

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE****NUMBER: 03-1-0501 -X****SUBSYSTEM NAME:** MAIN PROPULSION**REVISION:** 1 08/09/00**PART DATA**

	<b>PART NAME</b>	<b>PART NUMBER</b>
	<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
LRU	:GH2/GO2 1" REPRESS DISCONNECT (ORB) UNITED SPACE ALLIANCE - NSLD	MC276-0003-0007
LRU	:GH2/GO2 1" REPRESS DISCONNECT (GND) UNITED SPACE ALLIANCE - NSLD	MC276-0003-0008

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

DISCONNECT, PREPRESSURIZATION ONE INCH, SELF SEALING, GH2/GO2 SYSTEM.

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

**REFERENCE DESIGNATORS:** PD10  
PD9

**QUANTITY OF LIKE ITEMS:** 2  
ONE GH2, ONE GO2

**FUNCTION:**

CONNECTS WITH GSE TO PROVIDE HELIUM FOR PROPELLANT TANK PRESSURIZATION AND ANTI-ICING PURGE. ACTS AS REDUNDANT CLOSURE DEVICE WITH PREPRESSURIZATION CHECK VALVE (CV17/CV16) AFTER FLOW CESSATION TO PREVENT OVERBOARD LOSS OF ET PRESSURANT THROUGH ORBITER PLUMBING. THE PRESSURE ACTUATED POPPET IN THE DISCONNECT REQUIRES A DELTA P TO OPEN.

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**SUBSYSTEM NAME: MAIN PROPULSION**

**LRU: GH2/GO2 1" REPRESS DISC ORB (PD9, 10)**

**ITEM NAME: GH2/GO2 1" REPRESS DISC ORB (PD9, 10)**

**CRITICALITY OF THIS**

**FAILURE MODE: 1/1**

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**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 DEFECT

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO**

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**REDUNDANCY SCREEN**

A) N/A  
B) N/A  
C) N/A

**PASS/FAIL RATIONALE:**

A)

B)

C)

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION DURING PROPELLANT LOADING AND ET PREPRESSURIZATION. GHE FLOW RATE ANTICIPATED FROM THE GROUND SYSTEM DURING PREPRESSURIZATION FOR A RUPTURE OF THIS TYPE EXCEEDS 6.0 LB/SEC. A HELIUM FLOW RATE OF 3.5 LB/SEC, IN ADDITION TO THE NORMAL NITROGEN AFT COMPARTMENT PURGE FLOW, WILL CAUSE A DELTA P OF 1 PSID ACROSS THE AFT COMPARTMENT. THIS IS THE APPROXIMATE STRUCTURAL LIMIT WHILE ON THE GROUND.

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GHE LEAKAGE IS DETECTABLE IN THE AFT COMPARTMENT USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

**(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:**

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

- 1) RUPTURE/LEAKAGE OF VALVE BODY.
- 2) CHECK VALVE (CV17/CV16) FAILS TO REMAIN CLOSED/CHECK.

GH2 FLOW CONTROL VALVES WILL CYCLE TO THE HIGH FLOW POSITION IN AN ATTEMPT TO MAINTAIN ULLAGE PRESSURE. LOSS OF ET LH2/LO2 ULLAGE PRESSURE WILL RESULT IN VIOLATION OF TANK MINIMUM STRUCTURAL CAPABILITY REQUIREMENTS. POSSIBLE UNCONTAINED SSME SHUTDOWN DUE TO LOW LH2 NPSP. MASS OF LO2 AND VEHICLE ACCELERATION SHOULD BE SUFFICIENT TO MAINTAIN PROPER ENGINE NPSP, DELAYING UNCONTAINED SSME SHUTDOWN DUE TO LOW LO2 NPSP UNTIL LATE IN POWERED FLIGHT.

POSSIBLE LOSS OF ADJACENT CRITICAL COMPONENTS DUE TO IMPINGEMENT OF HIGH PRESSURE GAS. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION, FIRE/EXPLOSION HAZARD, POSSIBLE LOSS CREW/VEHICLE.

ALSO RESULTS IN POSSIBLE LOSS OF HELIUM SUPPLY DURING MANIFOLD REPRESSURIZATION CAUSING LOSS OF AFT COMPARTMENT REENTRY PURGE.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

THE ORBITER FLIGHT HALF HOUSING IS MADE OF HEAT TREATED INCONEL 718. THE GROUND HALF HOUSING IS MADE OF A286 CRES. THE FLIGHT AND GROUND DISCONNECT HALVES INCORPORATE A SWIVEL WHICH ACTS AS A SELF-ALIGNING DEVICE FOR PROPER ENGAGEMENT. THE SWIVEL IS PROTECTED AGAINST LEAKAGE (EXTERNAL TO THE VEHICLE) WITH A RACO SEAL. THE FLIGHT HALF HAS A FLOW-ACTUATED POPPET WITH A VESPEL SEAL. THE GROUND HALF DISCONNECT IS OPENED UPON ENGAGEMENT WITH THE FLIGHT HALF AND IT HAS A POPPET SEAL MADE OF VESPEL.

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THE GROUND HALF INTERFACE MATING SEAL IS A RACO TYPE SEAL MADE OF FEP TEFLON AND A 301 CRES SPRING. THE FLIGHT DISCONNECT HALF INTERFACE SEALING SURFACE UTILIZES AN 8 MICRO-INCH SURFACE FINISH. VENT HOLES ARE INCORPORATED IN THE FLIGHT HALF FOR RELIEVING PRESSURE ON THE INTERFACE MATING SEAL DURING PRESSURIZED DISENGAGEMENT.

DESIGN FACTORS OF SAFETY ARE 2 TIMES OPERATING PRESSURE FOR PROOF (1900 PSIG) AND 4 TIMES OPERATING PRESSURE FOR BURST (3800 PSIG - FLIGHT HALF, 18,000 PSIG - GROUND HALF). STRUCTURAL ANALYSIS, PERFORMED BY THE VALVE SUPPLIER, INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF VALVE OPERATION, AND FRACTURE ANALYSES SHOW THAT ALL CRITICAL PARTS ARE SATISFACTORY FOR FOUR TIMES THE ORBITER LIFE OF 100 MISSIONS.

**(B) TEST:**

ATP

EXAMINATION OF PRODUCT

PROOF PRESSURE

DEMATED

FLIGHT HALF: 1,900 PSIG

GROUND HALF: 9,000 PSIG

MATED: 1,900 PSIG

OPERATION TEST

MATE, PRESSURIZE TO 950 PSIG WITH GHE, AND MEASURE EXTERNAL LEAKAGE  
(200 SCIM MAX)

CRACK/RESEAT PRESSURE (15 PSID MIN)

DEMATE

EXTERNAL LEAKAGE

DEMATED

FLIGHT HALF

1 SCIM AT 5 PSIG

10 SCIM AT 950 PSIG

GROUND HALF

200 SCIM AT 950 PSIG

MATED: 200 SCIM AT 950 PSIG

CERTIFICATION

SHOCK PER MIL-STD-810

DESIGN

BENCH HANDLING

AT COMPLETION PERFORM OPERATION AND EXTERNAL LEAKAGE TESTS

FLOW CAPACITY (MATED)

675 PSIG INLET, 1.27 LB/SEC GN2, 18 TO 23 PSID

VIBRATION

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RANDOM (TWO AXES)  
9 MIN. IN EACH AXIS, MATED  
52 MIN. IN EACH AXIS, FLIGHT HALF  
9 MIN. IN EACH AXIS, GROUND HALF  
TRANSIENT (TWO AXES)  
5 TO 35 HERTZ  $\dot{N}$  0.25 G IN EACH AXIS  
BEFORE/AFTER PERFORM OPERATION AND EXTERNAL LEAKAGE TESTS

THERMAL CYCLE (5 CYCLES EACH)  
FLIGHT HALF: +70°F TO -250°F; PRESSURIZE TO 600 PSIG; -250°F TO +70°F TO  
+190°F; VENT; +190°F TO +70°F  
GROUND HALF: PRESSURIZE TO 2,000 PSIG; +70°F TO -250°F; PRESSURIZE TO 4,500  
PSIG; VENT; -250°F TO +70°F  
AT CONCLUSION, PERFORM OPERATION & EXTERNAL LEAKAGE TESTS

LIFE TEST  
LOW TEMPERATURE (-250°F): 100 CYCLES  
MATE, PRESSURIZE TO 950 PSIG, DEMATE, VENT  
AMBIENT: 1,900 CYCLES  
MATE, PRESSURIZE TO 950 PSIG, VENT, DEMATE  
AFTER EACH 500 CYCLES, PERFORM EXTERNAL LEAKAGE TEST AND HIGH  
TEMPERATURE EXTERNAL LEAKAGE TEST

HIGH TEMPERATURE EXTERNAL LEAKAGE TEST  
MATED: PRESSURIZE TO 950 PSIG WITH +165°F GHE; 200 SCIMS MAX  
FLIGHT HALF: HEAT TO +190°F, PRESSURIZE TO 950 PSIG; 20 SCIMS MAX

BURST  
3,800 PSIG MATED  
3,800 PSIG FLIGHT HALF  
18,000 PSIG GROUND HALF

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

**(C) INSPECTION:**

RECEIVING INSPECTION  
INCOMING COMPONENTS AND MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIALS  
AND PROCESSES CERTIFICATION.

CONTAMINATION CONTROL  
ALL PARTS AND ASSEMBLIES ARE MAINTAINED TO CLEANLINESS LEVEL 100A AS PER  
REQUIREMENTS. POST TEST DISCONNECT INLET AND OUTLET PROTECTION, TO MAINTAIN  
INTERNAL CLEANLINESS, IS VERIFIED BY INSPECTION. SEALS AND SEALING SURFACES  
PROTECTION ARE ALSO VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION  
DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. TORQUES APPLIED  
TO COUPLINGS ARE VERIFIED PER DRAWING SPECIFICATIONS. PRIOR TO INSTALLATION,  
SEALS ARE VISUALLY EXAMINED FOR DAMAGE AND CLEANLINESS USING 10X

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MAGNIFICATION. SEALING SURFACE OF THE POPPET IS INSPECTED. THE CLEAN ROOM LOG AND TOOL CALIBRATION RECORDS ARE VERIFIED BY INSPECTION. INSPECTION POINTS ARE ESTABLISHED TO VERIFY ASSEMBLY PROCESSES.

**CRITICAL PROCESSES**

APPLICATION OF DRY FILM LUBRICANT TO PARTS IS VERIFIED BY INSPECTION. HEAT TREATMENT AND PART PASSIVATION ARE VERIFIED BY INSPECTION.

**NONDESTRUCTIVE EVALUATION**

FLUORESCENT PENETRANT INSPECTION OF THE BODY HOUSING IS VERIFIED.

**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.

NO CREW ACTION CAN BE TAKEN FOR THE GO2 SYSTEM.

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**- APPROVALS -**

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