

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0248 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 2 08/10/00

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:LH2 RTLS REPRESS CHECK VALVE CIRCLE SEAL	ME284-0472-0024 P198-180

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

VALVE, CHECK, RTLS DUMP, 0.75 INCH DIAMETER

REFERENCE DESIGNATORS: CV30

QUANTITY OF LIKE ITEMS: 1

FUNCTION:

THIS CHECK VALVE PREVENTS LH2 OR GH2 IN THE FEEDLINE RELIEF LINE FROM ENTERING THE HELIUM PRESSURE LINE AND ITS ASSOCIATED COMPONENTS, AFTER MECO WHEN THE LH2 FEEDLINE RELIEF ISOLATION VALVE (PV8) IS OPENED.

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LRU: LH2 RTLS REPRESS CHECK VALVE (CV30)

CRITICALITY OF THIS

ITEM NAME: LH2 RTLS REPRESS CHECK VALVE (CV30)

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE

MISSION PHASE: LO LIFT-OFF

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

CAUSE:

FATIGUE, MATERIAL DEFECT

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:

AT MECO, THE LH2 FEEDLINE RELIEF ISOLATION VALVE (PV8) WILL OPEN AND HYDROGEN FROM THE LH2 MANIFOLD WILL LEAK THROUGH THE RUPTURE INTO THE AFT COMPARTMENT. POSSIBLE OVERPRESSURIZATION OF THE AFT COMPARTMENT. POSSIBLE FIRE/EXPLOSION HAZARD AND POSSIBLE LOSS OF CRITICAL ADJACENT COMPONENTS DUE TO EXPOSURE TO CRYOGENICS.

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(B) INTERFACING SUBSYSTEM(S):

SAME AS A.

(C) MISSION:

POSSIBLE LOSS OF CREW/VEHICLE.

(D) CREW, VEHICLE, AND ELEMENT(S):

SAME AS C.

(E) FUNCTIONAL CRITICALITY EFFECTS:

CASE 1:

1R/2 2 SUCCESS PATHS. TIME FRAME - ENGINE OPERATION.

- 1) CHECK VALVE (CV30) RUPTURES.
- 2) PV8 FAILS TO REMAIN CLOSED.

HYDROGEN FROM THE LH2 MANIFOLD WILL LEAK THROUGH THE RUPTURE INTO THE AFT COMPARTMENT. POSSIBLE FIRE/EXPLOSION HAZARD AND POSSIBLE LOSS OF CRITICAL ADJACENT COMPONENTS DUE TO EXPOSURE TO CRYOGENICS.

LEAKAGE OF HYDROGEN MAY REDUCE THE NPSP AND THE AMOUNT OF PROPELLANT AVAILABLE FOR ENGINE OPERATION. LOW NPSP MAY CAUSE TURBOPUMP CAVITATION AND UNCONTAINED ENGINE SHUTDOWN. MAY NOT HAVE SUFFICIENT HYDROGEN TO MEET VELOCITY MECO TARGET.

POSSIBLE ABORT DUE TO EARLY ENGINE SHUTDOWN.

POSSIBLE LOSS OF CREW/VEHICLE.

CASE 2:

1R/3 3 SUCCESS PATHS. TIME FRAME - PRELAUNCH, ASCENT, DEORBIT.

- 1) CHECK VALVE (CV30) RUPTURES.
- 2,3) LV74,75 FAIL TO REMAIN CLOSED.

DURING ASCENT, THE PNEUMATIC HELIUM SUPPLY WILL BE LOST. ESCAPING HELIUM MAY OVERPRESSURIZE THE AFT COMPARTMENT. CREW WILL ISOLATE MPS PNEUMATIC SYSTEM.

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

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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).

POSSIBLE LAUNCH SCRUB DUE TO LCC VIOLATION.

POSSIBLE LOSS OF CREW/VEHICLE.

-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-LBF) 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.

(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

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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

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.

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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

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:

NO CREW ACTION CAN BE TAKEN.

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- 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