NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		106FM13		
GLOVE ASSEMBLY, 4000, ITEM 106 --- 0106-111723-15/-16 (2) GLOVE ASSEMBLY, PHASE VI, ITEM 106 --- 0106-110106-09/-10, -11/-12 (2)	2/2	Physical binding or jamming of bearing. Contamination or foreign matter; Defective Material: ball bearings, races pressure seal, corrosion, dislodged environmental seal. P/N 10088: Defective material: inner/outer race, ball bearings, vespel spacer balls or lip seals. Contamination or foreign matter in race. Corrosion, dislodged seal.	END ITEM: Binding or jamming of bearing. Bearing torque increased. GFE INTERFACE: Hampered mobility in wrist movement. MISSION: Terminate EVA. CREW/VEHICLE: None. TIME TO EFFECT /ACTIONS: Minutes. TIME AVAILABLE: N/A TIME REQUIRED: N/A REDUNDANCY SCREENS: A-N/A B-N/A C-N/A	A. Design - The bearing design precludes contamination or foreign materials entering the bearing by use of environmental seals. Two environmental seals are utilized, one facing the pressurized side of the bearing. The environmental seals are made of teflon. These seals keep contaminants and foreign material from entering the bearing to cause it to jam. Bearing races are made of 17-4 PH stainless steel and the ball bearings are made of 440C stainless, both of which resist corrosion to preclude the bearing from jamming. The environmental seals fit into grooves provided in the inner and outer races which prevent dislodging of the seals. In use, no forces act on the seal to dislodge it from its grooves. Pressure seals are made of polyester polyurethane and are lightly lubricated to prevent wear and lessen torque. B. Test - Acceptance: The wrist disconnect glove side is subjected to testing per ATP 9807, ATP 9808, ATP 9924 or ATP 10088 at Airlock with ILC source verification. The assembly is rotated twenty complete turns and the torque is verified to be a maximum of 2.0 in-lb (9924) and 4.0 in-lb (9807, 9808, 10088) to verify proper assembly of the bearing. PDA: The following test is conducted at the Glove Assembly level in accordance with ILC Document 0111-70028 (4000 glove) or 0111-710112 (Phase VI glove): Wrist disconnect glove side torque to be less than 2.0 in-lbs. (9924) and 4.0 in-lbs (9807, 9808, 10088) at 4.3 +/- 0.1 psig. Certification: The wrist disconnect was successfully tested (manned) during SSA certification to duplicate six year(softgoods) and 15 year (hardware) operational life. P/N 9924: The following usage, reflecting requirements of significance for the low torque wrist disconnect (P/N 9924), was documented during certification (Ref. ILC Documents 0111-77511). Requirements — S/AD — Actual Wrist Rotations — 26519 — 56472 Pressurized Hours — 1153 — 1153 Pressurized Cycles — 1080 — 1080 Don/Doff Cycles — 360 — 432 P/N 9807, 9808: The following usage, reflecting requirements of significance for baseline wrist disconnect (P/N 9807/9808) was documented during certification: (Ref. ILC Document 0111-70027 and EM 83-1083). Requirements — S/AD — Actual

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		106FM13		

Wrist Rotations 26519 55579
Pressurized Hrs 1153 1182
Pressurized Cycles 1080 1080
Don/Doff Cycles 360 602

P/N 10088:
The following usage, reflecting requirements of significance for Dual Seal Wrist Bearing 10088, was documented during certification: (Ref. ILC Report 0111-711330).

Requirement	S/AD	Actual
Rotation	40224	82000
Engage/Disengage	300	1080
Don/Doff	98	400
Pressure Hours	458	916

In addition, Dual Seal Wrist Bearing 9924 was certified, by similiarity to Wrist Bearing 10088, for use with the Phase VI glove.

The 4000 Series glove wrist disconnect assembly was successfully subjected to an ultimate pressure of 13.2 psig during SSA certification. This is 1.5 times the BTA maximum operating pressure of 8.8 psig.

Recertification was by test and analysis (Ref. ILC EM 84-1108).

The Phase VI glove assembly was successfully subjected to an ultimate pressure of 13.2 psig during Certification Testing (Ref ILC doc 0111-7127901). This is 1.5 times the maximum BTA operating pressure based on 8.8 psig.

C. Inspection -
4000:
Components and material manufactured to ILC requirements at an approved supplier are documented from procurement through shipping by the suppliers. ILC incoming receiving inspection verifies that the materials received are as identified in the procurement documents, that no damage has occurred during shipping and that supplier certifications have been received which provide traceability information.

The following MIP's are performed during the glove wrist disconnect assembly manufacturing process to assure the failure cause is precluded from the fabricated item:
1. Visual inspection of the lip seal and environmental seals for gouges, nicks, tears and degradation.
2. Verification of bearing torque.

During PDA, the following inspection points are performed at the glove assembly level in accordance with ILC Document 0111-70028 (4000 glove) or 0111-710112 (Phase VI glove):
1. Visual inspection for cleanliness to VC level.
2. Visual inspection for damage after proof pressure test.
3. Verification of bearing torque not to exceed 2.0 in-lbs for 9924 assemblies and 4.0 in-lbs for 9807/9808 assemblies.

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		106FM13		

D. Failure History -
B-EMU-106-A024 (6/6/91) - The wrist disconnect exhibited high breakaway torque of 4.3 in-lbs (Spec: 0.5 in-lbs) and a running torque of 1.9 in-lbs (Spec: 1.2 in-lbs) due to the absence of lubrication on the seal lip or sealing surface of the bearing race. BAO procedures have been clarified to ensure lubrication of the sealing surface and verification.
B-EMU-106-A030 (6/8/92) - Low torque wrist disconnect P/N 9924-02, S/N 109, exhibited a high running torque of 2.0 in - lbs (spec:1.2 in - lbs) due to an unidentified brown substance on the bearing seals and sealing surfaces after STS-49 flight use (Intellsat). The origin of the brown contamination could not be determined. No corrective action taken.
B-EMU-106-A031 (6/10/92), B-EMU-106-A032 (6/16/92), B-EMU-106-A033 (6/19/92), B-EMU-106-A034 (7/1/92), B-EMU-106-A035 (7/1/92), B-EMU-106-A036 (7/10/92) - All cases of low torque wrist disconnect, P/N 9924-02 excessive torque. Tracked by B-106-A030.
I-EMU-106-A002 (1/29/93) - The wrist disconnect exhibited a high starting torque of 1.8 in-lbs (Spec:1.2 in-lbs) and a running torque of 2.9 in-lbs (Spec: 2.0 in-lbs) after STS-54. The cause was the combination of an unidentified brown substance on the pressurized side of the lip seal and the lip seal not being completely seated in the groove. The Maintenance Manual lube and lip seal installation procedures have been clarified.

E. Ground Turnaround -
Tested per FEMU-R-001, Glove Pre-Flight Test Requirements, wrist bearing subjective torque evaluation.

Additionally, every 2 yrs. or 56 hours of manned pressurized time on the 4000 or every 4 years or 229 hours of manned pressurized time on the 4000 when wrist bearing 10088 is installed, the wrist disconnect is disassembled, cleaned, inspected, lubricated and reassembled. Following reassembly quantitative torque test is performed.

F. Operational Use -
Crew Response -
Pre/post-EVA : Troubleshoot problem. If no success, use spare gloves if available. Otherwise continue EVA operations.
EVA : If hand dexterity is reduced considerably, stop hand intensive work or terminate EVA.
Special Training - No training specifically covers this failure mode.
Operational Considerations - Not applicable.

EXTRAVEHICULAR MOBILITY UNIT

SYSTEMS SAFETY REVIEW PANEL REVIEW

FOR THE

I-106 GLOVE ASSEMBLY

CRITICAL ITEM LIST (CIL)

EMU CONTRACT NO. NAS 9-97150

Prepared by: _____
HS - Project Engineering

_____
HS - Reliability

_____
HS - Engineering Manager

Approved by: _____
NASA – SSA/SSM

_____
NASA – EMU/SSM

_____
NASA – S&MA

_____
NASA – MOD

_____
NASA – Crew

_____
NASA – Program Manager