

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: 03-1-0510 -X****SUBSYSTEM NAME:** MAIN PROPULSION**REVISION:** 1 02/22/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: LINE ASSEMBLY BOEING	V070-415409

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

LINE ASSEMBLY, GHE PREPRESSURIZATION. THE LINE ASSEMBLY CONSISTS OF A TEE, TEST PORT FITTING, AND TUBE SEGMENTS.

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

PROVIDES THE FLOW PATH FOR GSE SUPPLIED HELIUM FROM THE GO2 PREPRESSURIZATION T-0 DISCONNECT (PD9) TO THE GO2 PREPRESSURIZATION CHECK VALVE (CV16) FOR PROPELLANT LOADING PRESSURIZATION, ANTI-ICING AND PREPRESSURIZATION PRIOR TO SSME START. THE LINE CONTAINS A TEST PORT (TP9).

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 03-1-0510-01

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SUBSYSTEM NAME: MAIN PROPULSION

LRU: GO2 HELIUM PRE-PRESS LINE ASSEMBLY

CRITICALITY OF THIS

ITEM NAME: GO2 HELIUM PRE-PRESS LINE ASSEMBLY

FAILURE MODE: 1/1

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:

MATERIAL DEFECT, FATIGUE, DAMAGED BRAZE JOINTS

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:

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.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0510-01**

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 THE PREPRESSURIZATION LINE.
2) PREPRESSURIZATION CHECK VALVE (CV16) FAILS TO CHECK/CLOSE.

THE FLOW CONTROL VALVES WILL OPEN IN AN ATTEMPT TO MAINTAIN ET ULLAGE PRESSURE (ACTIVE CONFIGURATION ONLY). LOSS OF ET LO2 ULLAGE PRESSURE WILL RESULT IN VIOLATION OF TANK MINIMUM STRUCTURAL CAPABILITY REQUIREMENTS. POSSIBLE LOSS OF ADJACENT CRITICAL COMPONENTS DUE TO IMPINGEMENT OF HIGH PRESSURE GAS. POSSIBLE UNCONTAINED SSME SHUTDOWN DUE TO LOW NPSP LATE IN ENGINE OPERATION.

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

ON GROUND, VIOLATION OF HGDS LCC WILL RESULT IN LAUNCH SCRUB.

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 TUBE SEGMENT IS MANUFACTURED FROM 21-6-9 CRES 1.0 INCH DIAMETER AND 0.028 INCH WALL THICKNESS. THE TEE IS MACHINED FROM 21-6-9 CRES MATERIAL 1.0 INCH DIAMETER BY 0.028 INCH WALL THICKNESS (TWO PORTS) AND A TEST PORT FITTING.

THE TUBES, TEE, DISCONNECT, AND CHECK VALVE ARE CONNECTED TOGETHER BY INDUCTION BRAZING USING A 21-6-9 CRES UNION AND A BRAZE ALLOY PREFORM (81.5 AU, 16.5 CU, 2 NI). THE ROCKWELL INTERNATIONAL BRAZING ALLOY WAS SELECTED DUE TO

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 03-1-0510-01**

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:

CERTIFICATION OF THE TUBING INSTALLATION WAS ACCOMPLISHED BY ROCKWELL INTERNATIONAL PER THE "ORBITER TUBING VERIFICATION PLAN SD-75-SH-205".

THE 21-6-9 CRES TUBING WAS CERTIFIED FOR THE DC10, L1011, AND 747 AIRCRAFT. THE TUBING WAS QUALIFIED BY SIMILARITY AND BY ANALYSIS FOR ORBITER USAGE EXCEPT FOR FLEXURE 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.

CRES TUBING WITH DYNATUBE FITTINGS AND SEALS WAS SUBJECTED TO THE FOLLOWING QUALIFICATION TESTS:

PROOF PRESSURE
TWO TIMES OPERATING PRESSURE

EXTERNAL LEAKAGE
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, AT DETAIL LEVEL ON MANUFACTURING ORDERS, WITH ALL PROCESSES INCORPORATED. 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.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
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ASSEMBLY/INSTALLATION

PARTS PROTECTION FROM DAMAGE AND CONTAMINATION IS VERIFIED. COMPONENTS ARE INSPECTED VISUALLY, DIMENSIONALLY, AND INCREMENTALLY DURING FABRICATION. AXIAL ALIGNMENT OF TUBING 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.

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	: ERICH BASS	:/S/ ERICH BASS