Subsystem: HPOTP B500 - 4750000-700	**Critical Item List**	Page: 88	
Functional Assy: Interpropellant Seal B50003	Prepared by: M.T. Spencer	Issue Date: December 23, 1993	
	Approved by: R.L. Pugh	Rev. Date: December 08, 1995	
	CIL Item: 0302		

CIL Item Code: 0302		Analyst: M.T. Spencer	
FMEA Item Code: 0302		Approved by: R.L. Pugh	
Function: Maintain Helium Barrier		Rev. No.:	
System/Subsystem: HPOTP B500 - 4750000-700		Rev. Date: December 08, 1995	
		Effectivity:	
		Hazard Ref.: See Listings Below	

Operating Phase	Failure Mode, Description and Effect	Criticality

Operating Phase:
s

Failure Mode:
Loss of Helium purge pressure.

Failure Cause(s):
A. f/n 154 Fracture, by-pass or wear of the helium buffer seal due to vibration, rub, excessive load, thermal deflection, contamination, or material/mfg defect.

Failure Effect:
Low He source pressure redline exceeded initiating engine shutdown.

System:
Engine shutdown

Mission/Vehicle:
Mission scrub. Loss of vehicle due to propellant crossover may result if not detected.

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.

Criticality:
1R

Hazard Ref:
A) C1S/A/M/C (AT) 3B1.1.1, 3B1.3, 3B1.4, 3B1.5, 3B8.2.1.1, 3B8.2.1.2

Operating Phase:
m

Failure Mode:
Loss of Helium purge pressure.

Failure Cause(s):
A. f/n 154 Fracture, by-pass or wear of the helium buffer seal due to vibration, rub, excessive load, thermal deflection, contamination, or material/mfg defect.

Failure Effect:
Low He source pressure redline exceeded initiating engine shutdown.

System:
Engine shutdown

Mission/Vehicle:
Mission abort. Loss of vehicle due to propellant crossover may result if not detected.

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

Criticality:
1R

Hazard Ref:
A) C1S/A/M/C (AT) 3B1.1.1, 3B1.3, 3B1.4, 3B1.5, 3B8.2.1.1, 3B8.2.1.2

Subsystem:	HPOTP B500 - 4750000-700	Critical Item List		Page:	69
Functional Assy:	Interpropellant Seal B50003	Prepared by:	M.T. Spencer	Issue Date:	December 23, 1993
		Approved by:	R.L. Pugh	Rev. Date:	December 08, 1995
		CIL Items	0302		

C: Pass. Loss of redundant hardware items could not result from a single credible event.

Subsystem: HPOTP B500 - 4750000-700	Critical Item List	Page: 70
Functional Assy: Interpropellant Seal B50003	Prepared by: M.T. Spencer	Issue Date: December 23, 1993
	Approved by: R.L. Pugh	Rev. Date: December 08, 1995
	CIL Item: 0302	

Part Name/No.	Design Considerations	Document Ref
f/n 154 Helium buffer seal	FAILURE CAUSE A. This seal assembly operates in a low pressure environment, and is made up of parts which reduce helium flow with a set of spring loaded carbon elements in close proximity to the rotating one piece seal land. Performance of the system is enhanced by use of a converter (f/n 61) in combination with de-swirl vanes which vaporizes LOX to GOX. The material of the vaporizer is PWA-SP 1146 (Inco 718), and was selected for its cryogenic strength and demonstrated experience in a LOX environment. High pressure Helium flows into a cavity between Carbon rings and leaks between the Carbon bore keeping the two fluids separated. Helium buffer pressure is also provided under the seal land to preclude mixing of the Hydrogen and Oxygen at the shaft O.D. This design features a positive taper of the carbon element to insure that under the worse tolerance condition, convergent flow provides the necessary lift which keeps the seal from running on the shaft. Carbon contact faces on the Cover and Housing sideplates are chrome plated to minimize wear and friction . The surface finish of the housing and seals are controlled to minimize leak and wear. Side plates deflect during operation, so to assure proper contact between the side plates and seal, the carbon has been cut back axially leaving a protruding nose. The cover is tight fit to the sleeve to provide the primary sealing system to prevent helium leakage to the drain cavities. Teflon seals installed into glands on the Housing and Cover provide the back-up to the tight fit to prevent leakage between the seal and IPS Sleeve. A low helium supply pressure limit is included in the monitoring system. The carbon material is P5N (PWA-SP 1148) and was selected for its strength and lubricity. These carbon rings fit into AMS 5732 (A286 SS) retainers. These are held tight against the AMS 5732 Housing and Cover by the AMS 5541 (Inconel X-750) wave washer. Both the Cover and Housing carbon contact surfaces are plated with AMS 2406 Chrome. The Carbon Seal Land is made of PWA-SP 1146 (Inconel 718). Mission life for the seal is greater than 1000 cycles. The Seal Assembly is retained in the IPS Sleeve by the IPS retention nut. Measurements are taken to confirm seating of the Carbon Seal Land which is retained on the shaft by the Axial Stacking Nut. Carbon Seal Housing snap integrity is verified by a Helium leakage rate test. This part meets CEI requirements. DVS 4.1.3.2.2 IPS evaluation test on a simulation has been completed, and can be found in FR-20904-1, FR-20728-03, and FR-20728-2. DVS 4.1.2.14 IPS analysis to determine/verify worst case leakage rates, and can be found in FR-19847-1, FR-20728-2, FR20730-09 and FR-20729-04. Seal test is documented in FR-20728-2. DVS testing for Item 1.4.2 are also applicable to this item.
f/n 61 Converter	FAILURE CAUSE a. Since the performance of the O2 side interpropellant labyrinth seal is dependent on having a gaseous medium, the function of the vaporizer is to convert LOX to GOX at approximately the same pressure (relatively low) to assure an adequate pressure drop across the downstream K.E. seal. This is accomplished by the use of a rotating vaporizer which in combination with the de-swirl vanes provides the desired

effect. Material is Inconel 718 (PWA-SP 1146) and was selected for its cryogenic strength and demonstrated experience in a LOX environment.

Mission life for the vaporizer is greater than 1000 cycles.

This part meets CEI requirements.

DVS 4.1.2.9 Structural design analysis has been completed and can be found in FR-20730-11.

DVS 4.1.3.2.2 IPS evaluation test on a simulation has been completed, and can be found in FR-20904-1, FR-20728-2, and FR-20728-03.

Subsystem: HPOTP B500 - 4750000-700	Critical Item List	Page: 72
Functional Assy: Interpropellant Seal B50003	Prepared by: M.T. Spencer	Issue Date: December 23, 1993
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	CIL Item: 0302	

Inspection and Test

Possible Causes	Significant Characteristics	Inspection and Test	Document Ref
Failure Cause A f/n 154 1. Carbon elements 2. Housing and Cover 3. Seal Land	Material Integrity	Material integrity is verified per specification requirements. High pressure LOX compatability is verified per specification Contamination control is verified per specification	1. PWA-SP 1148 PWA 82-72 BCGX PWA-SP 38180-4 2. AMS 5732 3. PWA-SP 1146
	INSPECTION	The seal I.D.diameter is verified per drawing requirements. The seal face surface finish is verified per drawing requirements.	
	Assembly Integrity	Cleanliness of components is verified per specification.	PWA-SP 80
Supporting hardware 0302a f/n 091 Converter	Material Integrity	Material integrity is verified per specification requirements.	PWA-SP 1148
	INSPECTION		
	Raw Material	Sonic per QAD	
	Finished Material	ECI per QAD	SP-ECM Master
		The I.D. of the seal is verified per drawing requirements.	
		FPI per QAD	SP-FPM Master
	Assembly Integrity	Part seating is verified per assembly drawing. Cleanliness of components will be verified per specification.	REI 013 PWA-SP 80
Supporting hardware 0302a f/n 081 Housing	Material Integrity	Material integrity is verified per specification requirements. EDMR	AMS 5732 PWA-SP 97-5
	Heat treat	Heat treat is verified per specification, & drawing requirements.	PWA-SP 11
	Plating Integrity	Plating integrity a verified per specification requirements.	AMS 2406

	INSPECTION		
	Raw Material	Sonic per QAD	
	Finished Material	FPI per QAD Surface finish of the housing inner face is verified per drawing requirements.	SP-FPM Master
	Assembly Integrity	Cleanliness of components will be verified per specification. Leak check of the housing is verified per drawing requirements. Assembly temperature limits for the Teflon seals is verified per drawing requirements.	PWA-SP 80 REI 013
Supporting hardware 0302a I/n 153 Cover	Material Integrity	Material integrity is verified per specification requirements.	AMS 5732
	Heat Treat	Heat treat is verified per specification, and drawing requirements.	PWA-SP 11
	Plating Integrity	Plating integrity is verified per specification.	AMS 2406
	INSPECTION		
	Raw Material	Sonic per QAD	
	Finished Material	FPI per QAD	SP-FPM Master
	Assembly Integrity	Cleanliness of components will be verified per specification.	PWA-SP 80
Supporting hardware 0302a I/n 156 Sleeve	Material Integrity	Material integrity is verified per specification requirements. EDMR	PWA-SP 1146 PWA-SP 97-6
	INSPECTION		
	Raw Material	Sonic per QAD	
	Finished Material	FPI per QAD ECI per QAD Sleeve O.D. diameter is verified per drawing requirements.	SP-FPM Master SP-ECM Master
	Assembly Integrity	Cleanliness of components will be verified per specification.	PWA-SP 80

All Cause	General Quality Requirements:	Supplier Quality Assurance requirements are included in PW-QA-6076, and include such requirements as first piece layouts. This requires the documentation of dimensions on all characteristics represented on the delivered article. 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. 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.	PWA-SP 300
	Acceptance	Acceptance test will be conducted as required by contract, to demonstrate specified performance.	DR SE-13
	Waivers	This section would contain a description of any limiting features of CIL hardware Not applicable at this time	DAR Numbers