NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		105FM01		
HELMET ASSEMBLY, ITEM 105 --- A/L 9672-03 (1)	1/1	External gas leakage beyond SOP makeup capability. Bubble cracked, or separated from neck ring. Chemical attack by on-board chemicals or fuels (hydrazine). Defective material, bonding. External impact on CPV assembly. Cracked neck ring.	END ITEM: Suit gas leakage to ambient. 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	A. Design - The helmet bubble is mechanically locked to the helmet neck ring via a bayonet configuration machined into both the helmet neck ring and helmet bubble. The machined groove in the bubble is 0.130 + 0.005-0.000 and the matching machined feature of the neck ring is 0.125 + 0.00-0.005. The gap created by the machining tolerance (.005 to .015) is filled with polyurethane adhesive to seal the helmet bubble to the neck ring interface. The mechanical bayonet fitting/groove locking feature locks the helmet to the neck ring against rotational and axial (plug) loading. The helmet bubble is therefore in shear and the adhesive serves as a sealant only. Defective bayonet fitting/grooves are precluded by adherence to specified engineering dimensions and tolerances defined by drawing/specification requirements. This same helmet configuration was utilized during the Apollo program. The helmet bubble is hydro-formed from polycarbonate sheet stock which is one of the high strength engineering thermoplastics. Defects are easily detected visually in this clear sheet stock both before and after forming. The Helmet neck ring is made from 7075-T73 aluminum. The only portion of the Helmet Assembly which is not protected by the EVVA (Extravehicular Visor Assembly) is the CPV (Combination Purge Valve). The geometry of the CPV attachment is such that it is not possible to apply a high external load to it, except perpendicular to the outer face of the CPV. Any other load will glance off as the CPV position changes as the Helmet Shell deflects. Non-perpendicular bench testing of a pressurized Helmet (without EVVA) on a tensile test machine showed 1 1/2" deflection of the CPV position at 128 lbs. applied load. This was the maximum load which could be applied before the load slipped off. There is only .040 inch clearance between the CPV and the EVVA, so the EVVA would have absorbed a major portion of the load, and distributed it. A leak check after the bench testing showed no Helmet leakage. The helmet is protected from direct impingement of hydrazine by the polycarbonate EVVA Shell and Protective Visor. If deployed, the polysulfone Sun Visor provides an additional barrier for the front of the helmet, since it resists hydrazine attack. The TMG on the EVVA Shell also absorbs some hydrazine before soaking through. The Apollo configuration helmet, which had an identical neck ring and shell as shuttle, was subjected to burst testing at ILC/JSC. Post test summary S81-16 shows that an attempt to burst test a helmet with water pressure saw leakage occur at the feed port (now CPV) opening at 33 psi. At 58 psi, the test was discontinued with no visible damage to neck ring, shell or their interfaces. This compares to the max operating pressure of 5.3 psi. B. Test - Acceptance: The helmet assembly is subjected to testing per ATP 9672 at airlock with ILC verification. The assembly is pressurized in the test fixture to 8.0 (+0.2 - 0.0) psig for a 5 minute duration and leakage tested to 4.3 +/- 0.1 psig. PDA: The following tests are conducted on the Helmet Assembly in accordance with ILC Document 0111-70028J:

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		105FM01		1. Initial leak test at 4.3 +/- 0.1 psig to verify leakage less than 5.0 scc/min. 2. Proof pressure test at 8.0 (+0.2 - 0.0) psig for 5 minutes to verify no structural damage. 3. Post-proof pressure leak test at 4.3 +/- 0.1 psig to verify leakage less than 5.0 scc/min. Certification: An Apollo helmet was successfully tested during SSA certification to duplicate operational life. (Ref. ILC Engineering Memorandum 83-1083 and EM 98-0008). The following usage, reflecting requirements of significance to the helmet was documented during certification. Requirement / S/AD / Actual Activation Cycles: 300 / 1080 Pressure Hours: 458 / 1162 Pressure Cycles: 300 / 1832 The helmet was successfully subjected to an ultimate pressure of 10.6 psig during SSA certification testing. Ref. ILC Document 0111-70027. This is two times normal maximum operating pressure based on 5.3 psi. Recertification to 5.5 psi was by test and analysis (ref. ILC EM 84-1108). Helmet was successfully tested to verify its acceptability for 8.0 psi use (ref. NASA Report CSD-SH-240). Testing included 50 pressure cycles and 1400 hours pressurized time @ 8.8 psig and 520 pressure cycles at 13.2 psig. Tests also included a burst presure check at 23.8 + .2 psig followed by a leakage check which disclosed no leaks. Maximum shuttle operating pressure is 5.3 psi. Maximum failure pressure is 5.5. 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 provides traceability information. The following MIP's are performed during the helmet assembly manufacturing process to assure the failure causes are precluded from the fabricated item: 1. Inspection for leakage during leakage tests. 2. Visual inspection for damage after proof and leakage tests. 3. Inspection of adhesive bonding. During PDA, the following inspection points are performed at the Helmet Assembly level in accordance with ILC Document 0111-70028J: 1. Visual inspection for damage prior to testing. 2. Verification of leakage less than 5.0 scc/min during initial leakage tests; no structural damage following proof pressure test, and leakage less than 5.0

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		105FM01		scc/min during post-proof pressure leak test. D. Failure History - None. E. Ground Turnaround - Tested for non-EET processing per FEMU-R-001, Pre-Flight leakage test. None for EET processing. Every four years the helmet is demated from the EVVA and CPV, and is visually inspected for material degradation or damage (particularly at CPV and EVVA interface attachment areas). F. Operational Use - 1. Crew Response - EVA : When CWS data confirms SOP activation, abort EVA. 2. Special Training - Standard training covers this failure mode. 3. Operational Consideration - EVA checklist procedures verify hardware integrity and systems operational status prior to EVA. Flight rules define go/no-go criteria related to EMU pressure regulation and pressure integrity.

EXTRAVEHICULAR MOBILITY UNIT

SYSTEMS SAFETY REVIEW PANEL REVIEW

FOR THE

I-105 HELMET ASSEMBLY

CRITICAL ITEM LIST (CIL)

EMU CONTRACT NO. NAS 9-97150

Prepared by: _____ 3/27/02
HS - Project Engineering

Approved by: _____
NASA - SSA/SSM

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NASA - MOD

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NASA - Crew

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NASA - Program Manager