

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0630 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 08/10/00

PART DATA

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

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

VALVE, CHECK, LH2 MANIFOLD REPRESS, ISOLATION, 0.75 INCH DIA (CV15)

REFERENCE DESIGNATORS: CV15

QUANTITY OF LIKE ITEMS: 1

FUNCTION:

THE CHECK VALVE PREVENTS LH2 FROM THE FEEDLINE MANIFOLD FROM ENTERING THE HELIUM PURGE, REPRESS AND GH2 PRESSURIZATION SYSTEMS VIA THE HELIUM PURGE LINES.

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SUBSYSTEM NAME: MAIN PROPULSION

LRU: LH2 MANIF REPRESS ISO CHECK VALVE (CV15)

CRITICALITY OF THIS

ITEM NAME: LH2 MANIF REPRESS ISO CHECK VALVE (CV15)

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE

MISSION PHASE:

PL PRE-LAUNCH

LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA

103 DISCOVERY

104 ATLANTIS

105 ENDEAVOUR

CAUSE:

FATIGUE, MATERIAL DEFECTS

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:

CASE 1:

1/1 TIME FRAME - PRELAUNCH AND ASCENT

RUPTURE OF THE CHECK VALVE RESULTS IN LH2 FROM THE MANIFOLD LEAKING INTO THE AFT FUSELAGE. POSSIBLE LOSS OF CRITICAL FUNCTIONS DUE TO COMPONENT EXPOSURE TO CRYOGENICS. POSSIBLE AFT FUSELAGE FIRE/EXPLOSION HAZARD.

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LEAKAGE DETECTABLE ON GROUND PRIOR TO T-31 SECONDS USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

CASE 2:

1/1 TIME FRAME – ENTRY

RUPTURE OF THE CHECK VALVE RESULTS IN HELIUM FROM ATTEMPTED MANIFOLD REPRESS INSTEAD LEAKING INTO AFT COMPARTMENT. POSSIBLE AFT COMPARTMENT OVERPRESS, LOSS OF CREW/VEHICLE.

(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 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.

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

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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

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)

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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 PERFORMED.

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

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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.

- 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