

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0451 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 08/09/00

PART DATA

PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
LRU : VALVE, DUAL CHECK PARKER-HANNIFIN	MC284-0515-0005

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

VALVE, DUAL CHECK, LO2 BLEED, 1 INCH DIAMETER.

REFERENCE DESIGNATORS: CV31
CV33
CV35

QUANTITY OF LIKE ITEMS: 3
ONE PER ENGINE

FUNCTION:

PARALLEL FLAPPERS CONTAINED IN ONE CHECK VALVE ASSEMBLY PROVIDE A PATH FOR LO2 RECIRCULATION/BLEED AND POGO SUPPRESSION FLOW. PREVENTS REVERSE FLOW OF LO2 INTO THE SSME DURING START SEQUENCE AND IN THE EVENT OF AN ENGINE MALFUNCTION (PREMATURE SHUTDOWN). ONE CHECK VALVE ASSEMBLY IS PROVIDED FOR EACH ENGINE SYSTEM.

EACH CHECK VALVE ASSEMBLY HAS ONE 0.052 INCH ORIFICE TO PROVIDE A CONTROLLED (4 SCFM) GHE REPRESSURIZATION PURGE TO THE RESPECTIVE SSME DURING ENTRY (DUE TO THE EXCESSIVE LEAK RATE THROUGH THE ENGINE HPOT SEALS THE LO2 PREVALVES ARE MAINTAINED CLOSED TO PREVENT LOSS OF HELIUM SUPPLY).

POGO RECIRCULATION VALVES (PV20,21) ARE OPENED AT T-12.5 SECONDS TO CHILL DOWN POGO RETURN LINE UNTIL OVERBOARD BLEED VALVE (PV19) IS CLOSED AT T-9.4 SECONDS. THIS CHECKS (VALVE FLAPPERS CLOSE) BLEED FLOW FROM ENGINES UNTIL ENGINE START. ENGINE START SEQUENCE BEGINS AT T-6.6 SECONDS.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 03-1-0451-04

REVISION#: 1 08/09/00

SUBSYSTEM NAME: MAIN PROPULSION

LRU: LO2 1" BLEED CHECK VALVE (CV31, 33, 35)

CRITICALITY OF THIS

ITEM NAME: LO2 1" BLEED CHECK VALVE (CV31, 33, 35)

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE OF THE VALVE BODY DURING LOADING, ASCENT, AND DUMP/ INERT.

MISSION PHASE:

PL PRE-LAUNCH
LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

FATIGUE FAILURE, MATERIAL DEFECT, DEFECTIVE/DAMAGED BODY JOINT SEAL

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 LEAKAGE OF LO2/GO2 INTO THE AFT COMPARTMENT. POSSIBLE LOSS OF CRITICAL ADJACENT COMPONENTS DUE TO CRYO EXPOSURE. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION AND FIRE HAZARD. GN2 PURGE OF THE AFT COMPARTMENT MAY LOWER THE GO2 CONCENTRATION BUT FIRE/EXPLOSION HAZARD STILL PRESENT. LEAKAGE IN THE AFT COMPARTMENT DETECTABLE DURING LOADING USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

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POSSIBLE LOSS OF HELIUM SUPPLY DURING MANIFOLD REPRESSURIZATION CAUSING
LOSS OF AFT COMPARTMENT PURGE FOR ENTRY.

(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:
NONE.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE LO2 CHECK VALVE HOUSING IS MADE FROM 321/304L CRES. PARALLEL FLAPPERS (TEFLON-COATED 304 CRES) ARE USED TO PROVIDE THE REVERSE FLOW CHECK CAPABILITY. A FLAPPER WEDGE IS USED TO KEEP THE FLAPPERS OPEN 30 DEGREES AND ALLOW THE FLOW FORCES TO CLOSE THE FLAPPERS BY THE HYDRODYNAMIC FORCES OF REVERSE FLOW. THE HINGE BOXES ARE TEFLON COATED TO PREVENT BINDING. THE FLAPPER CRACKING PRESSURE IS 0.5 PSID, WHICH IS LESS THAN THE SYSTEM PRESSURE ACTING TO OPEN THE FLAPPERS. THE ASSEMBLY INCLUDES A 0.052 INCH ORIFICE FOR REPRESSURIZATION/PURGING OPERATIONS.

THE DESIGN FACTORS OF SAFETY FOR PROOF IS 2 TIMES OPERATING PRESSURE (800 PSIG), AND 4 TIMES OPERATING PRESSURE (1600 PSIG) FOR BURST. STRUCTURAL ANALYSIS INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF VALVE OPERATIONS; FRACTURE/FATIGUE ANALYSES SHOW THAT ALL CRITICAL PARTS ARE SATISFACTORY FOR FOUR TIMES EXPECTED LIFE.

(B) TEST:
ATP (ALL TESTS RUN AT AMBIENT TEMPERATURE)

PROOF
CLOSURE DEVICE PROOF PRESSURE (550 PSIG)
BODY PROOF PRESSURE (800 PSIG)

LEAKAGE

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INTERNAL LEAKAGE, REVERSE DIRECTION (10 AND 275 PSIG)
EXTERNAL LEAKAGE (400 PSIG)

FUNCTIONAL
CRACKING (0.6 PSID MAX)
RESEATING (0.1 PSID) PRESSURES

CERTIFICATION (LEAKAGE AND CRACK/RESEAT TESTS WERE PERFORMED BEFORE AND AFTER THE FOLLOWING TESTS.)

LEAKAGE
INTERNAL, REVERSE DIRECTION (10 AND 275 PSIG)
EXTERNAL, (400 PSIG)

CRACKING/RESEAT
AMBIENT AND CRYOGENIC (0.6 PSID AND 0.1 PSID)

LIFE
2000 CYCLES AT AMBIENT TEMPERATURE WITH AMBIENT FUNCTIONAL TESTS AFTER 1000 AND 2000 CYCLES
1000 CYCLES AT -320 DEG F FOLLOWED BY CRYOGENIC FUNCTIONAL TESTS
2000 CYCLES AT +130 DEG F FOLLOWED BY AMBIENT FUNCTIONAL TESTS

THERMAL
THREE THERMAL CYCLE TESTS (AMBIENT TO 275 DEG F TO AMBIENT)
FOLLOWED BY AMBIENT FUNCTIONAL TESTS

SHOCK
BENCH HANDLING AND DESIGN SHOCK PER MIL-STD-810B

VIBRATION
RANDOM - 13.3 HOURS EACH AXIS (3) AT CRYOGENIC TEMPERATURES (-300 DEG F); 3.3 HOURS CLOSED AND 10 HOURS WITH FLOWING LIQUID NITROGEN; EACH AXIS TEST FOLLOWED BY CRYOGENIC FUNCTIONAL TEST
TRANSIENT - (5 TO 35 HZ AT + OR - .25G PEAK)

PERFORMANCE - FLOW TESTS
TWO FLAPPER
AMBIENT AND CRYOGENIC (-320 DEG F)
SINGLE FLAPPER
AMBIENT AND CRYOGENIC (-320 DEG F)

BURST
FLAPPER (1100 PSIG)
VALVE BODY (1600 PSIG)

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

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(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIALS ARE VERIFIED FOR MATERIAL PROCESS AND INSPECTION.

CONTAMINATION CONTROL

CONTAMINATION CONTROL PROCESS AND CORROSION PROTECTION PROVISIONS ARE VERIFIED. CLEANLINESS TO LEVEL 800A IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

PARTS ARE PROTECTED FROM DAMAGE AND CONTAMINATION. DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. THE INSIDE SURFACES OF THE VALVE ARE VISUALLY INSPECTED USING A BORESCOPE (10X MAGNIFICATION). ELECTROCHEM ETCH MARKING IS VERIFIED BY INSPECTION. MANDATORY INSPECTION POINTS ARE INCLUDED IN THE ASSEMBLY PROCEDURE.

CRITICAL PROCESSES

PROCESSES OF EB WELDING, HEAT TREATMENT, PASSIVATION, AND ELECTROPOLISH ARE VERIFIED BY INSPECTION. HELIUM LEAK TEST IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

X-RAY AND PENETRANT INSPECTION OF E.B. WELDS ARE VERIFIED BY INSPECTION.

TESTING

ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING, HANDLING, AND TRANSPORTATION OF PRODUCT 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:

FLIGHT:

NO CREW ACTION CAN BE TAKEN.

GROUND:

GROUND OPERATIONS SAFING PROCEDURES CONTAIN SAFING SEQUENCE OF EVENTS FOR MAJOR LEAKS IN THE OXYGEN SYSTEM.

- APPROVALS -

S&R ENGINEERING : W.P. MUSTY : /S/ W. P. MUSTY
S&R ENGINEERING ITM : P. A. STENGER-NGUYEN : /S/ P. A. STENGER-NGUYEN

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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