Australian Government
Department of Defence
Capability Acquisition and Sustainment Group

AIR TRAINING AND AVIATION COMMONS SYSTEMS PROGRAM OFFICE
"Creating Capability Together"

PC-9 Ageing Aircraft Challenges

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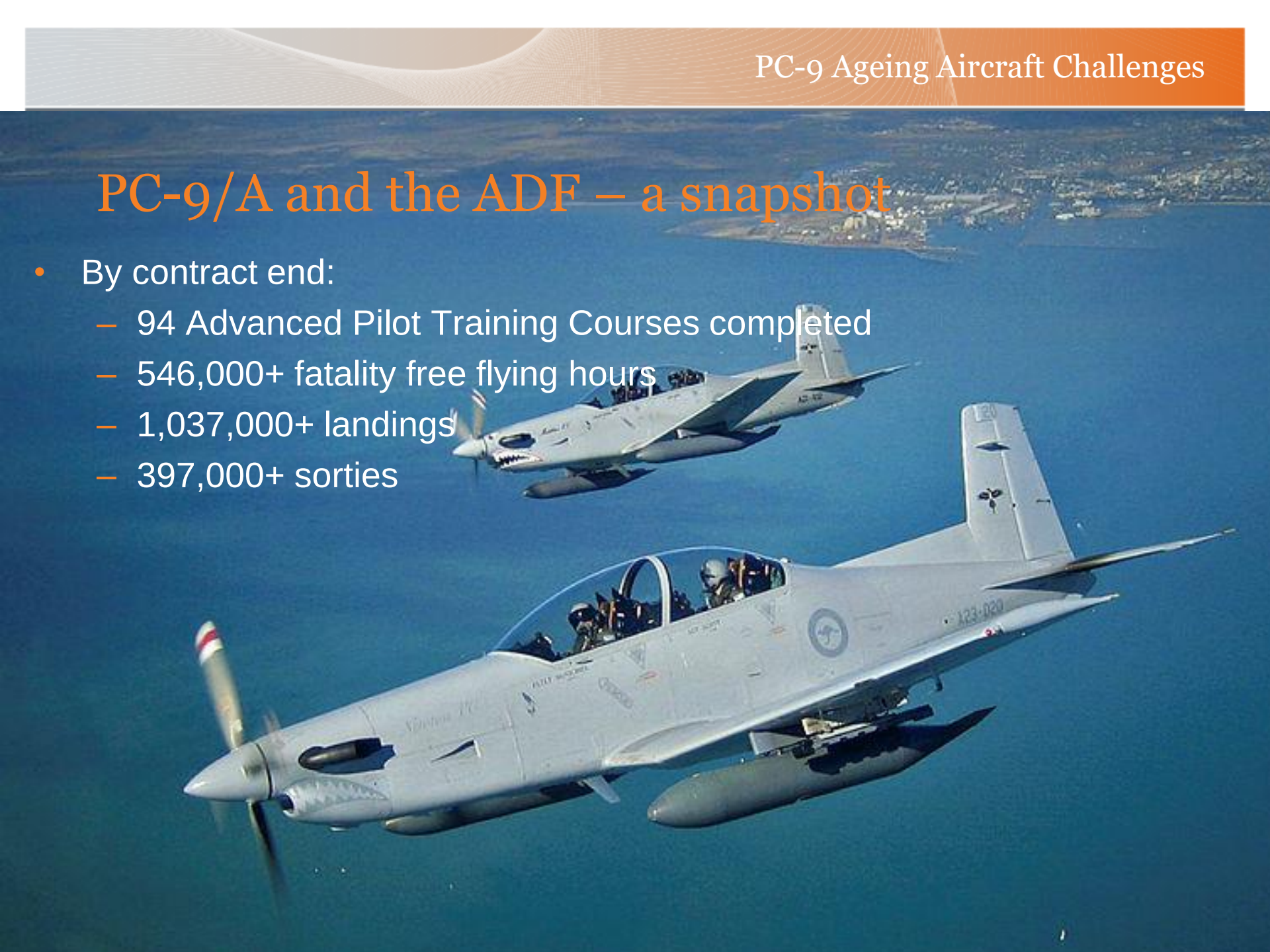
Commanding Officer
Air Training and Aviation Commons System Program Office

PC-9/A and the ADF – a snapshot

- By contract end:
  - 94 Advanced Pilot Training Courses completed
  - 546,000+ fatality free flying hours
  - 1,037,000+ landings
  - 397,000+ sorties



Points of Discussion

- Engineering challenges
  - Automatic Dependent Surveillance – Broadcast (ADS-B) installation
  - High Pressure Fuel Pump (HPFP) spline wear
  - Reduction Gearbox (RGB) Rear Case Corrosion
- Staff retention and a retiring platform

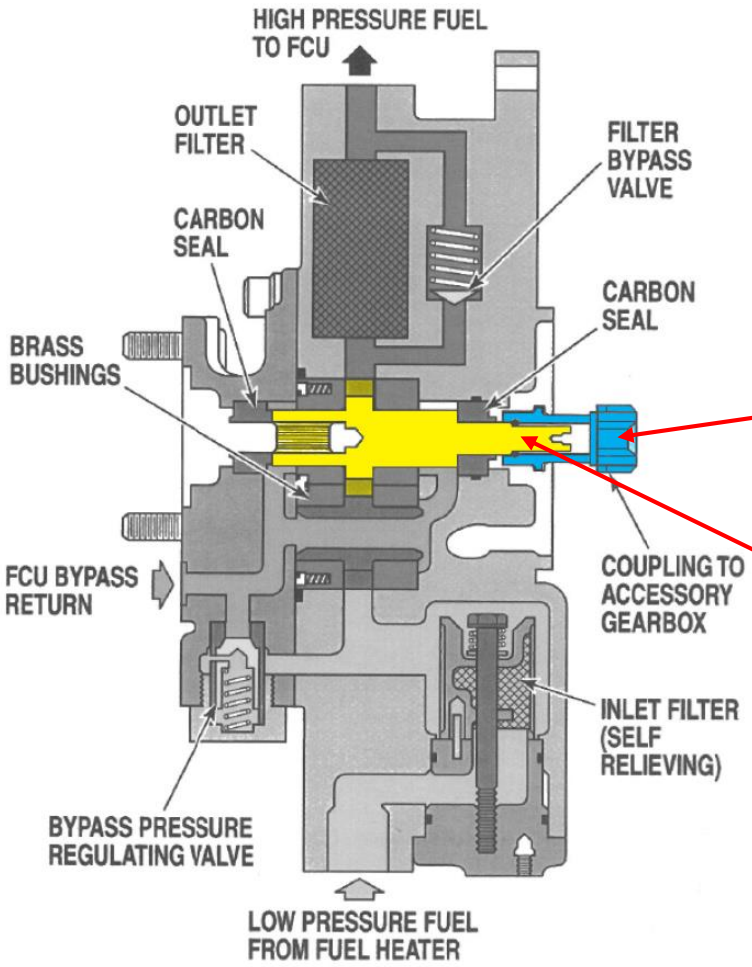
Automatic Dependent Surveillance – Broadcast (ADS-B)

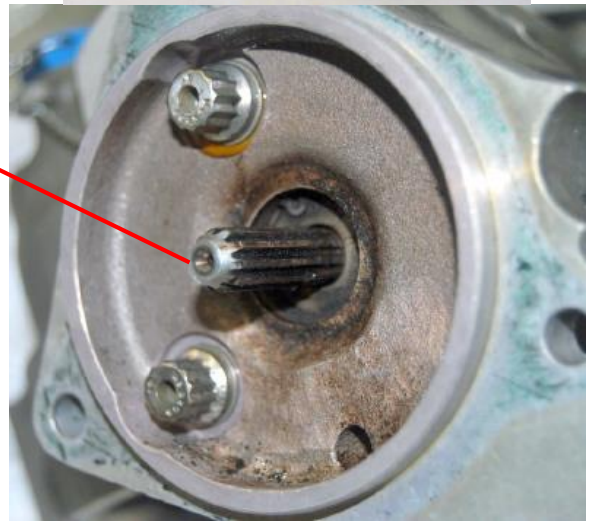
- The PC-9 avionics packaged lacked accurate collision avoidance equipment compatible with current technology.
- This introduced an increased risk of airborne collisions in a busy training airspace.
- Engineering challenge to rapidly install a traffic advisory system to reduce the current airborne risk.

Automatic Dependent Surveillance – Broadcast (ADS-B)

- Phase 1: PADO/ATACSPO/ATW
  - Investigation into options
- Phase 2: PADO
  - Draft Modification
  - Draft STI to Trial Fitment
  - Testing requirements
  - Draft ICA
- Phase 3:
  - Final Modification (to include any changes identified in Trial fitment)
  - Final ICA
- Phase 4:
  - Design Acceptance
  - Incorporation of PADO documentation into AAP's (supplements/TMP update etc).
  - Codification (Airflite)
- Phase 2a: ATACSPO
  - Project Management
  - Procure one unit for trial fitment
- Phase 3a: ATACSPO/Airflite
  - Procurement of remaining units
  - Codification of items on MILIS
- Phase 4a:
  - Service Release

High Pressure Fuel Pumps (HPFP)

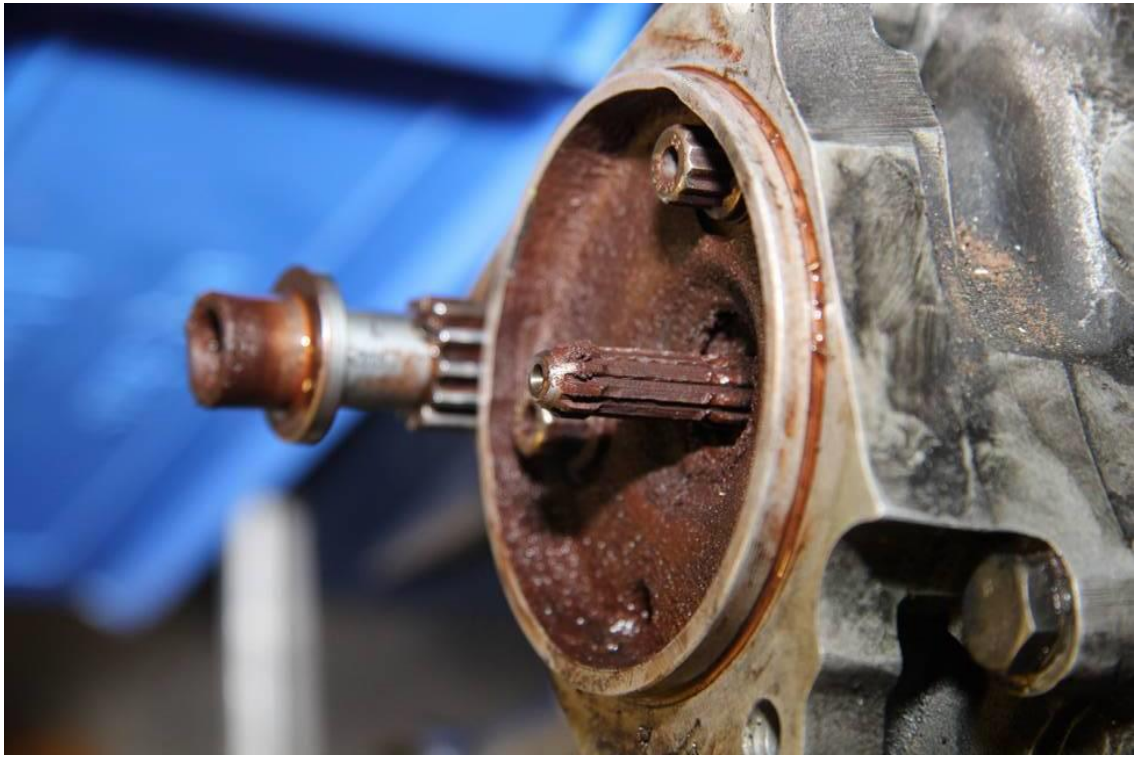




High Pressure Fuel Pumps (HPFP)

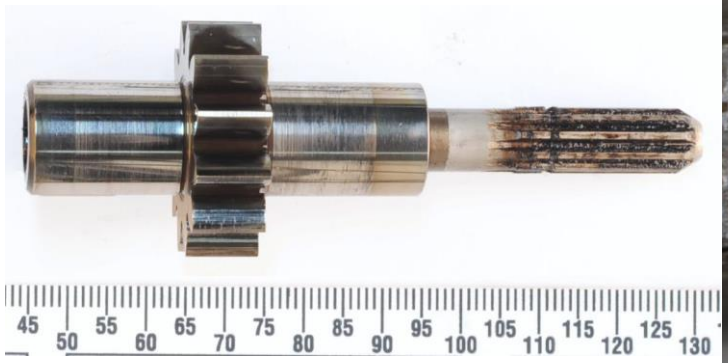
- Failure mode consistent with the cause of the May 2011 crash of A23-039; undetected wear failure of the HPFP driveshaft spline.
- The engine failure occurred 3nm from the RW04 RAAF East Sale at approx. 3,600ft AGL.

A23-039 HPFP

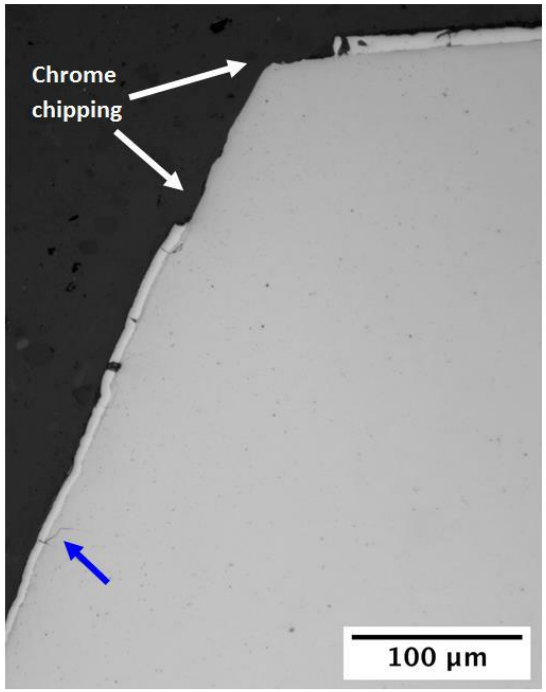


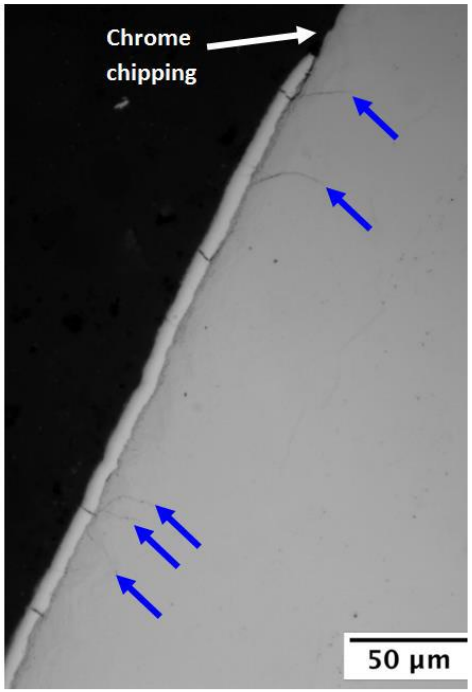
High Pressure Fuel Pumps (HPFP)

- DSTG analysis identified the composition of the black substance was consistent with fretting debris from the coupling mixed with lubricating oil, specifically being comprised of carbon with metallic components consistent with the steel coupling alloy AMS6470 and chromium plating.
- This fretting wear can be self-accelerating. The wear rate was not predictable.

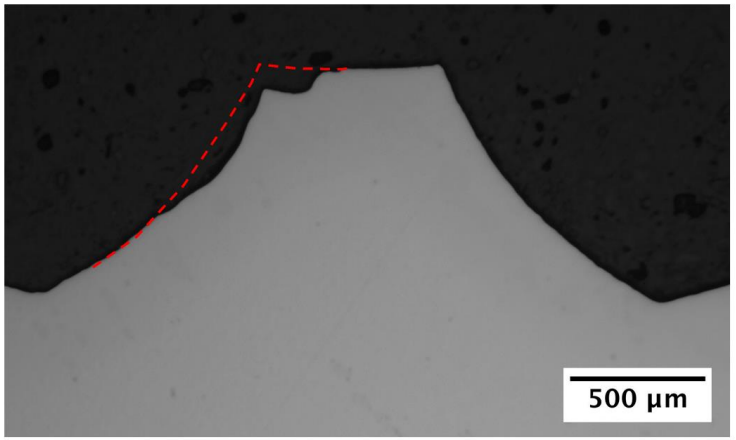


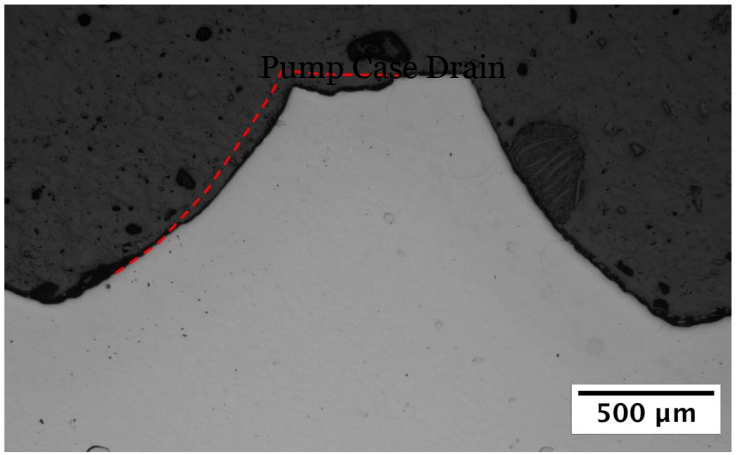
High Pressure Fuel Pumps (HPFP)





Drive shaft





Coupling

High Pressure Fuel Pumps (HPFP)

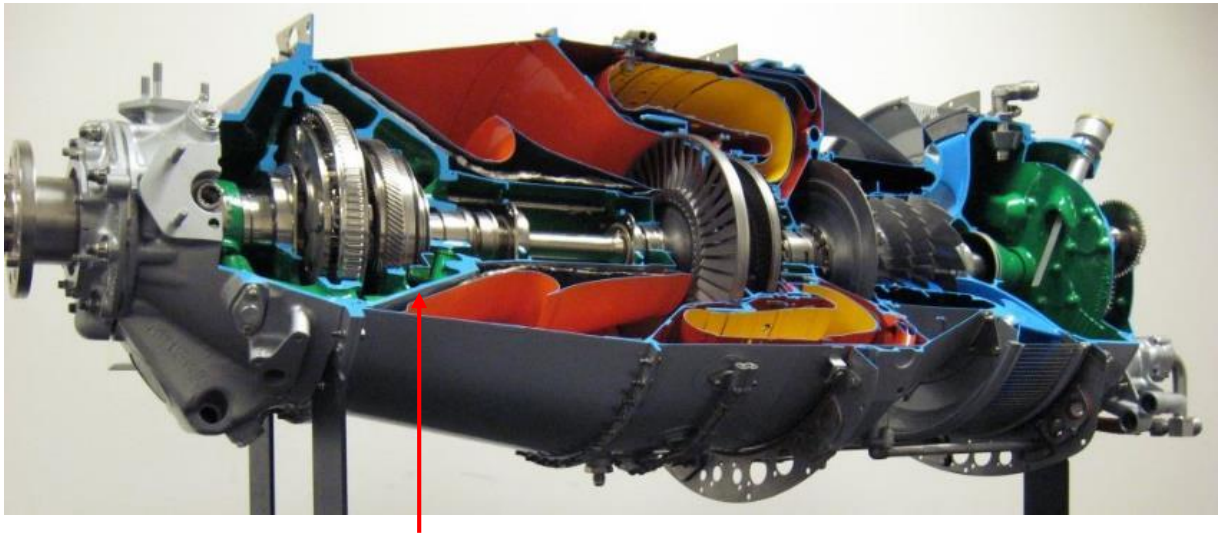
- Engineering actions:
  - Maintenance policy update to include swab testing at 300ENHRs to check for wear debris (OEM policy BS1 500ENHRs, BS2 1,500ENHRs).
  - Fleet HPFP In-situ Inspections carried out.
  - Incorporation of a modification to replace the existing Sundstrand pumps with Argo-tech HPFPs.

Reduction Gearbox Rear Case Corrosion

- During a S40 servicing (compressor wash) a gravel/ceramic substance discovered in the turbine case drain hole.
- Initially thought to be desiccant.

Reduction GearboxRear Case Corrosion

- The substance was analysed by DSTG and identified as Magnesium Oxide.
- In addition, the WDA identified purple flakes in the oil patch test. DSTG analysis identified this to be Quinizarate.



Reduction Gearbox Rear Case Corrosion

RGB Rear Case

Magnesium Oxide Debris

Quinizarate Metal Salt

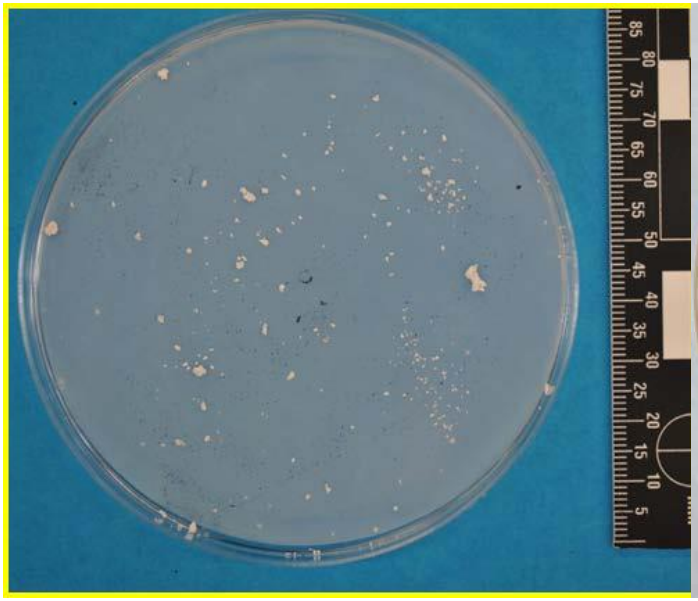
Reduction Gearbox Rear Case Corrosion

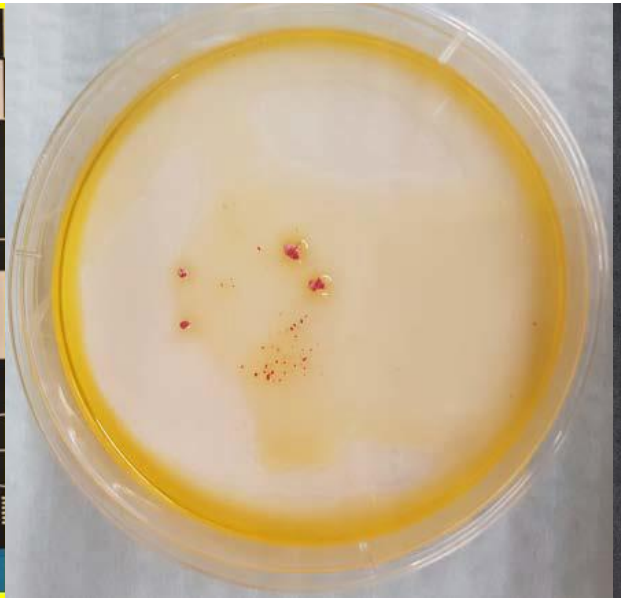
- Quinizarate metal salt occurs when oil containing quinizarin reacts with magnesium oxide.
- The presence of quinizarate metal salt on the outside of the RGB rear case confirmed that the corrosion has penetrated the case in several areas.

Reduction Gearbox Rear Case Corrosion

- Engineering actions:
  - Released inspection program to conduct borescope inspections of the exhaust case area for indications of gross magnesium oxide debris.
  - Borescope inspections are conducted every seven days as part of the compressor wash servicing.
  - Capture and analyse compressor wash water from the exhaust casing for the presence of MgO.

Magnesium Oxide Test Kit





Reduction Gearbox Rear Case Corrosion

- ATACSPO released instructions to conduct borescope inspections of the visible portion of the RGB rear case.

The inspections identified five engines which presented risk factors that required further inspection at an engine repair facility.

Reduction Gearbox Rear Case Corrosion

- Engineering actions:
  - Teardown of U/S engines conducted to gain an understanding of fleet condition.
  - ATACSPO purchased borescopes for each unit to conduct INAM inspections (protecting expensive units).
  - ATACSPO ranked all engines based upon operating hours, periods of inactivity both installed and uninstalled and results of borescope inspections.
  - Additional engines were inducted into repair.

Staff retention and a retiring platform

- Mixed maintenance and engineering workforce
  - Airflite East Sale and Pearce
  - Raytheon RAAF Edinburgh
  - 4 SQN RAAF Willamtown
  - ATACSPO
- Experienced workforce within a remote location
- Resolution
  - R2 servicings completed at Pearce
  - Embedding Pearce maintenance personnel at East Sale on a rotation
  - Orderly transfer to Pilot Training System (PC-21)

Acknowledgements

- DSTG Forensic Engineering Services
- DSTG ADF Wear Debris Analysis Laboratory
- NGA-TS
- PADO
- Airflite, Raytheon and 4SQN
- FLTLT Grant Lamb

Questions