

CRITICAL ITEMS LIST (CIL)

SYSTEM:	Propulsion/Mechanical	FUNCTIONAL CRIT:	1
SUBSYSTEM:	GH2 Pressurization	PHASE(S):	a, b, c
REV & DATE:	J, 12-19-97	HAZARD REF:	P.03, P.06, P.07, S.04, S.06
DCN & DATE:			
ANALYSTS:	J. Attar/H. Claybrook		

FAILURE MODE: Leakage

FAILURE EFFECT: a) Loss of mission and vehicle/crew due to fire/explosion.
 b) Loss of mission and vehicle/crew due to fire/explosion or LH2 Tank structural failure.
 c) Loss of mission due to premature engine shutdown caused by loss of NPSP.
 Loss of life due to ET impact outside designated footprint.

TIME TO EFFECT: Seconds

FAILURE CAUSE(S): A: Structural Failure of Hardline Component
 B: Flange Mating Surface Defects
 C: Structural Failure of Flex Joint
 D: Seizure of Flex Joint
 E: Fracture of One Flange Bolt (Disconnect End)

REDUNDANCY SCREENS: Not Applicable

FUNCTIONAL DESCRIPTION: Transports GHe/GH2 during prelaunch and GH2 during ascent to maintain LH2 tank ullage pressure requirements.

<u>FMEA ITEM CODE(S)</u>	<u>PART NO.</u>	<u>PART NAME</u>	<u>QTY</u>	<u>EFFECTIVITY</u>
2.7.8.1	PD4800205-060	Aft Flex Line	1	LWT-54 & Up

REMARKS:

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Propulsion/Mechanical
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FMEA ITEM CODE(S): 2.7.8.1

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RATIONALE FOR RETENTION

DESIGN:

- A, C, D: The Aft Flex Line Assembly consists of fixed flanges, straight tubing and tube bend sections, and 3 bellows type flexible joints. Each flexible joint contains a pressure carrier bellows and a ball strut assembly. The line assembly is fabricated from ARMCO 21-6-9 CRES and is an all welded configuration. Emphasis has been placed on joint geometry to enhance weld integrity. The line assembly has been designed to meet the required ultimate safety factors (1.4 for loads and 1.5 for pressure) and the required yield safety factors (1.1 for loads and 1.25 for pressure) (ET Stress Report 826-2188 and ET10-SR-0002, Arrowhead). The line assembly also meets the other operational and nonoperational requirements defined per PD4800205. Materials selected in accordance with MMC-ET-SE16 and controlled per MMA Approved Vendor Product Assurance Plan assures repetitive conformance of composition, material compatibility and properties. Fusion and seam welding specifications, processes, and quality controls are in accordance with MPS-MPQ-103 (Arrowhead).
- B: Flange mating seal surface flatness, waviness, and finish are specified on Engineering drawings to assure performance within the capability of the seal.
- C, D: The flexible joint assemblies provide for installation misalignments and recurring motions during loading and boost. The pressure carrier bellows is fabricated from 3 plies of .008 thick material and the joint design provides isolation from flow induced vibration. The ball located within the ball strut assembly is fabricated from Inconel 718. Vitrolube is applied to prevent seizure of the ball and strut.
- E: Attachment fasteners were selected from the Approved Standard Parts List (ASPL 826-3500), installed per STP2014 and torqued using values specified on engineering drawings.

TEST:

The Aft Flex Line Assembly is qualified. Reference COO MMC-ET-TM06-087.

BSTRA Development Test: Five ball-strut tie rod assembly flexible joints were subjected to development tests to determine their torsional loading resistance capability. In each test, loading was applied incrementally until failure occurred. Test results showed that the BSTRA can resist up to 6,800 in-lb which is more than three times the maximum flight load. (ET-DTR-10950-73, Arrowhead).

Qualification - ET: Testing of one line assembly included one 375 in-lb bending moment load deflection, proof load/operating pressure cycle deflection and leakage for acceptance, sine and random vibration, electrical bonding (for impedance), 500 motion/operating pressure cycles, leakage and ultimate load test (at 2,650 PSIG). There was no evidence of collapse, rupture or deformation. Acceptance criteria was no bubbles (helium) at 300 psig (MMC-ET-RA09-96).

Acceptance:

Vendor - (Line Subassembly):

- A: Perform flight proof load test during the build cycle (ATP 14205 Arrowhead)
- C, D: Perform load vs deflection test on each BSTRA joint (ATP 205-360 or ATP 14205-360, Arrowhead as applicable).

Vendor - (Line Assembly):

- A, C, D: Perform proof loads/operating pressure test (ATP 205-360 or ATP 14205-360, Arrowhead as applicable).
- C, D: Perform 4 deflection test cycles (ATP 205-360 or ATP 14205-360, Arrowhead as applicable).
- A-D: Perform leakage rate test (ATP 205-360 or ATP 14205-360, Arrowhead as applicable).

MAF - (Line Assembly):

- B: Perform seal leakage test for flange joint installation (MMC-ET-TM04k).

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INSPECTION:

Vendor Inspection - Lockheed Martin Surveillance:

- A, C, D: Verify materials selection and verification controls (MMC-ET-SE16, and drawing 14205-73, 14205-69, 14205-53, 14205-51, 14205-49, 14205-47, 14205-45, 10950-53-13-3, 10950-73-39-11, 10950-73-39-13, Arrowhead, and MMC Standard drawing 26L2).
- A, C: Inspect welding (MPS-MPQ-103, Arrowhead).
- A, C: Penetrant inspect welding (MIL-I-6866, Type I, Method A, Group VI).
- A, C: Verify X-ray results (QCI-16-057, Arrowhead).
- B: Inspect mating surface flatness, finish and dimensions (drawings 145205-73 and 14205-69, Arrowhead).
- D: Inspect dimensions (drawing 10950-73-25, Arrowhead)
- D: Verify vitrolube application (MPS-MPQ-121, Arrowhead).
- D: Witness cleaning (MPS-MPQ-105, Arrowhead).

Lockheed Martin Procurement Quality Representative:

- A-D: Witness load vs deflection, proof load/operating pressure, deflection and leakage tests (ATP 205-360 or ATP 14205-360, Arrowhead as applicable).
- A: Witness flight proof loads test during build cycle (ATP 14205, Arrowhead).

MAF Quality Inspection:

- B: Inspect sealing surfaces for freedom of nicks, radial scratches or other imperfections (acceptance drawing 82620000001).
- B, E: Verify installation and witness torque (drawing 80921021009).
- B: Witness seal flange leakage tests (MMC-ET-TM04k).

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.