NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		490FM03		
BATTERY, ITEM 490 ---------- SV767789-12 (1)	3/1RAB	Relief valve, one of two series relief valves fails open. Defective seal ring, seat seal spring relaxes.	END ITEM: Continuous flow path through the valve seat. The remaining relief valve may open when the differential pressure between the airlock and the battery cell exceeds 8 psi. GFE INTERFACE: None for single failure. If both relief valves in a monoblock fail open, the electrolyte would sublimate to vacuum and battery power would be lost. MISSION: None for single failure. Terminate EVA with loss of battery power (second) relief valve failed open. CREW/VEHICLE: None for single or multiple relief valve failures. Possible loss of crewman with loss of	A. Design - Poppet springs have low stress at operating load of 2.2 lbs. Safety factor is greater than 2. The 17-7 steel Belleville spring stem is stressed at 37,000 psi, and the material yield strength is 230,000 psi. The seal ring consists of a flat, 50 durometer rubber disc. The rubber sealing surface is controlled to a 32 microinch finish and is spring loaded against a 16 microinch finish surface of the plastic valve seat. B. Test - In-Process Manufacturing Test - Each of the two stages of the relief valve is tested for reseal after cracking per the SV778526-3 Operation Sheets. Reseal pressure is 3 pounds minimum after 30 minutes. Component Acceptance Test - The relief valve assembly is tested for reseal per AT-E-490RV. Reseal of assemblies is 3 pounds minimum after 30 minutes. PDA test - Data is transferred from the Acceptance test. Certification Test - Eleven relief valves were successfully tested for reseal per AT-E-490RV. C. Inspection - During assembly of upper and lower stages of the relief valve, a verification is done to ensure there is no "dirt or defects" on the flat ring seal (SV778916-2). A visual inspection is done on the upper and lower housings (SV778639 and SV778649 respectively) prior to assembly to ensure that the flat seal ring step interface meets B/P requirements for surface finish. A lapping procedure is included to provide a non stick surface during assembly. A 100% visual inspection is performed on the upper and lower housings and the flat seal ring at incoming receiving inspection for dimensional requirements and surface finish requirements. D. Failure History - H-EMU-490-D007 (10/16/91) - Seven battery relief valves cracked below the acceptance test cracking pressure range of 16-40 psig. (Bubbles became evident between 9-15 psig). Two separate causes were found: 1) Bonding of air release holes prior to the upper to lower stage bond process allowed pockets of trapped air to create voids/leakage paths in the bond joints while bonding the two stages. 2) Inadvertent adjustment nut movement between initial calibration and the nut adhesive locking procedure, which lowered the valve's cracking pressure. Relief Valve operation sheets have been revised to: 1) Seal air release holes after bonding of upper and lower housings. 2) Require caution while handling unlocked upper and lower housings prior to adhesive locking procedure. 3) Inspect the bond joint for voids and verify calibration after nut adhesive locking.

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
		490FM03		
			SOP.	B-EMU-490-A017 (6/28/93) - Battery relief valve S/N 2960 cracked at 12.2 psig (spec: 16 psig) during Acceptance Testing due to a broken hex relief valve adjustment nut. Without the nut in place, the upper stage of the relief valve did not function, resulting in low cracking pressure. Battery procedure P528/BAT101 currently contains a cautionary note for relief valve installation into the battery. It is recommended that a similar note be added to the paragraph on installation and removal of the relief valve on the test fixture in P528/BAT-101.
			TIME TO EFFECT /ACTIONS: Seconds.	
			TIME AVAILABLE: Days.	
			TIME REQUIRED: Days.	E. Ground Turnaround - None, because of the battery design, no ground turnaround test is possible without disassembly.
			REDUNDANCY SCREENS:	F. Operational Use -
			A-FAIL	Crew Response -
			B-FAIL	PreEVA/PostEVA/EVA: No response, single failure undetectable by crew or ground.
			C-PASS	Training - No training specifically covers this failure mode.
				Operational Considerations - No constraints for single failure.

EXTRAVEHICULAR MOBILITY UNIT

SYSTEMS SAFETY REVIEW PANEL REVIEW

FOR THE

I-490 BATTERY

CRITICAL ITEM LIST (CIL)

EMU CONTRACT NO. NAS 9-97150

Prepared by: _____
HS - Project Engineering

_____
HS - Reliability

_____
HS - Engineering Manager

Approved by: _____ 5/24/02
NASA ~~SFA~~/SSM
ES5

_____ 5/21/02
NASA ~~EMU~~/SSM

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NASA ~~S & MA~~

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NASA ~~MOD~~

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NASA ~~Crew~~

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