

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: 03-1-0426 -X****SUBSYSTEM NAME:** MAIN PROPULSION**REVISION:** 1 02/22/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: GN2 SSME PURGE LINE ASSEMBLY BOEING	V070-415101

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

LINE ASSEMBLY, GN2 PURGE. THE LINE ASSEMBLY CONSISTS OF A MANIFOLD, ENGINE FLANGES, AND TUBE SEGMENTS.

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

THE LINE EXTENDS FROM EACH INDIVIDUAL SSME INTERFACE AND CONTINUES TO A MANIFOLD. THE MANIFOLD IS CONNECTED TO THE GN2 PURGE DISCONNECT AT THE T-0 UMBILICAL. SUPPLIES A GN2 PURGE PATH FOR INERTING THE ENGINES DURING PROPELLANT LOADING.

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LRU: GN2 SSME PURGE LINE ASSEMBLY

ITEM NAME: GN2 SSME PURGE LINE ASSEMBLY

CRITICALITY OF THIS

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE.

MISSION PHASE: PL PRE-LAUNCH

VEHICLE/PAYLOAD/KIT EFFECTIVITY:	102	COLUMBIA
	103	DISCOVERY
	104	ATLANTIS
	105	ENDEAVOUR

CAUSE:

MATERIAL DEFECT, FATIGUE FAILURE, 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:

RESULTS IN GN2 LEAKAGE INTO AFT COMPARTMENT. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION. ENGINE PURGE IS AT 600-700 PSIA, 1.27 LBS/SEC FLOW RATE AND 250 DEGREES F. FLOW IS MONITORED ON GROUND. GN2 LEAK IS NOT DETECTABLE USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

(B) INTERFACING SUBSYSTEM(S):

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SAME AS A.

(C) MISSION:

POSSIBLE LAUNCH SCRUB OR DELAY DUE TO LOSS OF GN2 PURGE.

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

POSSIBLE LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

NONE.

-DISPOSITION RATIONALE-

(A) DESIGN:

THE LINE ASSEMBLY IS DESIGNED TO A MINIMUM FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST. THE TUBE SEGMENTS ARE MANUFACTURED FROM 21-6-9 CRES 1/2 INCH DIAMETER BY 0.020 INCH WALL THICKNESS AND 1 INCH DIAMETER BY 0.020 INCH WALL THICKNESS. THE MANIFOLD IS MANUFACTURED FROM 21-6-9 CRES BAR 1 INCH DIAMETER BY 0.020 INCH WALL THICKNESS (ONE PORT) AND 1/2 INCH DIAMETER BY 0.020 INCH WALL THICKNESS (THREE PORTS). THE ENGINE FLANGES ARE MANUFACTURED FROM 21-6-9 CRES BAR 1/2 INCH DIAMETER BY 0.031 INCH WALL THICKNESS AND CONTAIN LEAK DETECTION PORTS.

THE TUBE SEGMENTS, MANIFOLD, AND SSME INTERFACE FLANGES 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 BRAZE ALLOY WAS SELECTED DUE TO 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 MANIFOLD AND ENGINE FLANGES ARE PROOF PRESSURE TESTED AT 1400 PSIG AND LEAK TESTED AT 700 PSIG PRIOR TO INSTALLATION INTO THE VEHICLE. THE LINE ASSEMBLY IS PROOF PRESSURED TO 1400 PSIG AND LEAK CHECKED AT 650 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".

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THE 21-6-9 CRES TUBING WAS PREVIOUSLY QUALIFIED FOR THE DC-10, L1011, AND 747 AIRCRAFT. THE APOLLO INDUCTION BRAZING TECHNIQUE USING 302L AND 21-6-9 CRES TUBING WITH ROCKWELL INTERNATIONAL BRAZE UNION AND BRAZE ALLOY WAS CERTIFIED BY SUBJECTING A REPRESENTATIVE SAMPLE OF TUBE SEGMENTS TO PROOF PRESSURE, IMPULSE FATIGUE, FLEXURE FATIGUE, RANDOM VIBRATION, AND BURST TESTS.

TUBING WITH DYNATUBE FITTINGS AND SEALS WAS 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
INCOMING MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIALS AND PROCESSES CERTIFICATION.

CONTAMINATION CONTROL
PARTS MAINTAINED TO CLEANLINESS LEVEL 100A ARE VERIFIED. CORROSION PROTECTION IS CHECKED PER DRAWING REQUIREMENT.

ASSEMBLY/INSTALLATION
DIMENSIONS AND SURFACE FINISHES VERIFIED BY INSPECTION. FABRICATION OF FITTINGS AND TUBING INSTALLATION ARE INSPECTED PER QUALITY REQUIREMENT. ALL DIMENSIONS ARE VERIFIED WITHIN DEFINED TOLERANCE RANGES. SEALING SURFACE IS VERIFIED BY INSPECTION. MANDATORY INSPECTION POINTS ARE ESTABLISHED TO VERIFY PRODUCTION PROCEDURES.

CRITICAL PROCESSES
ELECTROPOLISHING AT TUBING ENDS AND PART PASSIVATION TREATMENT ARE VERIFIED. BRAZING OF TUBE UNION JOINTS IS VISUALLY INSPECTED.

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NONDESTRUCTIVE EVALUATION

RADIOGRAPHIC INSPECTION OF INDUCTION BRAZES IS VERIFIED BY INSPECTION. HELIUM LEAK DETECTION PROCESS IS MONITORED PER DRAWING SPECIFICATION. PENETRANT INSPECTION OF DETAIL PARTS IS EXAMINED.

TESTING

ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING AND PACKAGING FOR SHIPMENT 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:

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