NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		103FM18		
LOWER ARM ASSEMBLY, ITEM 103 ---------- 0103-212123-13/14 (2)	2/1RB	Loss of primary and secondary axial restraint bracket screws. Defective material; screw, helicoil or thread lock adhesive.	END ITEM: One of two screws missing on one side of bracket. GFE INTERFACE: Load is transferred to second screw. MISSION: None for single failure. CREW/VEHICLE: None for single failure. Loss of crewman with loss of second screw on same side of restraint brackets. TIME TO EFFECT /ACTIONS: Minutes. TIME AVAILABLE: Days. TIME REQUIRED: Days. 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 procurred to MS or NAS specifications. Loss of wrist disconnect primary and secondary restraint brackets screws is precluded in design by adherence to standard engineering torque requirements for screw installation and the use of thread locking adhesive. With one of the four screws missing, testing has demonstrated that the bracket system exhibits a minimum strength of 1540 lbs. At 4.4 psid (normal operating pressure), this load results in a minimum ultimate safety factor of 7.0 against a S/AD load of 219 lbs. At 5.5 psid (max failure pressure) and 8.8 psid (max BTA operating pressure) the minimum ultimate safety factors are 7.5 and 9.7 respectively. The S/AD minimum 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 - PDA: The following test is conducted at the arm assembly level in accordance with ILC Document 0111-710112: Visual examination of the primary and secondary restraint brackets for structural damage following a proof pressure test at 8.0 + 0.2 - 0.0 psig for a minimum of 5 minutes conducted with the TMG removed. Certification: The wrist disconnect 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: Requirement S/AD Actual Don/Doff 98 400 Pressure Hours 458 916 The wrist disconnect primary and secondary axial restraint brackets were successfully subjected to an ultimate pressure of 13.2 psid during SSA certification (Ref. ILC Report 0111-711330). This is 1.5 times maximum BTA operating pressure based on 8.8 psid. During certification testing, with one of four (two on each side) Wrist Disconnect Restraint Brackets Mounting screws missing, the primary restraint bracket yielded at 850 lbs. The load was transfered to the secondary bracket, which sustained a load of 1000 lbs. without failure. This demonstrates (for one screw missing) a Restraint Bracket mounting screw minimum ultimate safety factor of 4.6 when compared to the S/AD lower arm limit load of 219 lbs. and a safety factor requirement of 2.0. The baseline arm assembly has passed shock, vibration and acceleration testing without loss of screw torque (Ref. Hamilton Standard Reports TER 3067, 3048,

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3043 and 3076). The Enhanced Arm Assembly has been certified by similarity to the baseline arm.

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 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 following MIP's are performed during the lower arm assembly manufacturing process to assure the failure causes are precluded from the fabrication item:
1. Verification of the presence of screws during the torquing and thread lock application assembly operation.
2. Helicoil installation is verified during source inspection at the supplier.
3. Verification of a minimum engagement of 4.5 screw threads during screw thread engagement procedure prior to torquing and thread locking assembly operations.

D. Failure History -
None.

E. Ground Turnaround -
None for every component which is within its limited life requirements.

Also, every 229 hours of manned pressurized time or 4 years chronological time, during wrist disconnect 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 - Single failure not detectable.
EVA: No response. Single failure not detectable.
Training - No EMU training specifically covers this failure mode.
Operational Considerations - Not applicable.

EXTRAVEHICULAR MOBILITY UNIT

SYSTEMS SAFETY REVIEW PANEL REVIEW

FOR THE

I-103 ARM ASSEMBLY

CRITICAL ITEM LIST (CIL)

EMU CONTRACT NO. NAS 9-97150

Prepared by: _____
HS - Project Engineering

Approved by: _____
NASA - SSA/SSM

_____
HS - Reliability

_____
NASA - EMU/SSM

_____ 4/24/02
HS - Engineering Manager

_____ 6/26/02
NASA - S&MA

_____ 6/27/02
NASA - MOD

_____ 7/1/02
NASA - Crew

_____ 7-1-02
NASA - Program Manager