

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**

NUMBER: 03-1-0628 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 02/22/01

---

**PART DATA**

---

	<b>PART NAME</b>	<b>PART NUMBER</b>
	<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
LRU	: LINE, LH2 RTLS DUMP BOEING	V070-415282

---

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

LINE, LH2 RTLS DUMP, 1.5 INCH.

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

PROVIDES A FLOW PATH FOR DUMPING LH2 OVERBOARD FROM THE OUTBOARD RTLS DUMP VALVE (PV18). EXTENDS FROM OUTBOARD RTLS DUMP VALVE TO OUTER MOLD LINE. CONSISTS OF ONE TUBE SEGMENT AND FLANGE.

**FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE**

**NUMBER: 03-1-0628-01**

**REVISION#: 1 02/22/01**

**SUBSYSTEM NAME: MAIN PROPULSION**

**LRU: LH2 RTLS DUMP LINE**

**ITEM NAME: LH2 RTLS DUMP LINE**

**CRITICALITY OF THIS**

**FAILURE MODE: 1/1**

---

**FAILURE MODE:**

RUPTURE/LEAKAGE POST MECO.

**MISSION PHASE:**

PL PRE-LAUNCH

LO LIFT-OFF

**VEHICLE/PAYLOAD/KIT EFFECTIVITY:**

102 COLUMBIA

103 DISCOVERY

104 ATLANTIS

105 ENDEAVOUR

**CAUSE:**

MATERIAL DEFECT, FATIGUE

**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 LH2 INTO THE AFT COMPARTMENT WHEN RTLS VALVES ARE OPENED POST MECO. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION AND FIRE/EXPLOSION HAZARD. POSSIBLE LOSS OF ADJACENT CRITICAL FUNCTIONS DUE TO EXPOSURE TO CRYOGENICS.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE  
NUMBER: 03-1-0628-01**

LOSS OF REDUNDANCY TO PROTECT AGAINST LH2 LEAKAGE INTO THE AFT COMPARTMENT IF THE INBOARD AND OUTBOARD RTLS VALVES (PV17, 18) FAILS TO CLOSE/REMAIN CLOSED DURING LOADING OR ASCENT. LEAKAGE DETECTABLE ON GROUND USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

**(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:**

1R3 3 SUCCESS PATHS. TIME FRAME - LOADING, ASCENT.

- 1,2) BOTH INBOARD AND OUTBOARD RTLS DUMP VALVES FAIL TO REMAIN CLOSE/INTERNAL LEAKAGE.
- 3) RTLS DUMP LINE RUPTURE/LEAKAGE.

LH2 WILL LEAK INTO THE AFT FUSELAGE, POSSIBLE AFT COMPARTMENT OVERPRESS, AND FIRE/EXPLOSION HAZARD. THIS WILL NOT AFFECT 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 LINE ASSEMBLY IS MANUFACTURED USING TUBE SEGMENTS MADE OF 21-6-9 CRES MATERIAL (1.5 INCH DIAMETER BY 0.035 INCH WALL THICKNESS), FLANGE MACHINED FROM 304L CRES MATERIAL AND A TUBE EXIT SUPPORT PLATE MADE OF INCONEL 718. THE TUBE SEGMENTS AND FLANGE ARE WELDED TOGETHER. THE SUPPORT PLATE IS WELDED TO THE TUBE USING INCO 718 WELD WIRE. THE LINE ASSEMBLY IS BOLTED TO THE VALVE FLANGES. STRUCTURAL ANALYSIS INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF LINE OPERATIONS.

**(B) TEST:**

ATP

BOTH LINE ASSEMBLIES WERE PROOF PRESSURE TESTED AT 150 PSIG AND LEAK CHECKED AT 100 PSIG PRIOR TO INSTALLING THEM INTO THE VEHICLE. AFTER

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE  
NUMBER: 03-1-0628-01**

INSTALLATION THE SYSTEM WAS PROOF PRESSURE TESTED AT 66 PSIG AND LEAK CHECKED AT 30 PSIG.

CERTIFICATION

TUBING

THE 21-6-9 CRES TUBING WAS PREVIOUSLY QUALIFIED WITH THE DC-10, L1011, AND 747 AIRCRAFT. THE MAIN PROPULSION TEST ARTICLE MISSION DUTY CYCLE FIRINGS CONTRIBUTED TO THE CERTIFICATION OF THE MPS TUBING INSTALLATIONS.

VERIFICATION

QUALIFICATION TESTING OF A COMPLETED LINE ASSEMBLY WAS NOT PERFORMED, BUT THE LINE ASSEMBLIES WERE VERIFIED BY ANALYSIS. FOR OV103/OV104 REFER TO REPORT STS85-0254 (STRUCTURAL ANALYSIS FOR 6.0 LOADS, DATED APRIL 1988), VOLUME 10 (THRUST STRUCTURE, MPS, AND SECONDARY STRUCTURE). FOR OV102 REFER TO REPORT SD77-SH-0178 (DESIGN STRESS ANALYSIS OV102, DATED JULY 1988), VOLUME 10; AND REPORT SOD80-0173 (OV102 STRESS ANALYSIS AND 5.4 LOADS ASSESSMENT, DATED JULY 1980), VOLUME 10.

OMRSD

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

**(C) INSPECTION:**

RECEIVING INSPECTION

RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIALS AND PROCESSES CERTIFICATION.

CONTAMINATION CONTROL

CLEANLINESS LEVEL VERIFIED TO 400. CORROSION PROTECTION IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

PARTS ARE INSPECTED VISUALLY AND DIMENSIONALLY DURING FABRICATION. FABRICATION OF FLANGES AND TUBES IS VERIFIED TO MEET DRAWING AND SPECIFICATION REQUIREMENTS. PROTECTION OF SEALING SURFACES IS VERIFIED. DIMENSIONS AND SURFACE FINISHES ARE VERIFIED TO MEET SPECIFICATION REQUIREMENTS. INSTALLATION PER SPECIFICATION REQUIREMENTS IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

WELDING AND PASSIVATION ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

RADIOGRAPHIC INSPECTION OF TUBE TO FLANGE WELD IS VERIFIED BY INSPECTION. PENETRANT INSPECTION OF DETAIL PARTS IS VERIFIED. HELIUM LEAKAGE DETECTION IS CONDUCTED TO MEET SPECIFICATION REQUIREMENTS.

TESTING

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE  
NUMBER: 03-1-0628-01**

ATP, INCLUDING PROOF PRESSURE TEST, IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS ARE 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.

---

**- 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	: LEE DURHAM	:/S/ LEE DURHAM
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
MOD	: JEFF MUSLER	:/S/ JEFF MUSLER
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: ERICH BASS	:/S/ ERICH BASS