



Australian Government

Department of Defence

Defence Aviation Safety Authority

ADF Wear Debris Analysis

Introduction of ChipCHECK

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**Defence Aviation
Safety Authority**



Outline

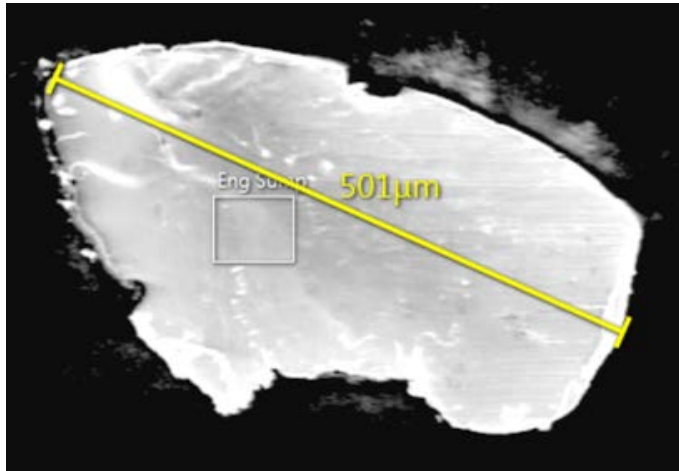
- Importance of Wear Debris Analysis (WDA)
- Current ADF WDA Capability
- ChipCHECK –
 - Overview
 - Specifics
 - Operation
 - Implementation
- Questions



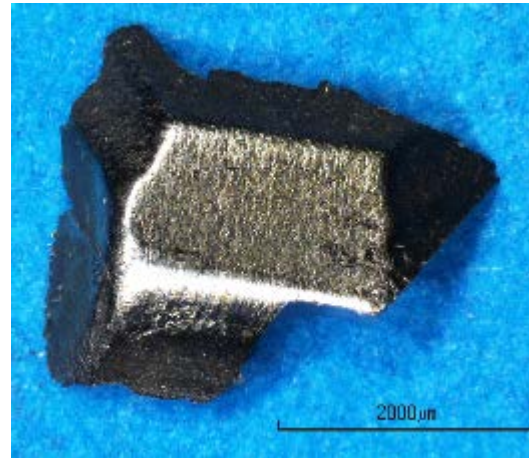


Importance of WDA

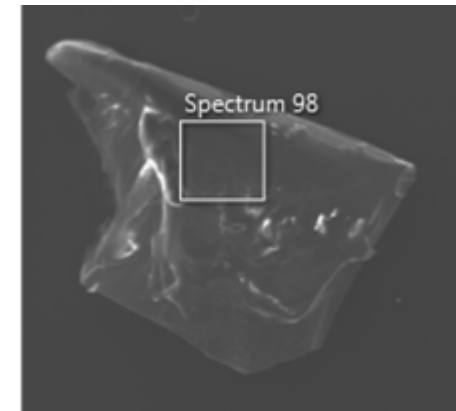
- Reliable indication of engine and gearbox health



Bearing fatigue



Gears/splines



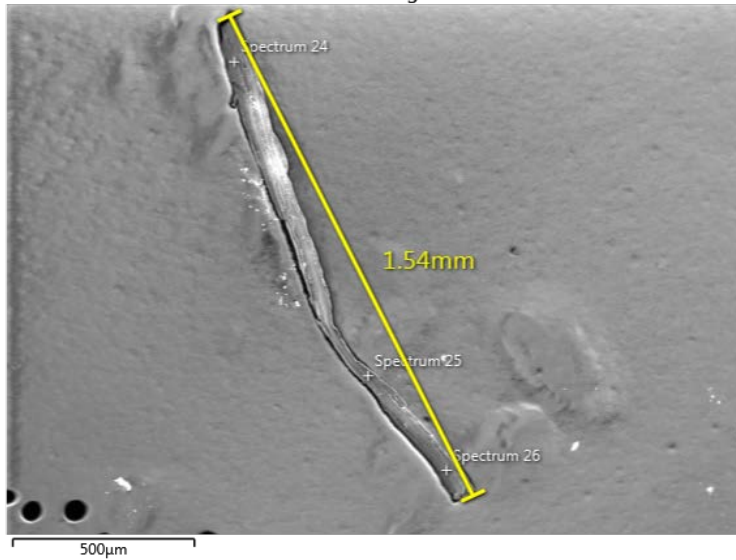
Other Contaminants



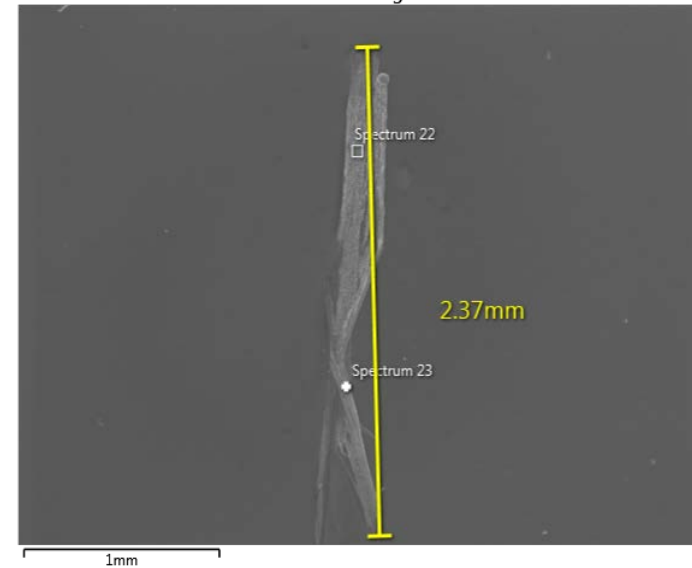


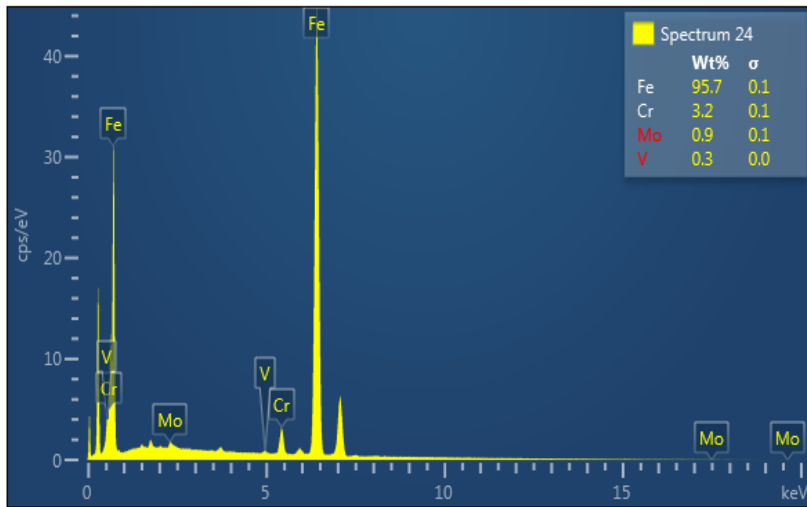
- Enables significance of debris to be determined
 - Safety
 - Aircraft availability
 - Cost of ownership

Electron Image 10

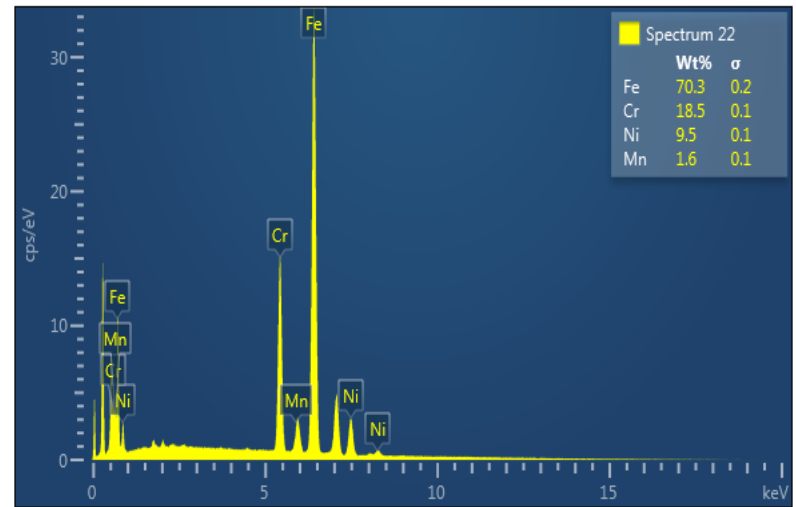


Electron Image 9





Gear Steel



Stainless Steel





Recent Examples

- Helicopter engine bearings
- Hydraulic system contamination
- Labyrinth seal Inconel
- Gearbox stainless
- Gearbox silver





Current ADF WDA Capability

- Currently the composition analysis is done by the ADF WDA lab at DSTG in Fisherman's Bend, Victoria
 - Samples are sent to ADF WDA Lab
 - Lab has optical Microscopes and Scanning Electron Microscope
 - Analysis performed by DST and ESI-DASA members
 - WDA report sent to operational Unit requesting analysis
- Main disadvantages of the current state:
 - Samples are sent via mail/courier meaning turn around times can vary from days to weeks
 - Aircraft availability reduced while results are pending
 - There is currently no in-field capability for composition analysis





ChipCHECK - Overview

- The ChipCHECK instrument is specifically designed for in-field composition analysis of aviation propulsion machinery wear debris



Image courtesy of GasTOPs

- Manufactured by GasTOPs Ltd and is commercial off-the-shelf
- Uses Laser Induced Breakdown Spectroscopy (LIBS) to determine elemental composition of wear debris





ChipCHECK – Specifics

- Dimensions
 - 360mm x 360mm x 470mm deep
 - Weighs 18Kg
- Requires 100-240V AC, 50-60Hz, power source
- The Instrument consists of:
 - User interface screen
 - Sample access panel
 - Power button
 - Isolating switch
 - USB and HDMI connections





ChipCHECK – Operation

- Debris are collected, washed and placed on an adhesive patch then into a sample tray. The sample tray is loaded into the instrument.





ChipCHECK – Operation

- Sample data is entered via on screen keyboard.

The screenshot displays the 'CHIP ANALYSIS' and 'ChipCHECK' interface. The form is divided into two columns. The left column, titled 'CHIP ANALYSIS', contains several mandatory fields (indicated by an asterisk) for data entry: Aircraft (dropdown menu with 'Seahawk Romeo' selected), Designation (text input with 'N48'), Aircraft Tail Number (dropdown menu with '11' selected), System (text input with 'Propulsion N48'), Location of Collection Device (dropdown menu with '1 Eng MCD' selected), and Serial Number (text input with '1234'). Below these is a 'Not Required' field. The right column, titled 'ChipCHECK', contains: 'Not Required' (text input with 'N/A'), 'Date of Analysis' (calendar icon with '31/07/2018'), 'Reason for Analysis' (dropdown menu with 'Routine' selected), 'Not Required' (text input), 'Analysis Completed By' (dropdown menu with 'ab'), and 'Notes' (dropdown menu). At the bottom of the form are two circular buttons: 'START' (green) and 'CANCEL' (red). The status bar at the bottom reads 'Unit Ready - Awaiting Input' and '-(UNIT READY)-'.

- Press the analyse button, once complete a report will be generated





ChipCHECK Patch Analysis Summary Report

SAMPLE IDENTIFICATION

Sample Source

Aircraft	DST Test
Designation	AXX
Aircraft Tail Number	X1
System	Propulsion AXX
Location of Collection Device	1 Test Eng Filter
Serial Number	Brass 1
Not Required	
Sample ID	1827198400135
Not Required	

Sample Analysis Result

Equipment Condition Status To Be Developed

Analysis/Analyzer

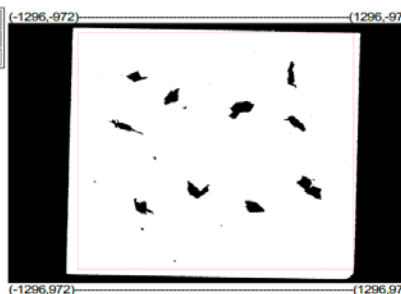
Not Required	MCD 1
Unit Serial Number	271984
Date of Analysis	2018-06-25
Date Run	2018-06-25 12:22:06 PM
Reason for Analysis	Other
Analysis Completed By	pcs
Notes	test cust

PATCH ANALYSIS SUMMARY

Patch Analysis Results

Alloy	No. Particles	Particle Area (um ²)		
		Min	Max	Total
Brass	13	9,010	713,684	4,538,620

Patch Image (2592 x 1944)



PARTICLE ANALYSIS SUMMARY

Particle ID	Area Size (um ²)	Centroid XY	Alloy Match
1	713,684	(X=-586,Y=-260)	Brass
2	672,995	(X=175,Y=-323)	Brass
3	502,741	(X=-99,Y=275)	Brass
4	445,137	(X=251,Y=403)	Brass
5	404,971	(X=-461,Y=402)	Brass
6	402,414	(X=-263,Y=-419)	Brass
7	374,222	(X=531,Y=-219)	Brass
8	347,484	(X=491,Y=-585)	Brass
9	340,857	(X=-575,Y=-196)	Brass
10	295,053	(X=507,Y=-572)	Brass
11	16,915	(X=-183,Y=-338)	Brass
12	13,137	(X=-374,Y=39)	Brass





ChipCHECK – Implementation

- DSTG have completed initial laboratory testing with satisfactory results
- Field testing at an operational base is planned to commence late 2018
- Additional steels to be added to the instrument library
- If aircraft serviceability and airworthiness assessments are based on OEM advice, then the ChipCHECK results will need to be accepted by the OEM. DSTG lab testing together with the field testing is intended to provide this supporting evidence.
- User training is minimal (1/2 day)



UNCLASSIFIED

QUESTIONS



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