

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE															
104FM31W BOOT FABRIC ATTACHMENT RING ITEM 104 (1) LEFT (1) RIGHT ----- 10154-04 (2)	2/1RB	Loss of primary and secondary bracket retention screws.  Defective material; screw, helicoil or thread lock adhesive.	END ITEM: One of two screws missing on one side of brackets.  GFE INTERFACE: Load is transferred to second screw.  MISSION: None for single failure.  CREW/VEHICLE: None with single failure. Loss of crewman with loss of second screw causing loss of primary and secondary restraint brackets.  TIME TO EFFECT /ACTIONS: Minutes.  TIME AVAILABLE: Days.  TIME REQUIRED: Hours.  REDUNDANCY SCREENS: A-PASS B-FAIL C-PASS	A. Design - The primary and secondary axial restraint brackets are installed with a single set of four screws fabricated from A-286 stainless steel and are procured to MS or NAS specifications. Loss of the brackets screws is precluded in design by adherence to standard engineering torque requirements for screw installation and the use of thread lock adhesive. Design requirements for proper installation of helicoils are specified in the assembly procedures when the helicoils are installed in the fabric attachment ring.  With one of the four screws missing testing has demonstrated that the bracket system exhibits an ultimate strength of 1750 lbs. At 4.4 psid (normal operating pressure), this load results in an ultimate safety factor of 2.1 against a S/AD load of 838 lbs. At 5.5 psid (max failure pressure) and 8.8 psid (max BTA operating pressure) the minimum ultimate safety factors are 2.9 and 9.1 respectively. The S/AD minimum ultimate safety factor requirement for hardware is 2.0 at 4.4 psid, 1.5 at both 5.5 psid and 8.8 psid.  B. Test - Acceptance: See Inspection.  PDA Test: The following test is conducted at the brief level in accordance with ILC Document 0111-710112: 1. Proof pressure test at 8.0 + 0.2 - 0.0 psig for a minimum of 5 minutes conducted with the TMG removed.  Certification: The Fabric Attachment Ring primary and secondary brackets were 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 primary and secondary brackets, was documented during certification: <table border="1"> <thead> <tr> <th>Requirement</th> <th>S/AD</th> <th>Actual</th> </tr> </thead> <tbody> <tr> <td>Ankle Cycles</td> <td>11614</td> <td>24000</td> </tr> <tr> <td>Don/Doff</td> <td>98</td> <td>400</td> </tr> <tr> <td>Pressure Hours</td> <td>458</td> <td>916</td> </tr> <tr> <td>Walking Steps</td> <td>4320</td> <td>77760</td> </tr> </tbody> </table> The Fabric Attachment Ring primary and secondary axial restraint brackets were successfully subjected to an ultimate pressure of 13.2 psig during SSA certification (Ref. ILC Document 0111-711330). This is 1.5 times maximum BTA operating pressure based on 8.8 psi.  The baseline LTA has passed shock, vibration and acceleration testing without loss of screw torque (Ref. Hamilton Standard Test Reports, TER 3067, 3048, 3043 and 3076). The enhanced LTA is certified by similarity to the baseline LTA assembly.  C. Inspection - Components and material manufactured to ILC requirements at an approved supplier	Requirement	S/AD	Actual	Ankle Cycles	11614	24000	Don/Doff	98	400	Pressure Hours	458	916	Walking Steps	4320	77760
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104FM31W

are documented from procurement through shipping by the supplier. ILC incoming receiving inspection verifies that the hardware received is 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 brackets which are machined from bar stock are magnetic particle inspected to detect the presence of flaws.

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

1. Verification of loctite application.
2. Helicoil installation is verified during source inspection at the supplier.
3. Verification of minimum engagement of 4 1/2 screw threads during screw threaded engagement procedures prior to torquing and thread locking assembly operation of the primary restraint bracket.
4. Brackets are visually inspected upon completion of the primary restraint webbing pull test for signs of defective materials.

During PDA, the following inspection points are performed at the boot level in accordance with ILC Document 0111-710112:

1. Visual inspection for structural damage to the primary bracket after proof pressure test.
2. Inspect for cleanliness to VC level, damage, wear and material degradation.

D. Failure History -

J-EMU-104--025 (1/28/99) -

Loose screws on upper outboard restraint bracket assembly. Design did not allow for tolerance stack-up of mating components, washers were thin enough to allow yielding during final torque. New screw and washer combinations incorporated per ECO 991-0042. ILC implemented an Engineering Department Operating Procedure (DOP #200-014) which incorporates a detailed mandatory design review checklist. HSD uses Pro/E for new designs. Pro/E has an interface checker function to identify potential tolerance stack-up problems.

E. Ground Turnaround -

None, for every component within its limited life requirement.

Every 4 years chronological time or 229 hours of manned pressurized time, during boot fabric attachment ring maintenance the primary and secondary restraint brackets are removed and reinstalled during which time loctite application and screw torque are verified.

F. Operational Use -

Crew Response -

PreEVA: No response, single failure undetectable by crew. Continue EVA prep.

EVA: No response, single failure undetectable by crew. Continue EVA.

Training -

No training specifically covers this failure mode.

Operational Considerations -

Not applicable.

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

Prepared by: *[Signature]* 3/27/02  
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