CRITICAL ITEMS LIST (CIL)

SYSTEM:	Propulsion/Mechanical	FUNCTIONAL CRIT:	1R
SUBSYSTEM:	Helium Inject	PHASE(S):	a
REV & DATE:	J, 12-19-97	HAZARD REF:	P.02, P.06
DCN & DATE:			
ANALYSTS:	E. Flauss/H. Claybrook		

FAILURE MODE: Fails Closed

FAILURE EFFECT: a) Loss of mission and vehicle/crew due to geysering followed by water hammer effect results in leakage of LO2 feedline and loss due to fire/explosion.

TIME TO EFFECT: Minutes

FAILURE CAUSE(S): Binding of Poppet

REDUNDANCY SCREENS:
Screen A: FAIL - No checkout capability for failure of a single check valve.
Screen B: N/A - Helium Inject System nonfunctional in flight.
Screen C: PASS

FUNCTIONAL DESCRIPTION: Allows flow of helium from facility to LO2 feedline during loading; prevents backflow of LO2/GO2 when helium inject system is inactive.

FMEA ITEM CODE(S)	PART NO.	PART NAME	QTY	EFFECTIVITY
2.4.19.4	47L1-1	Check Valve (Upstream & Downstream)	4	LWT-54 & Up

REMARKS:

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FMEA ITEM CODE(S):	2.4.19.4		

RATIONALE FOR RETENTION

DESIGN:

Two check valves and one filter are connected in series as one assembly and two of these assemblies are connected in parallel. The parallel paths provide redundancy for flow and protection against a check valve failing to open during helium inject operation. The series connected check valves provide redundancy for failing to close after ground umbilical separation. The valve incorporates a spring loaded poppet and nonmetallic seal.

The valve housing ends and poppets are fabricated from 304L CRES and were designed to operate to 3000 PSI between -320°F and +350°F. During ET operation the valves (housings) are used in the helium inject system at 750 psig and ambient to LO2 temperature. The valves have been designed to meet the required yield (1.5) and ultimate (2.0) safety factors (ET Stress Report 826-2188). 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. Compatibility for oxygen service is specified per NHB 8060.1. 100% inspection of valve components is specified and assures no damage to seals or mating surfaces.

Redundancy Description:

The helium inject system on the ET and Orbiter SSME bleed provide LO2 conditioning that will prevent geysering. The systems are considered to be redundant and loss of helium injection is assessed criticality 1R.

Effect of First Redundancy Loss:

(Helium Injection) - Flow of LO2 from the tank to the SSME's by the active engine bleed system provides a cooling effect within the feedline and geysering will not occur. A check valve failing closed in one of two flow paths will have no effect on helium system operation. A check valve failing closed in both flow paths resulting in loss of helium injection will be detected by the facility flowmeter and the action taken is LO2 stop flow.

Effect of Second Redundancy Loss:

(SSME Bleed) - For worst case (no helium injection, stop flow, and engine bleeds closed) geysering will occur in approximately 100 minutes. Action is taken to safe (off load) the ET.

TEST:

The check valve is qualified as a subassembly of the helium inject filter/check valve assembly. Reference COQ MMC-ET TM06-099.

Qualification: Qualification testing was performed partially at the check valve assembly level and filter/check valve assembly level. The latter assembly includes a filter connected in series with two downstream check valves and appropriate sealing elements.

Valve Assembly: Testing of two valves included proof pressure at 4500 psig, external leakage, internal leakage at ambient and -300°F and cracking/reseat cycles at -300°F and +400°F.

Filter/Valve Assembly: Further testing for acceptance with the check valves installed in the filter/check valve assembly configuration included proof pressure at 4500 psig, external leakage at 3000 psig, and internal leakage at 50 psig. Other testing included sine and random vibration, post vibration external leakage at 3000 psig, internal leakage at ambient and -300°F and cracking/reseat pressure cycles at -300°F, ambient, and +400°F. There was no evidence of check valve damage, wear or contamination (MMC-ET-RA09-20).

MPTA Firings/Tankings: Two helium inject filter/check valve assemblies have been installed on MPTA. One assembly (two check valves) has accumulated 62.5 minutes of firing time and 27 cryogenic cycles. The second assembly has accumulated 22.5 minutes of firing time and 9 cryogenic cycles. There was no evidence of internal leakage due to operation or environment.

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RATIONALE FOR RETENTION

TEST: (cont)

Acceptance:

Vendor - (Check Valve):

Perform proof pressure and cracking/reseat pressure cycle tests (TM545 Circle Seal).

Vendor - (Filter/Check Valve Assembly):

Perform proof pressure test (TM545 Circle Seal).

MAF - (Vehicle Assembly):

Perform flow test (MMC-ET-TM04k).

Launch Site:

Perform flow test (OMRSD File IV).

INSPECTION:

Vendor Inspection - Lockheed Martin Surveillance:

Verify materials selection and verification controls (MMC-ET-SE16 and drawings 34171 and 34173, Circle Seal).

Inspect dimensions (drawings 34171 and 34173 Circle Seal).

Verify assembly (CSC/CCD-700, Circle Seal).

Verify cleaning (CSC/CCD-700, Circle Seal).

Lockheed Martin Procurement Quality Representative:

Witness proof pressure, cracking and reseat tests (TM545, Circle Seal).

MAF Quality Inspection:

Witness flow test (MMC-ET-TM04k).

Launch Site:

Witness flow test (OMRSD File IV).

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.