CRITICAL ITEMS LIST (CIL)

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

FAILURE MODE: Loss of Relief Capability

FAILURE EFFECT:
a) Loss of mission and vehicle/crew due to LO2 tank over-pressurization.
b) Loss of mission and vehicle/crew due to LO2 tank over-pressurization.

TIME TO EFFECT: Seconds

FAILURE CAUSE(S):
A: Structural Failure of Primary Pilot Spring
B: Binding of Secondary Pilot Piston Shaft and Bearings Including Pistons in Bore
C: Binding of Main Piston in Bore
D: Seizure of Main Shaft and Bearing
E: Disengagement of Main Poppet
F: Disengagement of Main Shaft Nut
G: Disengagement of Primary Pilot Plug
H: Blockage of Primary/Secondary Pilot Bleed Line
I: Blockage of Primary Pilot Dump Line
J: Binding Between Primary Pilot Poppet Stem and Retainer
K: Disengagement of Primary Pilot Bias Spring Adjusting Plug
L: High Primary Pilot Pressure Setting During Assembly
M: Blockage of Primary Pilot Sense Port
N: Disengagement of Secondary Pilot Nut
O: Seizure of Secondary Pilot Adapter and Bearing
P: Disengagement of Threaded Orifice, Secondary Pilot

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
2.3.19.4	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):	2.3.19.4		

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.

A: The primary pilot bias spring is made from 302 CRES wire of different diameters. Spring selection is made at time of assembly to provide the required cracking pressure.

B: Binding of the secondary pilot piston shaft and bearing is precluded by vendor specified dimensional tolerances that provides clearance. The bearing is a slit configuration and is made from Fluorogold which is considered compatible within the required temperature range. The piston rings are slit configuration with adequate end gap to preclude binding.

C: Binding of the main piston in the bore is precluded by requirements for concentricity, surface finish and dimensional tolerances. Two slitted Fluorogold rings with a 301 CRES wavy spring to hold them in contact with the cylinder bore are used in the piston groove. The piston and cylinder bore are made of the same material, aluminum alloy, which precludes binding due to thermal expansion or contraction.

D: Seizure of the main shaft and bearing is precluded by vendor specified dimensional tolerances that provides clearance. The bearing is a slit configuration and is made from fluorogold which is considered compatible with temperature.

E: The main poppet is threaded onto the shaft and locked in place by a set screw which is staked to the main poppet.

F: The main shaft nut is threaded onto the shaft and locked by a set screw which is staked to the nut.

G: Primary pilot plug is lockwired.

H: Prior to assembly, passageway parts are cleaned per MSFC-SPEC-164, except particle size is limited to 1000 microns, and maintained clean during assembly and test. The source of gas flow through the passage is the ET ullage which is under contamination control.

I: Prior to assembly, the pilot dump line is a tube assy with a flow passage of .21 inch diameter. Prior to assembly, parts are cleaned per MSFC-SPEC-164, except particle size is limited to 1000 microns, and maintained clean during assembly and test. The source of gas flow through the line is the ET ullage which is under contamination control.

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RATIONALE FOR RETENTION

DESIGN: (cont)

J: Binding is precluded by vendor specified dimensional tolerances that provide clearance. The stem is teflon coated per PS-425 (Calmec). Cleanliness is maintained per PS-422 (Calmec). Assembly and testing of the stem and retainer at the subassembly level is performed during the build cycle per drawing 86650 AP1.

K: Gross leakage past the plug could cause the valve to relieve at a higher pressure than specified. The pilot valve body and plug sealing surfaces are machined to a 16 finish and a teflon gasket is used.

L: The primary pilot is very carefully assembled by highly trained technicians. Intermediate tests and inspections are frequently made to assure a good quality assembly which will meet all pilot valve requirements. Before the pilot valve is installed on the main valve, it is placed in a test fixture with sufficient instrumentation to precisely determine stroke, flow rate and leakage rates at applicable sense pressures. This test is run at cryogenic and ambient temperatures. The operation of the pilot is again checked after installation on the main valve at cryogenic and ambient temperatures.

M: Blockage of the primary pilot sense port would increase the relief pressure of the valve at altitude. Cleanliness is maintained during valve assembly, installation on the ET, and during launch operations.

N: The secondary pilot nut is locked with a KEL-F friction plug.

O: Seizure of the secondary pilot adapter and bearing is precluded by vendor specified dimensional tolerances that provide clearance. The bearing is a slit configuration and is made from Fluorogold which is considered compatible within the required temperature range.

P: Disengagement of the Secondary Pilot threaded orifice could cause loss of relief capability. The orifice is threaded into the secondary pilot piston and torqued to 40 inch pounds. A KEL-F friction plug provides locking to prevent disengagement. It is restricted to a one time entry.

TEST:

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

The P04700187-079 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 (P04700187-079): 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 (P04700187-079): 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 P04700187-059 valve (MMC-ET-RA09-119).

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RATIONALE FOR RETENTION

TEST: (cont)

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. One relief function was performed by special test (SF-10). Audible relief and reseat pilot valve tests were performed, which verified relief operation of the primary and secondary pilot sections.

Acceptance:

Vendor:

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

MAF - Total Assembly:

A-P: Perform V/R valve operation test after installation (MMC-ET-TM04k).

Launch Site:

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

INSPECTION:

Vendor Inspection - Lockheed Martin Surveillance:

A: Verify materials selection and verification control (MMC-ET-SE16 and drawing 1419-305, CCC) for LWT-54 thru 114; and K210-138 for LWT-115 & Up

B-D,J, L,O: Inspect dimensions (drawings 1419-262, 1419-4, 1419-17, 1419-253, 1419-258, 1419-252, 1419-257, 1419-25, 1419-286, 1419-292, and 1419-44, Calmec; drawing 86654, CCC) for LWT-54 thru 114; (K210-56, K210-5, K210-3, K210-48, K210-130, K210-46, K210-124, K210-28, K210-85, K210-80, K210-24) for LWT-115 & Up

E-G, K-P: Witness valve assembly (drawing 86650 AP1, CCC) for LWT-54 thru 114, and AIS-K210-501 for LWT-115 & Up

L: Witness pressure settings (drawing 86650 AP1, CCC) for LWT-54 thru 114, and AIS-K210-501 for LWT-115 & Up

Lockheed Martin Procurement Quality Representative:

A-P: Witness proof pressure, external and internal leakage, and ambient and cryogenic functional tests (drawing 86650 ATP 1, CCC) for LWT-54 thru 114; 8-480797 for LWT-115 & Up

H, I, Witness cleaning (procedure PS-422, CCC) for LWT-54 thry 114, and 8-440369 for LWT-115 & Up

MAF Quality Inspection:

A-P: Witness V/R valve operation test (MMC-ET-TM04k).

Launch Site:

A-P, M: 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.