

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE															
WAIST BEARING, ITEM 104 ----- A/L 10057-03 (1)	1/1	External gas leakage beyond SOP capability.	END ITEM: Suit gas leakage to ambient.	A. Design - Waist bearing races are made from 17-4 ph 1050 stainless steel. Bearing balls are 440c stainless steel. Clamping rings are made from 7075-t73 aluminum. Spacer balls are made from vespel. Silicone "o" rings are installed on both races to prevent a pressure leakage path between the races and the inter- facing bladder.															
OR ----- A/L 10043-04 (1)		Defective inner/outer races, O-ring or clamping ring. Loose or missing clamping ring screws, or cracked outer race.	GFE INTERFACE: Depletion of primary O2 supply and SOP. Rapid depressurizatio n of SSA beyond SOP makeup capability.	Incidence of loose clamping ring screws in the waist bearing assembly is precluded in design by adherence to standard engineering torque requirements for screw installation. Waist bearing stress analysis shows the maximum stress, due to bending, occurs when the waist is rotated 45 degrees. The maximum bending stress is 28,000 psi on the outer race resulting in a safety factor of 4.5 against yield and 5.2 against ultimate failure. For the waist bearing, thread engagement is sufficient so that bolt failure will occur before helicoil shearout.															
			MISSION: Abort EVA.	Design requirements for proper installation of the helicoils are specified in the assembly procedures when helicoils are installed in the waist bearing.															
			CREW/VEHICLE: Loss of crewman.	B. Test - Acceptance: The waist bearing is subjected to testing per airlock ATP 10043 at airlock with ILC source verification. The bearing is proof pressure tested in the test fixture. The fixture is pressurized to 8.0 (+0.2-0.0) psig and held for 5 minutes. Following proof pressure testing, the bearing is pressurized to 4.3 +/- 0.1 psig and subjected to cycle rotation. Leakage is verified to be less than 6.0 scc/min. The bearing is installed on the ILC lower torso fixture and pressurized to 4.3 +/- 0.1 psig.															
			TIME TO EFFECT /ACTIONS: Seconds.	LTA level leakage of less than 46.5 scc/min. is verified.															
			TIME AVAILABLE: N/A	PDA: See Acceptance test procedures.															
			TIME REQUIRED: N/A	Certification: The dual seal waist bearing successfully passed SSA certification testing (manned) to duplicate operational life. (Ref. "1153 Hour Cert Report for Redesigned Dual Seal Wasit Bearing, ILC Document 0111-710428). The following usage, reflecting requirements of significance to the waist bearing, was documented during certification:															
		REDUNDANCY SCREENS: A-N/A B-N/A C-N/A		<table border="1"> <thead> <tr> <th>Requirement</th> <th>S/AD</th> <th>Actual</th> </tr> </thead> <tbody> <tr> <td>Pressure Hours</td> <td>458</td> <td>1200</td> </tr> <tr> <td>Pressure Cycles</td> <td>300</td> <td>1080</td> </tr> <tr> <td>Waist Rotations</td> <td>2466</td> <td>7200</td> </tr> <tr> <td>Walking Steps</td> <td>4320</td> <td>77760*</td> </tr> </tbody> </table>	Requirement	S/AD	Actual	Pressure Hours	458	1200	Pressure Cycles	300	1080	Waist Rotations	2466	7200	Walking Steps	4320	77760*
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Walking Steps	4320	77760*																	

\* The walking steps were accomplished during the Enhanced Certification Testing (Ref. ILC Document 0111-711330).

In addition, the bearing has been subjected to screening tests where the bearing is bench cycled to a crew familiarization test profile with constant leakage monitoring.

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C. Inspection -

Components and material manufactured to ILC requirements at an approved supplier are documented from procurement through shipping by the supplier. ILC incoming receiving inspection verifies that the materials received are as identified in the procurement documents, that no damage has occurred during shipment and that supplier certifications have been received which provides traceability information.

The following MIP's are performed during the waist assembly manufacturing process to assure the failure cause is precluded from the fabricated item:

1. Visual inspection of the waist bearing O-Rings for gouges, nicks, tears and mold imperfections.
2. Verification of the presence of screws during the waist bearing clamping ring screw torque operation.
3. Visual inspection of races for foreign matter, corrosion or contamination.
4. Helicoil installation is verified during source inspection at the supplier.
5. Verification of cleanliness to vc level.
6. Visual inspection after proof and leakage testing for deformation, defects or damage.

During PDA, the following points are performed at the LTA assembly level in accordance with ILC document 0111-70028:

1. Visual inspection for vc level cleanliness and material degradation.
2. Visual inspection for structural damage following proof pressure test.
3. Verification of bearing torque less than 110 in-lb at 4.3 +/- 0.1 psig.

D. Failure History -

B-EMU-104-A058 (07/20/98) - Waist bearing failed leakage testing during PIA testing (6.9 sccm vs. limit of 6.0 sccm), but passed leakage testing on CTSD rigs after subtracting tare leakage. Waist bearing assembly was within allowable leakage specification during initial testing but falsely indicated high due to leakage of test stands and test fixtures. USA FCE/EVA requested to revise their test troubleshooting philosophy to account for any test stand leakages.

E. Ground Turnaround -

Tested per FEMU-R-001, Pre-Flight LTA Leakage Test. Additionally, every four years or 229 hours of manned pressurized time, the waist bearing is disassembled, inspected, cleaned, lubricated, reassembled and subjected to torque, structural, and leakage tests.

F. Operational Use -

Crew Response -

Pre/Post EVA: If during airlock operations, repress airlock. Otherwise consider third EMU if available. EMU no go for EVA.

EVA: When CWS data confirms SOP, abort EVA. Note: The SOP provides 30 minutes of O2 for a leak rate of 5 lb/hr.

Special Training - Standard training covers this failure mode.

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		104FM13		Operational Considerations - Flight rule A15.1.2-2 of "Space Shuttle Operational Flight Rules", NSTS-12820 defines go/no go criteria related to EMU pressure integrity. Generic EVA Checklist, JSC-48023, procedures Section 3 (EMU Checkout) and 4 (EVA prep) verify hardware integrity and systems operational status prior to EVA. Real Time Data System allows ground monitoring of EMU systems.

EXTRAVEHICULAR MOBILITY UNIT  
SYSTEMS SAFETY REVIEW PANEL REVIEW  
FOR THE  
I-104 LOWER TORSO ASSEMBLY (LTA)  
CRITICAL ITEM LIST (CIL)

EMU CONTRACT NO. NAS 9-97150

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