

CRITICAL ITEMS LIST (CIL)

SYSTEM: Electrical
 SUBSYSTEM: LH2 Depletion System
 REV & DATE: J, 12-19-97
 DCN & DATE:
 ANALYSTS: R. Lunden/A. Oser

FUNCTIONAL CRIT: 1R
 PHASE(S): b
 HAZARD REF: E.01, P.06

FAILURE MODE: Fails Shorted
 FAILURE EFFECT: b) Loss of mission and vehicle/crew due to engine(s) being destroyed.
 TIME TO EFFECT: Seconds
 FAILURE CAUSE(S):
 A: Abrasion of Wire Insulation
 B: Faulty Pin
 C: Faulty Backshell
 D: Faulty Ferrule
 E: Faulty Connector
 F: Broken Weld Clip (LWT-54 thru 88)(FMEA Item Code 3.6.2.2 only)
 G: Defective Scrim Cloth Bond (LWT-89 & Up)(FMEA Item Code 3.6.2.2 only)

REDUNDANCY SCREENS:
 Screen A: PASS
 Screen B: FAIL - Not detectable in flight.
 Screen C: FAIL - Failure of common support assembly.

FUNCTIONAL DESCRIPTION: Harnesses route the excitation current and return functions between the ET/Orbiter interface and each level sensor.

<u>FMEA ITEM CODE(S)</u>	<u>PART NO.</u>	<u>PART NAME</u>	<u>QTY</u>	<u>EFFECTIVITY</u>
3.6.2.2	80934003704-029 (302W02 P1/Splices)	Harnesses	1	LWT-54 & Up
3.6.3.2	80931003704-420 (305W01 P1/J23/J33) -520	Harnesses	1	LWT-54 thru 88
			1	LWT-89 & Up

REMARKS: These harnesses are grouped since the failure mode and Rationale for Retention are the same.

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CONTINUATION SHEET

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RATIONALE FOR RETENTION

DESIGN:

Engineering Process Specifications, STP6508 establishes the requirements to be met for fabrication and installation of airborne electrical interconnecting wire and cable assemblies. Harness assemblies produced as specified in STP6508 will meet the applicable requirements of MIL-W-81600 and 40MG9582A.

The wire is procured from vendors that have qualification approval from Lockheed Martin. The vendors meet material specification STM E659 and E658.

Crimp type splices are used to connect harness wires within the tank to the pigtail leads furnished with the sensors.

For additional weight savings on SLWT, spare wires were eliminated from the harnesses.

- A: Electrical wires, cables, and bundles are routed to avoid abrasion, cutting, or piercing of the insulation by contact with rough surfaces or sharp edges along the mounting surfaces. Sufficient slack is provided for installed harnesses to avoid strain on the conductor within the harnesses, termination points, and associated connectors.
- B: The connector is designed with alignment tolerances to ensure proper insertion. Pins have rounded tips and the insert is designed with a tapered entry to guide the male contact for a firm mating and to preclude bent pins.
- C: The backshells are designed to the same standards as the connector to ensure proper cable support and handling characteristics.
- D: Ferrules are designed to fit tightly over wire or bundle with inner formation ring of a harder material. The outer crimp ring is a soft material. When installed on wire or bundle, the shield/ferrule termination is a snug fit. This termination is insulated and supported by shrinkable tubing.
- E: The connector is designed with a positive locking mechanism which ensures a positive lock for the coupling ring when the plug is fully mated with the receptacle and an audible sound is indicated when the coupling ring is seated in the positive lock position.
- F: A series of 24 equally spaced (about 7.6" apart) 2219 aluminum alloy "T" clips (1.50" x 0.75" x 0.40") are fillet welded to the LH2 tank aft dome from the electrical feedthru connector location to the LH2 depletion sensor location. These clips are located beside a weld land between the +Z and +Y axis. Two fillet welds on the long sides attach each clip to the aft dome.

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RATIONALE FOR RETENTION

DESIGN: (cont)

G: For LWT-89 & UP the welded clips holding the ECO sensor wires to the LH2 aft dome are replaced by 24 adhesive scrim cloth bonds. Instrumentation wiring was bonded to the internal surfaces of the MPTA LH2 tank without any known problems. Adhesive bonding was also utilized on earlier flight LH2 tanks to reinforce the ECO wire attachment clips when the clips were spot welded instead of the present fillet welds.

Redundancy Description

Since each depletion sensor has its own circuit in the cable harnesses, the redundancy description and effects of loss of redundancy for the fails short failure mode are the same as described for the fails wet mode of the depletion sensors. Circuits are routed on non-adjacent pins on the connectors to reduce the probability of one failed circuit affecting another. The fails open mode results in a loss of all circuits and is not covered here.

Effects of First Failure

If any one circuit fails so as to produce a false wet indication, there is no effect since there are three circuits remaining.

Effects of First Redundancy Loss

If a second circuit fails so as to produce a false wet indication, there is no effect since there are two circuits remaining.

Effect of Second Redundancy Loss

If a third circuit fails so as to produce a false wet indication, the depletion function will be lost and the effect described above will occur.

TEST:

The harness and harness components are certified. Reference HCS's MMC-ET-TM08-L-E039 (3.6.2.2), MMC-ET-TM08-L-E051 (3.6.3.2).

Vendor:

Piece parts for the electrical system are procured and tested to approved Lockheed Martin Drawing 81L2, Specifications E658 and E659 and Government Specification 40M39569.

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TEST: (cont)

MAF:

- A-E: Perform Dielectric Withstanding Voltage Test (STP6508 and TM04k).
- A-E: Perform Isolation Resistance Test (TM04k).
- A-E: Perform DC Resistance Test (TM04k).
- A-E: Perform Crimp Tool Certification Test (STP6503 for ferrules and splices and STP6504 for sockets and pins).

Launch Site:

- A-E: Perform Level Sensor Test (OMRSD File II & IV).
- A: Perform insulation resistance test (OMRSD File IV).

INSPECTION:

Vendor:

Surveillance by Lockheed Martin Procurement Quality is performed to ensure compliance with specifications.

MAF Quality Inspection:

- A: Inspect wire for freedom of nicks, scrapes, cuts, breaks, abrasion or other physical damage prior to assembly (STP6508).
- A: Inspect the installed harness per the installation requirements (STP6508; add STP 6514 for FMEA Item 3.6.2.2 at LWT-89 & Up).
- B: Inspect connector, pins, or sockets for freedom of damage, are not broken, bent, misaligned or corroded, and connector is free of foreign material (STP6501).
- C: Inspect for freedom of damage of connector, backshell, attaching hardware and grommet (STP6501).
- D: Inspect for proper crimp configuration and freedom of physical damage (STP6503 for ferrules and splices and STP6504 for pins and sockets).
- D: Verify certification of crimping tool (STP6503 for ferrules and splices and STP6504 for pins and sockets).

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RATIONALE FOR RETENTION

INSPECTION: (cont)

- A-E: Witness Dielectric Withstanding Voltage Test (STP6508 and TM04k).
- A-E: Witness Isolation Resistance Test (TM04k).
- A-E: Witness DC resistance of level sensors in dry state when measured at the ET Interface (TM04k).
- F: Verify weld dimensions (STP5501) for LWT-54 thru 88.
- F: Inspect for freedom of cracks in the base metal and weld (STP5501) for LWT-54 thru 88.
- G: Verify hardness and bond integrity tests for LWT-89 & Up (STP6514).
- G: Verify proper surface preparation for LWT-89 & Up (STP 6514).
- G: Verify minimum cure time for LWT-89 & Up (STP 6514).

Launch Site:

- A-E: Witness sensor DC resistance in dry condition (OMRSD File IV).
- A-E: Witness sensors change from dry to solid wet condition at completion of slow fill (OMRSD File II).
- A: Witness insulation resistance test (OMRSD File IV).

FAILURE HISTORY:

Current data on test failures, unexplained anomalies and other failures experienced during ground processing activity can be found in the PRACA data base.