

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0605 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 08/10/00

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:GHE/GH2 PRESSURIZATION SYSTEM REPRESSURIZATION ISOLATION CHECK VALVE	ME284-0472-0011
	CIRCLE SEAL	P196-180

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

VALVE, CHECK. GH2/GHE,.GH2 PRESSURIZATION MANIFOLD REPRESSURIZATION (0.25 INCH DIA.) (CV13, 24)

REFERENCE DESIGNATORS: CV13
CV24

QUANTITY OF LIKE ITEMS: 2

FUNCTION:

THE SERIES CHECK VALVES PREVENT PREPRESSURIZATION GHE AND ET PRESSURIZATION GH2 FROM ENTERING THE HELIUM MANIFOLD REPRESSURIZATION SYSTEM. THE CHECK VALVES ALLOW THE FLOW OF HELIUM DURING THE DUMP SEQUENCE AND ENTRY FOR GH2 MANIFOLD PRESSURIZATION.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 03-1-0605-04

REVISION#: 1 08/10/00

SUBSYSTEM NAME: MAIN PROPULSION

LRU: GH2 PRESS SYS REPRESS ISO CK VLV (CV13, 24)

CRITICALITY OF THIS

ITEM NAME: GH2 PRESS SYS REPRESS ISO CK VLV (CV13, 24)

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE

MISSION PHASE:

PL PRE-LAUNCH
LO LIFT-OFF
DO DE-ORBIT

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:

RUPTURE OF CHECK VALVE (CV24) CAUSES GH2 AND/OR GHE LEAKAGE INTO THE AFT COMPARTMENT. POSSIBLE OVERPRESSURIZATION OF THE AFT COMPARTMENT AND FIRE/EXPLOSION HAZARD DUE TO LEAKAGE OF GH2 (GHE LEAKAGE HAS NO EFFECT). GHE LEAKAGE FROM ANTI-ICING PURGE DETECTABLE ON GROUND USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

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GH2 FLOW CONTROL VALVES WILL CYCLE TO THE HIGH FLOW POSITION IN AN ATTEMPT TO MAINTAIN ULLAGE PRESSURE. LOSS OF ET LH2 ULLAGE PRESSURE WILL RESULT IN VIOLATION OF TANK MINIMUM STRUCTURAL CAPABILITY REQUIREMENTS. POSSIBLE UNCONTAINED SSME SHUTDOWN DUE TO LOW LH2 NPSP.

RUPTURE OF CHECK VALVE (CV13) RESULTS IN LOSS OF MANIFOLD REPRESSURIZATION AND POSSIBLE INGESTION OF AIR INTO LH2 MANIFOLD ON RTLS/TAL ABORT ENTRY. POSSIBLE FIRE/EXPLOSION HAZARD DUE TO RESIDUAL HYDROGEN IN MANIFOLD.

POSSIBLE LOSS OF CREW/VEHICLE.

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

(C) MISSION:
ON GROUND, VIOLATION OF HGDS LCC WILL RESULT IN LAUNCH SCRUB.

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

(E) FUNCTIONAL CRITICALITY EFFECTS:

CASE 1:

1R/2 2 SUCCESS PATHS. TIME FRAME - PRELAUNCH, ASCENT

- 1) CHECK VALVE (CV13) RUPTURES
- 2) CHECK VALVE (CV24) FAILS TO CHECK/LEAKS INTERNALLY

GH2 AND/OR GHE LEAKAGE INTO THE AFT COMPARTMENT. POSSIBLE OVERPRESSURIZATION OF THE AFT COMPARTMENT AND FIRE/EXPLOSION HAZARD. GHE LEAKAGE FROM ANTI-ICING PURGE DETECTABLE ON GROUND USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

GH2 FLOW CONTROL VALVES WILL CYCLE HIGH FLOW IN AN ATTEMPT TO MAINTAIN ULLAGE PRESSURE. LOSS OF ET LH2 ULLAGE PRESSURE WILL RESULT IN VIOLATION OF TANK MINIMUM STRUCTURAL CAPABILITY REQUIREMENTS. POSSIBLE UNCONTAINED SSME SHUTDOWN DUE TO LOW LH2 NPSP.

POSSIBLE LAUNCH SCRUB DUE TO LCC VIOLATION.

POSSIBLE LOSS OF CREW/VEHICLE.

CASE 2:

1R/2 2 SUCCESS PATHS. TIME FRAME - PRELAUNCH, ASCENT

- 1) CHECK VALVE (CV13 OR CV24) RUPTURES.
- 2) CHECK VALVE (CV15) FAILS TO CHECK/LEAKS INTERNALLY.
OR CHECK VALVE (CV14) FAILS TO CHECK/LEAKS INTERNALLY.

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RESULTS IN LH2 FROM THE MANIFOLD (THROUGH CV15) OR LH2 RECIRCULATION LINE (THROUGH CV14) LEAKING INTO THE AFT FUSELAGE. POSSIBLE LOSS OF CRITICAL FUNCTIONS DUE TO COMPONENT EXPOSURE TO CRYOGENICS. POSSIBLE AFT FUSELAGE OVERPRESSURIZATION AND FIRE/EXPLOSION HAZARD.

LEAKAGE DETECTABLE ON GROUND PRIOR TO T-31 SECONDS 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 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 AND END CAP ARE MANUFACTURED FROM INCONEL 718. THE END CAP IS THREADED INTO THE HOUSING (TORQUED TO 12 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 TEMPERATURE TESTS:

BODY PROOF PRESSURE (1313 PSIG)
CLOSURE DEVICE PROOF PRESSURE (1313 PSIG)
EXTERNAL LEAKAGE (650 PSIG)
INTERNAL LEAKAGE (5, 25, 100, 650 PSIG)

CRYOGENIC 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, 650 PSIG)

CERTIFICATION

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FLOW (0.005 LB/SEC HELIUM, MIN)
MAXIMUM INLET PRESSURE OF 100 PSIG
PRESSURE DROP (11 PSID MAX)

CHATTER TEST (650 TO 0 PSIG)
RECORD FLOW RATE WHEN CHATTER OCCURS

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

INTERNAL LEAKAGE
AMBIENT (0 TO 650 PSIG)
CRYO (-300 DEG F, 0 TO 650 PSIG)

LIFE CYCLE TEST

ONE CYCLE CONSISTS OF INLET PRESSURE OF 100 PSIG FOLLOWED BY
CHECKING PRESSURE OF 650 PSIG

AMBIENT
7000 CYCLES FOLLOWED BY CRACKING, RESEATING, AND LEAKAGE
TESTS

CRYO (-300 DEG F)
3000 CYCLES FOLLOWED BY CRACKING, RESEATING, INTERNAL
LEAKAGE, FLOW, PRESSURE DROP, AND EXTERNAL LEAK TESTS

VIBRATION (-300 DEG F, 2 AXES)

QUALIFIED BY SIMILARITY TO TYPE III CHECK VALVE. TYPE III VALVES ARE
CERTIFIED BY THE FOLLOWING TESTS:

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.

EXTERNAL LEAKAGE TEST (650 PSIG)

BURST PRESSURE (2600 PSIG)

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

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(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:

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:

IF THE LH2 NPSP DROPS BELOW THE PRE-FLIGHT ACCEPTED LEVELS (PER FLIGHT RULES), THE CREW WILL MANUALLY THROTTLE THE ENGINES TO KEEP THE NPSP HIGH ENOUGH TO PREVENT LH2 TURBOPUMP CAVITATION.

- 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

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NASA SR&QA

: ERICH BASS

:/S/ ERICH BASS