(NAVY) NAVAIR 17-15-50.5
(ARMY) TM 38-301-5
(AIR FORCE) T.O. 33-1-37-5
(COAST GUARD) TO 33-1-37-5

15 April 2024

TECHNICAL MANUAL

JOINT OIL ANALYSIS PROGRAM MANUAL

VOLUME 5

FIELD DEPLOYABLE OIL ANALYSIS EQUIPMENT, METHODOLOGY, AND COMPONENT SPECIFIC EVALUATION CRITERIA

This manual NAVAIR 17-15-50.5 is a new volume.

This manual is incomplete without NAVAIR-17-15-50.1, NAVAIR-17-15-50.2, NAVAIR-17-15-50.3 and NAVAIR 17-15-50.4

Published by direction of
Commander, Naval Air Systems Command
under the authority of the Joint Oil Analysis Program Regulation AFI 21-131 (I), AR 700-132 and OPNAVINST 4731.2.

0817LP0029417

NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES/PAGES

List of Current Changes

Change #	*Date*		*Change #*	*Date*
Original 0	15 April 2024			

Only those work packages/pages assigned to the manual are listed in this index. Dispose of the superseded issues of the technical manuals. Superseded classified technical information shall be destroyed in accordance with applicable regulations. This is the original release of this volume; as such, no change bars are included in the outer margin of the text.

Total number of pages in Volume 5 of this manual is 76.

Note: The HMWS WP (Hazardous Materials Work Sheets Work Package) for this manual is located in Volume 2.

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
A	NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES/PAGES	A	0	0
TPDR	LIST OF TECHNICAL PUBLICATIONS DEFICIENCY REPORTS INCORPORATED	TPDR-1 thru TPDR-2	1	0
001 00	INTRODUCTION	1 thru 2	1	0
002 00	FIELD DEPLOYABLE OIL ANALYSIS EQUIPMENT AND METHODOLOGIES	1 thru 2	1	0
002 01	FIELDLAB 58MA TEST EQUIPMENT AND METHOD	1 thru 2	0	0
002 02	FIELDLAB 58MA SPECIAL TESTING METHOD FOR ZINC	1 thru 2	0	0
003 00	AVIATION TURBINE ENGINE OIL SERVICING CARTS	1 thru 2	1	0
004 00	ENGINE: F100-PW-200D/-220/-229 (AIR FORCE) AIRCRAFT: F-15/F-16	1 thru 4	1	0
005 00	ENGINE: F101-GE-102 (AIR FORCE) AIRCRAFT: B-1B	1 thru 4	0	0
006 00	ENGINE: F107-WR-101 (AIR FORCE) AIRCRAFT: AGM-86	1 thru 2	1	0
007 00	ENGINE: F108-CF-100 (AIR FORCE) AICRAFT: K/C-135R	1 thru 2	0	0

WP Number	Title	Total Number of Pages	Blank Pages	Change No.
008 00	ENGINE: F110-GE-100/-100B/-129 (AIR FORCE) AIRCRAFT: F-16	1 thru 6	0	0
009 00	ENGINE: F117-PW-100 (AIR FORCE) AIRCRAFT: C-17	1 thru 2	1	0
010 00	ENGINE: F118-GE-100/-101 (AIR FORCE) AIRCRAFT: B-2, U-2S	1 thru 4	0	0
011 00	ENGINE: F119-PW-100A/-611C/-614C (AIR FORCE) AIRCRAFT: F-22	1 thru 6	1	0
012 00	ENGINE: F135-PW-100/600 (AIR FORCE) AIRCRAFT: F35A/B/C	1 thru 2	0	0
013 00	ENGINE: J85-GE-5 (AIR FORCE) AIRCRAFT: T-38	1 thru 4	1	0
014 00	ENGINE: T53-L-13B, T53-L-703 (AIR FORCE) AIRCRAFT: UH-1H, TH-1H	1 thru 2	0	0
015 00	ENGINE: T56 (AIR FORCE) AIRCRAFT: C-130	1 thru 2	1	0
016 00	ENGINE: T102 (AIR FORCE) AIRCRAFT: TPE331-10	1 thru 2	1	0
017 00	ENGINE: T106 (AIR FORCE) AIRCRAFT:	1 thru 2	1	0
018 00	ENGINE: T400-CP-400 (AIR FORCE) AIRCRAFT: UH-1N	1 thru 2	0	0
019 00	ENGINE: T700-CP-400 (AIR FORCE) AIRCRAFT: H-60	1 thru 2	1	0
020 00	ENGINE: T406 (AR1107) (AIR FORCE) AIRCRAFT: V-22	1 thru 2	1	0
021 00	ENGINE: TF33-P-103/-102/-5/-9/-100/-102(JT3D-3B) (AIR FORCE) AIRCRAFT: B-52, C-135, E-8, E-3	1 thru 4	1	0
022 00	ENGINE: TF34-GE-100 (AIR FORCE) AIRCRAFT: A-10	1 thru 2	0	0
023 00	ENGINE: JT15D-5B (AIR FORCE) AIRCRAFT: T-1A	1 thru 4	1	0

This Page Intentionally Left Blank

NAVAL AIR SYSTEMS COMMAND TECHNICAL MANUAL PROGRAM

LIST OF TECHNICAL PUBLICATIONS DEFICIENCY REPORTS INCORPORATED

None.

This Page Intentionally Left Blank

INTRODUCTION

1. Purpose. Volume 5 contains a collection of field deployable oil analysis test devices/systems along with limits and evaluation guidance for each device/method when applied to specific components (engines, transmissions, etc.). These oil analysis test devices/systems, limits and guidance are designed to be operated at the organizational level.

2. Applicability. The provisions of this manual currently apply to all activities of the Departments of the Navy and the Air Force. Department of the Army activities are not currently authorized to utilize field deployable oil analysis test devices.

3. Manual Change Procedures. Detailed procedures for manual changes are contained in Volume 1.

This Page Intentionally Left Blank

FIELD DEPLOYABLE OIL ANALYSIS EQUIPMENT AND METHODOLOGIES

Table of Contents

This Page Intentionally Left Blank

FIELDLAB 58MA TEST EQUIPMENT AND METHOD

1. Scope. The FieldLab 58MA is a portable integrated oil analysis system designed for field use. It can be used to analyze a range of in-service fluid samples including engine oils, transmission and gearbox fluids, hydraulic fluids, electronic cooling system fluids, etc. The kit includes instruments that are capable of determining the wear metal and particle contaminants, and the viscosity and chemistry of the sample. The system also has the capability of evaluating the debris collected by a Magnetic Chip Detector (MCD).

2. Summary of Method. An in-service fluid sample extracted from an engine, transmission or system is used by the FL58MA to assess the oil condition. WP 003 00 of Volume 1 of this manual contains guidance on how to extract a representative fluid sample from an operational system. The operator selects the appropriate measurement module(s) based on the particular analysis desired. Viscosity is measured by a microchannel viscometer, chemistry is determined by IR spectroscopy, and particles / wear metals are measured via X-ray Fluorescence (XRF). The Viscosity module requires a 60 micro liter sample. The Chemistry module uses a few drops of sample oil. The Particles module requires 12mL of oil. The Elements module uses the filtered sample from the Particles module.

3. Equipment/Apparatus/Materials.

Table 1. Equipment / Apparatus / Materials

Description	Manufacturer	Part Number	NSN
FIELDLAB 58MA	AMETEK Spectro Scientific	800-00223	6650-01-678-4220
Aviation Filtergrams Qty 50	AMETEK Spectro Scientific	000-00025	6640-01-677-9591
Pipette/Cleaning Pad Qty 500	AMETEK Spectro Scientific	PV1028	6640-01-713-7708
12 ml syringes Qty 100	AMETEK Spectro Scientific	MHM-10605	6640-01-678-1647
MCD tab holder	AMETEK Spectro Scientific	450-00301	4920-01-709-0735
MCD tab alignment tool	AMETEK Spectro Scientific	400-00168	5120-01-709-2445
Titanium tweezers	AMETEK Spectro Scientific	400-00168	5120-01-709-1201
FL58 Verification Fluid	AMETEK Spectro Scientific	600-00173	9150-01-706-6924

4. Calibration/Verification. The FieldLab 58MA is calibrated at the factory. Verification samples are used by the field operator to determine if the unit is working correctly. If the unit fails verification it must be shipped back to the manufacturer for recalibration and/or repair. The FL58MA is not calibrated by the user - do not attempt to calibrate the FL58MA.

5. References/Guidelines.

   a. AMETEK Spectro Scientific FieldLab 58MA User Guide, T.O. 33B4-2-32-1.

   b. ASTM D8092, Standard Test Method for Field Determination of Kinematic Viscosity Using a Microchannel Viscometer.

   c. ASTM D7889, Standard Test Method for Field Determination of In-Service Fluid Properties Using IR Spectroscopy.

d. ASTM D8127, Standard Test Method for Coupled Particulate and Elemental Analysis using X-ray Fluorescence (XRF) for In-Service Lubricants.

6. Measurement of In-Service Fluid Properties using the FieldLab 58MA. The detailed step-by-step instructions contained in T.O. 33B4-2-32-1 must be followed including the routine use of verification samples to check the performance of the FieldLab.

7. Interpretation of Results. Consult the appropriate sub-work package for guidance / information on interpreting the analysis results obtained with the FieldLab 58MA.

a. If FL58 sample results increase from one category to another (example: Normal to Marginal) request an additional engine run and resample oil system. Request 2 oil samples from additional engine run. Verify that both sample results are consistent with original sample results for the engine.

b. Use the following guidance to determine action for FL58MA results:

Increase from Normal to Marginal – place on surveillance for 10 hours.

Increase from Marginal to High or Abnormal – resample, if resample confirms High or Abnormal – Inspect engine for source of High or Abnormal oil analysis readings

Increase from Normal to High or Abnormal – resample, if resample confirms High or Abnormal – Inspect engine for source of High or Abnormal oil analysis readings

c. All limits provided in Limit Tables in this manual are in Parts Per Million (PPM). Element values displayed on FL58MA Element screen are in PPM.

8. Training. Initial training for the FL58MA will be facilitated by Ametek, USAF, and OJT (On the Job Training). When formal training courses have been developed and fielded, new operators will be required to attend the formal course for FL58MA operation.

FIELDLAB 58MA ZINC TESTING METHODOLOGY

1. Scope. The FieldLab 58MA is a portable oil analysis system. It can determine various wear metals and particle contaminants in aircraft turbine engine oil. It cannot detect Zinc (Zn) using the standard method and consumable items listed WP 002 01. Zinc is an automotive oil additive and can be used to identify turbine oil that has small amounts of automotive oil. This Workpackage provides instructions for use of the FL58MA to detect Zn in an oil sample for the purpose of identifying possible contamination of turbine engine oil with automotive engine oil.

2. Summary of Method. A sample is drawn from an oil servicing cart or engine and provided to the laboratory. Volume 1 of this manual contains guidance on how to extract a representative fluid sample from an operational system

3. To process the suspected contaminated sample, the operator will perform the following steps:

    a. Turn FL58 MA on, login in and prepare for sample processing.

    b. Ensure the XRF analysis module is not tilted fore or aft and that the FL58 is not tilted left or right to avoid oil spillage in the XRF chamber.

    c. Select “Fluid Measurement” from the main menu.

    d. When the Sample Tab opens, insert an empty cupgram into the XRF chamber and close the door.

    e. Select the “ZERO FILTERGRAM” screen button to zero the cupgram.

    f. Input the information for the sample on the Sample Tab.

        i. Input System Serial Number.

        ii. Select Fluid Type.

        iii. Input Owning Unit information.

        iv. Select Component Type.

    g. When ZERO FILTERGRAM button is no longer inactive (indicating the cupgram has been zeroed), remove cupgram from XRF chamber.

    h. Use pipette to place exactly 16 drops of fluid into the inner cup of the cupgram.

    i. Select the ELEMENTS button on the screen.

    j. Enter .123 in the volume Dispensed box on the Elements screen.

    k. Carefully insert the filled cupgram into the XRF chamber. (Do not spill oil in the XRF chamber)

l. Close the XRF chamber door.

m. Select START button to begin.

n. Wait for the results.

o. Read the Zn value for the cupgram results and record the Zn results.

p. Open the XRF door, remove cupgram and dispose of cupgram and oil.

q. Select Results to open the Results screen.

r. Select SAVE to save the results.

4. Equipment required. FL58MA. Cupgram. (Note: a part number for the cupgram has not been established at the time of manual printing. A part number and NSN will be provided in a manual update.)

5. Limits for Zn in the cupgram Elements analysis. The limit for Zn in the cupgram analysis is 5 PPM. Any Zn reading equal to or over 5 PPM is indication of turbine oil contamination with Zn. Do not use any other element readings to determine oil serviceability. Other element readings are not accurate due to the high levels of elements recorded in this process. Zn is the only element being checked in this process.

6. Report Zn findings to appropriate personnel.

7. Action /Recommendation. If Zn is 5 PPM or greater, recommend drain and flush of equipment with known clean fluid. Sample for Zn per this Workpackage after every drain and flush until Zn PPM is below 5 PPM. If sample was from an oil servicing cart, notify maintenance control for determination if any engines or other equipment were serviced with the oil servicing cart. Request samples from any engine or equipment that was serviced with the oil cart and perform the Zn test per this Workpackage.

TYPE EQUIPMENT	Aviation Turbine Engine Servicing Carts
MANUFACTURER	N/A (Multiple Manufacturers)

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
Various Models MIL-PRF-23699 All Classes	N/A (Various Platforms)	DRAB
Various Models MIL-PRF-7808 All Classes Grade 3 / 4	N/A Various Platforms	DRAA

LUBRICATING OIL	MIL-PRF-7808
TECHNICAL AUTHORITY	Air Force
LUBRICATING OIL	MIL-PRF-23699
TECHNICAL AUTHORITY	NAVAIR

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Maximum	0.3	0.3	0.3	0.3	0.3	0.3	0.3	N/A	0.3	0.3	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104. Oil Servicing Carts shall be tested In Accordance With 33-1-37-5 WP 002 02 – Testing for Zinc in Turbine Oils to determine if aviation turbine engine oil servicing carts have been contaminated with automotive oil. If contamination of aviation turbine engine servicing carts is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Recommend drain and flush of oil servicing carts and verification of oils used to fill servicing cart. Isolate any equipment serviced by contaminated cart and perform Zinc test IAW WP 002 02 on equipment. Drain and flush equipment with known uncontaminated turbine oil and continue testing for Zinc IAW WP 002 02 until Zn concentrations fall below 5 PPM during Zn testing.

This Page Intentionally Left Blank

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**Pratt & Whitney**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
F100-PW-220	**F-15**	**FACA**
F100-PW-220	**F-16**	**FACB**
F100-PW-229	**F-15**	**FADA**
F100-PW-229	**F-16**	**FADB**
F100-PW-200*	**F-16**	**FABA**
F100-PW-100**	**F-15**	**FAAA**
F100-PW-100**	**F-16**	**FAEA**

* The F100-PW-200D in the QF-16 or on test cell is the only combination that may use this code.
** Denotes historical engine airframe combinations not currently in operation. Do not use these Type Equipment Codes.

LUBRICATING OIL	**MIL-PRF-7808**
TECHNICAL AUTHORITY	**Air Force F100 Propulsion Engineering Team**
STATUS	**In Use**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.9	0-0.6	0-0.7	0-0.2	N/A	N/A	0-0.15	N/A	0-3.8	0-0.22	N/A
Marginal Range	>0.9-1.7	>0.6-1.2	>0.7-1.5	>0.2-0.3	N/A	N/A	>0.15-0.3	N/A	>3.8-7.5	>0.22-0.44	N/A
High Range	>1.7-2.4	>1.2-1.8	>1.5-2.2	>0.3-0.5	N/A	N/A	>0.3-0.45	N/A	>7.5-11.3	>0.44-0.66	N/A
Abnormal	≥2.4	≥1.8	≥2.2	≥0.5	N/A	N/A	≥0.45	N/A	≥11.3	≥0.66	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With T.O. 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the

aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

F100 DECISION MAKING GUIDELINES

1. Engine teardown or surveillance is required for any of the following:

   a. Any wear metal exceeds the abnormal limit. Teardown is required.

   b. While on surveillance for Fe, Fe increases above the value that caused surveillance by any amount. Teardown is required.

   c. Fe increases by the single sample jump limit 1 PPM between 2 samples. Teardown is required.

   d. Fe increases by the No. 4 bearing teardown limit 2 PPM in 10 hours. Teardown of the No. 4 bearing is required, unless positive identification of another wear source can be made.

   e. All engines which have been disassembled for inspection due to exceeding Fe limits require surveillance for 10 hours total operating time after engine assembly and repair.

2. Any sample value which requires the engine to be placed under surveillance or requires teardown shall be confirmed by an additional oil sample for confirmation. Engine personnel shall be notified immediately. When an engine is put on surveillance, request for oil filter and chip detector inspection should be made.

3. When a F100 engine is on surveillance, oil samples must be drawn after each flight and analysis results must be known before the next flight. All chip detectors must be checked each time a sample is drawn. During ground or test cell operation of an engine on surveillance, oil samples must be drawn at intervals no longer than one hour total operating time. After an oil sample is drawn, the engine may not be run for more than one hour if oil analysis results are unknown.

4. When silicon (Si) reaches or exceeds 15 PPM, drain and flush the oil. If oil pressure transmitter PN 4039126 is installed, it must be replaced.

5. The main engine bearings may fail without indication reflected in the JOAP analysis. Spalling of these bearings is detected by chip detectors.

NOTE

A burnt oil condition is typically, but not always, accompanied by a darkened oil color and obvious burnt odor. The condition is generated by a local heat source. A burnt oil condition cannot be detected by an atomic emission rotrode oil analysis spectrometer or FL58.

6. Oil samples subjected to thermal degradation usually exhibit a burnt odor. If the oil sample has an apparent burnt odor, notify proper engine personnel of condition. Burnt oil can occur after only one flight.

WEAR METAL SOURCES - Fe and Ti are significant wear metals in this engine.

Fe	Mainshaft bearing balls, rollers, and races
	No. 1 area inner bearing sleeve
	No. 5 seal plate hub
	Accessory drive bearing balls, rollers, races, and gears
	Gearbox baffle (loose retaining nut)
Ag	Mainshaft and accessory drive bearing cages
Fe & Ni	No. 4 bearing spinning on high compressor hub
Ni	No. 4 bearing spinning on high compressor hub
Ni, Fe & Cr	No. 4 bearing spinning on high compressor hub
Fe & Cr	No. 4 bearing spinning on high compressor hub
Cr	No. 4 bearing spinning on high compressor hub
Al	Oil filter assembly, oil pump, and accessory drive gearbox
Ti & Fe	No. 5 bearing compartment

OIL CAPACITY AND CONSUMPTION INFORMATION

1. The F100 oil capacity is 5 gallons.
2. Allowable oil consumption rate is 0.125 gallons/hour.
3. Oil level is checked after every flight and consumption rate calculated at that time.
4. Maintenance action is required if consumption rate is exceeded, per troubleshooting technical order.

This Page Intentionally Left Blank

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**General Electric**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
F101-GE-102	**B-1B**	**FBAA**

LUBRICATING OIL	**MIL-PRF-7808**
TECHNICAL AUTHORITY	**Air Force F101 Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling. Guidance is provided for reference only and has not been established for operational engines.**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

F101 DECISION MAKING GUIDELINES

1. A sudden increase of Fe may indicate main bearing distress; small amounts of Ag may accompany the Fe.

2. A moderate increasing trend of Fe may indicate excessive wear of gears and gearshaft splines.

3. For a confirmed significant Ti reading, the Nos 1, 2 and possible No. 3 bearing inner races may be turning on the inner race journals.

4. Lube and scavenge pump bearing distress may be indicated by trends in Fe and Cu together. Al may accompany the Fe and Cu.

5. Increasing trends in Fe may indicate gearbox problems. Mg and Ag wear metals may accompany the increase in Fe.

6. Cr is used on Nos. 4 and 5 bearing journals and may be used for repair of gearbox bearing journals. Increasing Cr may indicate inner race spinning on the journals.

7. Inspect chip detectors when increases in JOAP wear metals cause concern; debris in the chip detector may indicate part distress.

8. The main engine bearings may fail without indication reflected in the JOAP analysis. Spalling of these bearings is detected by chip detectors.

9. High Si indicates oil contamination, possibly from oil servicing cart, engine wash chemicals, or hydraulic pump torque motor servo valve damping fluid. High Si content in oil sampled from the Hydraulic Pump with Normal Range Si content in the oil sampled from the Lube and Scavenge Pump oil would indicate leakage of the Hydraulic Pump Torque Motor Servo Valve damping solution, Hydraulic Pump replacement is recommended. The oil-servicing cart should be checked for contamination and, if contamination is confirmed, shall be drained and flushed. The engine shall be drained and flushed to remove Si contamination. Post maintenance samples from the engine and oil-servicing cart, if applicable, shall be analyzed by the OAP laboratory to ensure all Si contamination has been removed.

10. Boost pump bearing distress may be indicated by trends in Cu and Zn together.

11. When high JOAP levels (e.g., Cu) are noted, an additional sample should be taken from the hydraulic tank servicing tee to isolate the source to the lube or hydraulic components. When the hydraulic system is generating the wear metals, the contaminate level will be significantly higher in the hydraulic oil sample.

Significant Wear Metals (First element listed is the primary element)

Fe & Cr	Typical all main engine, accessory gearbox and inlet gearbox bearing races and balls/rollers
Fe & Ni Ag	All main engine, accessory gearbox and inlet gearbox bearing cages
Fe & Ni Cr	Gear/gearshafts in accessory gearbox and inlet gearbox; aft lube/scavenge pump coupling shaft
Mg	Accessory gearbox housing
Cr	May be used on some bearing journals during rework - required on LP shaft journals for Nos. 4 and 5 bearing and on HP shaft bore for No. 4 outer ring
Fe & Cr Ni Cu	Frame lab seals, rotating lab seals and inlet gearbox housing
Fe & Cr	Carbon seal housings
Fe	Seal races
Ti	Fan frame, sump housings (fwd and mid), fan and HPC shafts, No. 3 rotating air seal
Ni & Cr Fe	Turbine frame and LPT shaft
Fe & Cu	Hydraulic pump piston, lube and scavenge pump, A8 actuators
Cu & Zn	Boost pump bearings
Fe & Cr Mo Ni	Augmentor pump
Fe & Cr Ni	Alternator rotor hub

Al	Alternator stator housing
Fe & Si	Alternator core laminations
Si	Hydraulic pump torque motor servo valve

OIL CAPACITY AND CONSUMPTION INFORMATION

1. Total oil capacity is 5.3 gallons (minimum).
2. Maximum oil consumption rate is 0.1 gallons per hour.
3. If oil consumption rate is exceeded, locate source of leakage and make necessary adjustments or part(s) replacement. If unable to locate source of leakage, contact Engine Program Manager for further action.

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**Williams International**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
F107-WR-101	**AGM-86**	**KEAA**

LUBRICATING OIL	**MIL-PRF-7808**
TECHNICAL AUTHORITY	**Air Force F107 Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling. Guidance is provided for reference only and has not been established for operational engines.**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

This Page Intentionally Left Blank

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**CFM International**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
F108-CF-100	**K/C-135R**	**FFAA**

LUBRICATING OIL	**MIL-PRF-7808**
TECHNICAL AUTHORITY	**Air Force Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling.**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	N/A	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	N/A	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	N/A	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	N/A	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

F108 DECISION MAKING GUIDELINES

1. A sudden increase (1-2 PPM) of Fe or an increase (1-2 PPM) of Fe in conjunction with an indication (1 PPM) of Cu can indicate main bearing distress. The No. 3 bearing is the only main bearing with significant copper. Small amounts of Ag may accompany the Fe or Fe and Cu.

2. A moderate increasing trend of Fe may indicate excessive spline wear on the IGB horizontal shaft spline.

3. For a confirmed significant (0.4-0.5 PPM) Ti reading, the No. 3 bearing inner race is turning on the hub.

4. Lube and scavenge pump bearing distress may be indicated by trends in Fe and Cu together. Al may accompany the Fe and Cu.

5. Increasing trends in Fe may indicate gearbox problems. Al, Cu and Ag wear metals may accompany the increase in Fe.

6. Cr may be used for rework of main bearing journals and gearbox bearing journals. Increasing Cr may indicate inner race spinning on the journals except No. 3 bearing.

7. Inspect chip detectors when increases in OAP wear metals cause concern. Debris in the chip detector may indicate part distress.

8. The No. 3 main bearing may fail without indications reflected in the oil analysis. These are spalling or instantaneous failures that are detected by chip detectors.

Significant Wear Metals (First element listed is the primary element)

Fe	Nos. 1 and 2 main bearings
Fe Ag	Nos. 4 and 5 main bearings
Fe Cu Ag Ti	No. 3 main bearing (Ti hub)
Al	Transfer gearbox, accessory gearbox, and lube pump housings
Fe Cu Ag	Transfer gearbox and accessory gearbox bearings
Fe Ag	Gears/gearshafts in transfer/accessory gearboxes
Fe	Lube gears/shafts
Cr	May be used on some bearing journals during overhaul

TYPE EQUIPMENT	Aircraft Engine
MANUFACTURER	General Electric

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
F110-GE-100	F-16	FHAA
F110-GE-100B	F-16	FHDA
F110-GE-129	F-16	FHCA

LUBRICATING OIL	MIL-PRF-7808
TECHNICAL AUTHORITY	Air Force
STATUS	In Use

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb
Normal	0-0.7	0-0.4	0-0.1	0-0.2	0-0.10	0-0.4	0-0.05	0-0.6
Marginal	≥0.7 to <1.4	≥0.4 to <0.7	≥0.1 to <0.2	≥0.2 to <0.5	≥0.10 to <0.20	≥0.4 to <0.7	≥0.05 to <0.10	≥0.6 to <1.1
High	≥1.4 to <2.0	≥0.7 to <1.1	≥0.2 to <0.3	≥0.5 to <0.7	≥0.20 to <0.30	≥0.7 to <1.1	≥0.10 to <0.15	≥1.1 to <1.7
Abnormal	≥2.0 to <∞	≥1.1 to <∞	≥0.3 to <∞	≥0.7 to <∞	≥0.30 to <∞	≥1.1 to <∞	≥0.15 to <∞	≥1.7 to <∞

	Si	Sn	Ti	Mo	Zn	V	Co	W
Normal	0-1.3	0-0.6	0-0.06	0-0.2	N/A	N/A	N/A	N/A
Marginal	≥1.3 to <2.6	≥0.6 to <1.1	≥0.06 to <0.12	≥0.2 to <0.4	N/A	N/A	N/A	N/A
High	≥2.6 to <3.8	≥1.1 to <1.7	≥0.12 to <0.18	≥0.4 to <0.6	N/A	N/A	N/A	N/A
Abnormal	≥3.8 to <∞	≥1.7 to <∞	≥0.18 to <∞	≥0.6 to <∞	N/A	N/A	N/A	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

F110 WEAR METAL SOURCES (First element listed is the primary element)

Fe	Seals races
	No. 3 locknut loose
	Loose No. 3 bearing locknut
Fe & Cr	Carbon seal housings
Fe & Ni Cr	Gear/gearshafts in accessory gearbox and inlet gearbox
Fe & Cr Ni Mo	Augmentor pump
Fe & Cr Mo V	Typically all main engine, accessory gearbox and inlet gearbox bearing races and balls/rollers
Fe & Ni Ag	All main engine, accessory gearbox and inlet gearbox bearing cages
Fe & Cr	Carbon seal housings
Fe & Cr Cu Ni	Frame lab seals, rotating lab seals and inlet gearbox housing
Al	Alternator stator housing
Fe & Cr Ni	Alternator rotor hub
Fe & Cu	Hydraulic pump piston, lube and scavenge pump, A8 actuator
Cu & Zn	Boost pump bearings
Mg	Accessory gearbox housing
Cr	May be used for Depot repair of bearing journals, LP Number 4 and 5 journal and HP number 4 outer journal.
Ni & Cr Fe	Turbine frame and LPT shaft
Ag & Zn Cu Mg	Automotive oil contamination
Zn Mo	Automotive oil contamination

Ti & Fe or Fe & Ti Ni	#3 bearing locknut,
Ti	Fan frame, sump housings (fwd and mid), fan and HPC shafts, No. 3 rotating air seal
SI	Hydraulic pump torque motor servo valve

1. Main Bearings or Gearshafts.

   a. A sudden increase of Fe may indicate main bearing distress; small amounts of Ag and Ni may accompany the Fe.

   b. A moderate increasing trend of Fe may indicate excessive wear of gears and gearshaft splines.

   c. For a confirmed significant Ti reading (0.2 PPM), the numbers 1 and 2, and possible number 3 bearing inner races may be turning on the inner race journals.

   d. Increasing Cr may indicate the inner race may be spinning on the number 4 and 5 bearing journals.

   e. An abnormal rise in Fe may indicate loose No. 3 bearing locking nut; this may be accompanied by rises in Ti or Ni.

2. Accessory Items.

   a. Lube and scavenge pump distress may be indicated by increasing trends in Fe and Cu together. Al may accompany the Fe and Cu.

   b. Following hydraulic pump replacement, a rise in Cu level may be expected during the break-in period (10-12 engine flight hours (EFH)). This trend will continue to rise during this period. A rise in Cu (primarily) over 15 EFH may indicate hydraulic pump head port relief valve failure. Troubleshoot per applicable technical order (2J-F100-3-9, 2J-F110-6-4, 2J-F110-6-13, or 1F-16CJ-70FI-00-11 for the F110-GE-100).

   c. Boost pump bearing distress may be indicated by increasing trends in Cu and Zn together.

3. Gearbox.

   a. Increasing trends in Fe may indicate gearbox problems. Mg and Ag wear metals may accompany the increase in Fe.

   b. Chrome plating may be used for repair of gearbox bearing journals. Increasing Cr may indicate the bearing race may be spinning on the journals.

4. Miscellaneous.

   a. High Si indicates oil contamination, possibly from the oil servicing cart. The oil servicing cart shall be checked for contamination and, if contamination is confirmed, shall be drained and flushed. The engine shall be drained and flushed to remove Si contamination. Post maintenance samples from the engine and oil servicing cart, if applicable, shall be analyzed by the OAP laboratory to ensure all Si contamination has been removed.

b. Indications of Pb are not indicative of a need for further troubleshooting. Pb residue is a result of the tube forming process.

c. If darkening of the oil occurs, the most immediate concern is overheating of the oil. Oil overheating will generally be evidenced by darkening of the oil, accompanied by a burned oil smell. Black oil may also be an indication of abnormal carbon seal wear.

RECOMMENDATIONS, DIRECTIONS, AND REQUIREMENTS

1. Historically, high or abnormal wear metal levels have been tracked to engine accessory item failures. Main engine bearing failures on the F110 engine are typically caused by spalling, which are more likely to be detected on engine chip detectors. Bearing failures may occur without any indication reflected in the JOAP analysis. Chip detector inspection results and JOAP analysis results may be used together to increase the accuracy of the evaluation process for the F110 engine.

2. Chip detectors shall be inspected when increases in JOAP wear metal concentrations cause concern or when the OAP lab request a Red cap sample. Debris on the chip detector may indicate part distress.

3. When high wear metal concentrations are noted, a sample should be taken from the hydraulic tank servicing port to isolate the wear metal source to either the lube oil or hydraulic components. When the hydraulic system is generating the wear metals, the concentration level will be significantly higher in the hydraulic oil sample. A significant rise in Fe accompanying Ti may indicate a loose No. 3 locknut.

4. When an F110 engine has a wear metal concentration in the high range, or a trend approaching the abnormal limit, the engine shall be placed on surveillance in accordance with T.O. IF-16C-2-70FI-00-11 and T.O. 33-1-37-3.

5. When an F110 engine has a wear metal concentration in the high range, or a trend approaching the abnormal limit, the engine shall be placed on surveillance in accordance with T.O. IF-16C-2-70FI-00-11 and T.O. 33-1-37-3.

6. Any wear metal concentration which requires the engine to be placed on surveillance or requires engine maintenance shall be confirmed by analyzing a second sample taken from the suspect engine. The base engine manager shall be notified of any special sample red cap requests and engine surveillance code changes.

7. When an engine is on surveillance, oil filter and chip detector inspections shall be accomplished by the appropriate personnel each time an oil sample is taken. Results will be reported to the OAP laboratory and base engine manager. Again, JOAP analysis and chip detector inspection results shall be used together to effectively evaluate the condition of the F110 engine.

8. When an F110 engine is on surveillance, oil samples shall be drawn after each flight and analysis results shall be known before the next flight. All aircraft on E code are restricted to the local area

9. An engine on surveillance may be operated for maintenance or test cell operations as long as samples are taken and analyzed and results received at intervals not to exceed one hour engine operating time. Under no circumstances shall an engine be operated past the one hour time without having the sample results.

10. When an F110 engine is on surveillance, any of the following require maintenance action to correct problem(s) causing the wear metal increases:

    a. If any wear metal concentration level moves into a higher range (i.e., marginal to high).

b. The wear metal trend continues to increase.

c. Chips are found on the chip detectors.

d. When a wear metal concentration level is in the abnormal category.

e. When element(s) exceed the abnormal trend limit.

11. Engines with less than 100 flying hours since new may exhibit Fe trending and concentrations that exceed the limits prescribed in the tables. This is due to initial break-in of oil lubricated parts and the cleaning action of the oil which may remove microscopic manufacturing residues. Iron may trend out of the normal range, provided that all other wear metal concentrations, oil consumption and magnetic chip detector (MCD) inspections are normal/within limits.

    a. Specific limits have not been developed or evaluated for the FL58 and Fe concentrations on new or recently overhauled engines.

    b. Monitor Fe increases after overhaul. The first 25 hours may have a rapid increase of Fe. The rate of Fe increase should reduce over the next 75 hours.

    d. For any given engine, the rate at which the maximum concentration drops will depend on the rate of oil consumption. Once Fe has stabilized for 10 hours, a drain and re-service may be performed to reduce any high concentrations of Fe that are above the table limits.

    e. Engines may be coded E for the first 100 hours after overhaul. After the engine has accumulated 100 flight hours, the trending and concentration limits defined in the tables must be applied.

12. F110-GE-100 engine maximum allowable consumption is 1.5 half-pints per EOT. Consumption inspection is recommended at every servicing (calculated). If the maximum consumption rate is exceeded, troubleshooting per applicable technical order (2J-F110-3-9, 2J-F110-6-4, 2J-F110-6-13, or 1F-16CJ-70FI-00-11.)

13. F110-GE-100 engine lubrication system attributes differ according to which oil tank is mounted, as follows: P/N 1583M89G01 Lube Capacity - Full (Half-Pints) 43 Volume from “Fill” Line to "Full" Line (Half-Pints) 3 P/N 7127M47G02 Lube Capacity - Full (Half-Pints) 45 Volume from “Fill” Line to "Full" Line (Half-Pints) 6

This Page Intentionally Left Blank

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**Pratt & Whitney**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
F117-PW-100	**C-17**	**FLAA**

LUBRICATING OIL	**MIL-PRF-7808**
TECHNICAL AUTHORITY	**Air Force F117 Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling**

Table 1 – JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

The F117 engine is not enrolled in the JOAP program. Limits provided above are for general reference only and have not been validated by F117 Engineering.

This Page Intentionally Left Blank

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**General Electric**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
F118-GE-100	**B-2**	**FKAA**
F118-GE-101	**U-2S**	**EMAC**

LUBRICATING OIL	**MIL-PRF-7808**
TECHNICAL AUTHORITY	**Air Force F118 Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

F118 DECISION MAKING GUIDELINES

NOTES

1. Historically, high or abnormal wear metal levels have been tracked to engine accessory item failures. Main engine bearing failures on the F-118 engine are typically caused by spalling which is detected by the quantitative debris monitor QDM (-100) or chip detectors (-101). Bearing failures may occur without any indication reflected in the JOAP analysis. QDM inspection (-100) or chip detector inspection (-101) and JOAP analysis results may be used together to increase the accuracy of the evaluation process for the F-118 engine.

2. QDM (-100) or chip detectors (-101) shall be inspected when increases in JOAP wear metal concentrations cause concern or when the OAP lab requests a special red cap sample. Debris on the QDM may indicate part distress.

3. When an engine has a wear metal concentration in the high range, or a trend approaching the abnormal limit, the engine shall be placed on surveillance with T.O. U-2S-2-4.

4. If an engine has been disassembled for inspection due to wear metal concentration limits being exceeded, that engine shall be placed on surveillance in accordance with T.O. U-2S-2-4.

1. Potential Sources of Wear Metal

   a. A sudden increase of iron Fe may indicate main bearing distress, small amounts of silver Ag and nickel Ni may accompany the Fe.

   b. A moderate increasing trend of Fe may indicate excessive wear of gears and gear shafts splines.

   c. For a confirmed significant titanium Ti readings, 8-9 PPM for emission rotrode, the numbers 1 and 2, and possibly number 3 bearing inner races may be turning on the inner race journals.

NOTE

If a significant rise in Fe accompanies Ti, this may indicate a loose number 3 locknut.

   d. Increasing chromium Cr may indicate the inner race may be spinning on the numbers 4 and 5 bearing journals.

   e. An abnormal rise in Fe may be accompanied by increases in Ti or Ni.

2. Accessory Items.

   a. Lube and scavenge pump distress may be indicated by increasing trends in Fe and copper Cu together. Al may accompany the Fe and Cu.

3. Gearbox.

   a. Increasing trends in Fe may indicate gearbox problems. Al and Ag wear metals may accompany the increase in Fe.

4. Miscellaneous.

   a. High silicon Si indicates oil contamination, possibly from the oil servicing cart. The oil servicing cart and engine shall be checked from contamination and, if contamination is confirmed, both oil servicing cart and engine shall be drained and flushed to remove the Si contamination. Post maintenance samples from the engine and oil servicing cart, if applicable shall, be analyzed by the OAP laboratory personnel to ensure all Si contamination has been removed.

   b. Indications of lead Pb are not indicative of a need for further troubleshooting. Pb residue is a result of the tube forming process.

SIGNIFICANT WEAR METALS (Primary metal listed first)

Fe	&	V	Mo		Typical all main engine, accessory gearbox and inlet gearbox bearing races and balls/rollers
Fe	&	Ni	Ag		All main engine, accessory gearbox and inlet gearbox bearing cages
Fe	&	Ni	Cr		Gear/gearshafts in accessory gearbox and inlet gearbox; aft lube/scavenge pump coupling shaft
Cr					May be used on some bearing journals during rework - required on LP shaft journals for Nos. 4 and 5 bearing and on HP shaft bore for No. 4 outer ring
Fe	&	Cr	Ni	Cu	Frame lab seals, rotating lab seals and inlet gearbox housing
Fe	&	Cr			Carbon seal housings
Fe					Seal races, loose No. 3 bearing locking nut

Ti				Fan frame, sump housings (fwd and mid), fan and HPC shafts, No. 3 rotating air seal
Ni	&	Cr	Fe	Turbine frame and LPT shaft
Fe	&	Cu		Lube supply and scavenge pump
Fe	&	Cr	Ni	Alternator rotor hub
Al				Alternator stator housing and accessory gearbox housing
Fe	&	Si		Alternator core laminations
Fe	&	Ti	Ni	Loose No. 3 bearing locking nut
Fe	&	Ti		Loose No. 3 bearing locking nut, frame or shaft wear in forward or mid sump

TYPE EQUIPMENT	Aircraft Engine
MANUFACTURER	Pratt & Whitney

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
F119-PW-100A	F-22	FRAA
F119-PW-614C	F-22	FRCA
F119-PW-611C	F-22	FRBA

LUBRICATING OIL	MIL-PRF-7808
TECHNICAL AUTHORITY	Air Force F119 Propulsion Engineering Team
STATUS	In Use

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	≥0.0-<0.7	≥0.0-<0.4	≥0.0-<0.1	≥0.0-<0.2	≥0.0-<0.1	≥0.0-<0.4	≥0.0-<0.05	N/A	≥0.0-<1.3	≥0.0-<0.6	N/A
Marginal Range	≥0.7-<1.4	≥0.4-<0.7	≥0.1-<0.2	≥0.2-<0.5	≥0.1-<0.2	≥0.4-<0.7	≥0.05-<0.10	N/A	≥1.3-<2.6	≥0.6-<1.1	N/A
High Range	≥1.4-<2.0	≥0.7-<1.1	≥0.2-<0.3	≥0.5-<0.7	≥0.2-<0.3	≥0.7-<1.1	≥0.10-<0.15	N/A	≥2.6-<3.8	≥1.1-<1.6	N/A
Abnormal	≥2.0	≥1.1	≥0.3	≥0.7	≥0.3	≥1.1	≥0.15	N/A	≥3.8	≥1.6	N/A

* Ti High Range exceedance: If three of the previous ten Ti readings are 0.6 PPM or higher, or if one Ti reading is 1.5 PPM or higher, proper engine personnel shall be notified immediately that the main fuel pump (MFP) and the oil must be replaced. See appropriate manual FRC in step 2 below. If only one or two readings are 0.6 PPM, no action is necessary.

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force

only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

F119 DECISION MAKING GUIDELINES

1. Teardown maintenance for the F119 is directed within the F-22 Integrated Maintenance Information System (IMIS) by Advanced Engine Failure Resolution (AEFR).

2. Manual JOAP Fault Report Codes (FRCs) entered in the New Failures Screen within the Process Failure Data application are utilized to create a JCN that will direct the appropriate engine teardown maintenance. Direct the appropriate maintenance personnel to enter one of the FRCs listed below. If the engine is to be removed from the aircraft for maintenance, enter the FRC after the removal has been documented in IMIS.

   a. Manual JOAP FRCs: X=1 for left engine, 2 for right engine, 0 for uninstalled.
      Fe - 7900x3204 observed JOAP iron (Fe) beyond limits
      Ag - 7900x3208 observed JOAP silver (Ag) beyond limits
      Al - 7900x3201 observed JOAP aluminum (Al) beyond limits
      Cr - 7900x3202 observed JOAP chromium (Cr) beyond limits
      Cu - 7900x3203 observed JOAP copper (Cu) beyond limits
      Mg - 7900x3205 observed JOAP magnesium (Mg) beyond limits
      Ni - 7900x3206 observed JOAP nickel (Ni) beyond limits
      Ti - 7900x3209 observed JOAP titanium (Ti) beyond limits
      Si - 7900x3207 observed JOAP silicon (Si) beyond limits

3. Any sample value which requires the engine to be placed under surveillance or requires teardown shall be confirmed by a reburn. Proper engine personnel shall be notified immediately if the reburn confirms that surveillance or teardown is required. When an engine is put on surveillance, request for oil filter and chip detector inspection will be made. When an engine is on surveillance, all chip detectors are to be checked each time an oil sample is taken.

4. When an F119 engine is on surveillance, oil samples must be drawn after each flight and analysis results must be known before the next flight. During ground or test cell operation of an engine on surveillance, oil samples must be drawn at intervals no longer than one hour total operating time. After an oil sample is drawn, the engine may not be run for more than one hour before oil analysis results are available.

5. The main engine bearings may fail without indication reflected in the JOAP analysis. Spalling of these bearings is detected by chip detectors.

6. Engine teardown or surveillance is required for any of the following

   a. Any wear metal exceeds the abnormal limit. Teardown is required. Enter the manual FRC for the appropriate JOAP wear metal on the New Failures screen within the Process Failure Data application in IMIS. The JCN created from this FRC will direct the appropriate maintenance.

   b. Wear metal increase by the value of their abnormal trend within a 10 hour engine operating period (total operating time). Surveillance is required for a 10 hour total operating time period.

c. While on surveillance for an abnormal JOAP Fe trend, Fe increases above the value that caused surveillance by any amount. Teardown is required. Enter manual FRC 7900X3204 “observed JOAP iron (Fe) beyond limits.”

d. Ti increases by the value of the abnormal trend within a 10 hour engine operating period (total operating time). Proper engine personnel shall be notified immediately that the Main Fuel Pump and the oil must be replaced prior to surveillance. While on surveillance for Ti, Ti increases above any other sample taken during surveillance by the abnormal trend value. Teardown is required. Enter manual FRC 7900X3209 “observed JOAP titanium (Ti) beyond limits.”

e. Fe increases by the single sample jump limit (0.7 PPM or more) between any two consecutive samples, Teardown is required. Enter manual FRC 7900X3204 “observed JOAP iron (Fe) beyond limits.”

f. All engines which have been disassembled for inspection due to Fe limits being exceeded are to be placed on surveillance for 10 hours total operating time following repair.

7. When silicon (Si) reaches or exceeds 3.8 PPM in any two consecutive samples, the customer will perform F-22 IMIS task "test engine – perform oil contamination check run" (LCN A720000) or suitable drain and flush procedure.
8. If lead (Pb) or molybdenum (Mo) exceed 5 PPM, recommend suitable drain and flush procedure. No action is required for levels below 5 PPM.
9. Sodium (Na) or Tin (Sn) at levels exceeding 2 PPM may be indicative of oil cart contamination. Recommend suitable drain and flush procedure and check the servicing carts for contamination.

WEAR METAL SOURCES - Fe and Ti are significant wear metals in this engine.

1. Fe

   - No. 1, 2, 3, 4, and 5 mainshaft balls/roller bearings (including races and rolling elements)

   - Front, mid, and rear compartments

   - Upper towershaft pinion gear/bull gear - mid compartment

   - Upper towershaft ball/roller bearings - mid compartment

   - Accessory ball/roller bearings - gearbox

   - No. 3 bearing inner ring spinning on the bull gear – mid compartment

   - Carbon seal runners - front, mid, and rear compartments

   - Gear rotor wear - main oil pump

2. Ag

   - Mainshaft, upper towershaft, and accessory bearing cages (silver plated) - gearbox, front, mid, and rear components

- No. 4 and 5 bearing nuts (silver plated) - rear compartment

- Upper towershaft pinion gear and gearbox spiral bevel gear (silver flash) - mid compartment

- Bushings in oil pump (silver impregnated) - main oil pump

3. Fe & Ni

   - No. 4 bearing inner ring and no. 5 bearing inner ring spinning on shaft - rear compartment

   - No. 5.5 carbon seal housing rubbing against oil slinger – rear compartment

   - OD Knife Edges spinning on HPT shaft - rear compartment

4. Fe & Ti

   - No. 1 bearing inner ring spinning on the fan hub – front compartment

   - No. 2 bearing inner ring spinning on the stub shaft - mid compartment

   - No. 1, 3, and 5 bearing outer race bottoming on housing - front, mid, and rear compartments

   - All carbon seal runners against seal housings (except 5.5 carbon seal runner) - front, mid, and rear compartments

5. Ni

   - No. 4 bearing inner ring and no. 5 bearing inner ring spinning on shaft - rear compartment

   - No. 5.5 carbon seal housing rubbing against oil slinger – rear compartment

   - OD Knife Edges spinning on HPT shaft - rear compartment

6. Ti

   Main fuel pump – bearing liner

   - No. 1 bearing inner ring spinning on the fan hub – front compartment

   - No. 2 bearing inner ring spinning on the stub shaft – mid compartment

   - All seal housings - front, mid, and rear compartments

   - PTO shaft - gearbox

7. Fe, Ni, & Cr

   - No. 4 or no. 5 bearing inner ring spinning on its shaft – rear compartment

8. Fe & Cr

   - No. 4 or no. 5 bearing inner ring spinning on its shaft – rear compartment

9. Mg

   - Gearbox housing

   - Lube scavenge pump housing (main oil pump)

10. Al

    - Oil pump port plates and sleeve

11. Cu & Ni

    – The 4/5 bearing compartment knife edge airseals rub against a copper-nickel abradable material. Ni and Cu levels near the top of the Normal range are expected for the first 50 hours of operation following abradable seal replacement. No maintenance is required during this 50-hour period unless there is an abnormal trend above the Normal range.

12. Sn

    - External contaminant (servicing cart deterioration)

OIL CAPACITY AND CONSUMPTION INFORMATION

1. The F119 oil capacity is 13.2 quarts.

2. Oil level and consumption rate are monitored by the engine. FRCs processed in Debrief will direct any necessary maintenance.

This Page Intentionally Left Blank

TYPE EQUIPMENT	Aircraft Engine
MANUFACTURER	Pratt & Whitney

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
F135-PW-100	F35A/C CTOL/CV	FSAA
F135-PW-600	F35B STOVL	FSAB

LUBRICATING OIL	MIL-PRF-23699 or MIL-PRF-7808 Grade 4
TECHNICAL AUTHORITY	JSF Propulsion Engineering Team
STATUS	In Use

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-2.0	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>2.0-4.0	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>4.0-6.0	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥6.0	N/A

NOTE

This section contains JOAP information for the F-35 Joint Strike Fighter (JSF) aircraft Main Engine Oil System. Oil sample analyses should fall within the normal range as defined above. When reporting results to the submitting squadron, Lab Operators should use Recommendation Code “X” for all samples which exceed the limits and refer to disposition and corrective actions IAW the F-35B Joint Strike Fighter (JSF) Joint Technical Data (JTD) DM F35-AAB-P7200010000-371B-B and F35-ACC-P7200010000-371B-B.

The meaning of “Trend” is an increase of stated value in 10 engine operating hours (EOH).

NOTE

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

NOTE

Elevated silicon (Si) concentration usually indicates contamination with soil, sand, or dust. Recommend resampling.

NOTE

Samples taken in support of Oil Servicing Cart Sampling shall be compared to the in-service limits listed above.

NOTE

A burnt oil condition is typically, but not always, accompanied by a darkened oil color and obvious burnt odor. The condition is generated by a local heat source. A burnt oil condition cannot be detected by an atomic emission rotrode oil analysis spectrometer or FL58. A burnt oil condition can be detected by an immediate objective, obvious, acrid smell. If the oil sample has an apparent burnt odor, notify proper engine personnel of condition. Darkened oil color alone does not indicate burnt oil. Reference JTD DM F35-AAB/ACC-P7200010000-371A-B.

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**General Electric**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
J85-GE-5	**T-38**	**ERDA**

LUBRICATING OIL	**MIL-PRF-7808 or MIL-PRF-23699**
TECHNICAL AUTHORITY	**Air Force J85 Propulsion Engineering Team**
STATUS	**Active**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

J85 DECISION MAKING GUIDELINES

No. 2 main bearing is a major problem area detectable by JOAP. These failures usually occur rapidly. Maintain close surveillance even when small increases in Fe are noted. High Fe and Cu (with/without Ag) indicate main or accessory bearing defect. Suspect first, No. 3 and No. 2 main bearings; next, Axis "E" accessory bearing. High Fe is also frequently due to defect in gearbox Axis "B" bearing. High Ag alone may indicate fuel contamination of lube system; recommend inspection of fuel oil cooler and/or fuel pump. Fuel contamination can also occur without significant Ag present and is detectable by sample odor.

Fe	&	Ni		No. 1 bearing races
Fe	&	Cr		No. 1 bearing rollers and front frame casing Nos. 2 and 3 bearing support Accessory drive gearbox and PTO bearing balls/rollers and races Accessory drive gearbox seal and bearing housings
Fe	&	Cr	Ni	Gearbox bearing spinning in liners, PTO scavenge tube Main bearing carbon seal runners No. 1 bearing compressor rotor front shaft No. 2 bearing locknut and compressor driveshaft No. 3 bearing locknut and turbine wheel shaft PTO radial driveshaft, bevel gears, bearing housing, axial bearing support and retainer Accessory lube and scavenge pump spur gear, lube filter and oil cooler valve Accessory drive gearbox shaft and bevel gears
Fe	&	Cr		Accessory drive gearbox gear locknut
Ni	Si			
Fe	&	Cr		PTO and No. 2 bearing retainer
Ni	Mg			Accessory drive gearbox spanner nuts
Fe	&	Cr	A	Nos. 2 and 3 bearing balls/rollers and races Accessory drive gearbox seal mating rings Accessory lube and scavenge pump rotors, liners and blades
Al				Accessory oil cooler housing, oil pressure transducer and oil tank Rotor wear in front frame sump
Al	&	Mg	Si	Accessory filter bypass relief valve housing

Al	&			Accessory lube and scavenge pump bearings
Cu	Mg	Si		
Cu	&			Accessory lube and scavenge pump bearings
Al	Fe	Pb	Si	
Cu	Si	&		Main and PTO bearing cages
Fe	Ag			Accessory drive gearbox bearing cages

OIL CAPACITY AND CONSUMPTION INFORMATION

1. The oil capacity for the J85-GE-5 is four quarts.

2. The maximum allowable oil consumption for the J85-GE-5 is three-eighths (⅜) pint per hour.

3. There is no recommended oil consumption checking interval in the manual, but check the oil level after each flight and after a test cell run.

4. Action to take if maximum allowable oil consumption is exceeded:

   a. External Oil Leaking. Check all external oil lines for leaks and make any necessary corrections.

   b. Loose or Leaking Oil Filler Caps. Check filler caps for proper assembly and for damaged packings. Tighten caps or replace packing.

   c. Oil Venting from Oil Tank Relief Valve. Check for overfilled tank. Remove and replace tank relief valve.

   d. Internal Oil Leak. Return engine to shop for further investigation. Disassemble engine and inspect for missing or damaged packing and for damaged or leaking carbon seals. Replace damaged parts as necessary.

This Page Intentionally Left Blank

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**Lycoming**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
T53-L-13B, T53-L-703	**UH-1H, TH-1H**	**SBEE**

LUBRICATING OIL	**MIL-PRF-7808 or MIL-PRF-23699**
TECHNICAL AUTHORITY	**Air Force T53 Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

T53 limits for FL58 have not been developed. Limits shown above are for reference only.

Wear Metals

Fe	Bearing Speed reduction or accessory drive gearing, spacer, shims or splines
Fe & Cu	Bearings
Fe Ag & Cu	Main bearing or Gear Assemblies
Fe & Mg	Accessory bearing lining and case

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**Alison (Rolls Royce)**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
T56	**C-130 (variants)**	

LUBRICATING OIL	**MIL-PRF-7808 or MIL-PRF-23699**
TECHNICAL AUTHORITY	**Air Force T56 Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

The T56 engine does not currently perform routine JOAP sampling. The limits above are for reference only for the FL58 and have not been validated for the T56.

This Page Intentionally Left Blank

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**Garrett**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
T102	**TPE331-10**	**N/A**

LUBRICATING OIL	**MIL-PRF-7808**
TECHNICAL AUTHORITY	**Air Force Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

This workpackage is a placeholder for the T102 engine. FL58 limits shown above are for reference only.

This Page Intentionally Left Blank

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
T106		

LUBRICATING OIL	
TECHNICAL AUTHORITY	**Air Force Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

This workpackage is a placeholder for the T106. FL58 limits have not been developed.

This Page Intentionally Left Blank

TYPE EQUIPMENT	Aircraft Engine
MANUFACTURER	Pratt & Whitney Canada

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
T400-CP-400 (Air Force)	UH-1N	SRAB

LUBRICATING OIL	MIL-PRF-7808 or MIL-PRF-23699
TECHNICAL AUTHORITY	Air Force Propulsion Engineering Team
STATUS	Active

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

T400 DECISION MAKING GUIDELINES

Increases in Fe and Ag may be indicative of discrepancy in No. 5 bearing area if sample is taken from power section oil system. Increases in Fe in the third oil system may indicate a discrepancy in the clutch area.

Specific guidance for the T400 engine has not been developed for FL58. Above limits are for reference only.

Wear Metals (Primary metal listed first)

Fe	Cr				Power turbine rotor shaft, Nos. 1, 2, 3, and 4 bearing balls, rollers and races, compressor shaft, compressor air/oil seal, accessory gearbox bearing balls, rollers and races, reduction gearbox bearing balls, rollers and races.
Fe	Ni				Power turbine rotor shaft, compressor rotor shaft, air rotor seal, No. 1 bearing cage.
Fe	Ni	Cr			Accessory gearbox gears and shafts, accessory gearbox oil pump gears and shafts, reduction gearbox gears and shafts, reduction gearbox oil pump gears and shafts.
Al	Cu	Mg	Si		Accessory gearbox housings, accessory gearbox oil pump housings, reduction gearbox housings, reduction gearbox oil pump housing and cover.
Cu	Si	Zn	Fe	Ag	Nos. 2, 3, and 4 bearing cages, accessory gearbox bearing cages, reduction gearbox bearing cages.
Al	Si	Ni	Cu		Reduction gearbox sleeve bearings.
Al	Cu	Mg			Reduction gearbox carrier oil seals.

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**General Electric**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
T700-CP-400	**H-60 (Air Force)**	

LUBRICATING OIL	
TECHNICAL AUTHORITY	**Air Force Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

T700 does not perform JOAP. Limits for the T700 on FL58 have not been developed. The limits in the above table are for reference only.

This Page Intentionally Left Blank

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**Rolls Royce**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
T406 (AE1107)	**V-22**	

LUBRICATING OIL	**MIL-PRF-7808**
TECHNICAL AUTHORITY	**Air Force Propulsion Engineering Team**
STATUS	**Active / Does not perform routine JOAP sampling**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

T406 (AE1107) does not perform routine oil sampling. The above limits have not been verified for the T406 and FL58. This workpackage is retained for reference only.

This Page Intentionally Left Blank

TYPE EQUIPMENT	Aircraft Engine
MANUFACTURER	Pratt & Whitney

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
TF33-P-103	B-52	KCGA
TF33-P-102	C-135	KCFA
TF33-P-102 / JT3D-3B	E-8	KCFD
TF33-P-5	C-135	KCBA
TF33-P-9	E-8	KCDC
TF33-P-100	E-3	KCEA

LUBRICATING OIL	MIL-PRF-7808
TECHNICAL AUTHORITY	Air Force TF33 Propulsion Engineering Team
STATUS	Active

Table 1 – JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air

Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

TF33 DECISION MAKING GUIDELINES

Sudden increase in Mg indicates discrepancy in the accessory gearbox. All bearing journals except those that are titanium may be chrome plated during rework. Increases in titanium indicate bearing inner race turning on journal or hub.

NOTE

TF33 engines that have experienced a rise in magnesium only may be returned to service after accomplishing the following procedures:

1. Establish that magnesium is the only metal that is experiencing an increase (Si does not apply to this). Most likely cause is oil relief valve rubbing. Shim is available to stop valve contact to eliminate the need for the following, recurring drain and flush.
2. Drain all oil (main) from the engine.
3. Inspect oil filter and sump screen for contaminants.
4. Inspect the front gearbox assembly (front door) for any signs of abnormal wear.
5. If the above procedures check ok, then fill the engine with oil and perform a run to reestablish the baseline.
6. Take a JOAP sample and if limits fall within parameters, the engine may be returned to service.
7. A follow-up JOAP must be taken after the first five hours of engine operation.
8. FOLLOW ANY COMMAND GUIDANCE IN REPORTING HIGH MAGNESIUM OCCURRENCE.

TF33 Wear Metals (primary wear metal listed first)

Fe	Main bearing ball/roller, races, seals and housing Front and main accessory drive gears Main gearbox gears
Fe Al	Front accessory drive and main gearbox oil pumps
Fe Ag	Main accessory drive gearings No. 2½ bearing cages

Fe	Ag	Cu	&		Main gearbox bearings
Si	Sn				
Ag	Cu	&	Si	Sn	Nos. 1, 2, 3, 4, 4½, 5, and 6 bearing cages
Mg					Main accessory drive housing
Ti					Nos. 1 and 3 bearing hub

All bearing journals except titanium may be chrome plated during overhaul.

This Page Intentionally Left Blank

TYPE EQUIPMENT	**Aircraft Engine**
MANUFACTURER	**General Electric**

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
TF34-GE-100	**A-10**	**KDAA**

LUBRICATING OIL	**MIL-PRF-7808**
TECHNICAL AUTHORITY	**Air Force Propulsion Engineering Team**
STATUS	**Active**

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

TF34 DECISION MAKING GUIDELINES

1. A rapid increase of Fe could indicate No. 1 bearing spalling. This failure occurs quickly, often with OAP readings within normal range. If a 1 PPM increase of Fe, or if abnormal trend of any metal is noted, or if Fe increases in combination with a 0.5 PPM increase in two or more of Ag, Cr, or Ni between consecutive samples:

Perform chip detector inspection per T.O.'s 1A-10C-2-71JG-5 and 2JA18-2- 2-1. If engine is not rejected for chip detector contamination, perform three ground runs: idle-80% (for 5 minutes) idle (for 5 minutes) per run and take OAP sample after each run.

a. If ground runs confirm the 1 PPM increase in Fe or abnormal trend, remove engine for teardown inspection.

b. If the 1 PPM increase in Fe or abnormal trend is not confirmed, place engine on special sampling after every flight until normal trend is firmly reestablished.

2. High Si indicates oil contamination, possibly from engine wash chemicals. Oil tank should be drained and reserviced.

3. Fuel contamination in oil indicates oil cooler leak.

TYPE EQUIPMENT	Aircraft Engine
MANUFACTURER	Pratt & Whitney Canada

EQUIPMENT/SYSTEM MODEL NUMBER/DESIGNATION	WEAPON SYSTEM PLATFORM(S)	JOAP TYPE EQUIPMENT CODE
JT15D-5B	T-1A	KPAA

LUBRICATING OIL	MIL-PRF-7808
TECHNICAL AUTHORITY	Air Force Propulsion Engineering Team
STATUS	Active

Table 1 - JOAP FL58 X-RAY FLUORESCENCE LIMITS

	Fe	Ag	Al	Cr	Cu	Mg	Ni	Pb	Si	Ti	Zn
Normal Range	0-0.7	0-0.3	0-0.4	0-0.1	0-0.1	0-0.8	0-0.15	N/A	0-2.0	0-0.20	N/A
Marginal Range	>0.7-1.4	>0.3-0.7	>0.4-0.8	>0.1-0.3	>0.1-0.2	>0.8-1.6	>0.15-0.3	N/A	>2.0-4.0	>0.20-0.40	N/A
High Range	>1.4-2.1	>0.7-1.0	>0.8-1.2	>0.3-0.5	>0.2-0.3	>1.6-2.4	>0.3-0.45	N/A	>4.0-8.0	>0.40-0.60	N/A
Abnormal	≥2.1	≥1.0	≥1.2	≥0.5	≥0.3	≥2.4	≥0.45	N/A	≥8.0	≥0.60	N/A

FL58 cannot detect elevated Boron (B) and/or Zinc (Zn) concentrations through Particles and Elements modules. Increased concentrations of B and Zn usually indicate contamination with another oil type, primarily MIL-PRF-2104 automotive oil. Engines or equipment suspected to be contaminated with automotive oil shall be tested In Accordance With 33-1-37-5 WP 002 02 – Fieldlab 58MA Zinc Testing Methodology, to determine if the aviation turbine engine has been contaminated with automotive oil. If contamination of aviation turbine engines is confirmed by WP 002 02, report results and contamination to chain of command and maintenance control (Air Force only). Drain and flush equipment with known uncontaminated turbine engine oil and continue testing for Zinc IAW WP 002 02 until B or Zn concentrations fall below 5 PPM during Zn testing.

JT15D DECISION MAKING GUIDELINES

For NORMAL or MARGINAL range, continue the engine in service and refer to JOAP Volume III WP 001 00, DECISION MAKING GUIDANCE, and maintain a normal sampling interval. For HIGH and ABNORMAL range or ABNORMAL TREND, provide the JOAP laboratory results to the Logistic Support Contractor (LSC) for recommended course of action. (See the notes below.)

For the HIGH or ABNORMAL range, refer to JOAP Volume 3 WP 001 00, DECISION MAKING GUIDANCE, and proceed as follows: Provide maintenance personnel with the indicated engine components and advise them to check the engine oil filter element for blockage IAW 1T-1A-2-71GS-00-1. If the filter element is serviceable, continue in service. Perform the following steps after the shortest of the following intervals: between one and three hours of operation maximum, since the initial sample or after the next flight

a. Analyze a second engine oil sample. If analysis indicates the presence of elements in the MARGINAL or NORMAL ranges, continue the engine in service and maintain a normal sampling interval.

b. Inspect the engine oil filter element IAW 1T-1A-2-71GS-00-1. Advise the LSC of any contamination found.

c. If analysis of the second oil sample indicates the presence of elements in the HIGH or ABNORMAL ranges, perform the following steps.

(1) Obtain and analyze third and fourth engine oil samples during and after a one-hour engine ground run. Take the third sample after 30 minutes of operation and the fourth after the conclusion of the ground run.
(2) Inspect the engine oil filter element IAW 1T-1A-2-71GS-00-1. If the filter element is serviceable, continue in service.
(3) If analysis of the third and fourth samples indicate the presence of elements in the NORMAL range, continue the engine in service and return to the normal sampling interval.
(4) If analysis of the third and fourth samples indicate the presence of elements in the MARGINAL range, continue the engine in service with special sampling intervals.
(5) If analysis of the third and fourth samples indicate the presence of elements in the HIGH or ABNORMAL ranges, provide the JOAP laboratory results to the LSC for a recommended course of action.

NOTE

The first two elements are the two most predominant wear elements (in sequence) for each of the components.

Fe	&	Mo	Cr	V	Mn	Nos. 1, 2, 3, 3½ and 4 bearings and associated races.
	Si	Co	W	Ni	Cu	
Fe	&	Cr	Mn	Si	Ni	Accessory gearbox driveshaft upper and lower tower shaft bearings.
	Cu	Mo				
Ag	&	Fe	Ni	Cr	Mn	Nos. 1, 2, 3, 3½, 4 and tower shaft bearing cages.
Fe	&	Ni	Cr	Mn	Cu	Accessory gearbox and oil pump gears.
	Si	Mo				

Fe	&	Cr	Mn	Si	Ni	No. 4 bearing air seal (on LPT rotor).
	Cu	Mo				
Al	&	Sn	Cu	Ni		Accessory gearbox plain bearings, oil check valve housings.
Al	&	Si	Cu	Mg		Oil pump housing, upper tower shaft bearing housing.
Al	&	Cu	Mg	Mn		Accessory gearbox scavenge strainer transfer tube.

INSPECTION RECOMMENDATIONS

If bearing or keywasher material is found in the filter element and is at or above the normal range, provide the JOAP laboratory results to the LSC for a recommended course of action.

If gear material is found, make sure that procedures in 1T-1A-2-71GS-00-1 are completed and advise the laboratory of the results.

This Page Intentionally Left Blank