FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 03-1-0241 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 2 08/10/00

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
LRU	:GHE PNEUMATIC ISOLATION CHECK VALVE	ME284-0472-0024
	CIRCLE SEAL	P198-180

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
VALVE, CHECK, PNEUMATIC HELIUM ISOLATION, 0.50 INCH DIAMETER

REFERENCE DESIGNATORS: CV8

QUANTITY OF LIKE ITEMS: 1

FUNCTION:
THE CHECK VALVE ISOLATES AND RETAINS PNEUMATIC ACTUATOR SYSTEM HELIUM PRESSURE AT THE PROPELLANT CONTROL VALVES IN THE NON-ACCUMULATOR AND ACCUMULATOR LEGS IN THE EVENT OF AN UPSTREAM PRESSURE LOSS.

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SUBSYSTEM NAME: MAIN PROPULSION
LRU: GHE PNEUMATIC ISOLATION CHECK VALVE (CV8) **CRITICALITY OF THIS**
ITEM NAME: GHE PNEUMATIC ISOLATION CHECK VALVE (CV8) **FAILURE MODE:** 1/1

FAILURE MODE:
RUPTURE/LEAKAGE

MISSION PHASE:
LO LIFT-OFF
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:
102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:
MATERIAL DEFECT, FATIGUE

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
DURING ASCENT, THE PNEUMATIC HELIUM SUPPLY WILL BE LOST. ESCAPING HELIUM MAY OVERPRESSURIZE THE AFT COMPARTMENT.

WHEN THE CROSSOVER VALVE (LV10) OPENS AT MECO, THE PNEUMATIC HELIUM DISTRIBUTION SYSTEM WILL BE FED FROM THE LEFT ENGINE HELIUM SUPPLY. WHEN THE

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INTERCONNECT "OUT" VALVES OPEN AT MECO PLUS 20 SECONDS, THE ENGINE 1 AND 3 HELIUM SUPPLIES WILL LEAK THROUGH THE FAILED LINE.

STORED HELIUM PRESSURE IN THE ACCUMULATOR LEG SHOULD BE ADEQUATE TO OPERATE THE LO2 PREVALVES AT MECO. LOSS OF HELIUM MAY PREVENT OPERATION OF VALVES FOR MPS DUMP.

PURGE OF AFT COMPARTMENT AND LH2/LO2 SYSTEMS WOULD DEPEND SOLELY ON THE LEFT ENGINE HELIUM SYSTEM RESIDUALS, RESULTING IN INADEQUATE ABORT PURGE, INCOMPLETE PROPELLANT DUMP, AND INGESTION OF CONTAMINATION.

DURING ENTRY, VENT DOORS ARE CLOSED TO PREVENT INGESTION OF RCS AND APU GASES. RUPTURE DURING THE TIME PERIOD THAT THE VENT DOORS ARE CLOSED MAY RESULT IN OVERPRESSURIZATION OF AFT COMPARTMENT. VENT DOORS ARE OPENED WHEN VEHICLE VELOCITY DROPS BELOW 2400 FT/SEC.

EXCESSIVE HELIUM LEAKAGE WILL BE DETECTABLE USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

(B) INTERFACING SUBSYSTEM(S):
SAME AS A.

(C) MISSION:
ON GROUND, POSSIBLE LAUNCH SCRUB DUE TO LCC VIOLATION.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:
NONE.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE CHECK VALVE IS A POPPET TYPE, SPRING LOADED AND PRESSURE ASSISTED TO THE CLOSED POSITION. THE POPPET AND SPRING ARE CONTAINED IN A THREADED HOUSING AND END CAP. THE POPPET SEAL IS A SELF-CENTERING TEFLON O-RING. THE VALVE BODY PROVIDES A GUIDE FOR THE POPPET TRAVEL. THE VALVE BODY IS DESIGNED TO A FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST.

THE THREADED HOUSING IS MANUFACTURED FROM 316L CRES AND THE END CAP IS INCONEL 718. THE END CAP IS THREADED INTO THE HOUSING (TORQUED TO 140 FT-LBS) AND TIG WELDED TO SEAL THE JOINT.

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STRUCTURAL ANALYSIS, PERFORMED BY THE CHECK VALVE SUPPLIER, INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF CHECK VALVE OPERATION.

(B) TEST:
ATP

EXAMINATION OF PRODUCT

AMBIENT TESTS
BODY PROOF PRESSURE (1717 PSIG)
CLOSURE DEVICE PROOF PRESSURE (1717 PSIG)
EXTERNAL LEAKAGE (850 PSIG)
INTERNAL LEAKAGE (5, 25, 100, 850 PSIG)
CRACKING AND RESEAT PRESSURE: 3 CYCLES
CRACKING PRESSURE 5 PSID MAX
RESEAT PRESSURE 2 PSID MIN

CYROGENIC TESTS (-300 DEG F)
INTERNAL LEAKAGE (5, 25, 100, 850 PSIG)

CERTIFICATION

FLOW TEST (0.202 LB/SEC GHE)
MAX INLET PRESSURE OF 130 PSIG
PRESSURE DROP (45 PSID MAX)

CHATTER TEST (850 TO 0 PSIG)
RECORD FLOW RATE WHEN CHATTER OCCURS

CRACKING AND RESEAT PRESSURE
CRYO (-300 DEG F): 3 CYCLES EACH
CRACKING PRESSURE 5 PSID MAX
RESEAT PRESSURE 2 PSID MIN

INTERNAL LEAKAGE
AMBIENT (0 TO 850 PSIG)
CRYO (-300 DEG F, 0 TO 850 PSIG)

EXTERNAL LEAKAGE (AMBIENT, 850 PSIG)

LIFE CYCLE TEST

ONE CYCLE CONSISTS OF PRESSURIZING THE INLET TO 130 PSIA, VENTING THE INLET TO AMBIENT, PRESSURIZING THE OUTLET TO 850 PSIG (AMBIENT) OR 130 PSIG (CRYO), AND VENTING THE OUTLET TO AMBIENT.

AMBIENT
42,000 CYCLES, FOLLOWED BY CRACKING, RESEATING, AND INTERNAL LEAKAGE TESTS

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CRYO (-300 DEG F)
18,000 CYCLES, FOLLOWED BY CRYO CRACKING, RESEATING, INTERNAL LEAKAGE TESTS

UPON COMPLETION OF BOTH AMBIENT AND CRYO TESTS PERFORM AMBIENT FLOW, PRESSURE DROP, AND EXTERNAL LEAKAGE TESTS.

VIBRATION (AMBIENT, 2 AXES)
QUALIFIED BY SIMILARITY TO TYPE V CHECK VALVE. TYPE V VALVES ARE CERTIFIED BY THE FOLLOWING TESTS:

TRANSIENT
5 TO 35 HZ AT +/- 0.25 GS PEAK

RANDOM
13.3 HOURS FOR EACH OF 2 AXES

UPON COMPLETION OF VIBRATION TESTS PERFORM CRACK, RESEAT, AND INTERNAL LEAKAGE TEST.

BURST PRESSURE (3400 PSIG)

GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
ALL RAW MATERIALS ARE VERIFIED FOR MATERIAL AND PROCESS CERTIFICATION. RECEIVING INSPECTION VERIFIES CERTIFICATION OF SPRING HEAT TREATMENT AND PERFORMS LOAD TEST OF SPRINGS.

CONTAMINATION CONTROL
ALL PARTS AND ASSEMBLIES ARE MAINTAINED TO CLEANLINESS LEVEL OF 100A.

ASSEMBLY/INSTALLATION
DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. REQUIRED TORQUES ARE VERIFIED PRIOR TO WELDING. INSPECTION POINTS ARE ESTABLISHED TO VERIFY ASSEMBLY PROCESS. WELDS ARE VISUALLY VERIFIED BY 10X MAGNIFICATION.

CRITICAL PROCESSES
ALL WELDING, ELECTROPOLISHING AND PARTS PASSIVATION ARE VERIFIED BY INSPECTION. DRY FILM LUBRICANT COATED THREADS ARE VERIFIED PER DRAWING REQUIREMENT.

NONDESTRUCTIVE EVALUATION
HELIUM LEAKAGE DETECTION IS VERIFIED.

TESTING
ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

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PACKAGING FOR SHIPMENT IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
AN EXTERNAL LEAK WAS DETECTED DURING PANEL ASSEMBLY AND CHECKOUT AT DOWNEY. THE LEAK WAS CAUSED BY A MISSING SECTION OF THE TEFLON COATING FROM THE DYNATUBE END FITTING ON THE CHECK VALVE. CLOSER INSPECTION OF SEALING SURFACES PRIOR TO ASSEMBLY HAS BEEN IMPLEMENTED (REFERENCE DR AC6781).

CURRENT DATA ON TEST FAILURE, FLIGHT FAILURE, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

(E) OPERATIONAL USE:
PNEUMATIC ACTUATION HELIUM BOTTLE PRESSURE IS ON A DEDICATED DISPLAY IN COCKPIT. CREW ACTION IS TO FOLLOW NORMAL LEAK ISOLATION PROCEDURE. PRIOR TO MECO, ISOLATION VALVES (LV7, LV8) WILL BE REOPENED AND THE LEFT ENGINE HELIUM CROSSOVER VALVE (LV10) WILL BE OPENED.

PNEUMATIC TANK, REGULATOR, AND ACCUMULATOR PRESSURE ARE ON S/M ALERT FDA SYSTEM AND THE BFS SYSTEM SUMMARY DISPLAY. THIS ALLOWS THE FLIGHT CREW TO RESPOND TO A PNEUMATIC HELIUM SYSTEM LEAK INDEPENDENT OF GROUND CONTROL.

- APPROVALS -

S&R ENGINEERING	: W.P. MUSTY	:/S/ W. P. MUSTY
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	:/S/ P. A. STENGER-NGUYEN
DESIGN ENGINEERING	: MIKE FISCHER	:/S/ MIKE FISCHER
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
MOD	: BILL LANE	:/S/ BILL LANE
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: ERICH BASS	:/S/ ERICH BASS