Hard Chrome Alternatives for Hydraulic Components

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**Hard Chrome Alternatives for Hydraulic Components**

26th Replacement of Hard Chrome and Cadmium Plating Program Review Meeting, January 24-26, 2006, San Diego, CA. Sponsored by SERDP/ESTCP.

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<td>ARINC, 2551 Riva Rd, Annapolis, MD, 21401</td>
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Standard Form 298 (Rev. 8-98)
Proscribed by ANSI Std Z39-18
Hard Chrome Alternatives for Hydraulic Components

- Program established to assist Oklahoma City Air Logistics Center Airborne Accessories Directorate Avionics and Accessories Division (448 ACSG/ENWF, formerly OC-ALC/LGERC) in development and implementation of replacement, repair, and overhaul procedures for hydraulic actuators across multiple weapon systems.
Hard Chrome Alternatives for Hydraulic Components

• Phase 1 – TO and Drawing Review, Database Development, Test Requirement Development
• Phase 2 – Delta-Qualification and Service Testing
• Phase 3 – Data Evaluation
• Phase 4 - Implementation
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- Phase 1 – TO and Drawing Review, Database Development, Test Requirement Development
  - 100% Complete
    - 729 Engineering Drawings Reviewed.
    - 276 Chrome plated parts and 195 potentially chrome plated parts have been identified
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- **Phase 2 – Delta-Qualification and Service Testing**
  - **Delta-Qualification Testing**
    - Flight Control Actuators
      - 87 distinct part numbers
      - 10 estimated to require delta-qualification
    - Utility Actuators
      - 73 distinct part numbers
      - 10 estimated to require delta-qualification
    - Snubbers/Other
      - 12 distinct part numbers
      - 3 estimated to require delta-qualification
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- Rig Testing
  - Completed
    • C-130 rudder actuator
    • C-130 ramp cylinder
    • KC-135 main landing gear actuator
    • KC-135 aileron snubber
    • A-10 aileron actuator
    • B-1 horizontal stab actuator
    • T-38 aileron actuator (testing completed, report in review)
  - In progress
    • F-15 Pitch/Roll Channel Assembly (PRCA)
    • KC-135 Ruddevator (additional seal options)
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• Service Testing
  – In preparation / progress
    • C/KC-135
    • C-130
    • Test plan approved through AMC, SPOs
    • Single test plan for both platforms
    • Two year plan, with mid term option to terminate
  – In planning / negotiation with SPOs, using commands
    • A-10
    • T-38
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- Service Testing (cont)
  - C/KC-135 Service Test to include
    - Snubbers (2 units)
    - Main Landing Gear Actuator (2 units)
    - Main Landing Gear Door Actuator (2 units)
    - Ruddevator Actuator (2 units)
  - Installation planned for Feb 06 at Grand Forks and MacDill AFBs
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• C/KC-135 Aileron Snubber
  – Endurance Testing Results
    • Actuator C, with O-ring and back-ups, completed 21,200 cycles with zero leakage
    • Actuator D, with VL Seal (S), completed 21,200 cycles with 8 total drops of fluid.
      ➢ This piston rod had small circumferential scratch at test completion.
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- **C/KC-135 Main Landing Gear Actuator**
  - Used to extend and retract the C/KC-135 MLG
  - Rig test included 20,000 cycles, high and low temp
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• C/KC-135 Main Landing Gear Door Actuator
  – Used to open and close the C/KC-135 MLG Door
  – Similarity arguments in lieu of rig testing
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• Service Testing (cont)
  – C-130 Service Test to include:
    • Rudder Actuator (1 unit)
    • Aileron Actuator (1 unit)
    • Elevator Actuator (2 units)
    • Ramp Actuator (2 units)
    • Aft Cargo Door Actuator (2 units)
  – Components of these actuators are being coating and finished.
  – Assembly into actuators planned for Feb/Mar 06
  – Installation planned for Mar 06 at Little Rock AFB and Delaware ANG.
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- C-130 Rudder Cylinder in Cold Test
  - Early leakage determined to be due to gland OD seals
  - Similarity arguments applied to aileron and elevator actuators in lieu of rig testing
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- **C-130 Ramp Actuator**
  - Used to operate the C-130 Ramp Door
  - Rig test included 20,000 cycles, high and low temp
  - Similarity argument applied to aft cargo door in lieu of rig testing
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- B-1 Horizontal Stabilizer
  - Drives horizontal stab surfaces for pitch and roll control
  - USAF contract to Boeing
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- B-1 Horizontal Stabilizer
  - Coating
    - Forward Piston coated by Southwest United Industries
    - Aft Piston coated by PTI
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• B-1 Horizontal Stabilizer
  – Rig Testing
    • Performed by Boeing
    • Endurance – 750,000 (approx 1/2 aircraft life)
    • No unacceptable leakage observed
  – Service Tests - None
  – Similarity Arguments
    • Other B-1 flight control actuators
  – Drawing updates completed
  – TO and stocklist updates in progress
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• B-1 Pitch/Roll SCAS
  – Provides pitch and roll input to mixers and on to horizontal stab surfaces for added stability and for autoflight

• USAF contract to Boeing
• Simplified endurance scan to qualify
• Test in progress
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• Phase 4 – Implementation
  • B-1 horizontal stab drawings updated, TOs under review by 448 ACSG/ENWF (formerly OC-ALC/LGERC) to prepare for implementation at overhaul
  • Component repair drawings in preparation for other projects (ARINC and 448 ACSG/ENWF)
  • Implementation strategy under discussion with AF internal Technical Review Boards (TRBs), OEMs, SPOs (e.g., configuration issues, part numbers, etc.)
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• **Summary**
  
  • 1 Actuator (B-1 Horizontal Stab) has completed qualification testing and is ready for implementation.
  
  • 6 Actuators (C/KC-135 Aileron Snubber, A-10 Aileron, C/KC-135 MLG, C-130 Rudder Booster, T-38 Aileron and C-130 Ramp Cylinder) have successfully completed rig testing.
  
  • 4 C/KC-135 Actuators (MLG, MLG Door, Aileron Snubber, Ruddevator) are ready for installation on the C/KC-135 for service testing.
  
  • 5 C-130 Actuators (Ramp Cylinder, Aft Cargo Door Cylinder, Elevator Booster, Aileron Booster, and Rudder Booster) being prepared for installation on the C-130 for service testing.
  
  • 2 Actuators (KC-135 Ruddevator, F-15 PRCA) are on contract for rig testing
  
  • Numerous additional actuators will be considered for similarity pending successful completion of rig and service testing described above.
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• Questions?