FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 03-1-0607 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 11/08/00

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
LRU	: FLEX HOSE/LINE ASSEMBLY COAST METAL CRAFT/FMH CORP.	MC271-0077-0014 92141
LRU	: FLEX HOSE/LINE ASSEMBLY COAST METAL CRAFT/FMH CORP.	MC271-0077-0015, V070-415165-001, V070-415165-002 92142

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
FLEX HOSE/LINE ASSEMBLY, SENSE LINE FOR 20 PSIG REPRESS REGULATOR, LO2 AND LH2. 0.25 DIAMETER.

FLEX HOSES V070-415165-001 AND V070-415165-002 ARE MADE FROM MC271-0077-0004 AND MC271-0077-0014.

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 2
ONE LINE ASSY, LH2 (0014)
ONE LINE ASSY, LO2 (0015)

FUNCTION:
THE ASSEMBLY EXTENDS FROM THE DELTA PRESSURE LINE ASSEMBLY TO THE 20 PSIG REPRESS REGULATOR SENSE PORT. SIMILAR DESIGN FOR THE LO2 & LH2 SYSTEM. REFERENCE FMEA/CIL 03-1-0433-01 FOR THE DELTA PRESSURE LINE ASSEMBLY.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

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SUBSYSTEM NAME: MAIN PROPULSION
LRU: 20 PSIG REG SENSE FLEX HOSE/LINE ASSEMBLY **CRITICALITY OF THIS**
ITEM NAME: 20 PSIG REG SENSE FLEX HOSE/LINE ASSEMBLY **FAILURE MODE:** 1/1

FAILURE MODE:
RUPTURE/LEAKAGE.

MISSION PHASE:
PL PRE-LAUNCH
LO LIFT-OFF
DO DE-ORBIT

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

CAUSE:
METAL FATIGUE, MATERIAL DEFECT.

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:
PROPELLANT LEAK INTO AFT COMPARTMENT. POSSIBLE LOSS OF CRITICAL ADJACENT COMPONENTS DUE TO CRYOGENIC EXPOSURE. POSSIBLE AFT COMPT OVERPRESS AND FIRE/EXPLOSION HAZARD. LEAKAGE DETECTABLE ON GROUND USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

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(B) INTERFACING SUBSYSTEM(S):
SAME AS A.

(C) MISSION:
ON GROUND, VIOLATION OF HGDS LCC WILL RESULT IN LAUNCH SCRUB.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:
1R/2 2 SUCCESS PATHS. TIME FRAME - MANIFOLD REPRESS.
1) SENSE LINE RUPTURE/LEAKAGE.
2) MANIFOLD RELIEF SYSTEM FAILS TO RELIEVE.

FIRST FAILURE RESULTS IN HIGH FLOW FROM REPRESS REGULATOR. SECOND FAILURE RESULTS IN INABILITY TO RELIEVE, RUPTURE OF THE MANIFOLD AND POSSIBLE AFT COMPT OVERPRESS. POSSIBLE LOSS OF CREW/VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE FLEXIBLE HOSE ASSEMBLY IS CONSTRUCTED USING 321 CRES TUBING (0.250 INCH O.D., 0.025 INCH WALL THICKNESS), FLEX LINES (321 CRES BELLOWS COVERED WITH ONE LAYER OF 321 CRES BRAID) AND ONE MECHANICAL FITTING (DYNATUBE) MADE OF 718 INCONEL. THE PARTS ARE CONNECTED TOGETHER USING INERT ARC WELDING. THE ASSEMBLY IS DESIGNED TO A MINIMUM FACTOR OF SAFETY OF 2.0 PROOF PRESSURE AND 4.0 BURST PRESSURE.

(B) TEST:
ATP

EXAMINATION OF PRODUCT: LENGTH VARIATION, DIAMETER VERIFICATION, VISUAL.

PROOF PRESSURE (GN2)
-0014 TESTED AT 113 PSIG
-0015 TESTED AT 553 PSIG

EXTERNAL LEAKAGE (GHE)
-0014 TESTED AT 55 PSIG
-0015 TESTED AT 275 PSIG

CERTIFICATION

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THE MC271-0077-0014 AND -0015 FLEXIBLE HOSE ASSEMBLIES ARE QUALIFIED BY SIMILARITY TO THE -0003, -0004, -0005, -0006, AND -0007 WHICH WERE SUBJECTED TO THE FOLLOWING QUALIFICATION TESTS:

FLEXURE TEST (-0004) - 2700 CYCLES AT 34 PSIG.

FLEXURE TEST (-0005) - 900 CYCLES AT 60 PSIG, 900 CYCLES AT 100 PSIG, AND 900 CYCLES AT 190 PSIG.

VIBRATION (-0005) - ALL THREE AXES
THE LINE ASSEMBLY WAS PRESSURIZED TO 60 PSIG FOR 1/3 OF THE TESTING, 100 PSIG FOR 1/3 AND 190 PSIG FOR THE FINAL 1/3. THE LINE ASSEMBLY WAS FIXED AT THE BRAZED END AND VIBRATED AT THE OPPOSITE END (NUT END). THE LINE WAS SUBJECTED TO 13.3 HOURS OF RANDOM VIBRATION OVER A FREQUENCY RANGE OF 20 - 2000 HZ.

VIBRATION (-0004) - ALL THREE AXES
THE LINE ASSEMBLY WAS PRESSURIZED TO 34 PSIG FOR THE FULL TEST DURATION. BOTH ENDS WERE SIMULTANEOUSLY SUBJECTED TO 13.3 HOURS OF VIBRATION OVER A FREQUENCY RANGE OF 20 - 2000 HZ.

PRESSURE IMPULSE TEST (-0006, -0007):
10,000 CYCLES AT 75 PSIG TO 1275 PSIG (AMBIENT TEMPERATURE)

EXTERNAL LEAKAGE (GHE)
-0014 TESTED AT 55 PSIG
-0015 TESTED AT 275 PSIG

BURST (-0004) - NO LEAKAGE OR DAMAGE AFTER 5 MINUTES AT 225 PSIG.

BURST (-0005) - NO LEAKAGE OR DAMAGE AFTER 5 MINUTES AT 1100 PSIG.

SALT FOG (-0003)

OMRSD
ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING/INSPECTION
RAW MATERIALS, INCLUDING CHEMICAL AND MECHANICAL REQUIREMENTS, ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL
CLEANLINESS TO LEVEL 100A VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
COMPONENTS ARE INSPECTED VISUALLY, DIMENSIONALLY, AND INCREMENTALLY DURING FABRICATION. ALL SURFACES REQUIRING CORROSING PROTECTION ARE VERIFIED. THE HOLE ASSEMBLIES ARE VISUALLY INSPECTED. FLEX SECTION ARE SERIALIZED AND INSPECTED AND VERIFIED FOR LENGTH.

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CRITICAL PROCESS
LINE ENDS ARE CAPPED, CLEANED AND ELECTROPOLISHED AND VERIFIED BY INSPECTION. HEAT TREATMENT VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
WELDS ARE PENETRANT AND RADIOGRAPHICALLY INSPECTED.

TESTING
ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PACKAGING FOR SHIPMENT VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
ONE FAILURE OCCURRED DURING QUALIFICATION FLEXURE TESTING (CAR A6721) OF THE -0003 LINE ASSEMBLY, WHICH IS NOT USED ON THE VEHICLE. STRUCTURAL FAILURE OF BRAIDS OCCURRED DUE TO BRAID LOCKUP. THE TEST FIXTURE CREATED ABNORMAL LOADING ON THE LINE CONTRIBUTING TO RUPTURE OF THE BRAID. CORRECTIVE ACTION WAS TO ADD DRY FILM LUBE TO THE EXTERNAL SURFACE. THIS ACTION IS NOT REQUIRED ON OTHER LINE CONFIGURATIONS.

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 AND OXYGEN SYSTEMS.

- 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	: EARL HIRAKAWA	:/S/ EARL HIRAKAWA
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