

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: 03-1-0432 -X****SUBSYSTEM NAME:** MAIN PROPULSION**REVISION:** 1 08/09/00

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:LH2 HI POINT BLEED DISCONNECT, 1.5 INCH (GND) UNITED SPACE ALLIANCE - NSLD	MC276-0004-0002
LRU	:LH2 HI POINT BLEED DISCONNECT, 1.5 INCH (ORB) UNITED SPACE ALLIANCE - NSLD	MC276-0004-0003

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

DISCONNECT, HIGH POINT BLEED 1.5 INCH, SELF SEALING, FLIGHT AND GROUND HALF.

VALVE WAS ORIGINALLY DESIGNED AND MANUFACTURED BY FAIRCHILD CONTROLS BUT IS NOW MANUFACTURED BY UNITED SPACE ALLIANCE-NSLD AS AN ALTERNATE PRODUCTION AGENCY.

REFERENCE DESIGNATORS: PD17**QUANTITY OF LIKE ITEMS:** 1**FUNCTION:**

THE DISCONNECT PROVIDES A PATH FOR GH2 TO BLEED OVERBOARD FROM THE HIGH POINT BLEED VALVE (PV22) INTO THE GROUND VENT SYSTEM. BLEED FLOW STARTS AT SLOW FILL AND TERMINATES AT HIGH POINT BLEED VALVE CLOSURE (T-26 SECONDS) ISOLATING THE DISCONNECT FROM THE FEED SYSTEM. DURING T-0 UMBILICAL DISENGAGEMENT, THE DISCONNECT POPPETS CLOSE, PROVIDING A REDUNDANT INHIBIT AGAINST OVERBOARD FLOW (FLIGHT FLOW) AND ISOLATING THE GROUND VENT SYSTEM (GROUND HALF).

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SUBSYSTEM NAME: MAIN PROPULSION

LRU: LH2 HI POINT BLEED DISC, 1.5 INCH (ORB)

CRITICALITY OF THIS

ITEM NAME: LH2 HI POINT BLEED DISC, 1.5 INCH (ORB)

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE OF THE DISCONNECT ASSEMBLY DURING BLEED OPERATION.

MISSION PHASE:

PL PRE-LAUNCH
LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

FATIGUE, MATERIAL DEFECTS, DAMAGED/DEFECTIVE GROUND HALF BODY/POPPET 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:

RUPTURE/LEAKAGE OF THE AIRBORNE DISCONNECT BODY RESULTS IN LEAKAGE INTO THE AFT COMPARTMENT. POSSIBLE LOSS OF ADJACENT CRITICAL FUNCTIONS DUE TO EXPOSURE TO CRYOGENICS. POSSIBLE AFT COMPARTMENT OVERPRESS AND FIRE/EXPLOSION HAZARD. ON GROUND, HAZARDOUS GAS DETECTION SYSTEM (HGDS) IN THE AFT COMPARTMENT WILL DETECT THE PRESENCE OF HYDROGEN.

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RUPTURE/LEAKAGE OF THE GROUND HALF ASSEMBLY AND/OR LEAKAGE OF THE FLIGHT HALF BODY/POPPET SEAL RESULTS IN EXTERNAL LEAKAGE OF LH2. HELIUM PURGE AT THE LH2 T-0 AND MLP HOOD WILL DISSIPATE SOME OF THE PROPELLANT. LEAKAGE MAY BE DETECTABLE AT THE LH2 T-0 USING HGDS. LEAKAGE MAY BE DETECTED VISUALLY BY TV MONITORING. LH2 LEAKAGE MAY RESULT IN FIRE/EXPLOSION HAZARD AT THE VEHICLE EXTERIOR, AND POSSIBLE DAMAGE TO TPS AND SURROUNDING STRUCTURE.

(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:

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

- 1) BLEED DISCONNECT (PD17) RUPTURES.
- 2) HIGH POINT BLEED VALVE (PV22) FAILS TO REMAIN CLOSED.

LH2 WILL LEAK INTO THE AFT FUSELAGE/OVERBOARD CAUSING LOSS OF 230 POUNDS OF PROPELLANT. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION AND FIRE/EXPLOSION HAZARD BOTH EXTERIOR AND INTERIOR TO THE VEHICLE. THIS WILL NOT EFFECT ENGINE INLET CONDITIONS OR CAUSE A LOW LEVEL CUTOFF. POSSIBLE LOSS OF CRITICAL ADJACENT COMPONENTS DUE TO CRYO EXPOSURE. POSSIBLE LOSS OF CREW/VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:

THE MATED FLIGHT HALF AND GROUND HALF ARE DESIGNED FOR 100 PSIG OPERATING, 200 PSIG PROOF, AND 400 PSIG BURST. THE UNMATED FLIGHT HALF IS DESIGNED FOR 400 PSIG OPERATING, 520 PSIG PROOF, AND 600 PSIG BURST. THE FLIGHT HALF BODY IS CAST A357 OR MACHINED A367 ALUMINUM; THE GROUND HALF BODY IS MACHINED 6061 ALUMINUM. THE GROUND HALF BELLOWS (TWO PLY) IS MANUFACTURED FROM INCONEL. THE GROUND HALF/FLIGHT HALF BODY/POPPET SEALS ARE MADE OF SP-21 VESPEL.

STRUCTURAL ANALYSIS INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF VALVE OPERATION; FRACTURE/FATIGUE ANALYSES SHOW THAT ALL CRITICAL PARTS ARE SATISFACTORY FOR FOUR TIMES EXPECTED LIFE. THE DISCONNECT ASSEMBLY (INCLUDING THE BELLOWS) HAS BEEN SUBJECTED TO A FLOW INDUCED VIBRATION TEST

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FOR THE CENTAUR PROGRAM AT FLOW RATES THAT EXCEED SHUTTLE REQUIREMENTS. THE VALVE WAS DESIGNED AND TESTED FOR 2,000 CYCLES (OVER 100 MISSIONS) UNDER BOTH CRYOGENIC AND AMBIENT CONDITIONS. AMBIENT PROOF AND LEAKAGE TESTS ARE PERFORMED DURING ATP.

THE LAUNCH FACILITY HAS DEDICATED, CONTINUOUS TV OBSERVATION OF THE UMBILICAL AREA THROUGHOUT HIGH POINT BLEED OPERATION SO THAT MASSIVE LEAKAGE WOULD BE OBSERVED. THIS UMBILICAL AREA IS ALSO MONITORED FOR LH2 LEAKAGE BY A HAZARDOUS GAS DETECTION SYSTEM AND OBSERVED WITH ULTRAVIOLET DETECTORS FOR FIRE DETECTION. THE UMBILICAL PLATE PURGE IS ADEQUATE TO SAFELY DILUTE A 1000 SCIM H2 LEAK.

(B) TEST:
ATP

DISCONNECT DISENGAGED

ORBITER HALF

AMBIENT PROOF (520 PSIG)

AMBIENT HOUSING LEAKAGE (400 PSIG)

AMBIENT CLOSURE DEVICE LEAKAGE (20 & 400 PSIG)

GROUND HALF

AMBIENT PROOF (200 PSIG)

AMBIENT HOUSING LEAKAGE (100 PSIG)

AMBIENT CLOSURE DEVICE LEAKAGE (100 PSIG)

DISCONNECT ENGAGED (WITH RADIAL AND ANGULAR MISALIGNMENT AT MINIMUM AND MAXIMUM BELLOWS COMPRESSION)

PROOF PRESSURE (200 PSIG)

AMBIENT EXTERNAL LEAKAGE (25 & 100 PSIG)

CRYO (-255 DEG F) EXTERNAL LEAKAGE (100 PSIG)

ENGAGE - DISENGAGE CYCLE

CERTIFICATION

DURING ALL MATED TESTS THE ORBITER HALF IS RIGIDLY MOUNTED AND THE GROUND HALF IS MOUNTED WITH RADIAL AND ANGULAR MISALIGNMENT.

CRYO LEAKAGE (-400 DEG F)

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MATED: 100 PSIG
ORBITER HALF: 25 AND 100 PSIG
GROUND HALF: 25 AND 100 PSIG

AMBIENT LEAKAGE

MATED: 25 AND 100 PSIG
ORBITER HALF: 20 AND 400 PSIG
GROUND HALF: 25 AND 100 PSIG

AMBIENT EXTERNAL BODY LEAKAGE

ORBITER HALF: 400 PSIG
GROUND HALF: 100 PSIG

LIFE CYCLES

2000 CYCLES (10 SERIES):
199 CYCLES AT AMBIENT TEMPERATURE
ONE CYCLE AT CRYO TEMPERATURE (-255 DEG F)

VIBRATION

TRANSIENT SINUSOIDAL VIBRATION
ORBITER HALF: 5 TO 35 HZ AT ZERO PSIG AND AMBIENT TEMPERATURE

RANDOM VIBRATION IN EACH OF TWO AXES AT -280 DEG F
MATED: 40 PSIG, 9 MINUTES
ORBITER HALF: 80 PSIG, 52 MINUTES
GROUND HALF: 0 PSIG, 9 MINUTES

THERMAL CYCLE TEST: 3 CYCLES (+70 TO -280 TO +70 TO +350 DEG F)

SALT FOG, BENCH HANDLING SHOCK AND DESIGN SHOCK PER MIL-STD-810, SAND AND DUST TEST

FLOW CAPACITY TEST (8 TO 18.5 LBS/SEC)

BURST TEST

MATED: 400 PSIG
ORBITER HALF: 600 PSIG
GROUND HALF: 400 PSIG

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIALS, INCLUDING CHEMICAL AND MECHANICAL REQUIREMENTS, ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION. INSPECTION VERIFIES CERTIFICATION OF ULTRASONIC INSPECTION OF BODY HOUSING FORGING.

CONTAMINATION

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CLEANING PROCEDURES AND CONTAMINATION CONTROL REQUIREMENTS ARE VERIFIED BY INSPECTION. CLEANLINESS TO LEVEL 400A IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

ALL PARTS ARE PROTECTED FROM DAMAGE AND CONTAMINATION. ALL CRITICAL DIMENSIONS AND FINISHES ARE VERIFIED BY INSPECTION. SEALING SURFACE OF THE POPPET IS INSPECTED USING 10X MAGNIFICATION. DRAWING TORQUE REQUIREMENTS ARE VERIFIED. SEALS ARE VISUALLY EXAMINED, PRIOR TO INSTALLATION, FOR DAMAGE AND CLEANLINESS USING 10X MAGNIFICATION. MANDATORY INSPECTION POINTS ARE INCLUDED IN THE ASSEMBLY PROCEDURE. LOG OF CLEAN ROOM AND TOOL CALIBRATION IS REQUIRED AND VERIFIED. ALL SPRINGS ARE LOAD TESTED AND VERIFIED BY INSPECTION.

CRITICAL PROCESS

HEAT TREATMENT, PARTS PASSIVATION, AND ANODIZING ARE VERIFIED. CHEMICAL FILM PROTECTANT AND DRY FILM LUBRICANT ARE VERIFIED.

NONDESTRUCTIVE EVALUATION

BODY HOUSING IS FLUORESCENT PENETRANT INSPECTED. WELDS ARE VISUALLY EXAMINED AND VERIFIED BY X-RAY AND DYE PENETRANT. BELLOWS ASSEMBLY IS PROOF PRESS TESTED AND LEAK CHECKED.

TESTING

ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING FOR SHIPPING 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:

FLIGHT:
NO CREW ACTION CAN BE TAKEN.

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

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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