

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

102FM03				
NECK RING ASSEMBLY & VENT SEAL ASSEMBLY, ITEM 102	1/1	External gas leakage beyond SOP makeup capability.	END ITEM: Suit gas leakage to ambient.	A. Design - The neck ring is attached to the hard torso shell flange by 24 screws. A gasket made from RTV-630 silicone is installed between the neck ring and flange to provide a seal. The static nature of this seal precludes leakage caused by contamination and wear. Testing has shown that one missing neck ring attachment screw did not result in a significant leak. It wasn't until four attachment screws over the arm were removed that leakage exceeded the SOP make up capability. The screws are loctited and torqued to 5-7 in-lbs to insure that they remain in place. The neck ring housing is made from 7075-T73 aluminum. A stress analysis of the HUT neck ring and mating helmet neck ring for bending, shearing, compression and torsional shear stress of the latch housing, latch pins and latch pin landing show that the lowest ultimate factor of safety is 3.63. This represents the latch pin bearing stress on the helmet neck ring and occurs at the S/AD condition of 5.5 psid maximum operating pressure. This type of stress is not likely to result in failure or loss of sealing. The next lowest ultimate factor of safety is 4.69 and represents shear stress of the material above the latch pin in the outer neck ring. Ring bending and torsional shear stresses from a four pin support with transverse uniform loading resulted in safety factors greater than 30. The neck ring to helmet lip seal is made of polyurethane which has a specified eight year limited life to eliminate unacceptable deterioration. The portion of the helmet which mates with the lip seal has a 15 degree taper, a radius of 1/32 inch and an anodized surface finish of 63 to prevent seal wear. The seal is lightly lubricated with Krytox 240 AC to further preclude wear during don/doff. The maximum clearance between the the helmet and the neck ring at the seal interface is 0.024 inches. This prevents contamination greater than 600 microns from entering the seal area. Once mated, the seal becomes static and is not subjected to wear from relative motion.
A/L 9357-11 (1)		Contamination, wear, or deterioration of Neck Ring Lip Seal.	GFE INTERFACE: Depletion of primary O2 supply and SOP. Rapid depressurizatio n of SSA beyond SOP makeup capability.	
A/L 9715-03 (1)		Missing or loose mounting screws. Defective Neck Ring Gasket. Cracked Neck Ring.	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	B. Test - Component Acceptance Test - The neck ring assembly which includes the lip seal is proof pressure tested at 8.0 + 0.2 - 0.0 psig and leak checked at 4.3 +/- 0.1 psig per Airlock ATP 9357-10 prior to acceptance by ILC. The specified leakage for the neck ring assembly is 10.0 scc/min. PDA Test - The following tests are conducted at the HUT Assembly level in accordance with ILC Document 0111-70028J (Pivoted HUT) or 0111-710112 (Planar HUT). 1. Initial leak test at 4.3 +/- 0.1 psig to verify leakage less than 21.0 scc/min. 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 21.0 scc/min. 4. Final leak test at 4.3 +/- 0.1 psig to verify leakage less than 21.0 scc/min. Five neck ring plug engagements, actuations and disengagements are performed prior to the pressure tests. To assure proper assembly, fit and operation of the parts. Certification Test - The neck ring was successfully tested (manned) during SSA certification to duplicate operational life (Ref. EM 83-1083, EM 98-0008 and ILC Report 0111-711330). The following usage reflecting requirements of significance to the neck ring was documented during certification:

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Requirement	S/AD	Actual
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Actuation Cycles	300	1080
Pressure Hours	458	916
Pressure Cycles	300	600

The neck ring was successfully subjected to an ultimate pressure of 13.2 psid during SSA certification testing (Ref. ILC Report 0111-79405). This is 1.5 times the maximum BTA operating pressure based on 8.8 psid. The neck ring also passed shock, vibration, and acceleration testing to S/AD limits. REF-Hamilton Standard TER's 3043,3048 & 307C.

Two acceptable alternate materials for the lip seal of the neck ring were developed and certified (Ref. Certification Report 0111-712694). Each material is a polyurethane rubber, however, each is of a different compound. The lip seal design envelope is identical for each of the materials used in the neck ring lip seal.

Requirement	S/AD	Actual
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Engagement Cycles	300	600
Pressure Hours	458	916
Pressure Cycles	194 @ 4.3 psid	388
	74 @ 5.3 psid	148
	32 @ 6.6 psid	64
	4 @ 13.2 psid	10
	2 @ 15.8 psid	7

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 certification has been received which provides traceability information. The following MIP's are performed during the neck ring assembly manufacturing process to assure the failure causes are precluded from the fabricated item:
 Verify no permanent deformation after 8.0 psig proof pressure test.
 Verify leakage at 4.3 psi (10 scc/min max).
 Verify conformance to all dimensions of drawing.
 Verify presence of screws, screw torquing and applications thread locking adhesive.

During PDA, the following inspection points are performed at the HUT assembly level in accordance with ILC Document 0111-70028J (Pivoted HUT) or 0111-710112 (Planar HUT):

1. Verify successful completion of proof pressure and leakage tests.
2. Verify neck ring closure dimensions.
3. Verify neck ring disconnect engagement 5 times and record force.
4. Inspect for cleanliness to VC level.

D. Failure History -

None.

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E. Ground Turnaround -
Tested for non-EET processing per FEMU-R-001, Pre-Flight Final SEMU Gas Structural and Leakage. None for EET processing. Every 4 years or 229 hours of manned pressurized time the neck ring is disassembled, cleaned, inspected, lubricated and reassembled. Additionally, structural and leakage tests and engagement tests are performed.

F. Operational Use -
Crew Response -

Pre/PostEVA: If during airlock operations repress airlock.
Otherwise consider third EMU if available. EMU no go for EVA.
EVA: When detected audibly or CWS data confirms SOP activation with accelerated O2 use rate, abort EVA.

Training - Standard EMU training covers this failure mode.

Operational Considerations -EVA checklist procedures verify hardware integrity and systems operational status prior to EVA. Flight rules define go/no go criteria related to EMU pressure integrity. Real Time Data System allows ground monitoring of EMU systems.

EXTRAVEHICULAR MOBILITY UNIT
SYSTEMS SAFETY REVIEW PANEL REVIEW
FOR THE
I-102 HARD UPPER TORSO (HUT)
CRITICAL ITEM LIST (CIL)
EMU CONTRACT NO. NAS 9-97150

Prepared by: J. Chumley 3/27/02
HS - Project Engineering

Approved by: [Signature]
NASA - SSFVSSM

M. Snyder
HS - Reliability

[Signature] 5/14/02
[Redacted]

[Signature] for RTR
HS - Engineering Manager

[Signature] 5/23/02
[Redacted]

[Signature] 5/23/02
[Redacted]

[Signature] 6/04/02
[Redacted]

[Signature] 6/14/02
[Redacted]