PAX RIVER HCAT ROD TESTING

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July 2004 HCAT

Report Documentation Page

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13. SUPPLEMENTARY NOTES
24th Replacement of Hard Chrome Plating Program Review Meeting, July 20-21, 2004, Park City, UT. Sponsored by SERDP/ESTCP.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
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NAVAIR PAX Work Status:

- Currently Planning the Functional Rod/Seal Testing at PAX Hydraulic Lab.
  - Rods have been Received at PAX
  - Evaluated Past Testing Seal Types.
- Test Primarily Based on HCAT Joint Test Protocol Dated 30 September 2003. JTP has been Modified to Include:
  - High Temp at 275 F (not 300 F)
  - MIL-PRF-83282 Fluid Used (not MIL-PRF-87257)
- JTP Will Validate HVOF Thermal Spray Coatings as Replacements for Hard Chrome Plating on Hydraulic/Pneumatic Actuators.

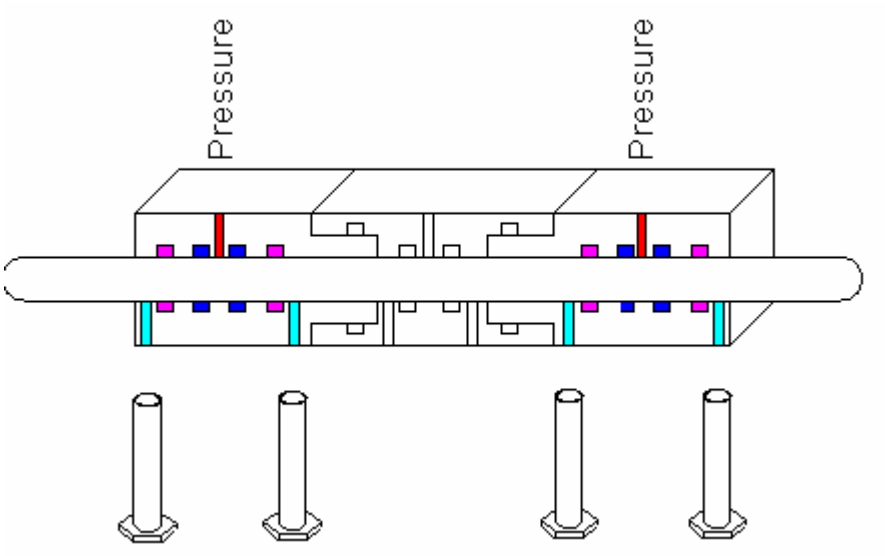
Test Apparatus:

- Located at NAVAIR Patuxent River Hydraulic Lab.
- Master hydraulic piston drives four test rods. Each rod passes through two blocks ("Near End Block" and "Far End Block").
- Apparatus is mounted inside an environmental chamber capable of maintaining a temperature between -65° and +300° F.
- The master piston passes through a sealed port on the environmental chamber.
- The hydraulic power supply is located outside the chamber for increased reliability of the test hardware.
- Hydraulic lines to the fixture are single-ended and thus should not heat or cool the test hardware.

Test Rod and Block/Seal Configuration:

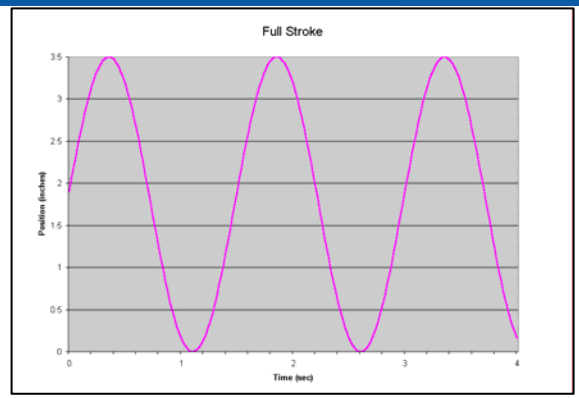
• There are two seal configurations per block and two blocks per rod so that 16 rod/seal configurations are being evaluated per test.

• Primary seals are indicated in blue and the secondary seals in magenta.

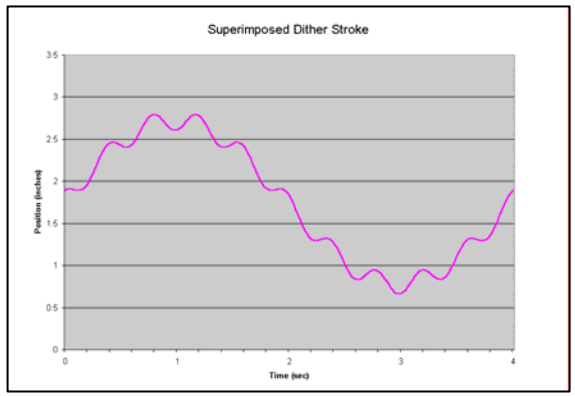


Stroke Profile:

- Full Stroke (3.5” Stroke, 1.5 second Period, 20 Minute Duration per Hour)



- Superimposed Dither (2” Main Stroke, 0.25” Dither stroke, 4 second Period, 4 Hz Frequency, 20 Minute Duration per Hour)



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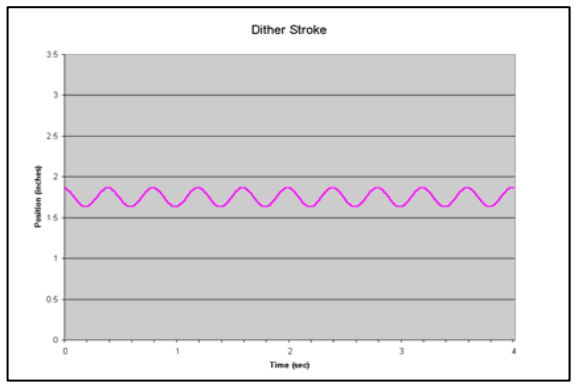

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NAVAIR-PAX Hydraulic Systems

Temperature Profile:

Day No.	Hours	Temp (F)
1	8	160
2	8	200
3	8	160
4	8	225
5	8	160
6	8	250
7	8	160
8	8	250
9	8	160
10	8	275
11	8	160
12	8	275
13	4	-40

Notes:

1. Between Test Days the Temperature Shall be 0°F to Evaluate Static Leakage at Startup.
2. Total Cycles will Total 1,040,000 and Travel 13.6 miles. Total run time will be 100 hours.

Test Configuration (Phase 1):

Rod No.	Rod Description	Block Location	Gland Location	Seal Description	Vendor
1	HVOF applied WC/CoCr, ground with progressively finer wheels to Ra of 4 or better	Near End	Inboard	MIL-P-83461 O-ring with PTFE Capstrip	TBD
			Outboard	MIL-P-83461 O-ring with 2 Backup Rings	TBD
		Far End	Inboard	Fluorosilicon O-ring with PTFE Capstrip	TBD
			Outboard	Spring energized PTFE seal	TBD
2	HVOF applied WC/CoCr, ground to dimension with a 180 or 220 or so wheel, leaving an Ra of 16-24, followed with superfinishing with a D-17 stone, followed by a felt pad and diamond paste, to produce Green Tweed recommended roughness parameters, Ra<= 4 micron, Tp = 60-90% @ 0.25 Rz.	Near End	Inboard	MIL-P-83461 O-ring with PTFE Capstrip	TBD
			Outboard	MIL-P-83461 O-ring with 2 Backup Rings	TBD
		Far End	Inboard	Fluorosilicon O-ring with PTFE Capstrip	TBD
			Outboard	Spring energized PTFE seal	TBD
3	HVOF applied WC/CoCr, ground to dimension with a 320 or so wheel, leaving an Ra of 4-8 micron, followed with superfinishing with progressively finer stones, to produce an Ra of 1 micron or better, with essentially no peaks and valleys.	Near End	Inboard	MIL-P-83461 O-ring with PTFE Capstrip	TBD
			Outboard	MIL-P-83461 O-ring with 2 Backup Rings	TBD
		Far End	Inboard	Fluorosilicon O-ring with PTFE Capstrip	TBD
			Outboard	Spring energized PTFE seal	TBD
4	Baseline chrome plated rod, ground to an Ra of 12-16 micron.	Near End	Inboard	MIL-P-83461 O-ring with PTFE Capstrip	TBD
			Outboard	MIL-P-83461 O-ring with 2 Backup Rings	TBD
		Far End	Inboard	Fluorosilicon O-ring with PTFE Capstrip	TBD
			Outboard	Spring energized PTFE seal	TBD

Primary and Secondary Seals are identical for each different seal type.

Test Evaluation and Reporting:

• Each rod will be inspected and characterized before testing (optical microscopy and surface profilometry).

•Hydraulic fluid leakage from each block will be measured and recorded.

• Fluid that is collected will be retained for possible analysis for seal and coating constituents.

• Seals will be weighed and measured, with the results recorded.

• A report will document the testing conducted, the results of the characterization of the rods and seals, and the results of the measurements of fluid leakage and analysis.

F/A-18 C/D Stabilator Testing:

- Based on laboratory results, fluorocarbon static seals and PTFE spring energized dynamic seals were selected.
- Rebuild kits for F/A-18 C/D stabilator actuator were developed by seal vendors using hardware dimensions.
- Endurance testing of seal kits from three vendors had no external leakage and acceptable internal leakage after endurance testing. Post-test leakage was within ATP limits.
- Follow-on testing evaluated HVOF coated rod against these seals.
- Leakage performance was equivalent to chrome plated rod.
- STAB Actuator Testing is Complete. Finalizing Test Report for ECP.

F/A-18 C/D Trailing Edge Flap:

- Same dynamic and static seal materials used for TEF as proven on STAB.
- Side by side design allows one chrome rod and one HVOF rod to evaluate seals against both rod surfaces.
- Endurance testing of TEF has begun and is 2/3 complete. Currently awaiting a different seal configuration to resume the evaluation.