FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 03-1-0207 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 2 08/10/00

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
LRU	:GHE SUPPLY ISO CHECK VALVE	ME284-0472-0034
	CIRCLE SEAL	P200-180

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
VALVE, CHECK, SSME HELIUM SUPPLY ISOLATION, 0.750 INCH

REFERENCE DESIGNATORS:
CV5
CV6
CV7
CV29
CV40
CV45

QUANTITY OF LIKE ITEMS: 6
TWO PER ENGINE HELIUM SUPPLY

FUNCTION:
THE CHECK VALVE PROVIDES PROTECTION AGAINST ENGINE HELIUM ESCAPING THROUGH A FAILED PARALLEL REDUNDANT LEG (ISOLATION VALVE TO CHECK VALVE). ONE CHECK VALVE IS PROVIDED IN EACH PARALLEL ENGINE HELIUM SUPPLY LEG.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 03-1-0207-03

REVISION#: 2 08/10/00

SUBSYSTEM NAME: MAIN PROPULSION
LRU: GHE SUPPLY ISO CHECK VALVE
ITEM NAME: GHE SUPPLY ISO CHECK VALVE

CRITICALITY OF THIS 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, HELIUM SUPPLY TO ONE ENGINE WILL BE LOST. POSSIBLE OVERPRESSURIZATION OF THE AFT COMPARTMENT. POSSIBLE UNCONTAINED ENGINE SHUTDOWN IF REDUNDANT LEG CANNOT PROVIDE ENGINE HELIUM REQUIREMENTS. EXCESSIVE HELIUM TANK PRESSURE DECAY (SM ALERT: >20 PSI/3 SECONDS; CAUTION AND WARNING: 1150 PSIA LOWER LIMIT) AND/OR REGULATOR PRESSURE OUT OF LIMITS

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WILL BE INDICATED BY SM ALERT (BOTH LEGS: 679 LOWER AND 810 UPPER) OR CAUTION AND WARNING (LEG A ONLY: 680 LOWER LIMIT AND 810 UPPER LIMIT).

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

DURING ENTRY, VENT DOORS ARE CLOSED TO PREVENT INGESTION OF RCS AND APU GASES. LEFT ENGINE B LEG ISOLATION VALVE IS OPENED WHEN VEHICLE TRANSITIONS TO ORBITER SOFTWARE MAJOR MODE 304 (MM304). RUPTURE ON THIS LINE DURING THE TIME PERIOD THAT THE VENT DOORS ARE CLOSED MAY RESULT IN OVERPRESSURIZATION OF THE AFT COMPARTMENT. VENT DOORS ARE OPENED WHEN VEHICLE VELOCITY DROPS BELOW 2400 FT/SEC.

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

(C) MISSION:
ON GROUND, POSSIBLE LAUNCH SCRUB DUE TO LCC VIOLATION. POSSIBLE ABORT DUE TO EARLY SHUTDOWN OF ONE ENGINE.

(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 75 FT-LBS) AND TIG WELDED TO SEAL THE JOINT.

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

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(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 0.6 PSID MAX
RESEAT PRESSURE 0.1 PSID MIN

LOW TEMPERATURE TESTS (-160 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 (15 PSID MAX)

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

CRACKING AND RESEAT PRESSURE
AMBIENT: 3 CYCLES EACH
CRACKING PRESSURE 0.6 PSID MAX
RESEAT PRESSURE 0.1 PSID MIN

INTERNAL LEAKAGE AMBIENT (0 TO 850 PSIG) LOW TEMPERATURE (-160 DEG F, 0 TO 850 PSIG)

EXTERNAL LEAKAGE (AMBIENT, 850 PSIG)

LIFE CYCLE TEST

ONE CYCLE CONSISTS OF PRESSURIZING THE INLET TO 130 PSIG, VENTING THE INLET TO AMBIENT, PRESSURIZING THE OUTLET TO 850 PSIG, AND VENTING THE OUTLET TO AMBIENT.

42,000 CYCLES (AMBIENT)

FOLLOWED BY CRACK, RESEAT, AND INTERNAL LEAKAGE TESTS (-160 DEG F)

VIBRATION (AMBIENT, 2 AXES)

RANDOM
4.4 HOURS FOR EACH OF 2 AXES

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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. INLET AND OUTLET ARE PROTECTED AFTER TESTS TO MAINTAIN INTERNAL CLEANLINESS.

ASSEMBLY/INSTALLATION
DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. 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.

NONDESTRUCTIVE EVALUATION
HELIUM LEAKAGE DETECTION IS VERIFIED.

TESTING
ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
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:

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ENGINE HELIUM BOTTLE PRESSURE IS ON DISPLAY IN COCKPIT. CREW ACTION IS TO FOLLOW NORMAL LEAK ISOLATION PROCEDURE.

- 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