

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
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BOOT FABRIC ATTACHMENT RING ITEM 104 (1) LEFT, (1) RIGHT ----- 10154-04 (2)	1/1	104FM29 External gas leakage beyond SOP makeup capability.  Contamination, wear or deterioration of lip seal or o-ring, Defective material; clamping ring, fabric attachment ring, loose or missing clamp ring screws.	END ITEM: Suit gas leakage to ambient.  GFE INTERFACE: Depletion of primary O2 supply and SOP. Rapid depressurization of SSA beyond SOP makeup capability.  MISSION: Loss of EVA.  CREW/VEHICLE: Loss of crewman.  TIME TO EFFECT /ACTIONS: Seconds.  TIME AVAILABLE: N/A  TIME REQUIRED: N/A  REDUNDANCY SCREENS: A-N/A B-N/A C-N/A	A. Design - The fabric attachment ring is made of 7075-T73 Aluminum Alloy and is finished with Type II CLI anodize. All surfaces have a 63 finish. The threaded portion of the sizing ring is designed for "one way" initiation of threaded engagement to ensure proper alignment and locking. The static seal is made of a polyurethane compound. The clamping ring and the o-ring are used to seal the brief restraint and bladder to the fabric ring.  The fabric attachment ring threads were determined by analysis to have a minimum ultimate strength of 2344 lbs and a yield strength of 1674 lbs. At 4.4 psid (normal operating pressure) the S/AD limit load is 1076 lbs, giving the fabric attachment ring a safety factor of 2.2 for ultimate and 1.6 for yield. At 5.5 psid (max failure pressure) and 8.8 psid (max BTA operating pressure) the fabric attachment ring provides safety factors for ultimate of 2.2 and 2.7 respectively. The S/AD minimum safety factor for hardware at 4.4 psid is 2.0 for ultimate and 1.5 for yield. At both 5.5 psid and 8.8 psid the S/AD minimum safety factor for hardware is 1.5 for ultimate.  The threaded portion of the fabric attachment ring is coated with a dry film lubricant to allow smooth travel of the ring when being mated.  Design requirements for proper installation of helicoils into the fabric attachment ring are specified in its assembly procedures. Loss of fabric attachment ring clamping screws is precluded in the design by adherence standard engineering torque requirements for screw installation. The screws are torqued to 7-9 in lbs.  B. Test - Acceptance: The fabric attachment ring is subjected to testing per ATP 10154 at Airlock with ILC source verification. The assembly is pressurized in the test fixture to 8.0 + 0.2 - 0.0 psig for a 5 minute duration and leakage tested at 4.3 +/- 0.1 psig.  PDA: The following tests are conducted at the boot level in accordance with the ILC Document 0111-710112: 1. Initial leak test at 4.3 +/- 0.1 psig to verify leakage less than 7.0 scc/min. 2. Proof pressure test at 8.0 + 0.2 - 0.0 psig to verify no structural damage. 3. Post-proof pressure leak test at 4.3 +/- 0.1 psig to verify leakage less than 7.0 scc/min. 4. Final leak test at 4.3 +/- 0.1 psig to verify leakage less than 7.0 scc/min.  Certification: The LTA was successfully subjected to an ultimate pressure of 10.6 psig during SSA Certification testing. Ref. ILC Document 0111-70027. This is two times maximum operating pressure based on 5.3 psi. Recertification to 5.5 psi (maximum failure pressure) was by test and analysis (Ref. ILC EM 84-1108).  Certification: The boot assembly successfully passed SSA certification (manned) to duplicate operational life (Ref. ILC Document 0111-711330). The following usage, reflecting requirements of significance to the boot assembly, was during

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104FM29

certification:

Requirement	S/AD	Actual
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Ankle Cycles	11614	24000
Don/Doff Cycles	98	400
Pressure Hours	458	916
Pressure Cycles	300	600

The Enhanced Boot Assembly was successfully subjected to a BTA ultimate pressure of 13.2 psig (1.5 times max BTA operation pressure based on 8.8 psig). (Ref. ILC EM 91-1088).

The fabric attachment ring was successfully tested (manned) during SSA certification to duplicate 458 hours operational life (Ref. ILC Report 0111-711330). The following usage, reflecting requirements of significance to the fabric attachment ring, was documented during certification:

Requirement	S/AD	Actual
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Ankle Cycles	11614	24000
Don/Doff	98	400
Pressure Hours	458	916
Walking Steps	4320	77760

Two acceptable alternate static seals were developed and passed certification testing (Ref. Certification Report 0111-712694). The following usage, reflecting requirements of significance to the seal, were documented during certification:

Requirement	S/AD	Actual
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Engagement Cycles	300	600
Pressure Hours	458	916
Pressure Cycles	194 @ 4.3 psid	388
	74 @ 5.3 psid	148
	32 @ 6.6 psid	64

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 provide traceability information.

The following MIPs are performed during the boot assembly manufacturing process to assure that the failure causes are precluded from the fabricated item:

1. Visually inspect ring for scratches and burrs.

During PDA, the following inspection points are performed at the LTA assembly level per ILC document 0111-710112:

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		104FM29		<p>1. Inspection for cleanliness to VC level. 2. Visual inspection for damage, wear or material degradation. 3. Visual inspection for damage following proof-pressure test.</p> <p>D. Failure History - B-EMU-104-A067 (9/27/00) - EMU leaked during pre-flight full-up structural and leakage test. Right boot static seal cut. Boot seal punctured by improper use of unauthorized tool used to straighten seal lip after STS-92 pre-flight leak test. Field technicians re-instructed to follow procedures and visually inspect seal lips following any tool contact.</p> <p>E. Ground Turnaround - Tested for non-EET processing per FEMU-R-001, Pre-Flight LTA leakage test. None for EET processing. Additionally, every 4 years or 229 hours of manned pressurized time the sizing ring is disassembled, cleaned, inspected, lubricated, and reassembled.</p> <p>F. Operational Use - 1. Crew Response - Pre/PostEVA: If during airlock operations repress airlock. Otherwise consider third EMU if available. EMU no go for EVA. EVA : When CWS data confirms SOP activation with accelerated O2 use rate, abort EVA.</p> <p>2. Special Training - Standard training covers this failure mode.</p> <p>3. Operational Considerations - EVA checklist procedures verify hardware integrity and systems operational status prior to EVA. Flight rules define go/no-go criteria related to EMU pressure integrity.</p>

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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