

CRITICAL ITEMS LIST (CIL)

SYSTEM:	Propulsion/Mechanical	FUNCTIONAL CRIT:	1
SUBSYSTEM:	GH2 Vent/Relief	PHASE(S):	a, b, c
REV & DATE:	J, 12-19-97	HAZARD REF:	E.01, S.04,
DCN & DATE:	005, 6-30-00		S.06, S.10
ANALYSTS:	J. White/H. Claybrook		

FAILURE MODE: External 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, LH2 tank structural failure or Intertank structural failure.
 c) Loss of life due to ET impact outside designated footprint.

TIME TO EFFECT: Seconds

FAILURE CAUSE(S): A: Structural Failure of Valve Body
 B: Structural Failure of Flange
 C: Primary Pilot Seal Leakage
 D: Secondary Pilot Seal Leakage
 E: Disengagement of Secondary Pilot Plug
 F: Structural Failure of Primary Pilot Component
 G: Structural failure of Switch Housing
 H: Disengagement of Switch Housing Cap
 I: Switch Housing Seal Leakage
 J: Structural Failure of Dump Line Component
 K: Dump Line Seal Leakage
 L: Primary Pilot to Main Valve Seal Leakage
 M: Disengagement of Primary Pilot Bias Spring Adjusting Plug
 N: Disengagement of Primary Pilot Plug
 O: Flange Mating Surface Defects

REDUNDANCY SCREENS: Not Applicable

FUNCTIONAL DESCRIPTION: The vent/relief valve limits maximum tank pressure through relief operation and provides a manual venting capability during prelaunch operation.

FMEA ITEM CODE(S)	PART NO.	PART NAME	QTY	EFFECTIVITY
2.8.14.5	PD4700189-029	GH2 Vent/Relief Valve	1	LWT-54 thru 84, 89-93
	-039		1	LWT-85 thru 88, 94 thru 114
	-040		1	LWT-115 & Up

REMARKS:

CRITICAL ITEMS LIST (CIL)
CONTINUATION SHEET

SYSTEM: Propulsion/Mechanical
SUBSYSTEM: GH2 Vent/Relief
FMEA ITEM CODE(S): 2.8.14.5

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

RATIONALE FOR RETENTION

DESIGN:

- The GH2 Vent/Relief (V/R) valve assembly design is based on the Saturn S-II configuration. Poppet flow control, actuation and relief sensing system concepts have been incorporated. The ET GH2 valve was designed to meet the required ultimate safety factors (1.4 for loads and 2.0 for pressure) and the required yield safety factors (1.1 for loads and 1.5 for pressure) (ET Stress Report 826-2188 and Calmec Stress Report TR-4-1). Material selected in accordance with MMC-ET-SE16 and controlled per MMMA approved vendor product assurance plan assures conformance of composition, material compatibility and properties. Each design feature of the V/R valve has been tested and proven on similar valves used on previous programs.
- A, B: The GH2 V/R valve body casting is aluminum alloy A356-T61 per MIL-A-21180C Class 11 Grade B in critical areas, Class 12 Grade C in noncritical areas. Critical areas are flanges where loads are greatest (Calmec Stress Report TR-4-1).
- C, D: Test port plug seal is a K-seal, spring is CRES A-286 coated with Dupont 850-204 green TFE primer followed by a coat of 851-245 black TFE enamel. The primary pilot plug gasket, cover plate gasket and the secondary pilot cover gasket are all made from .003 inch thick FEP teflon sheet.
- E: The secondary pilot plug is lockwired.
- F: The primary pilot body is 6061-T651 aluminum alloy. The diaphragm is supported by a spherical spring which carries all the load. The cover is made of 304L CRES. All of these parts were designed to meet the required ultimate safety factors (1.4 for loads and 2.0 for pressure). They are proof pressure tested at 56 psig; the maximum operating pressure is 37 psig.
- G: Switch housing is a low stress item (TR-4-1, Calmec).
- H: Switch housing cap has a KEL-F locking plug to prevent disengagement.
- I: Switch housing cap gasket is .010 inch thick sheet KEL-F. Only when the valve is in the relief mode is the gasket exposed to pressures greater than ambient. Switch housing seal is a Creavey type O-ring seal. A Sandvik 1150 CRES helical spring is covered with a FEP/LP-389 teflon jacket.
- J: Pilot dump line fitting is 304L CRES. It is welded to the tube per Calmec Spec. WPS-106. The bellows is fabricated from single ply 321 CRES. The bellows is burst pressure tested at 2300 psig. The bellows to tube joints are induction brazed per MIL-B-7883 Type III, Grade B using silver solder per QQ-B-654 Grade 7. The tube is .250 inch CRES 321.
- K: Pilot dump line seals are FEP teflon sheets. They are leak checked at the Vendor, at MAF and at Launch Site.
- L: The primary pilot-to-main valve gas passageway seals are Raco type. The seal is fabricated by Furon and is similar to seals that were qualified and used on Atlas, Centaur, and Saturn IC, II and IVB vehicles. The design consists of a U shaped circular spring with a teflon jacket. The spring force assisted by media pressure is adequate to provide a seal between the teflon jacket and adjacent mating surfaces.
- M: Gross leakage past this plug could cause the valve to relieve at higher pressure than specified. The pilot valve body and plug sealing surfaces are machined to a 16 finish and a teflon gasket is used. A KEL-F friction plug provides locking to prevent disengagement. It is restricted to a one time entry.
- N: Primary pilot plug is lockwired.
- O: Flange mating surface flatness, waviness, and finish are specified on engineering drawings to assure performance within the capability of the seal.

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DCN & DATE: 006, 6-30-00

RATIONALE FOR RETENTION

TEST:

The GH2 V/R Valve Assembly is qualified. Reference COQ MMC-ET-TM06-065.

The PD4700189-040 (Ketema) GH2 V/R Valve will be qualified by test and similarity. Test criteria is specified in the Procurement Drawing (PD4700189). Ketema will have all testing responsibility. Applicable test reports will be identified in this section at the conclusion of all testing.

Development: Two development valves, GO2 and GH2, were fabricated and tested to develop the relief mechanism and provide confidence to proceed with qualification test. Cryogenic and ambient functional checks were run which included vent mode response and relief mode response, life cycle and leakage test (MMC-T-77-18-2). Development vibration testing was accomplished on the GH2 valve using a composite of the two required vibration spectra for the GO2 and GH2 valves (MMC-T-77-18-1).

Qualification: Two GH2 qualification valves were fabricated and tested. Both valves were given relief mode response tests at various temperature and pressure (altitude simulation). Also, functional and leak tests, minimum vent actuation pressure tests, vent mode response, life cycle tests (500 relief and 500 vent), vibration, post vibration cryogenic functional and leak test, and burst pressure tests were run. All test requirements were met; relief and reseat pressures were within the required limits (MMC-ET-RA09-61 and MMC-ET-RA09-84).

The GH2 valve was later qualified by similarity for 5000 vent mode cycles (MMC-ET-RA09-60 addendum). It was also qualified by similarity to new and higher vibration levels (MMC-ET-RA09-91).

MPTA Firings/Tankings: One flight configuration valve assembly installed on MPTA has accumulated 60.9 minutes of firing time, 17 cryogenic cycles and 33 pressurization cycles.

Acceptance:

Vendor - Total Assembly:

A-O: Perform proof pressure test, external leak test, and functional test at ambient and cryogenic temperatures (document T-290, CCC for LWT-54 thru 84, 89-93; 88690 ATP1 for LWT-85 thru 88, 94 thru 114; 8-440369 for LWT-115 & Up).

MAF - Total Assembly:

B, C, K, O: Perform leakage test after valve installation (MMC-ET-TM04k).

A-O: Perform V/R valve timing test (MMC-ET-TM04k).

Launch Site:

A-O: Perform V/R valve operation test (OMRSD File II).

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RATIONALE FOR RETENTION

INSPECTION:

Vendor Inspection - Lockheed Martin Surveillance:

- A-D, F,G,I, J-L: Verify materials selection and verification control (MMC-ET-SE16 and drawings 1419-3, 1419-300, 1419-299, 1419-264, 1419-270, 1419-295, 1419-304, 1419-296-3, 81741, 1419-10-1, 1419-94, 1419-317, 1419-318, 1419-319, 1419-320, 1419-327, 1419-290 and 1419-281-5, CCC for LWT-54 thru 114; K210-106, K210-135, K210-136, K210-133, K210-132, K210-71, K210-89, K210-74-3-5, K210-111, K210-140, K210-145, K210-98, K210-95, K210-96, K210-94, K210-165, K210-93, K210-4 for LWT-115 & Up).
- C,E,H, K-O: Witness valve assembly and torque (PS-413, CCC for LWT-54 thru 84, 89-93; 88691 AP1 for LWT-85 thru 88, 94 thru 114; AIS-K210-502 for LWT-115 & Up).
- J: Inspect weld (visually) for surface cracks and voids (STP5502, class III).
- O: Inspect surface flatness, finish and dimensions (drawings 1419-281-5 and 1419-3, Consolidated Controls for LWT-54 thru 114; K210-106 and K210-4 for LWT-115 & Up).

Lockheed Martin Procurement Quality Representative:

- A-O: Witness proof pressure, external leakage and functional tests (document T-290, CCC for LWT-54 thru 84, 89-93; 88690 ATP1 for LWT-85 thru 88, 94 thru 114; 8-480798 for LWT-115 & Up).

MAE Quality Inspection:

- B, C, K, O: Witness seal flange leakage test (MMC-ET-TM04k).
- A-O: Witness V/R valve operation timing test (MMC-ET-TM04k).

Launch Site:

- A-O: Witness V/R valve operation test (OMRSD File II).

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.