NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		106FM10		
GLOVE ASSEMBLY, 4000, ITEM 106 --- 0106-111723-15/-16 (2)	1/1	External gas leakage beyond SOP makeup capability.	END ITEM: Suit gas leakage to ambient.	A. Design - 9924 and 10088 contamination is precluded from entering the wrist bearing assembly by two teflon environmental seals, one on each side of the bearing assembly. These seals fit into mating grooves in the inner and outer races and form a seal to preclude introduction of contamination into the pressure seal and ball raceway areas. The lip seal is made of polyester polyurethane and is lightly lubricated with Brayco 814Z oil to preclude wear. The 9924 seal cross section provides a minimum 0.004" seal squeeze to maintain positive operational pressure. When pressurized, the 9924 lip extends to seal firmly against the inner race to insure a maximum bearing leak of 4.0 SCCM and torque that will not exceed 2 in-lbs. The 10088 seal cross section is "V" shaped and provides a 0.012" to 0.018" seal squeeze to maintain positive operational pressure. When pressurized the lip expands to seal firmly against the bearing races to insure a maximum bearing leak of 4.0 SCCM and a torque that will not exceed 4 in-lbs. Wrist bearing races are made from 17-4 PH stainless steel hardened to a 1050 condition. Bearing balls are 440C stainless steel and the clamping rings are 7075-T73 aluminum.
GLOVE ASSEMBLY, PHASE VI, ITEM 106 --- 0106-110106-09/-10, -11/-12 (2)		ALL P/Ns 9807, 9808, 9924, 10088: Contamination. Defective inner/outer race, clamping ring, O-ring. Cracked outer race, missing or loose clamping ring screws or ball port plug retainer screws helicoils. P/Ns 9807, 9808, 9924: Wear or deterioration of separator pressure seal or lip seal.	GFE INTERFACE: Depletion of primary O2 supply and SOP. Rapid depressurizatio n of SSA beyond SOP makeup capability. MISSION: Abort 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	Results of a stress analysis identifies the most likely failure modes, i.e., those with the lowest safety factor for the low torque wrist disconnect (P/N 9924). The maximum bending stress occurs on the outer race at the restraint bracket interfaces. An ultimate stress safety factor of 5.2 exists compared to the S/AD requirement of 2.0. Wrist bearing races are made from 17-4 PH stainless steel hardened to a 1050 condition. Bearing balls are 440C stainless steel and the clamping rings are 7075-T73 aluminum, for the 4000 Series Gloves. Design requirements (9924, and 10088) for proper installation of the helicoils are specified in the assembly procedures when helicoils are installed in the wrist bearing. Testing, during the screw thread engagement study, showed that the thread shear out ultimate safety factor for the wrist disconnect arm restraint/clamping ring screws is 7.1. A Fluorosilicone O-ring is mounted on the outer race of the wrist disconnect glove side to preclude leakage between the wrist disconnect and glove restraint/bladder. The O-ring is in a static condition and is unlikely to be damaged or degraded during usage. Incidence of a loose retainer screw is precluded in design by adherence to standard enginering torque requirements for screw installation. The insert retainer screw is torqued to 2-3 in-lbs. B. Test - Acceptance Test - The wrist disconnect glove side is subjected to testing per ATP 9924, or 10088 at Airlock with ILC source verification. The assembly is pressurized to 8.0 (+0.2, 0.0) psig for a five minute duration and leakage tested to 4.3 +/- 0.1 psig. The assembly is rotated twenty complete turns. The torque is verified in a test fixture to be a maximum of 4.0 in lb for the 10088 and 2.0 in-lb for the 9924 assemblies, indicating proper assembly of the bearing. PDA Test - The following tests are conducted at the glove assembly level in accordance with ILC Document 0111-70028 (4000 glove) or 0111-710112 (Phase VI glove): 1. Initial leak test at 4.3 +/- 0.1 psig to verify leakage less than 8.0 scc/min.

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		106FM10		

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 8.0 SCC/MIN.
4. Post-cycle leak test at 4.3 +/- 0.1 psig to verify leakage less than 8.0 scc/min.
5. Wrist disconnect glove side torque to be less than 10.0 in-lb for the 9924 and 4.0 in-lbs for the 10088 at 4.3 + 0.1 psig which is an indication that an acceptable seal is contained in the wrist disconnect.

Certification Test -
The wrist disconnect (9924) was successfully tested (manned) during SSA certification to duplicate six year (softgoods) and 15 year (hardware) operational life. The wrist bearing (10088) was successfully tested during SSA certification to duplicate 458 hours operational life.

The following usage, reflecting requirements of significance for the wrist disconnect, was documented during certification (ref. ILC Documents 0111-70027, and EM 83-1083). For the wrist bearing (10088) Ref. ILC Document 0111-711330:

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

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

C. Inspection -
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 pressure/separator seal (or lip seal) and O-ring for gouges, nicks, tears and mold imperfections.
2. Verification of the presence of screws during the torquing assembly operation.
3. Verification of a minimum engagement of 4.5 screw threads during axial restraint bracket screw thread engagement procedure prior to torquing and thread locking assembly operations of the wrist disconnect.

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 material degradation.
2. Visual inspection for cleanliness to VC level.

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		106FM10		3. Visual inspection, for structural damage after proof pressure test. 4. Verification of torque to be less than 2.0 in-lbs for the 9924, and 4.0 in-lbs for the 10088 at 4.3 + 0.1 psig. D. Failure History - B-EMU-106-A018 (8-9-88) External leakage through wrist disconnect above 8 sccm caused by defect on pressure seal due to improperly cleaned seal mold prior to fabrication. Employee retrained correctly per PS1173. E. Ground Turnaround - Tested per FEMU-R-001, Pre-Flight leakage test. F. Operational Use - Crew Response - EVA: When CWS data confirms SOP activation, abort EVA. Special Training - Standard training covers this failure mode. Operational Considerations - Flight rule A15.1.2-2 of "Space Shuttle Operational Flight Rules", NSTS-12820 defines go/no go criteria related to EMU pressure integrity. Generic EVA Checklist, JSC-48023, procedures Section 3 (EMU Checkout) and 4 (EVA prep) verify hardware integrity and systems operational status prior to EVA. Real Time Data System allows ground monitoring of EMU systems.

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