment and technique differences, only one laboratory should be used.

(a) Send oil sample to a laboratory capable of emission or atomic absorption testing for parts per million (ppm) of Silicon (Si) and the following wear metals: Aluminum (Al), Chromium (Cr), Copper (Cu), Iron (Fe), Magnesium (Mg), Nickel (Ni), Silver (Ag) and Titanium (Ti).

CAUTION: WEAR METAL IS NORMALLY GENERATED AT A SLOW STEADY RATE. SUCCESSIVE OIL SAMPLES SHOULD SHOW A TREND OF INCREASING WEAR METAL CONTENT. A SUDDEN JUMP OR INCREASE IN WEAR METAL CONTENT BETWEEN SUCCESSIVE OIL SAMPLES INDICATES AN ACCELERATED WEAR RATE. AFTER CONFIRMATION OF AN ACCELERATED WEAR RATE, THE CAUSE SHOULD BE IMMEDIATELY IDENTIFIED AND CORRECTED. ALLOWING ACCELERATED WEAR TO CONTINUE MAY RESULT IN FAILURE OF AN ENGINE COMPONENT.

(b) Evaluate laboratory reports for wear metal buildup trends from one sample to another. (See Figure 602.)

(c) If an abnormal increase in wear metal is noted, immediately take another oil sample and forward to laboratory for verification of increase.

NOTE: If possible, do not add oil, as addition of new oil will mask wear metal increase and confuse the sampling program.

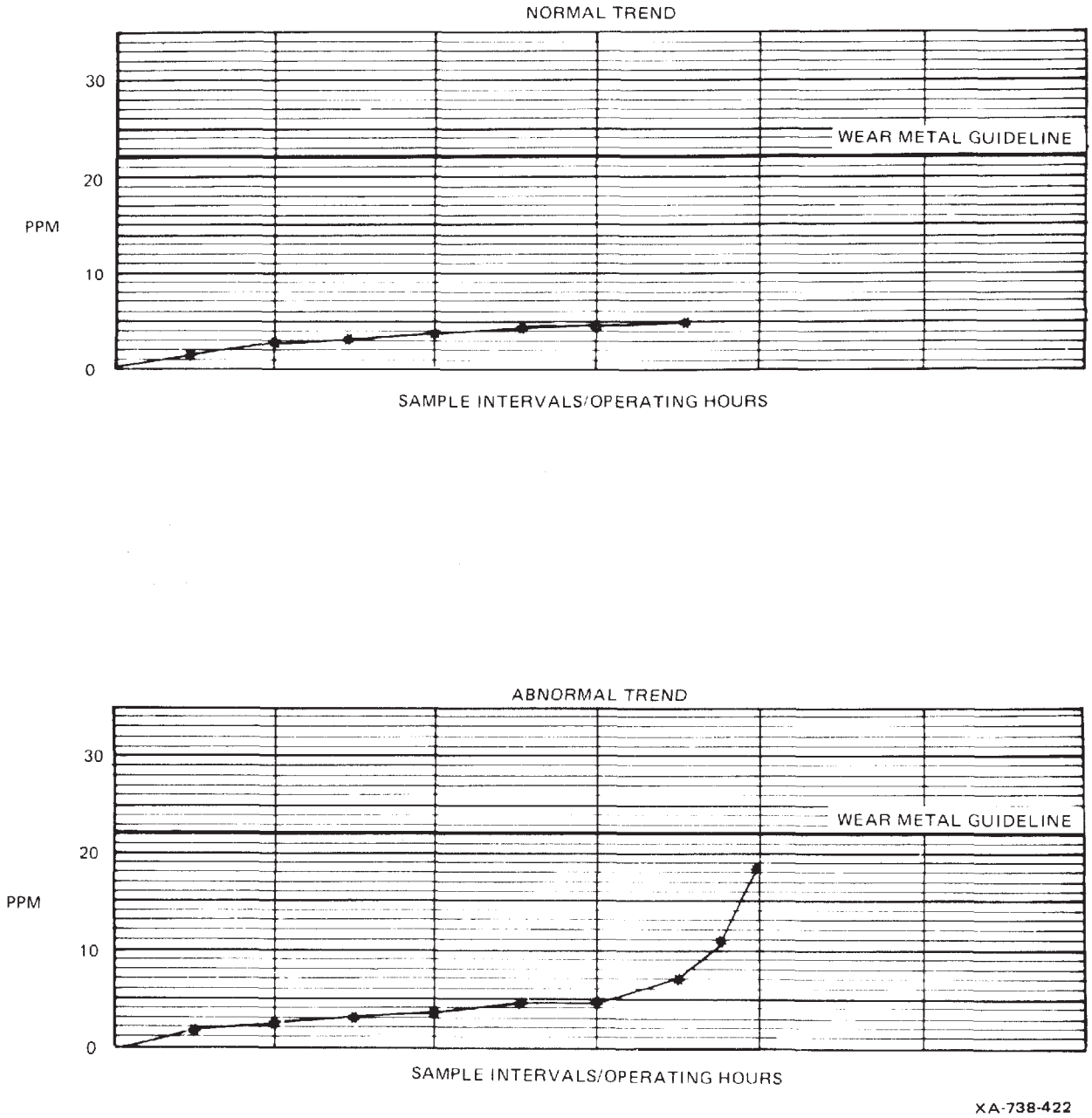
(d) If increase is verified, change oil sample interval to every 10 operating hours. (see step (h) for probable source areas)

(e) Immediately inspect filters and chip detector. Send any debris to laboratory for analysis of material. (See Table 601 for probable source areas.)

(f) Use borescope, if available, to detect oil wetted part distress. For aid in determining location of distress, contact the following, giving as many details as possible.

Military Customer Support
Honeywell
111 South 34th Street
P.O. Box 52181
Phoenix, Arizona 85072-2181

Attention: Manager, Customer Support Engineering



Wear Metal Trend (Example)
Figure 602

(g) If wear metal shows no increase during two 10 hour intervals, and does not greatly exceed the guidelines, sampling interval may be increased back to 100 hours. Guidelines are as follows:

NOTE: Wear metal guidelines in general are not go no go criteria. They are established just below the level of wear metal content determined to be abnormal based on past experience. The wear metal guideline is that level of wear metal content at which an engine is considered suspect and must be checked. It is not the absolute point at which the engine or module must be removed. These wear metal guidelines have been established based upon experience with a limited number of engines. Each operator is asked to assist in validating these guidelines by forwarding a copy of each laboratory report to:

I

Military Customer Support
Honeywell
111 South 34th Street
P.O. Box 52181
Phoenix, Arizona 85072-2181

Attention: Manager, Customer Support Engineering

Please include any maintenance actions performed to correct excessive wear metal content.

Wear Metal	Normal Wear Range Guideline parts per million (ppm) by weight
Aluminum (Al)	0 - 10
Chromium (Cr)	0 - 5
Copper (Cu)	0 - 8
Iron (Fe)	0 - 13
Magnesium (Mg)	0 - 10
Nickel (Ni)	*
Silicon (Si)	*
Silver (Ag)	0 - 3
Titanium (Ti)	*

*Report only - no guideline established.

(h) Wear metal sources for use on determining maintenance action requirements or checks are as follows:

1 Aluminum - oil pump.

2 Chromium - power turbine shaft (Refer to Iron).

3 Copper - bearing cages or oil pump.

4 Iron - gears, bearings, bearing liners, oil pump.

5 Magnesium - Gearbox, paint.

TEMPORARY REVISION NO. 126

INSERT PAGE 2 OF 16 FACING 72-00-00, PAGE 629.

Reason: To replace TR 114 (added Step 1.H.(3)(i)5 to inspect fuel control drive shaft).

Step 1.H.(3)(i)5 is added as follows:

5 Inspect fuel control drive shaft for chipped or worn splines. (See 73-20-01, Step 5.A.(2).)

TEMPORARY REVISION NO. 139

INSERT PAGE 2 OF 2 FACING 72-00-00, PAGE 629.

Reason: To change 1000 to 1250 in paragraph 1.H.(3)(i).

Paragraph 1.H(3)(i). is changed as follows:

1. H. (3)

(i) Inspection of the Fuel Control (Every 1250 Hours)

SEE MULTIPLE TR

6 Nickel - (Refer to Iron).

7 Silver - bearing cages.

8 Titanium - support structures, paint, No. 2 bearing housing.

NOTE: Wear metal guidelines in general are not go no go criteria. They are established just below the level of wear metal content determined to be abnormal based on past experience. The wear metal guideline is that level of wear metal content at which an engine is considered suspect and must be checked. It is not the absolute point at which the engine or module must be removed. These wear metal guidelines have been established based upon experience with a limited number of engines. Each operator is asked to assist in validating these guidelines by forwarding a copy of each laboratory report to:

I

Honeywell
111 South 34th Street
P.O. Box 52181 Box 34-77
Phoenix, Arizona 85072-2181

Attention: Manager, Customer Support Engineering

Please include any maintenance actions performed to correct excessive wear metal content.

(i) Inspection of the Fuel Control (Every 1000 Hours)

1 Disconnect aft end of P1 pressure sense line 1-300-135-XX from union AN815-4D on fuel regulator.

CAUTION: MAKE SURE THE MEASURING STICK IS CLEAN SO THE SILICONE OIL DOES NOT BECOME CONTAMINATED.

2 Use a clean measuring stick to determine if the silicone oil level is no lower than 3.5 inches below the P1 fitting boss.

3 If oil level is lower than 3.5 inches, refer to Servicing the fuel control for instructions on adding silicone oil to the proper level.

4 Reconnect aft end of P1 pressure sense line 1-300-135-XX to union AN815-4D on fuel regulator.

(j) Starter Gear Drive Spline Inspection (Every 300 Hours)