

Subsystem: <u>HPOTP B500 - 4750000-700</u> Functional Assy: <u>Pump Section B50001</u>		Critical Item List Prepared by: <u>M.T. Spencer</u> Approved by: <u>R.L. Pugh</u> CIL Item: <u>0104</u>		Page: <u>21</u> Issue Date: <u>December 23, 1983</u> Rev. Date: <u>December 08, 1995</u>
CIL Item Code: <u>0104</u> FMEA Item Code: <u>0104</u> Function: <u>Direct Preburner Pump Flow</u> System/Subsystem: <u>HPOTP B500 - 4750000-700</u>				Analyst: <u>M.T. Spencer</u> Approved by: <u>R.L. Pugh</u> Rev. No.: _____ Rev. Date: <u>December 08, 1995</u> Effectivity: _____ Hazard Ref.: <u>See Listings Below</u>
Operating Phase	Failure Mode, Description and Effect	Criticality		

Operating Phase:

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Failure Mode:

Pressure drop, or flow distortion.

Failure Cause(s):

- A. In 234 Damage or distortion of the preburner inner bag due to vibrations, contamination, or material/mfg defects
- B. In 232 ASO Fracture of the preburner bag due to vibration, over pressure, thermal, plumbing loads, or material/mfg defect.

Failure Effect:

Energy loss reduces pump discharge pressure and flow to the Preburner Oxidizer Valve, which commands it further open. OPOV command limit results in controller issued MCF and vehicle commanded shutdown.

System:

Engine shutdown

Mission/Vehicle:

Mission scrub

Redundancy Screening:

- A: Pass. Redundant hardware items are capable of checkout during normal ground turnaround.
- B: Pass. Loss of a redundant hardware item is detectable during flight
- C: Pass. Loss of redundant hardware items could not result from a single credible event.

Criticality:

1R

Hazard Ref:

- A) C1SM (AT) 1B2.1.3.3.2, 1B2.1.3.3.3
- B) C1SM (AT) 1B2.1.3.3.2, 1B2.1.3.3.3

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Operating Phase:

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Failure Mode:

Pressure drop, or flow distortion.

Failure Cause(s):

- A. In 234 Damage or distortion of the preburner inner bag due to vibrations, contamination, or material/mfg defects
- B. In 232 ASO Fracture of the preburner bag due to vibration, over pressure, thermal, plumbing loads, or material/mfg defect.

Failure Effect:

Energy loss reduces pump discharge pressure and flow to the Preburner Oxidizer Valve, which commands it further open. OPOV command limit results in controller issued MCF and vehicle commanded shutdown.

System:

Engine shutdown

Criticality:

1R

Hazard Ref:

- A) C1SM (AT) 1B2.1.3.3.2, 1B2.1.3.3.3
- B) C1SM (AT) 1B2.1.3.3.2, 1B2.1.3.3.3

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Mission/Vehicle:

Mission abort

Redundancy Screens:

- A: Pass. Redundant hardware items are capable of checkout during normal ground turnaround.
- B: Pass. Loss of a redundant hardware item is detectable during flight
- C: Pass. Loss of redundant hardware items could not result from a single credible event.

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Part Name/No.	Design Considerations	Document Ref
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l/n 234
 Preburner inner hag.

FAILURE CAUSE A. The Preburner pump hag is forged Inconel 718 (PWA-SP 1146), and provides the inlet area to the impeller, the collector and exit area to the preburner pump, support for the various seals, and maintains the required clearance for the impeller.

The cast discharge volute inner housing which is utilized as a flow guide only is Micro-Cast Inconel 718 (PWA-SP 1490-2) for its high strength and experience in a LOX environment. This material has a proven history in a LOX environment, LOX testing of this material appears in Appendix 52 of the P&W MCL Manual. The inner hag is retained in the structural outer housing by a locked spanner nut, l/n 235 which is PWA -SP 1146 material. The lock, l/n 236, is AMS 5599 material. This inner hag arrangement minimizes pressure loading stresses, and allows sharp cutwater leading edges for reduced turbulence.

Proof pressure test stress analysis documentation can be found in FR-20729-02.

This part meets CEI requirements.

l/n 232
 Preburner hag

FAILURE CAUSE B. The Preburner pump hag is forged PWA-SP 1146 (Inconel 718), which was selected for its high cryogenic strength, ductility, and experience in a LOX environment. This material has a proven history in a LOX environment, LOX testing of this material appears in Appendix 52 of the P&W MCL Manual.

Integral structural ribs are machined into the preburner housing to reduce the bending stress caused by the high preburner pump discharge pressure.

This assembly is made up of the outer hag which has an access cover plate, and a series of bolts and studs which attach the preburner assembly to the main pump housing. An O-seal eliminates leakage to the outside.

Race track slots engage pins in the main pump housing to allow for alignment.

This part serves as a pressure vessel, and meets CEI requirements.

DVS 4.1.2.9 structural design analysis has been completed, and can be found in FR-20729-05, and FR-20730-2.

The P/B housing pressure tests are complete, and documentation will be found in FR-20729-49.

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Inspection and Test			
Possible Causes	Significant Characteristics	Inspection and Test	Document Ref
Failure Cause A 1/n 234 P/B Inner Hag	Material Integrity	Material integrity is verified per specification requirements.	PWA-SP 1490-2
	Weld Integrity	Weld repair verified per specification.	PWA-SP 36158
	INSPECTION		
	Raw Material	X-Ray per QAD	SP-XRM Master
	Finished Material	FPI per QAD X-ray per QAD	SP-FPM Master SP-XRM Master
	Assembly Integrity	Part seating will be verified per assembly specification. Fastener installed in accordance with REI 016. Cleanliness of components will be verified per specification.	REI 013, REI 016 PWA-SP 80
Failure Cause B 1/n 232 P/B Hag	In-Process Testing	Proof pressure test per specification.	REI 005
	Material Integrity	Material integrity is verified per specification Contamination Control	PWA-SP 1146 PWA-SP 36180-4
	INSPECTION		
	Raw Material	Sonic per QAD	
	Finished Material	ECI per QAD FPI per QAD Corner radius where volute intersects the discharge flowpath is verified per drawing requirements.	SP-ECM Master SP-FPM Master
	Assembly Integrity	Part seating will be verified per assembly specification. Fastener installed in accordance with REI 016. Cleanliness of components verified per specification. Leak check with GHe. Interface seal surface is verified per the installation drawing as specified in the assembly specification.	REI 013 PWA-SP 80 REI 013

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	In-Process Testing	Proof pressure & leak test per specification.	REI 005
All Cause	General Quality Requirements:	<p>Supplier Quality Assurance requirements are included in PYY-QA-6078, and include such requirements as first piece layouts. This requires the documentation of dimensions on all characteristics represented on the delivered article.</p> <p>Inspection Methods Sheets for use in the inspection of purchased parts and assemblies contain the necessary information to insure that the requirements of the QADs, engineering drawings, and referenced documents are satisfied. For shop fabricated parts, the sheets are audited by Inspection Methods.</p> <p>The purchase orders for vendor supplied parts must comply with PWA-SP 300, 'Control of Materials Processes and Parts', which requires the vendor to provide material, process, and dimensional information to the Quality Department.</p>	PWA-SP 300
	Acceptance	Acceptance test will be conducted as required by contract, to demonstrate specified performance.	DR SE-13
	Maintenance	On a contingency basis perform a Post Flight borecope of the P/B inlet thru port 02.3 and 09.1.	V41BUO.128
	Waivers	<p>This section would contain a description of any limiting features of CIL hardware</p> <p>Not applicable at this time</p>	DAR Numbers

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