

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

102FM20				
GIMBAL ASSEMBLY/PIVOT, ITEM 102 ----- SV772302-1 (2) OR ----- SV772303-5 (2) OR ----- SV772305-1 (2)	1/1	Broken pivot. Defective material; pivot, pivot support, bushing or gimbal, shearing of pivot support; binding. Missing or loose pivot support screws. Worn pivot. Impact.	END ITEM: Loss of gimbal axial load restraining capability. GFE INTERFACE: Bellows loaded and separates from attachment or ruptures. Depletion of primary O2 supply and SOP. Rapid depressurization of SSA beyond SOP makeup capability. MISSION: Abort EVA. CREW/VEHICLE: Loss of crewman. TIME TO EFFECT /ACTIONS: Immediate. TIME AVAILABLE: N/A TIME REQUIRED: N/A REDUNDANCY SCREENS: A-N/A B-N/A C-N/A	A. Design - The Pivot Support is precision machined from AMS 5663 or AMS 5596 stainless steel, precipitation hardened to HRC 34-44 for strength. It is designed to a 1.5 factor of safety against yield strength based on the minimum engagement with the pivot bushing allowed by drawing dimensions and pivot to pivot deflection at 5.5 psig. The bushing is made from AMS 5735 and both bushing and support are dry film lubricated per HS 248 CL 40 Type A1. The pivot socket is chrome plated AMS 5512 stainless steel. The socket/bushing interface is lubricated per standard ILC procedure. An interference interlocking attachment of the gimbal and pivot support prevents disengagement of the gimbal even if all the pivot support screws are lost during EVA. The screws have self-locking kel-F inserts to prevent loosening. The screws are not loaded during pressurization or man load due to interlocking design of support and gimbal. The screws prevent gimbal disengagement during HUT Doffing. The pivot is designed to insure adequate support shaft and bushing engagement under all loading conditions. The position of the gimbal pivots in relation to the DCM and PLSS significantly reduces the possibility of impact directly at the pivot area. Radial load limiters are bonded to the fiberglass retention rings on HUT's that have a gap of 0.1075 inches or more between the fiberglass retainer ring and the scye bearing retainer ring. The radial load limiter is a rectangular shim that assists in reacting pivot loads into the Hard Torso Shell to preclude gimbal pullout. The load limiter is bonded using EA934NA epoxy adhesive to the fiberglass retainer in the front pivot area only. B. Test - Acceptance: A pivot pull test is conducted per HS Document SVHS8512 to a minimum of 1.35 times max. load. PDA: During PDA, the Pivot as part of the HUT Assembly, is proof pressure checked at 8.0 psig, per ILC Document 0111-70028. This is 1.5 times the maximum operating pressure of the SSA. Certification: The Pivoted HUT was successfully tested (manned) during SSA certification to duplicate operational life. (Ref. EM 83-1083, ILC Report 0111-70027 and EM 98-0008). The following usage reflecting requirements of significance to the HUT was documented during certification: Requirement S/AD Actual ----- ---- ----- Pressure Hours 461 1707 Pressure Cycles 432 1425 Don/Doff Cycles 144 625

Two tests of production HTS's (Ref. H.S. Documents SEMU-62-005 and SEMU-62-007) verified a minimum Pivot strength of 780 pounds per pivot. The worst-case load on an extra large HUT at 5.5 psig suit pressure (212 lbs. plug load) plus maximum man load (150 lbs) on a pivot is 362 lbs/pivot. This represents an ultimate strength safety factor of 2.15 vs. a requirement of 2.0.

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The radial load limiters successfully passed certification testing duplicating 6 year (softgoods) operational cycle life requirements (Ref. Hamilton EM-543).

C. Inspection -

Vendor certifications are received to verify compliance with drawing requirements and obtain traceability documentation. At H.S., the pivot, pivot supports and bushings are 100% dimensionally inspected to drawing requirements, lab analysis is performed and lab release documentation obtained to verify compliance with AMS specifications.

D. Failure History -

None.

E. Ground Turnaround -

Tested per FEMU-R-001, Pre-Flight Final SEMU Gas Structural and Leakage. Every 56 hours of manned pressurized time the HUT is separated from the DCM and PLSS and subjected to complete visual inspection which includes a 10X power inspection of the pivot bond areas. Additionally, the HUT is subjected to structural and leakage tests at HUT level.

Additionally, every 12 months, the pivot socket bearing surfaces are lubricated with a mixture of Krytox oil and molybdenum disulfide powder.

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 CWS data confirms SOP activation, abort EVA.

2.Training - Standard training covers this failure mode.

3. Operataional 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

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