

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
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		490FM02		
BATTERY, ITEM 490 ----- SV767789-12 (1)	3/1RA	Relief valve fails closed.	END ITEM: Flow path through valve seat blocked.	A. Design - P/N SV767789-12 The relief assembly consists of two series relief valves. The inlet to each relief valve is through three redundant 0.028 dia. holes. The exit area of each relief is greater than 30 times the inlet area.
OR BATTERY, ITEM 490 ----- SV819600-01 (1)		Contamination or sticking.	If cell fails and generates excess pressure, cell overpressurizat ion occurs rupturing one or more of the battery-cell bond joints.	The inlet of the second relief is protected by a cellulose sponge which acts as a filter to keep the inlet holes clear. The ethylene propylene seal and Noryl plastic seat have low sticking characteristics. The seal is coated with a light coat of Krytox 240 AC grease. The battery proof test is 60 psi and the relief valve design allows a relief pressure of 40 psi max. Cell generation of 150 CC of H2 is below the explosive limit.
			GFE INTERFACE: Battery generated gas flows through valve curtailed. If excessive battery discharging or recharging occurs and generates excessive pressure, cell bond joint would rupture exhausting electrolyte, causing loss of battery power.	P/N SV819600-00 The relief valve assembly is a single valve poppet type design. It consists of a 316 stainless steel valve housing, a 316 stainless steel poppet and a 17-7 PH stainless steel poppet spring. An ethylene propylene quad "Q" seal is installed in the poppet head and seals against the valve housing. The 316 stainless poppet guide slides in the 316 stainless steel housing. The sealing surface is a 32 micro-inch finish for smoothness. The relief valve design allows a relief pressure of 40 psid maximum.
			MISSION: None for single valve failure. Terminate EVA with loss of battery power.	B. Test - P/N SV767789-12 Component Acceptance Test - The battery relief valve is tested for proper operation per AT-E-490RV. A cracking pressure test verifies that the relief valve assembly cracks at 16.0 to 40.0 psig. Cracking pressure is defined as a flow of 1-10 bubbles every 5 seconds. Each relief valve also undergoes a flow test to ensure that it will flow a minimum of 2.5 scc/min. at a pressure of 39-40 psig.
			CREW/VEHICLE: None for single valve failure or second failure that excessively discharges	P/N SV819600-00 The battery relief valve is tested for proper operation per AT-E-490-RV-1. A cracking press test verifies that the relief valve assembly cracks at 36 +/- 4 psid. Cracking pressure is defined as a flow of 5.0 sccm minimum flow.
				PDA Test - Data is transferred from Acceptance Test.
				Certification Test - P/N SV767789-12 Eleven relief valves were tested for cracking pressure per AT-E-490-RV in December 1980 (reference SEMU-46-008, Attachment 2A, Pages 5-15). The cracking pressures ranged from 24.0 to 41.0 psig. The specification requirement is from 16.0 to 50.0 psig.
				P/N SV819600-00 A relief valve was cycled through crack, flow, and reseal for 148 cycles in June 1999. All cracking pressures recorded were within the required specification of 32 psig to 40 psig. The item has completed all certification requirements.
				C. Inspection -

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		490FM02	battery. Possible loss of crewman with subsequent loss of SOP.	P/N SV767789-12 Upper and lower stages of the relief valve are pressure tested and adjusted during an in-process test to verify that each stage "crack" at the specified 9 to 16 psig (reference SV778526-1 Op sheets). 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).
			TIME TO EFFECT /ACTIONS: Seconds. None for failed closed valve alone. But if cell (bond joint) ruptures during EVA, turn off battery by switching to SCU power, open the purge valve to activate the SOP. Terminate EVA.	A visual inspection is done on the upper and lower housings (SV778639 and SV778649) prior to assembly to ensure that the flat seal ring step interface meets B/P requirements for surface finish. 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. P/N SV819600-00 The relief valves are pressure tested and adjusted during vendor manufacturing to verify that the valves crack at the specified 35 +/- 4 psid.
			TIME AVAILABLE: Minutes.	D. Failure History - P/N SV767789-12 H-EMU-490-D008 (10/16/91) - Four battery relief valves failed to crack within the acceptance test cracking pressure range of 16-40 psig. (No bubbles occurred at 40 psig). The increased valve cracking pressure was due to inadvertent tightening of the set point adjustment nut between initial calibration and the nut adhesive locking procedure. Relief Valve operation sheets have been revised to:
			TIME REQUIRED: Seconds.	1) Require caution while handling unlocked upper and lower housings. 2) Inspect all bond joints for voids and verify calibration after the adhesive locking of the nut.
			REDUNDANCY SCREENS: A-FAIL B-N/A C-PASS	B-EMU-490-A018 (6/28/93) - Battery Relief Valve S/N 2961 failed to open at 40.0 psig during Acceptance Testing due to stiction caused by prolonged storage of the relief valve prior to assembly into the battery. Corrective Action has been implemented by revision to P528/BAT-101/AM which eliminates potential stiction test failure by exercising the relief valves prior to verification of maximum cracking pressure and installation into the battery.
				P/N SV819600-00 None
				E. Ground Turnaround - None. Relief valve testing would be invasive due to its being threaded and bonded in place as well as its location under wicks and pressure sensitive foil.
				F. Operational Use - Crew Response - PreEVA/PostEVA/EVA: No response, single failure undetectable by crew or ground. 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

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