

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0209 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 2 08/10/00

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:GHE PNEUMATIC ACCUMULATOR ISOLATION	ME284-0472-0013
	CHECK VALVE	
	CIRCLE SEAL	P197-180

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

VALVE, CHECK, PNEUMATIC HELIUM ACCUMULATOR ISOLATION, 0.50 INCH DIAMETER

REFERENCE DESIGNATORS: CV9

QUANTITY OF LIKE ITEMS: 1

FUNCTION:

THE CHECK VALVE ISOLATES AND RETAINS PNEUMATIC ACTUATOR SYSTEM HELIUM PRESSURE AT THE PROPELLANT CONTROL VALVES IN THE ACCUMULATOR LEG IN THE EVENT OF AN UPSTREAM PRESSURE LOSS.

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LRU: GHE PNEU ACCUM ISO CHECK VALVE (CV9)

CRITICALITY OF THIS

ITEM NAME: GHE PNEU ACCUM ISO CHECK VALVE (CV9)

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:

RESULTS IN LOSS OF PNEUMATIC HELIUM SUPPLY. HELIUM PRESSURE WILL NOT BE AVAILABLE TO CLOSE THE PREVALVES AT MECO OR THE ET/ORBITER UMBILICAL DISCONNECTS PRIOR TO ET SEPARATION. DISCONNECTS WILL CLOSE IN MECHANICAL BACKUP MODE DURING UMBILICAL RETRACT. FAILURE TO CLOSE THE LO2 PREVALVES AT MECO WILL RESULT IN UNCONTAINED ENGINE DAMAGE. RESULTS IN THE INABILITY TO MAINTAIN INJECTED HELIUM AND LO2 PRESSURE AT THE SSME PUMP, RESULTING IN POSSIBLE PUMP OVERSPEED AND EXPLOSION. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION AND FIRE/EXPLOSIVE HAZARD.

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ENGINE HELIUM SUPPLY SYSTEM IS CONNECTED TO VALVE ACTUATION SUPPLY BY THE CROSSOVER VALVE (LV10) AT MECO BY SOFTWARE COMMAND. THE ADDITIONAL HELIUM SUPPLY MAY NOT ACTUATE LO2 PREVALVES CLOSED.

RESULTS IN LOSS OF PNEUMATIC AND LEFT ENGINE HELIUM SUPPLY IF THE FAILURE OCCURS AFTER THE LEFT ENGINE HELIUM CROSSOVER VALVE (LV10) OPENS AT MECO. LOSS OF PNEUMATIC AND ALL ENGINE HELIUM SUPPLIES IF FAILURE OCCURS WHILE THE INTERCONNECT "OUT" VALVES (LV60, 62, 64) AND LV10 ARE OPEN, BEGINNING AT 20 SECONDS AFTER MECO.

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

HELIUM WILL NOT BE AVAILABLE FOR AFT COMPARTMENT PURGE.

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 THE AFT COMPARTMENT. VENT DOORS ARE OPENED WHEN VEHICLE VELOCITY DROPS BELOW 2400 FT/SEC.

(B) INTERFACING SUBSYSTEM(S):

SAME AS A.

(C) MISSION:

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 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.

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THE THREADED HOUSING AND END CAP ARE MANUFACTURED FROM INCONEL 718. THE END CAP IS THREADED INTO THE HOUSING (TORQUED TO 45 FT-LBS) AND EB 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.

(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)

CYROGENIC TESTS (-300 DEG F)

CRACKING AND RESEAT PRESSURE: 3 CYCLES
CRACKING PRESSURE 5 PSID MAX
RESEAT PRESSURE 2 PSID MIN
INTERNAL LEAKAGE (5, 25, 100, 850 PSIG)

CERTIFICATION

FLOW TEST (0.08 LB/SEC GHE)
MAX INLET PRESSURE OF 715 PSIG
PRESSURE DROP (10 PSID MAX)

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

CRACKING AND RESEAT PRESSURE
AMBIENT AND 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 715 PSIA, VENTING THE INLET TO AMBIENT, PRESSURIZING THE OUTLET TO 850 PSIG, AND VENTING THE OUTLET TO AMBIENT.

AMBIENT

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36,000 CYCLES, FOLLOWED BY CRACKING, RESEATING, AND INTERNAL LEAKAGE TESTS

CRYO (-300 DEG F) 24,000 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 (-300 DEG F, 2 AXES)

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

RANDOM
48 MINUTES 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:

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 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.

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.

- 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