CRITICAL ITEMS LIST (CIL)

SYSTEM:	Electrical	FUNCTIONAL CRIT:	1R *
SUBSYSTEM:	GH2 Pressurization System	PHASE(S):	a, b
REV & DATE:	J, 12-19-97	HAZARD REF:	E.01, P.01, S.09
DCN & DATE:			
ANALYSTS:	J. McCardle/T. McKeough/A. Oser		

FAILURE MODE: Fails with Low Reading

FAILURE EFFECT: a,b) Loss of mission and vehicle/crew due to tank structural failure from overpressure.
b) Loss of mission and vehicle/crew due to fire/explosion when relief valve opens.

TIME TO EFFECT: Minutes

FAILURE CAUSE(S):
A: Winding Open Between Wiper Arm and Excitation Signal
B: Wiper Arm Stuck in Incorrect Position
C: Excitation Wire and Return Wire Shorted Together
D: Wiper Arm Wire Open
E: Shorted Turns in Winding
F: Wiper Liftoff
G: Sensitivity and Bias (Zero) Shifts
H: Leakage

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

FUNCTIONAL DESCRIPTION: Tank ullage pressure measured by three sensors. Each sensor controls a flow control valve to open or close. (Measurement Number: T41P1700C, T41P1701C, T41P1702C, T41P1703C)

FMEA ITEM CODE(S)	PART NO.	PART NAME	QTY	EFFECTIVITY
3.4.1.2	PD7400098-089 (303A02, 303A03, 303A04, 303A05)	GH2 Pressure Transducers	4	LWT-54 & Up

REMARKS: * Item criticality is increased to 1 during intact abort since the ET pressurization system is not single failure tolerant with one SSME out (one FCV nonfunctional). Failure of an ullage pressure transducer such that the corresponding FCV fails open causes ullage pressure to increase until the relief valve opens. Subsequent venting of GH2 is criticality 1 since there is always a possible ignition source such as lightning.

SYSTEM:	Electrical	REV & DATE:	J, 12-19-97
SUBSYSTEM:	GH2 Pressurization System	DCN & DATE:	
FMEA ITEM CODE(S):	3.4.1.2		

RATIONALE FOR RETENTION

DESIGN:

The GH2 Transducer is a potentiometer type unit which operates as an absolute sensor in the range of 12 to 52 PSIA. This transducer is completely sealed and the potentiometer is in a vacuum. The unit is enclosed in a stainless steel case and all seams are TIG welded. The unit is designed and fabricated to withstand all test conditions, checkout installation, pre-launch and launch without mechanical/or electrical failure.

A: The coil winding is a platinum commercial alloy wire Class H Alloy No. 479 (approved by MUA 146) with insulation of Isonel 200 Enamel. It is wound on a core of solid copper wire per J-W-1177 and insulated with a Heavy Coat Mil Enamel. The tension and consistency of wire lay are controlled. The wiper is made of Paliney #7 palladium alloy. The leads are soldered using Lockheed Martin approved vendor materials, drawings, and process instructions.

B: The smooth finish and a tension setting of the wiper per Gulton SPI-3031-13803 provides for firm contact of the wiper to the coil. The coil cleaning and manufacturing processes provide a contact surface that is clean and free from high/low points.

C: The wires from the coil are cut to a minimum length and potted in place. The wiper wire is also a minimum length. The three wires are routed in areas which will prevent interference with the wiper and coil operations.

D: The routing of the wire provides for sufficient slack to eliminate strain and provides a path that will prevent the wire from being damaged while the unit is in operation. Soldering of the termination is by procedures approved by Lockheed Martin.

E, F: The coil winding is processed through a soda honing operation per Gulton Process SSP-079-81 to remove enamel coating and provide a clean surface free from high/low points. The interfacing wiper is polished to a finish No. 4 per Gulton Process SSP-187-81. To provide a constant pressure on the coil and to eliminate wiper liftoff and chatter, the wiper tension on the coil is set per Gulton SPI-3031-13803. The processes and assembly are all validated and approved by Lockheed Martin.

G: Assembly techniques as defined on Gulton drawings 121-600 and Process Specification (SPI-3031-13803) provide the selection and matching of the detail parts for the sensing assembly. In process cycling provides a unit that will operate to P07400098 requirements.

H: The case material is 321SS per MIL-T-8808 and is nominally .10 inches thick and all welds are TIG. The unit is leak tested at 1 x 10^{-7} cc/s. The capsule is constructed of NI-Span-C. It is press formed and TIG welded at the seams. The capsules are designed to withstand 200% of range. During manufacturing the capsule assemblies are subjected to helium leak checks at several stages of detail assembly and final assembly.

SYSTEM:	Electrical	REV & DATE:	J, 12-19-97
SUBSYSTEM:	GH2 Pressurization System	DCN & DATE:	
FMEA ITEM CODE(S):	3.4.1.2		

RATIONALE FOR RETENTION

DESIGN: (cont)

Redundancy Description

Four transducers are used in the LH2 tank to control ullage pressure. Of the four, only three are used in flight. The fourth transducer is a spare which can be substituted into the circuit by ground control in case of a failure prior to T-10 seconds. The LH2 tank relief valve is standby redundant to the pressure transducers to prevent structural failure due to overpressure.

The effect of losing the first, second (first redundancy) and third transducers (second redundancy) and the relief valve (third redundancy) is shown in the matrix below.

FAILURE	EFFECT
1 Xducer fails low output (1 FCV Closed)	No effect
2 Xducers fail low output (2 FCV Closed)	Loss of mission and vehicle/crew due to fire/explosion when relief valve opens
3 Xducers fail low output (3 FCV Closed)	Loss of mission and vehicle/crew due to fire/explosion when relief valve opens
2 or 3 Xducers fail low output and relief valve fails closed	Loss of mission and vehicle/crew due to tank structural failure from overpressure

FCV - Flow Control Valve

The transducers are not used in phase c.

TEST:

The GH2 ullage transducers are qualified. Reference COQ MMC-ET-TM06-037.

Vendor:

A-H: Perform Functional Test (PD7400098).

A-H: Perform Calibration Test (PD7400098).

A-D,F: Perform Noise Test (PD7400098).

B,E,H: Perform Hysteresis and Friction Test (PD7400098).

H: Perform Proof Pressure Test (PD7400098).

SYSTEM: Electrical
SUBSYSTEM: GH2 Pressurization System
FMEA ITEM CODE(S): 3.4.1.2

REV & DATE: J, 12-19-97
DCN & DATE:

RATIONALE FOR RETENTION

TEST: (cont)

MAF:

A-H: Perform Functional Test (TM04k).

A-F: Perform Noise and Drop Out Test (TM04k).

A-H: Perform Calibration Test (TM04k).

A: Perform DC Resistance from excitation to return (TM04k).

Launch Site:

A-H: Perform Transducer Operation Test (OMRSD FILE II).

A-H: Perform Functional Test (LCC).

INSPECTION:

Vendor Inspection - Lockheed Martin Surveillance:

A, E: Inspect the soldering of wires for Electrical/Mechanical integrity (SSP-037-81).

A: Verify certification of solder operator (SSP-037-81).

A, B: Verify cure of potting material on wire connection (Gulton drawing 121-600).

B: Inspect bearing for freedom of foreign matter (SSP-185-81).

B, C, G: Inspect for movement of wiper arm prior to closure (Gulton Drawing 121-600).

C: Inspect routing of wire to ensure full range movement of wiper arm (Gulton Drawing 121-600).

C: Inspect length of wire to ensure it does not interfere with wiper movement (Gulton Drawing 121-600).

A, D: Inspect wire for freedom of nicks, scrapes, cuts or breaks prior to installation (Gulton drawing 121-600).

SYSTEM:	Electrical	REV & DATE:	J, 12-19-97
SUBSYSTEM:	GH2 Pressurization System	DCN & DATE:	
FMEA ITEM CODE(S):	3.4.1.2		

RATIONALE FOR RETENTION

INSPECTION: (cont)

Lockheed Martin Procurement Quality Representative:

A-H: Witness Functional Test (PD7400098).

A-D,F: Witness Noise Test (PD7400098).

B: Inspect for freedom of foreign material from winding upon completion of soda honing (SSP-079-81).

B, F: Inspect wiper working surface for a smooth finish (SSP-079-81).

A-H: Witness Calibration Test (PD7400098).

B, E, H: Witness Hysteresis and Friction Test (PD7400098).

F: Witness Wiper Tension Test (SPI-3031-13803).

H: Witness Proof Pressure Test (PD7400098).

MAF Quality Inspection:

A-H: Witness Functional Operation Test (TM04k).

A-H: Witness Calibration Test (TM04k).

A-F: Witness Noise and Drop Out Test (TM04k).

A: Witness DC Resistance from Excitation to Return (TM04k).

Launch Site:

A-H: Verify Transducer Operation (OMRSD File II).

A-H: Verify Transducer Operation at T-10 seconds (LCC - 3 of 3 mandatory).

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.