

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0119 -X

SUBSYSTEM NAME: MAIN PROPULSION**REVISION:** 2 02/21/01**PART DATA**

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: LINE ASSEMBLY BOEING	V070-415145

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

LINE ASSEMBLY, HELIUM, LOW PRESSURE. THE LINE ASSEMBLY CONSISTS OF DYNATUBE FITTINGS, ORIFICE (RP9), UNION, SEAL, AND TUBE SEGMENTS.

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

THE LINE ASSEMBLY PROVIDES A HELIUM FLOW PATH FROM LH2 FEED MANIFOLD RTLS PRESSURIZATION SOLENOID VALVE (LV75) TO LH2 FEED MANIFOLD RTLS PRESSURIZATION CHECK VALVE (CV30) FOR LH2 MANIFOLD PRESSURIZATION DURING AN RTLS AND TAL ABORT.

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LRU: LH2 RTLS REPRESS VLV (LV75) OUTLET LINE ASSY

CRITICALITY OF THIS

ITEM NAME: LH2 RTLS REPRESS VLV (LV75) OUTLET LINE ASSY FAILURE MODE: 1R2

FAILURE MODE:

RUPTURE/LEAKAGE

MISSION PHASE:

LO LIFT-OFF
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

MATERIAL DEFECT, FATIGUE, DEFECTIVE BRAZE JOINTS, DAMAGED/DEFECTIVE JOINT SEALS

CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES

RTLS RETURN TO LAUNCH SITE
TAL TRANS-ATLANTIC LANDING

REDUNDANCY SCREEN

A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS B SCREEN BECAUSE FAILURE CANNOT BE DETECTED WITH CURRENT INSTRUMENTATION.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

NO EFFECT FOR NOMINAL MISSION. REDUNDANT COMPONENTS WILL PREVENT FLOW OF HYDROGEN OR HELIUM THROUGH LINE.

DURING RTLS AND TAL ABORTS, THE PNEUMATIC HELIUM SUPPLY WILL BE LOST. ESCAPING HELIUM MAY OVERPRESSURIZE THE AFT COMPARTMENT.

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(B) INTERFACING SUBSYSTEM(S):

SAME AS A.

(C) MISSION:

NO EFFECT FOR NOMINAL MISSION. POSSIBLE LOSS OF CREW/VEHICLE DURING RTLS AND TAL ABORT.

(D) CREW, VEHICLE, AND ELEMENT(S):

SAME AS C.

(E) FUNCTIONAL CRITICALITY EFFECTS:

CASE 1:

1R/2 2 SUCCESS PATHS. TIME FRAME - POST-MECO.

- 1) HELIUM LINE RUPTURES.
- 2) CHECK VALVE (CV30) FAILS TO CHECK.

AT MECO, THE LH2 FEEDLINE RELIEF ISOLATION VALVE (PV8) WILL OPEN AND HYDROGEN FROM THE LH2 MANIFOLD WILL LEAK THROUGH THE RUPTURED LINE. POSSIBLE FIRE/EXPLOSION HAZARD AND POSSIBLE LOSS OF CRITICAL ADJACENT COMPONENTS DUE TO EXPOSURE TO CRYOGENICS.

POSSIBLE LOSS OF CREW/VEHICLE.

CASE 2:

1R/3 3 SUCCESS PATHS. TIME FRAME - PRELAUNCH, ASCENT, ENTRY

- 1) HELIUM LINE RUPTURES.
- 2,3) BOTH RTLS SUPPLY VALVES (LV74,75) FAIL TO REMAIN CLOSED.

DURING ASCENT, THE PNEUMATIC HELIUM SUPPLY WILL BE LOST. ESCAPING HELIUM MAY OVERPRESSURIZE THE AFT COMPARTMENT.

WHEN THE CROSSOVER VALVE (LV10) OPENS AT MECO, THE PNEUMATIC HELIUM DISTRIBUTION SYSTEM WILL BE FED FROM THE LEFT ENGINE HELIUM SUPPLY. WHEN THE INTERCONNECT "OUT" VALVES OPEN AT MECO PLUS 20 SECONDS, THE ENGINE HELIUM SUPPLIES WILL LEAK THROUGH THE FAILED LINE.

STORED HELIUM PRESSURE IN THE ACCUMULATOR LEG SHOULD BE ADEQUATE TO OPERATE THE LO2 PREVALVES AT MECO. LOSS OF HELIUM MAY PREVENT OPERATION OF VALVES FOR MPS DUMP.

PURGE OF AFT COMPARTMENT AND LH2/LO2 SYSTEMS WOULD DEPEND SOLELY ON THE LEFT ENGINE HELIUM SYSTEM RESIDUALS, RESULTING IN INADEQUATE ABORT PURGE, INCOMPLETE PROPELLANT DUMP, AND INGESTION OF CONTAMINATION.

DURING ENTRY, VENT DOORS ARE CLOSED TO PREVENT INGESTION OF RCS AND APU GASES. RUPTURE DURING THE TIME PERIOD THAT THE VENT DOORS ARE CLOSED MAY

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RESULT IN OVERPRESSURIZATION OF AFT COMPARTMENT. VENT DOORS ARE OPENED WHEN VEHICLE VELOCITY DROPS BELOW 2400 FT/SEC.

EXCESSIVE HELIUM LEAKAGE WILL BE DETECTABLE USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

POSSIBLE LAUNCH SCRUB DUE TO LCC VIOLATION.

POSSIBLE LOSS OF CREW/VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:

DESIGNED TO A MINIMUM FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST. THE MECHANICAL FITTINGS (DYNATUBE) ARE MANUFACTURED FROM INCONEL 718 WITH TUBE ENDS THAT ARE NICKEL PLATED. THE TUBE SEGMENTS ARE MANUFACTURED FROM 304L CRES 3/8 INCH DIAMETER BY 0.025 INCH WALL THICKNESS AND 3/4 INCH DIAMETER BY 0.028 INCH WALL THICKNESS. THE ORIFICE IS MACHINED FROM 304L CRES BAR 3/8 INCH DIAMETER, 0.020 INCH WALL THICKNESS BY 3/4 INCH DIAMETER, 0.028 INCH WALL THICKNESS.

THE SOLENOID VALVE IS CONNECTED TO THE DYNATUBE FITTING USING A UNION (ME273-0115-0006) MADE OF INCONEL 718 AND A METALLIC BOSS SEAL (ME261-0033-0206) FABRICATED FROM A286 CRES THAT IS COATED WITH K-6 NICKEL-LEAD. THE TUBE SEGMENTS, DYNATUBE FITTINGS, AND ORIFICE ARE JOINED BY INDUCTION BRAZING USING A CRES UNION AND A BRAZE ALLOY PREFORM (81.5 AU, 16.5 CU, 2 NI). THE ROCKWELL INTERNATIONAL BRAZE ALLOY WAS SELECTED BECAUSE OF ITS LOWER BRAZING TEMPERATURE REQUIREMENT THAN THE INDUSTRY STANDARD, AIDING IN THE PREVENTION OF EXCESSIVE GRAIN GROWTH AND REDUCING EROSION OF TUBE ENDS.

(B) TEST:

ATP

THE LINE ASSEMBLY IS LEAK CHECKED AT 22 PSIG AFTER INSTALLATION INTO THE VEHICLE.

CERTIFICATION

CERTIFICATION OF THE TUBING INSTALLATION WAS ACCOMPLISHED BY ROCKWELL INTERNATIONAL PER THE "ORBITER TUBING VERIFICATION PLAN SD75-SH-205".

THE 304L CRES TUBING WAS CERTIFIED FOR THE APOLLO PROPULSION SYSTEM, THE F5E, A-9, C130A, 707, 727, AND 737 AIRCRAFT. THE TUBING WAS QUALIFIED BY SIMILARITY AND BY ANALYSIS FOR ORBITER USAGE EXCEPT FOR FLEXURAL FATIGUE AND RANDOM VIBRATION FOR THE LONG-LIFE ORBITER REQUIREMENTS. DATA FROM THE MISSION DUTY CYCLES CONDUCTED ON MPTA WERE ALSO USED TO CERTIFY TUBING INSTALLATIONS.

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THE DYNATUBE FITTINGS AND SEALS WITH 304L TUBING WERE SUBJECTED TO THE FOLLOWING QUALIFICATION TESTS:

PROOF PRESSURE
TWO TIMES OPERATING PRESSURE

EXTERNAL LEAKAGE
AT 1.5 TIMES OPERATING PRESSURE
1X10-6 SCCS MAX

IMPULSE FATIGUE (200,000 CYCLES)

FLEXURE FATIGUE (10 MILLION FLEXURE CYCLES)

VIBRATION (7 UNITS)
45 MINUTES AT 0.4 G2/HZ
30 MINUTES AT 0.7 G2/HZ
10 MINUTES AT 0.2 G2/HZ

BURST TEST
FOUR TIMES OPERATING PRESSURE

OMRSD
ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION
ALL DETAIL HARDWARE IS VERIFIED INDIVIDUALLY, BY INSPECTION. RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL
CLEANLINESS LEVEL IS VERIFIED TO 100A. CORROSION PROTECTION IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
PARTS PROTECTION FROM DAMAGE AND CONTAMINATION IS VERIFIED. COMPONENTS ARE INSPECTED VISUALLY, DIMENSIONALLY, AND INCREMENTALLY DURING FABRICATION. AXIAL ALIGNMENT OF DYNATUBE FITTINGS AND TUBING IS VERIFIED. TORQUES AND SEALING SURFACES ARE VERIFIED BY INSPECTION. LUBRICATION OF ALL THREADED FLUID FITTING COUPLINGS IS VERIFIED. MANDATORY INSPECTION POINTS ARE INCLUDED IN THE ASSEMBLY PROCEDURES.

CRITICAL PROCESSES
ELECTRICAL BONDING AND PARTS PASSIVATION ARE VERIFIED BY INSPECTION. INDUCTION BRAZING IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
RADIOGRAPHIC INSPECTION OF INDUCTION BRAZED JOINTS IS VERIFIED.

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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:
NO CREW ACTION CAN BE TAKEN.

- 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	: BILL PRINCE	:/S/ BILL PRINCE