

CRITICAL ITEMS LIST (CIL)

SYSTEM: Propulsion/Mechanical FUNCTIONAL CRIT: 1
 SUBSYSTEM: LH2 Propellant Feed PHASE(S): b
 REV & DATE: J, 12-19-97 HAZARD REF: P.06, S.11
 DCN & DATE:
 ANALYSTS: J. Attar/H. Claybrook

FAILURE MODE: Loss of Anti-Vortex Capability
 FAILURE EFFECT: b) Loss of mission and vehicle/crew due to gas ingestion resulting in uncontrolled engine shutdown.
 TIME TO EFFECT: Seconds
 FAILURE CAUSE(S): Structure Failure of Support/Attachment Hardware
 REDUNDANCY SCREENS: Not Applicable
 FUNCTIONAL DESCRIPTION: Prevents vorticity of LH2 at siphon inlet and dampens LH2 slosh during vehicle maneuvers.

<u>FMEA ITEM CODE(S)</u>	<u>PART NO.</u>	<u>PART NAME</u>	<u>QTY</u>	<u>EFFECTIVITY</u>
2.5.2.1	80914901995-009	Anti-Vortex Baffle Assembly	3	LWT-54 thru 88
	-500	"	1	LWT-89 & UP
	-510	"	1	LWT-89 & Up
	-519	"	1	LWT-89 & Up
2.5.3.1	80914901995-030	Anti-Vortex Baffle Assembly	1	LWT-54 thru 88
	-509	"	1	LWT-89 & UP

REMARKS: The anti-vortex baffle assemblies are grouped together since the failure mode, causes, and effects are the same.

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Propulsion/Mechanical
SUBSYSTEM: LH2 Propellant Feed
FMEA ITEM CODE(S): 2.5.2.1, 2.5.3.1

REV & DATE: J, 12-19-97
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RATIONALE FOR RETENTION

DESIGN:

LWT-54 thru 88:

The LH2 anti-vortex baffle consists of four baffles positioned at right angles to each other and supported from the LH2 feedline siphon. Each baffle is made from 2024 aluminum and consists of a flat web stiffened and framed by extrusions. Construction is a conventional riveted frame. The webs are perforated with 4 inch holes for fluid damping. The baffles are bolted directly to pods on the siphon bell at the aft end and to a collar welded to the siphon about 3 feet forward of the bell. Materials were selected in accordance with MMC-ET-SE16 which assures repetitive conformance of composition and properties. The assembly was designed for the required yield (1.1) and ultimate (1.4) safety factors (ET Stress Report 826-2188).

The aft end of each baffle has two bolted connections to thickened portions of the LH2 siphon bell which itself serves as the aft support. At the forward end, each baffle has two bolted connections to a collar which is welded to the siphon. Additionally, the baffles are braced by the rods which extend from the siphon bell to the forward and aft baffle frames at a point midway along their length. This provides parallel load paths. Special rigging procedures are specified to assure no structural damage during installation.

Attachment hardware was selected from the Approved Standard Parts List (ASPL 826-3500). Bolts are installed per STP2014 and torqued using values specified on engineering drawings. Jam nuts and tie rods are safety wired per STP2013. Hi-Loks are installed per STP2006. Hardware material is vendor certified and controlled by part standards.

LWT-89 & Up (SLWT Project):

The SLWT anti-vortex baffle structural design is the same as the LWT design with the exception of three redesigns to the clevis units. The 32 clevis units are part of the rod assemblies that provide bracing support for the anti-vortex baffles to the siphon bell. The three redesigns to the clevis units are the result of vibration levels and hardware failures experienced during the SLWT dynamic testing described under "TEST: LWT-89 & UP" below. Redesigns include; (1) radius blocks added to each clevis, (2) modified clevis geometry to carry loads more efficiently and (3) a reduced number of fasteners used in the clevis design. Following these redesigns, subsequent testing demonstrated that the new clevis is adequate for the more severe SLWT environments.

TEST:

LWT-54 thru 88:

The Anti-Vortex Baffle Assembly is certified. Reference HCS MMC-ET-TM08-L-P001.

Qualification - ET: The anti-vortex assembly successfully passed sine and random vibration testing with the LH2 siphon assembly. Structural integrity of the baffle siphon support ring was verified by load tests (MMC-ET-RA09-5).

Certification - MPTA: The anti-vortex assembly was subjected to additional vibration testing during propellant screen qualification and MPTA extended testing. Upon completion of this test, the anti-vortex baffle assembly had accumulated two complete flight vibration cycles and an equivalent MPTA life of 112 minutes (X axis) and 82 minutes (Y & Z axis) of random vibration (MMC-ET-RA09-5, MMC-ET-RA09-21 and MMC Report T-77-18-2).

MPTA Firings/Tankings: The MPTA anti-vortex baffle assembly has accumulated 62.5 minutes of firing time, 26 cryogenic cycles and 42 pressurization cycles. No visual defects were noted during tank entries, the last of which was after SF-12.

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RATIONALE FOR RETENTION

TEST: (cont)

LWT-89 & Up (SLWT Project):

Delta Qualification - SLWT: Due to an increased vibroacoustic environment for the SLWT, random vibration (definition) tests were first performed on the LH2 siphon and vortex baffle assembly. These tests were to accurately define the SLWT environments and to determine the proper qualification environment for the SLWT ECO level sensors. During the definition test, six anti-vortex baffle clevis's failed and one tension rod came free (Ref. 801982 Supl AR). As a result, the design changes described above were made to the SLWT anti-vortex baffle assembly clevis units, and the decision was made to perform an "all-up" siphon assembly qualification test.

In preparation for this, a confidence test was performed on the newly designed tie-rod clevis configuration against the old configuration. The worst case test condition failed the old design almost immediately. However, the new design experienced no failures during 15 minutes of testing. This confidence test proved that the new design was significantly stronger and more durable, and cleared the way for the siphon assembly qualification test (809-2084).

The "all-up" qualification test at MSFC was successful for the new hardware configuration and design. Results were based on detailed post test visual inspection of the hardware and on dye penetrant of all external welds.

Vendor

Attachment hardware are procured and tested to Standard drawings 25L1, 26L2, and 26L4.

INSPECTION:

Vendor Inspection - Lockheed Martin Surveillance:

Verify materials selection and verification controls (MMC-ET-SE16, drawings 80914901976, 80914901977, Standard Drawings 25L1, 26L2 and 26L4).

MAF Quality Inspection:

Inspect all attaching hardware for freedom of damage prior to installation (drawing 80914901999).

Verify installation and witness torque (drawing 80914901999).

Inspect for freedom of damage during post installation shakedown (MPP 80904000SCL for LWT-54 thru 68 and 80934003719 for LWT-69 & up).

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.