

CRITICAL ITEMS LIST

REFERENCE DESIGNATOR:
 NAME/QUANTITY: Battery Assy, LiBCX "C" Size
 DRAWING REFERENCE: 86-80200 (Cell PIN 38464)

PROJECT: ARU
 LRU NAME/QUANTITY: Accelerometer Recording Unit
 LRU PART NUMBER: 86-80000

SUBSYSTEM: ARU
 EFFECTIVITY: All Orbiters

FAILURE MODE NUMBER ARU-01	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION Power source for the ARU.		END ITEM The ARU assembly stops generating data.	1. Design Features to Minimize Failure Mode. <ul style="list-style-type: none"> a. The LiBCX cells use lithium (Li) as the anode and thionyl chloride (SOCl₂) with 16 percent bromine chloride (BrCl) as the catholyte reacting on an inert carbon cathode to produce an open circuit voltage of 3.9 volts. The normal operating temperature range for the LiBCX cell is -40°F to 160°F. b. A fiberglass separator material between the positive and negative electrodes is designed to provide ion conduction while insulating against internal shorts. c. The cell contents are contained in an approximately 1 mm thick 304 stainless steel case with a welded metal lid. d. A low voltage cutoff circuit is used to preclude cell reversal. 2. Test or Analysis to Detect Failure Mode. <p><u>Acceptance:</u></p> <ul style="list-style-type: none"> a. Vendor cell lot certification (acceptance) tests (Boeing-FEPC Spec 9526/ATP-08001). A certified lot is defined as a set of cells which has been consecutively made within 2 consecutive calendar days using a single batch of electrolyte mix. Additionally, the cells are made from one batch of anode, cathode, and separator material. To certify a lot, a sample (20 percent minimum) of a lot is subjected to the following tests performed by the vendor. <ul style="list-style-type: none"> (1) <u>Capacity Discharge</u> - one sample (6 percent) of cells is discharged through a 75 ohm load at 70°F until reaching a cutoff voltage of 2 volts. <u>Pass/Fail Criterion</u> - average capacity must be greater than 6.5 ampere-hours. <u>Fuse Check</u> - 3 ampere fuse must blow within 15 seconds at 6 amperes. <u>Overdischarge Tolerance</u> - 3 weeks after the discharge test, the cells are overdischarged at low current for 16 hours at 160°F with bypass diodes. <u>Pass/Fail Criterion</u> - no venting or rupture of cell material. (2) <u>High Temperature Exposure</u> - a second sample (6 percent) is placed in an oven 200°F for 2 hours. <u>Pass/Fail Criterion</u> - no venting or leakage.
FAILURE MODE AND CAUSE A) Mode: Internal short resulting in venting/explosion. B) Cause: <ul style="list-style-type: none"> • Excessive vibration or shock. • Defective separator membrane (manufacturing defect.) 		MISSION Possible reassessment of the mission.	
		CREW/VEHICLE Possible injury to or loss of crewmember because of toxic venting/explosion.	
REDUNDANCY SCREENS A - N/A B - N/A C - N/A	REMAINING PATHS N/A	INTERFACE None.	
MISSION PHASE All	TIME TO EFFECT Immediate	TIME TO CORRECT None	

PREPARED BY:

REVISION:

SUPERSEDING DATE:

DATE:

CRITICAL ITEMS LIST

REFERENCE DESIGNATOR:
 NAME/QUANTITY: Battery Assy, LiBCK "C" Size
 DRAWING REFERENCE: 86-80200 (C-1) PIN 38464

PROJECT: ARU
 LRU NAME/QUANTITY: Accelerometer Recording Unit
 LRU PART NUMBER: 86-80800

SUBSYSTEM: ARU
 EFFECTIVITY: ANY Orbiters

FAILURE MODE NUMBER ARU-01	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE								
FUNCTION Power source for the ARU.		END ITEM The ARU assembly stops generating data.	(3) <u>Short Circuit Tolerance</u> - a third sample (4 percent) is electrically shorted through a load equal to or less than 50 milliohms. Pass/Fail Criterion - no venting or leakage. (4) A sample of four cells per lot is subjected to random vibration for 15 minutes/axis prior to being discharged for capacity information. The random vibration testing is identical to that for NASA acceptance in paragraph (6) below. (5) Visual and open circuit voltage (OCV) tests are performed on 100 percent of delivered cells. (6) A sample from each lot of the cells is tested to the following spectrum by the vendor or are delivered to NASA who subjects them to acceptance vibration test for 15 minutes in each of three mutually perpendicular axes, according to the following spectrum, before being discharged for capacity information. <table style="width: 100%; border: none;"> <tr> <td style="text-align: center;">FREQUENCY (Hz)</td> <td style="text-align: center;">LEVEL</td> </tr> <tr> <td style="text-align: center;">20 to 80</td> <td style="text-align: center;">+ 3 dB/octave</td> </tr> <tr> <td style="text-align: center;">80 to 350</td> <td style="text-align: center;">0.1g²/Hz</td> </tr> <tr> <td style="text-align: center;">350 to 2000</td> <td style="text-align: center;">-3 dB/octave</td> </tr> </table> The OCV is monitored during testing and a load test is performed after vibration testing is complete. CERTIFICATION: During cell certification (JSC-EP5--81-014), the LiBCK cell was evaluated over a variety of performance and off limits test conditions in order to meet the three basic requirements for certification: <ol style="list-style-type: none"> a. Capacity performance b. Venting temperature under off limits testing c. Vibration/shock 	FREQUENCY (Hz)	LEVEL	20 to 80	+ 3 dB/octave	80 to 350	0.1g ² /Hz	350 to 2000	-3 dB/octave
FREQUENCY (Hz)	LEVEL										
20 to 80	+ 3 dB/octave										
80 to 350	0.1g ² /Hz										
350 to 2000	-3 dB/octave										
FAILURE MODE AND CAUSE A) Mode: Internal short resulting in venting/explosion. B) Cause: <ul style="list-style-type: none"> • Excessive vibration or shock. • Defective separator membrane (manufacturing defect.) 		MISSION Possible reassessment of the mission.									
		CREW/VEHICLE Possible injury to or loss of crewmember because of toxic venting/explosion.									
REDUNDANCY SCREENS A - N/A B - N/A C - N/A	REMAINING PATHS N/A	INTERFACE None.									
MISSION PHASE All	TIME TO EFFECT Immediate	TIME TO CORRECT None									

PREPARED BY

REVISION:

SUPERSEDING DATE:

DATE:

CRITICAL ITEMS LIST

REFERENCE DESIGNATOR:
 NAME/QUANTITY: Battery Assy, LiBCX "C" Size
 DRAWING REFERENCE: 96-80200 (Cell PIN 38454)

PROJECT: ARU
 LRU NAME/QUANTITY: Accelerometer Recording Unit
 LRU PART NUMBER: 86-80000

SUBSYSTEM: ARU
 EFFECTIVITY: All Orbiters

FAILURE MODE NUMBER ARU-01	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE								
FUNCTION Power source for the ARU.		END ITEM The ARU assembly stops generating data.	The lithium "ARU" battery cell was subjected to the following vibration tests conducted by EP6/TTA. The battery cells did not experience any failures for the duration of 300 seconds in each of 3 axes. <table style="margin-left: 20px; border: none;"> <tr> <td style="text-align: center;">FREQUENCY</td> <td style="text-align: center;">LEVEL</td> </tr> <tr> <td style="text-align: center;">20-80 Hz</td> <td style="text-align: center;">+ 3 dB/octave</td> </tr> <tr> <td style="text-align: center;">80-350 Hz</td> <td style="text-align: center;">0.067 g²/Hz</td> </tr> <tr> <td style="text-align: center;">350-2000 Hz</td> <td style="text-align: center;">- 3dB/octave</td> </tr> </table> Shock testing was according to MIL-STD-810C, method 516.2, Procedure I, 20g peak, 11 ms rise, 1 ms decay. <p>TURNAROUND:</p> After a cell configuration has been certified, each cell is useable for flight for 1 year from date of manufacture. This nonrechargeable cell may be reflighted as long as it was not activated during flight. Once a cell has had any use (no matter how limited) during a flight, it is removed from inventory and submitted for disposal. Unused cells are subjected to a visual inspection, DCV, and load test and returned to flight status, provided the 1 year shelf life has not expired.	FREQUENCY	LEVEL	20-80 Hz	+ 3 dB/octave	80-350 Hz	0.067 g ² /Hz	350-2000 Hz	- 3dB/octave
FREQUENCY	LEVEL										
20-80 Hz	+ 3 dB/octave										
80-350 Hz	0.067 g ² /Hz										
350-2000 Hz	- 3dB/octave										
FAILURE MODE AND CAUSE A) Mode: Internal short resulting in venting/explosion. B) Cause: <ul style="list-style-type: none"> • Excessive vibration or shock. • Defective separator membrane (manufacturing defect.) 		MISSION Possible reassessment of the mission.									
REDUNDANCY SCREENS A - N/A B - N/A C - N/A		CREW/VEHICLE Possible injury to or loss of crewmember because of toxic venting/explosion.									
REMAINING PATHS N/A		INTERFACE None.									
MISSION PHASE All	TIME TO EFFECT Immediate	TIME TO CORRECT None									

CRITICAL ITEMS LIST

REFERENCE DESIGNATOR
 NAME/QUANTITY: Battery Assy, LIBCX "C" 5129
 DRAWING REFERENCE: 86-80200 (Cell PIN 38464)

PROJECT: ARU
 LRU NAME/QUANTITY: Accelerometer Recording Unit
 LRU PART NUMBER: 86-80080

SUBSYSTEM: ARU
 EFFECTIVITY: All Orbiters

FAILURE MODE NUMBER ARU-01	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION Power source for the ARU.		END ITEM The ARU assembly stops generating data.	e. After filling, all the cells are put in an oven at 160°F for 2 hours followed by <ol style="list-style-type: none"> (1) OCV test - must be greater than 3.85 volts (2) Load test - must be greater than 3.5 volts. (3) Size and weight check to verify no swelling or venting occurred TURNAROUND: Cells not used during a mission can be reused after a visual inspection and verification that all have not passed their 1 year shelf life NOTE: Visual and OCV inspections are done on 100 percent of the delivered cells. All the tests conducted in part 2 and inspections in part 3 serve to prevent the occurrence of internal shorts in flight cells by product quality control during manufacturing and by parametric screening during cell acceptance testing 4. Failure History None reported. As of February 1989, 595 LIBCX cells have been flown in the Shuttle, Orbiter without a hazardous event occurring. no internal shorts have been detected in more than 4,000 cells at JSC 5. Operational Use. <ol style="list-style-type: none"> a. <u>Operational Effect of Failure</u>. Possible loss of crewmember. b. <u>Crew Action</u>. None identified. c. <u>Crew Training</u>. The crew will be trained to perform a preuse visual and subjective temperature checkout of the battery cells when possible. d. <u>Mission Constraints</u>. None identified e. <u>In-flight Checkout</u>. A preuse visual and subjective temperature checkout of the battery cells will be performed when possible
FAILURE MODE AND CAUSE A) Mode: Internal short resulting in venting/explosion. B) Cause: <ul style="list-style-type: none"> • Excessive vibration or shock. • Defective separator membrane (manufacturing defect.) 		MISSION Possible reassessment of the mission.	
		CREW/VEHICLE Possible injury to or loss of crewmember because of toxic venting/explosion.	
REDUNDANCY SCREENS A - N/A B - N/A C - N/A	REMAINING PATHS N/A	INTERFACE None.	
MISSION PHASE	TIME TO EFFECT	TIME TO CORRECT	
All	Immediate	None	

PREPARED BY:

REVISION:

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