CRITICAL ITEMS LIST (CIL)

SYSTEM:	Propulsion/Mechanical		
SUBSYSTEM:	GO2 Vent/Relief	FUNCTIONAL CRIT:	1
REV & DATE:	J, 12-19-97	PHASE(S):	b
DCN & DATE:	005, 6-30-00	HAZARD REF:	E.01, S.03, S.07, S.10
ANALYSTS:	J. White/H. Claybrook		

FAILURE MODE: External Leakage

FAILURE EFFECT: b) Loss of mission and vehicle/crew due to LO2 tank structural failure or nose cone structural failure.

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 operations.

FMEA ITEM CODE(S)	PART NO.	PART NAME	QTY	EFFECTIVITY
2.3.19.5	PD4700187-079	GO2 Vent/Relief Valve	1	LWT-54 thru 114
	-089		1	LWT-115 & Up

REMARKS:

SYSTEM:	Propulsion/Mechanical	REV & DATE:	J, 12-19-97
SUBSYSTEM:	GO2 Vent/Relief	DCN & DATE:	
FMEA ITEM CODE(S):	2.3.19.5		

RATIONALE FOR RETENTION

DESIGN:

The GO2 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 GO2 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 ET GO2 V&R valve has been tested and proven on similar valves used on previous programs.

A, B: The GO2 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 factor 1.4 for loads and 2.0 for pressure. These parts are proof pressure tested at 48 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 and at MAF.

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 SIC, S-II and S-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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SUBSYSTEM:	GO2 Vent/Relief	DCN & DATE:	005, 6-30-00
FMEA ITEM CODE(S):	2.3.19.5		

RATIONALE FOR RETENTION

TEST:

The GO2 V/R Valve Assembly is qualified. Reference COQ MMC-ET-TM06-094.

The PD4700187-089 (Ketema) GO2 V/R Valve will be qualified by test and similarity. Test criteria is specified in the Procurement Drawing (PD4700187). Ketema will have all testing responsibility. Applicable test reports will be identified in this section at the conclusion of all testing.

The PD4700187-079 valve was qualified by similarity to the -059 valve with the following additional testing performed. (See FMEA Item Code 2.3.19.3 for full description of the -059 valve development/qualification).

Development (PD4700187-079): A new Belleville Primary Pilot Assembly (31 ± 1 PSIG relief pressure setting) was installed on a refurbished GO2 Vent/Relief Valve. Proof pressure and external leakage tests were performed on the development valve. The valve was then installed on the test tank and 42 relief mode life cycles at ambient and cryogenic temperatures were run using either the GN2 or Helium prepress (Memo MMC-ET-3515-89-024).

Qualification (PD4700187-079): The Belleville spring in the GO2 vent/relief valve was modified in order to accommodate the new higher relief pressure setting (31 ± 1 PSIG). Testing was performed on 1 Type VI valve which included 250 relief mode life cycles (150 at cryogenic temperature and 100 at ambient). All testing met criteria for relief and reseat pressures of 31 ± 1 PSIG and 29 PSIG minimum. The rest of the valve parts were unchanged and qualified by similarity to the PD4700187-059 valve (MMC-ET-RA09-119).

MPTA Firings/Tankings: One flight configuration valve assembly installed on MPTA has accumulated 60.5 minutes of firing time, 18 cryogenic cycles and 24 pressurization cycles. No excessive external leakage rates have been reported.

Acceptance:

Vendor - Total Assembly:

A-O: Perform proof pressure test, external leak test, and functional test at ambient and cryogenic temperatures (drawing 86650 ATP 1, CCC for LWT-54 thru 114; and 8-480797 for LWT-115 & Up)

MAF - Total Assembly:

B, C, K, O: Perform leakage test after valve installation (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,U-L: Verify materials selection and verification control (MMC-ET-SE16 and drawings 81734, 1419-300, 1419-299, 1419-264, 1419-270, 1419-295, 1419-304, 81741, 1419-10-1, 1419-94, 1419-317, 1419-318, 1419-319, 1419-320, 1419-327, 1419-290, 86652 and 85382-3, CCC for LWT-54 thru 114; K210-180, K210-135, K210-136, K210-133, K210-132, K210-71, K210-89, K210-177, K210-140, K210-145, K210-98, K210-95, K210-96, K210-94, K210-165, K210-93, K210-74, K210-26 for LWT-115 & Up).

C,E,H, K-O: Witness valve assembly and torque (drawing 86650 AP1, CCC for LWT-54 thru 114; AIS-K210-501 for LWT-115 & Up).

J: Inspect weld (visually) for surface cracks and voids (STP5502, Class III).

O: Inspect surface flatness, finish and dimensions (drawings 1419-281-3 and 81734, Consolidated Controls for LWT-54 thru 114; K210-4, K210-180 for LWT-115 & Up).

Lockheed Martin Procurement Quality Representative:

A-O: Witness proof pressure, external leakage, and ambient and cryogenic functional tests (drawing 86650 ATP 1, CCC for LWT-54 thru 114; AIS-K210-501 for LWT-115 & Up).

MAF Quality Inspection:

B, C, K, O: Witness seal flange leakage 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.