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2024 F-15 TCP WWR

F-15 Secondary Power System (SPS) Updates

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Overview

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- Power Take Off (PTO) Shaft Redesign
- Jet Fuel Starter (JFS) Mechanical Switch Elimination (-8 JFS)
- Central Gear Box (CGB) Clutch and Brake Upgrade

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Power Take Off Shaft Redesign

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Background:

- PTO redesign effort began August of 2016 to address main engine gearbox cracking issues and low reliability
- Spline and pilot wear #1 reason for return
- PTO MTBO is 300-400 hours; Far less than the 1200 hour designed life
- Issues Identified:
  - Dissimilar material hardness
  - Inadequate spline lubrication
  - Relative axial motion

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Power Take Off Shaft Redesign

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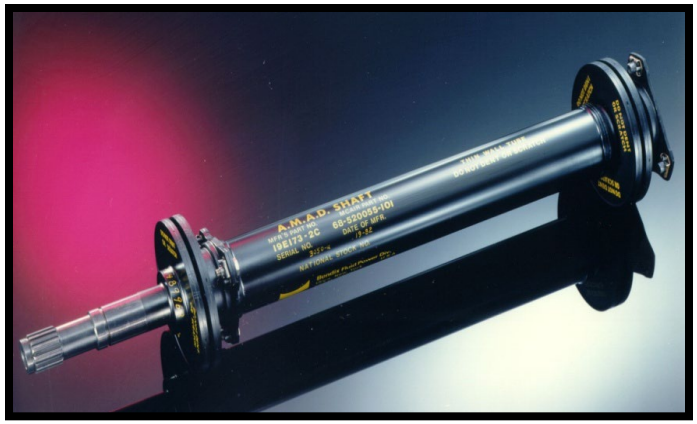
19E173-6A Improvements:



- Increased wear resistance
- Distributed loading more evenly
- Shift axial resonant frequencies out of operating range
- Improved ball and socket assembly
- Longer life nut plates (100 uses vs. legacy 10-15 uses)
- Offset bolt hole 2 degrees between input and output coupling
- AMAD/PTO lubrication system components upgraded to increase spline lubrication
  - PTO Output Coupling
  - AMAD PTO Gearshaft
  - AMAD PTO Bearing Cover
  - AMAD PTO Bearing Carrier

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Power Take Off Shaft Redesign

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Current Status of Redesign:

- PTO/AMAD testing at Honeywell- Completed
- PTO Acceptance/Qualification Testing- Completed
- PTO Engineering Review and Airworthiness- Completed
- Upgrade of 4 AMADs- Completed
- AMAD Endurance Testing- In Progress
- AMAD Engineering Review and Airworthiness- In Progress
- Field Service Evaluation- In Progress

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Power Take Off Shaft Redesign

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Field Service Evaluation:

- Test Plan
  - 200+ hour test with multiple inspections (every 50 flight hours)
  - 4 shafts with 2 new and 2 legacy AMAD configuration
  - Also will collect data on two -4A PTO shafts with two upgraded AMADs
  - Data will be collected on both -220 and -229 engines
- Status
  - 2 of the 4 shafts are currently flying and have over 400 and 800 hours
  - Both shafts are paired with legacy AMADs
  - Current wear trends for both shafts put expected life well beyond 1200 hour goal before falling below spline wear limit
- FSE with 2 remaining upgraded PTO shafts and upgraded AMADs expected to begin March 2025 after AMAD endurance testing

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Power Take Off Shaft Redesign

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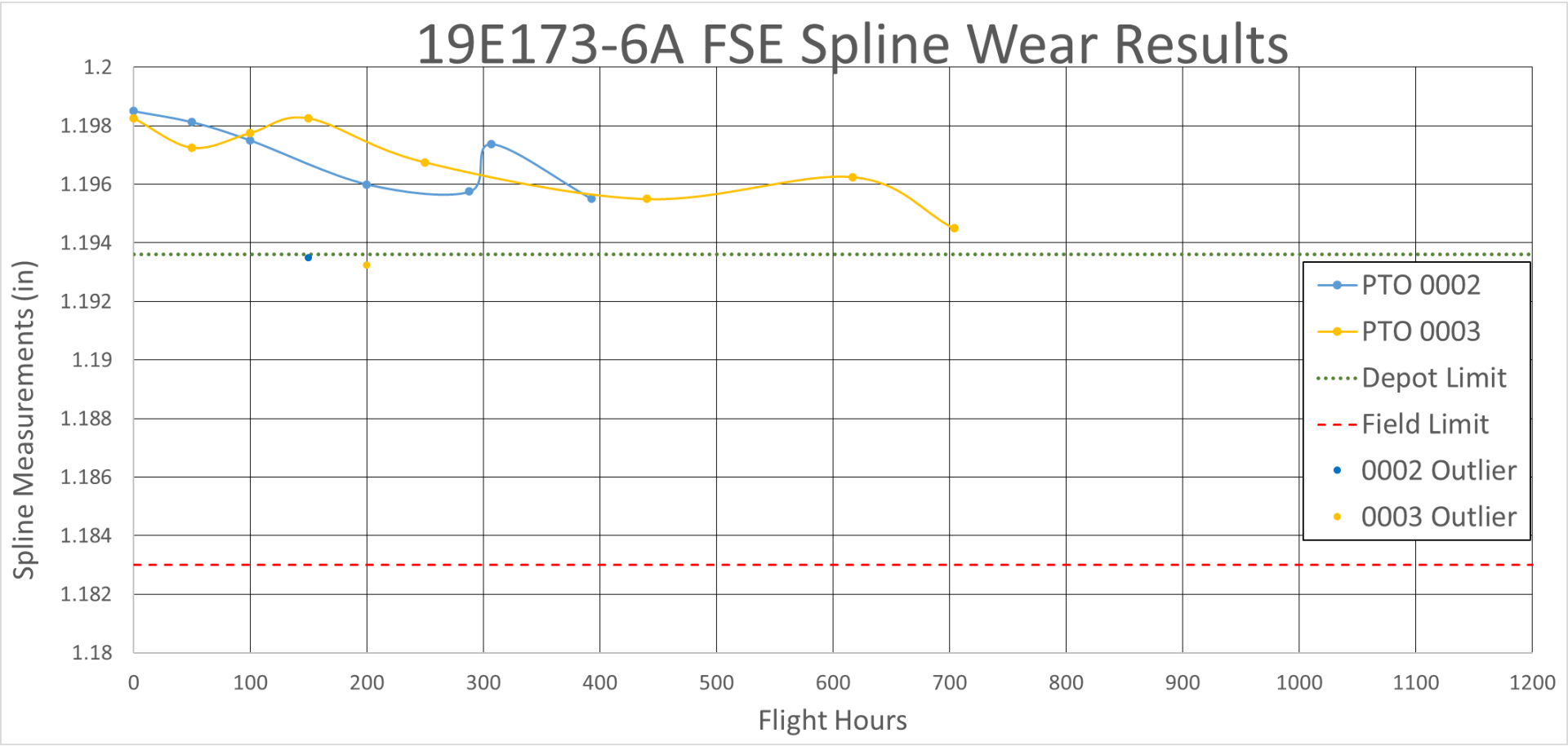

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Power Take Off Shaft Redesign

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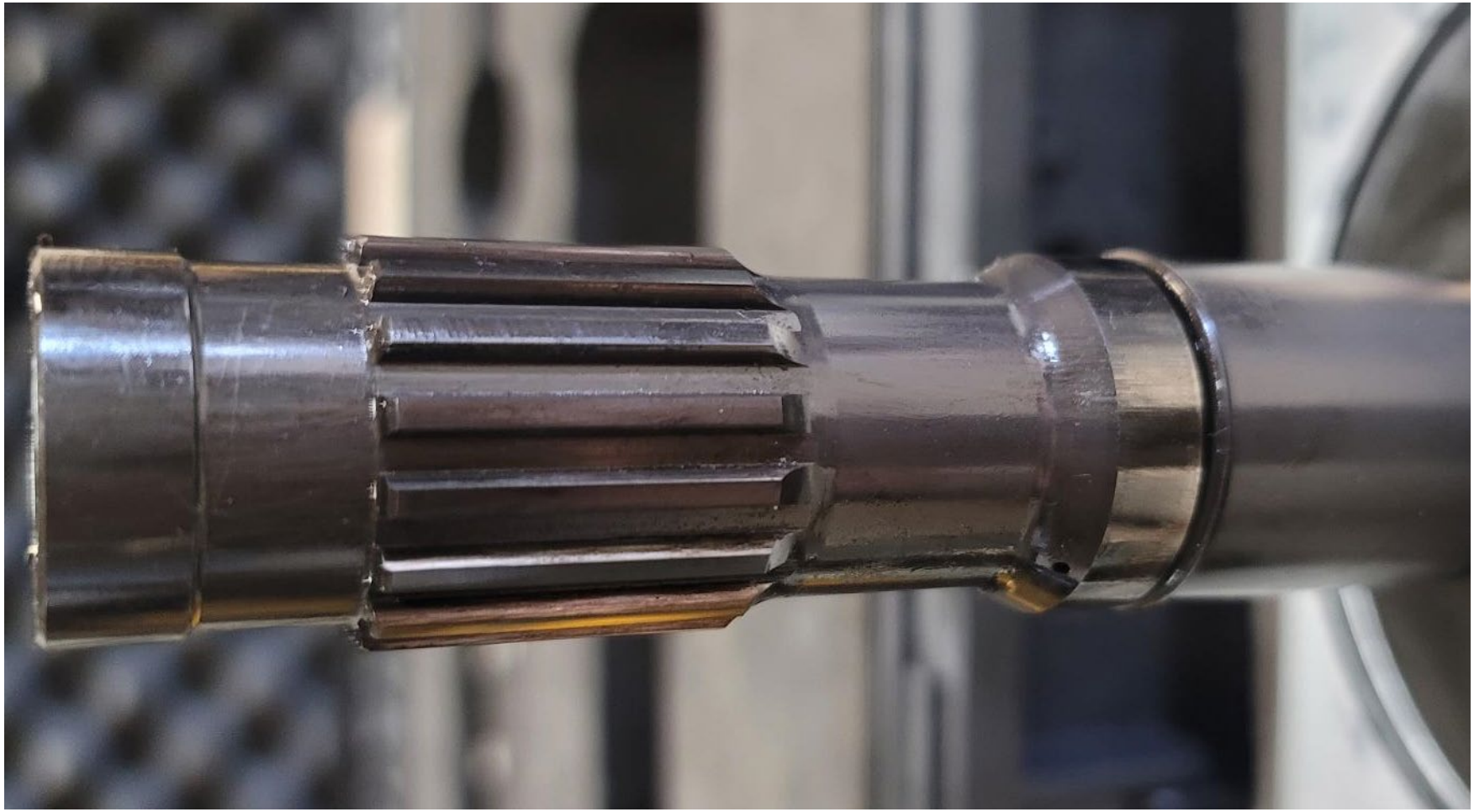
PTO Shaft 0003 After 600 Hours of Use



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Power Take Off Shaft Redesign

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Upcoming Schedule	ECD
TO Updates (Commodity and Aircraft)	January 2025
USAF Contracting and Ordering of New Shaft	February 2025
AMAD Endurance Testing	March 2025
FSE with Remaining PTOs and AMAD configurations	December 2025
Final Fielding Configuration Control Board (CCB) Review	December 2025
USAF Field New PTO Shaft	February 2027

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JFS Mechanical Switch Elimination Project

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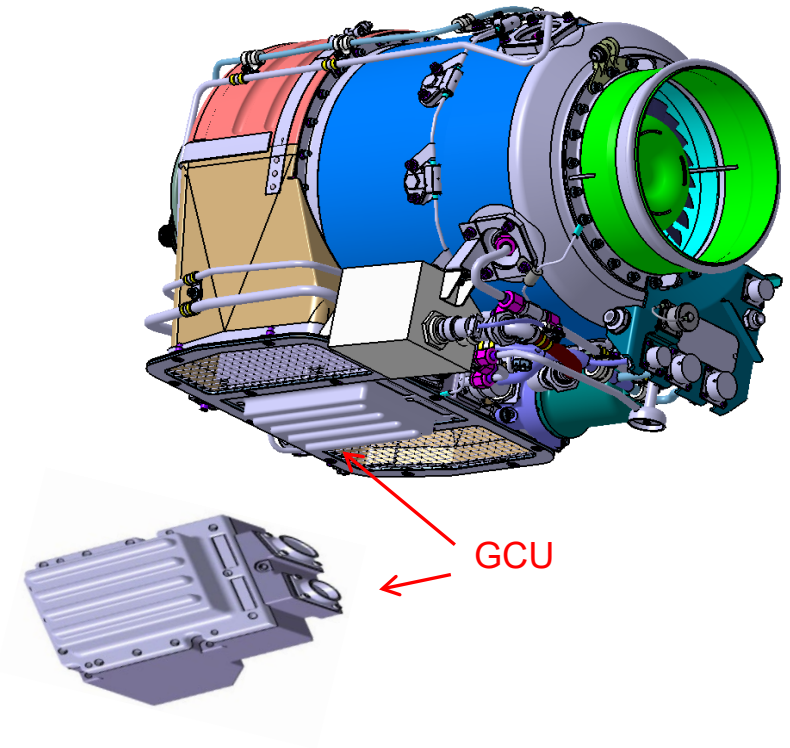
- Began modifications during depot overhaul April 2016
- Project addressed leading cause of F-15 ground aborts related to SPS:
  - Aircraft Mounted Accessory Drive (AMAD) 50% switches
  - JFS 2-speed switch
  - JFS wire harness
- Switch functionality was incorporated into the new Generator Control Unit (GCU)



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JFS Mechanical Switch Elimination Project

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- **Discussion Cont.**
  - **Implementation through JFS modification**
    - **Old JFS Part Number: 384238-7-1**
    - **New JFS Part Number: 384238-8-1**
    - **See Figures on subsequent slide for changes**
    - **Modification accomplished at Depot**
  - **384238-8-1 JFS is compatible with all aircraft configurations**
  - **Full benefit results from a modified JFS and aircraft wiring**
- **Status**
  - **USAF depot modification began April 2016. Due to part supply issues, modification was stopped for multiple years**
  - **USAF modification program is still in progress**
  - **Additional field time needed to quantify reliability improvements**

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JFS Mechanical Switch Elimination Project

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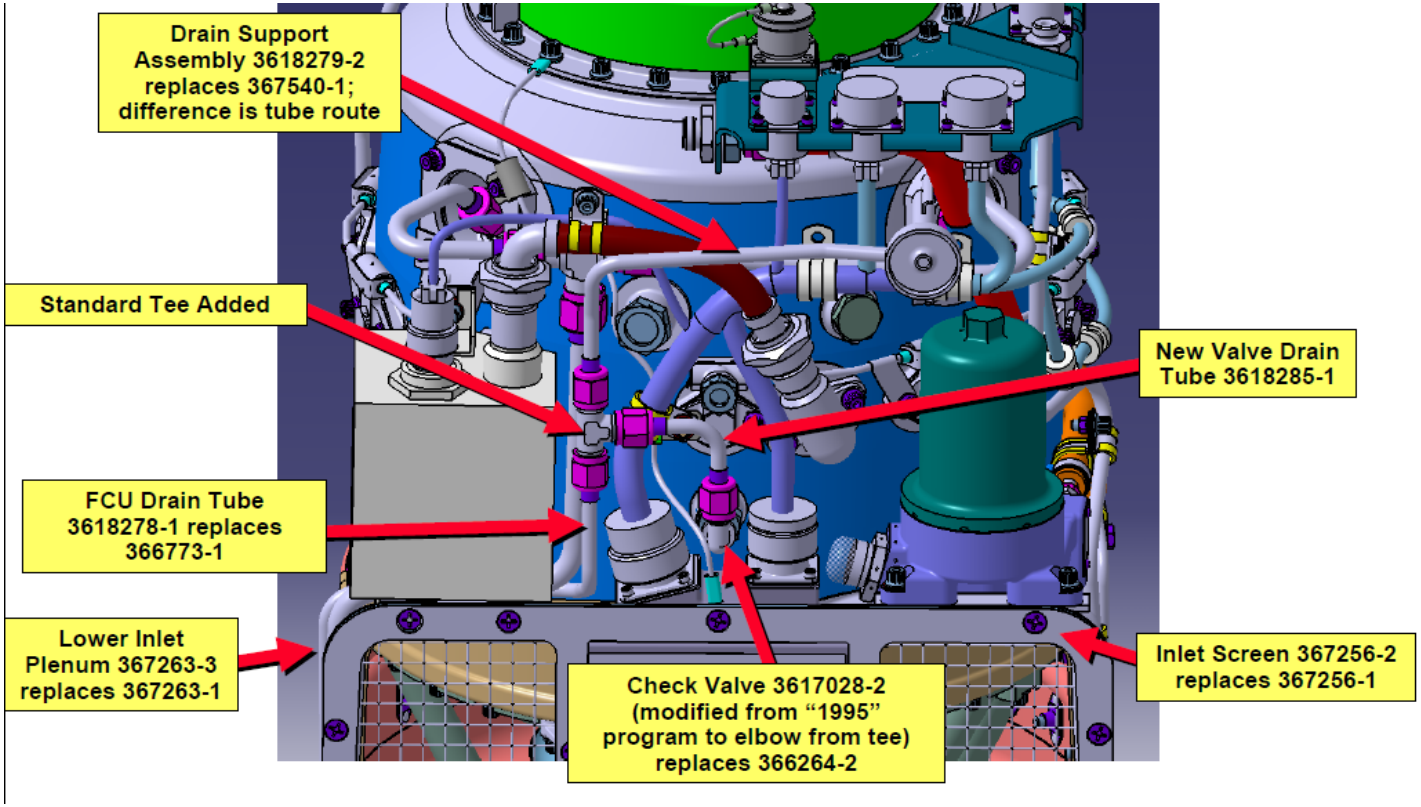

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JFS Mechanical Switch Elimination Project

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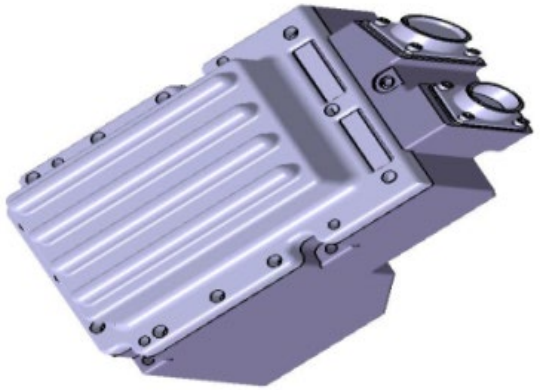
- New GCU has had some reported "no-start" issues
  - 21 GCUs, either from the field or identified at depot, have been confirmed as malfunctioning
  - OEM Investigation Results
    - "No-start" issues found to be due to a failed power supply
    - Power Supply Investigation found failed fuses, some of which were miswired during production causing early failure
      - OEM implementing check to ensure proper wiring going forward
    - Causes of other failures unknown
- USAF will continue to monitor issue but reported "no start" issues have slowed with none reported for over 2 years



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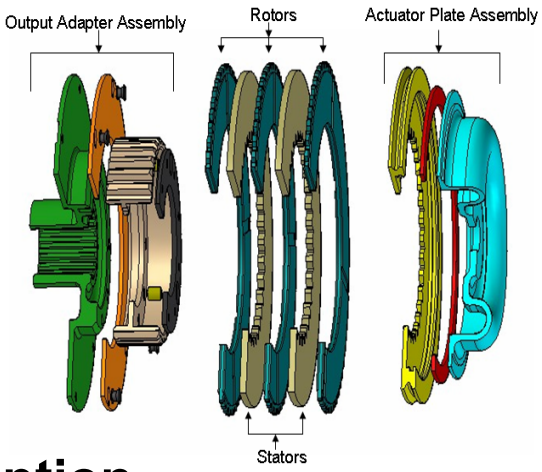
CGB Clutch and Brake Upgrade



- **Description**
  - **Clutch provides mechanical linkage to AMAD during main engine startup**
- **Issue**
  - **Clutch and brake wear causing early CGB returns**

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CGB Clutch and Brake Upgrade

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- Discussion
  - Clutch and Brake wear estimated to be cause for ~50% of all CGB returns to depot
  - Prior to PBL contract, an overhauled Thomas Instrument clutch and brake (87060-01) was used at USAF depot
    - Baseline tested the overhauled clutch 87060-01 on a CGB (1 test)
      - Reached 273 engagements stopped for vibration issues
      - Extrapolated results suggest <500 engagements
      - Limiting factor is the brake
      - Test replicated results from bench testing
  - New Clutch and Brake
    - Thomas Instrument developed a new friction material to increase service life, “2X clutch”
    - Baseline tested the “2X clutch” on a CGB at Honeywell test cell
      - Tested to 800 engagements with measurements every 200
      - Extrapolated results suggest >1500 engagements with the brake failing first
      - Test replicated results from bench testing

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CGB Clutch and Brake Upgrade

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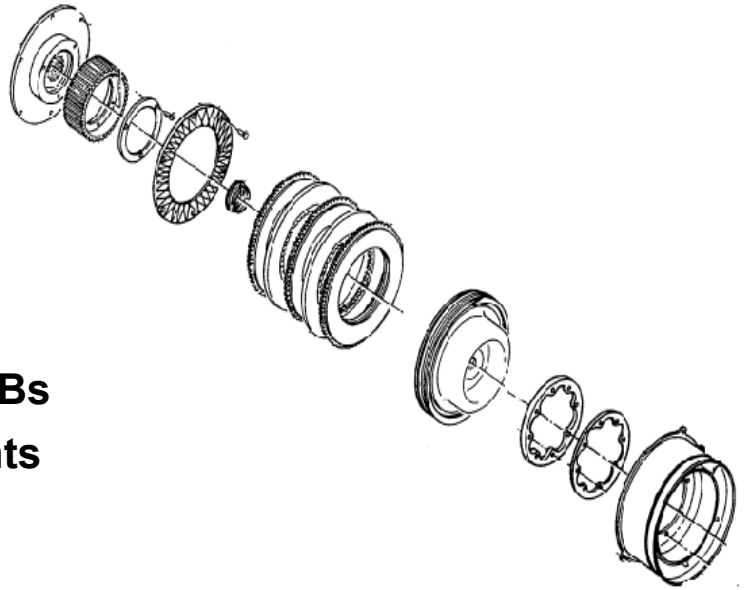
- **Status**
  - **Material Analysis completed on new friction material**
  - **Engineering Review/Airworthiness Complete and approved for use**
  - **New part numbers have been added to the IPB**
    - **88448-10: 2X Clutch and Brake Assembly**
    - **88371-10: 2X Disk Assembly**
    - **88376-10: 2X Brake Flange**
  - **USAF working with Honeywell for implementation under PBL contact**
    - **Approximately 50 2X Clutches installed in CGBs**
      - **Four currently near or over 1000 engagements**
    - **Additional field time needed to quantify reliability improvements**



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Questions