NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		104FM23		
BRIEF ASSEMBLY, ITEM 104 ---------- 0104-811071-04 (1)	2/1RB	Loss of fabric restraint. Separation of seam or hole in restraint fabric. Defective thread or restraint material.	END ITEM: Opening in fabric restraint exposing bladder. Loss of restraint circumferential load carrying capability. GFE INTERFACE: Loading and abrading of bladder. MISSION: None. CREW/VEHICLE: None with single failure. Loss of crewman with loss of bladder. TIME TO EFFECT /ACTIONS: N/A TIME AVAILABLE: N/A TIME REQUIRED: N/A REDUNDANCY SCREENS: A-PASS B-FAIL C-PASS	A. Design - The restraint is fabricated from 6.4 ounce dacron fabric which exhibits a minimum tensile strength of 300 lbs. (warp) and 250 lbs. (fill). Material strength is 7.1 (warp) and 8.5 (fill) times greater than the hoop load of 35.2 lbs. predicted for the lower torso at normal operating pressure of 4.4 psid. At 5.5 psid (max operating pressure) the restraint fabric provides ultimate safety factors of 6.8 for warp and 5.7 for fill. At 8.8 psid (max BTA operating pressure) the restraint fabric provides ultimate safety factors of 4.3 for warp and 3.6 for fill. S/AD minimum safety factors for softgoods at 4.4 psid is 2.0 for ultimate. At both 5.5 psid and 8.8 psid he S/AD minimum safety factors for softgoods is 1.5 for ultimate. The basic seam employed in the restraint construction is one row of join stitching and two rows of top stitching. Seams are formed using size "F" polyester thread per V-T-285D type II, class I with a lock stitch type 301 per FED-STD-751A. Seams are terminated by backtacking and searing of thread ends. Seam strength, as determined by testing, is equal to or better than the restraint material. A TMG serves to protect the restraint fabric and stitching from abrasion and puncture. There are two types of bladder fabric. One is constructed of a base nylon fabric with a solution coated urethane. The other is constructed of the same base nylon with a urethane laminate coating. The following paragraph applies to the solution coated nylon. Testing has shown that the bladder fabric minimum tensile strength is 105 lbs/inch (fill) and 140 lbs/inch (warp). The tearing strength is 3.5 lbs/inch in fill and 6.0 lbs/inch in warp. Nominally, hoop load is absorbed by the bias direction of the bladder fabric. However, the safety factors are based on the fabric yarns (fill yarns) which have the least strength. Based on a predicted hoop load of 35.2 lbs/inch at 4.4 psid (normal operating pressure), the minimum safety factor for hoop stress is 3.0. At 5.5 psid (max failure pressure) and at 8.8 psid (max BTA operating pressure) the safety factor are 2.4 and 1.5, respectively. The S/AD minimum safety factor for softgoods at 4.4 psid is 2.0. At both 5.5 and 8.8 psid, the S/AD minimum safety factor is 1.5. Testing has demonstrated that the breadkin strength of the bladder seams meets or exceeds that of the bladder fabric. The following paragraph applies to the laminate coated nylon. Testing has shown that the bladder fabric minimum tensile strength is 180 lbs/inch in the warp direction and 170 lbs/inch in the fill direction. The tearing strength is 3.5 lbs/inch minimum in both directions. Based on a predicted hoop load fo 35.2 lbs/inch, the minimum safety factor for hoop stress is 4.8 against a S/AD design minimum ultimate safety factor of 2.0 at 4.4 psid (normal operating pressure). At 5.5 psid (max failure pressure) and 8.8 psid (max BTA operating pressure) the safety factors are 3.8 and 2.4, respectively. The S/AD minimum safety factor for softgoods at 4.4 psid is 2.0. At both 5.5 and 8.8 psid, the S/AD minimum safety factor is 1.5. Testing has demonstrated that the breaking strength of the bladder seams meets for exceeds that of the bladder fabric.

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B. Test -
Acceptance -
Component- see inspection.
PDA:
The following test is conducted at the LTA level in accordance with ILC Document 0111-710112:
Proof pressure test at 8.0 + 0.2 - 0.0 psig with the TMG removed to verify no structural damage.

Certification -

The Brief assembly was successfully tested (manned) during SSA certification to duplicate 458 hours operational life with a factor of safety of 2.0 (Ref. ILC Report 0111-711330). The following usage, reflecting requirements of significance to the brief assembly, was documented during certification:

Requirement	S/AD	Actual
Hip Abd/Add	458	1200
Hip Flex/Ext	1524	3200
Waist Flex/Ext	1234	2800
Waist Roation	2466	6000
Don/Doff	98	400
Pressure Hours	458	916

The brief bladder assembly was successfully subjected to an ultimate pressure of 13.2 psid during SSA certification testing (Ref. ILC Report 0111-711330). This is 1.5 times maximum BTA operating pressure based on 8.8 psid.

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.

MIP's are performed for visual inspection of sewn seams during the lower torso restraint manufacturing process to assure that this particular failure cause is precluded from the fabricated item.

During PDA, the following inspection points performed at the LTA assembly level in accordance with ILC Document 0111-710112:
1. Visual inspection for fabric or material degradation. Seams are inspected for broken or frayed stitches.
2. Visual inspection for structural damage following proof pressure test conducted with TMG removed.

D. Failure History -
B-EMU-104-T005 (04/23/98) - Inspection revealed two small holes in a brief restraint due to abrasion agianst the axial restraint brackets. Investigation revealed that the brackets were boot brackets and not the authorized brief brackets. Boot brackets to be marked so that they can be positively identified.

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B-EMU-104-A064 (11/12/99) - Broken stitches along the inside seam of right leg of brief assembly (inboard) during buildup of LTA S/N 2027 for STS-101 support. Most probable cause is improper technique by sewing machine operator. Investigation results shared with machine operators to heighten awareness of skill requirements. Explained closed for all flights. All Class I briefs are acceptable based on successful completion of inspection per FEMU-R-001. All Class III briefs are acceptable based on successful completion of 40-hour maintenance.

B-EMU-104-T014 (11/23/99) - During 40-hour reverification (CL III) pressure testing, stitching on the brief assembly broke. Approximately 3 to 4 stitches were broken. Probable cause is abrasion of stitch from relative motion between brief restraint and bladder while exposed to NBL. Additional contributer is brief thigh break line termination in 4-corner seam junction. Broken stitch condition limited to Cl III hardware. Per NASA, future broken stitches along outside seams in CL III briefs to be reported on DR and returned to ILC for repair.

E. Ground Turnaround -
None, for every component within its limited life requirement.

The lower torso restraint and bladder assembly is subjected to LTA and EMU level structural and leakage tests. Every 4 years or 229 hours of manned pressurized time the brief restraint and bladder assembly is separated from the LTA and subjected to a complete visual inspection (interior and exterior surfaces) for material damage and degradation. Following reassembly to the LTA structural and leakage tests are performed.

F. Operational Use -

1. Crew Response:
Pre/post-EVA : Single failure not detectable, no response.
EVA : Single failure not detectable, no response.

2. Special Training -
No training specifically covers this failure mode.

3. 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

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