

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE  
NUMBER: 03-3-20011-X

SUBSYSTEM NAME: ORBITAL MANEUVERING SYSTEM (OMS)  
REVISION : 6 02/05/91

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	ASSEMBLY, FLEXLINE COAST METAL CRAFT	MC271-0082
----- PART DATA -----		

- EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
FLEXLINE ASSEMBLY, CROSSFEED INTERFACE

QUANTITY OF LIKE ITEMS: 4

- FUNCTION:  
A FLEXIBLE HOSE ASSEMBLY CONSISTING OF RIGID TUBE END CONNECTIONS AND A 321 STAINLESS STEEL BELLOWS CONSTRAINED BY TWO LAYERS OF EXTERNAL WIRE BRAID IS PROVIDED FOR ALIGNMENT AND CONNECTION BETWEEN THE CROSSFEED LINE AND OMS POD. THIS ASSEMBLY IS USED ON OV-102 ONLY. GIMBAL CONNECTORS ARE PROVIDED FOR THE OTHER VEHICLES AS DETAILED ON FMEA 03-3-20010.

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ATTACHMENT -  
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SUBSYSTEM: ORBITAL MANEUVERING SYSTEM (OMS)  
LRU :ASSEMBLY, FLEXLINE  
ITEM NAME: ASSEMBLY, FLEXLINE

CRITICALITY OF THIS  
FAILURE MODE:1/1

FAILURE MODE:  
STRUCTURAL FAILURE, RUPTURE, EXTERNAL LEAKAGE.

MISSION PHASE:  
PL PRELAUNCH  
LO LIFT-OFF  
OO ON-ORBIT  
DO DE-ORBIT  
LS LANDING SAFING

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

CAUSE:  
WELD DEFECT, CORROSION, PROPELLANT EXPOSURE, INSTALLATION DAMAGE,  
PRESSURE SURGE, FLOW INDUCED OR FLIGHT VIBRATION. FAILED CLOSED OF  
A.C. MOTOR VALVE RELIEF DEVICE.

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:  
SUBSYSTEM DEGRADATION - LOSS OF PROPELLANT.

(B) INTERFACING SUBSYSTEM(S):  
INABILITY TO USE CROSSFEED LINE (REQUIRED FOR ABORT DUMP), ALSO

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REQUIRED FOR REACTION TO OME FAILURES. CORROSION DAMAGE IN POD/ORBITER AFT COMPARTMENT. INABILITY TO INTERCONNECT TO RCS.

(C) MISSION:  
ABORT DECISION.

(D) CREW, VEHICLE, AND ELEMENT(S):  
POSSIBLE LOSS OF CREW/VEHICLE IF LEAK RESULTS IN EXCESSIVE PROPELLANT LOSS OR DAMAGE TO TPS/STRUCTURE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

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- DISPOSITION RATIONALE -  
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■ (A) DESIGN:

A SINGLE-PLY CONVOLUTED BELLOWS WITH TWO-LAYER EXTERNAL WIRE CONSTRAINT CONSTRUCTION IS UTILIZED. PROPELLANT COMPATIBLE MATERIALS ARE USED. FACTOR OF SAFETY IS 2 X MAX SURGE PRESSURE. FLOW INDUCED VIBRATION AND STRESS ANALYSES PERFORMED.

■ (B) TEST:

QUALIFICATION TESTS

ENDURANCE (1200 SURGE PRESSURE CYCLES, 30 HOURS FLOW, 600 FLEX CYCLES), RANDOM VIBRATION UNDER SIMULATED MISSION CONDITIONS, SHOCK, BURST.

ACCEPTANCE TESTS

INSPECTION, PROOF, ANGULATION, OPERATION (PRESSURE CYCLE, FLOW), LEAKAGE, CLEANLINESS.

GROUND TURNAROUND

V42880.130 AND V43C80.160 PERFORMS CROSSFEED VALVE RELIEF DEVICE CHECKOUT ON CONTINGENCY.

V43C80.210 PERFORMS FIRST FLIGHT LEAK CHECKS AND CONTINGENCY THEREAFTER.

V43C80.260 TOXIC VAPOR LEAK CHECK ON CROSSFEED LINE 1ST FLIGHT AND ON CONTINGENCY.

V43CE0.125 STATIC AIR SAMPLE OF ORBITER THE SECOND FLIGHT AND EVERY FLIGHT THEREAFTER

TO LIMIT CORROSION FROM MINOR PROPELLANT LEAKAGE, PURGE REQUIREMENTS ARE DEFINED IN V05AGO.010 (OLS), V05AGO.020 (OPF), V05AGO.030 (VAB), AND V05AGO.040 (PAD).

MONITORING OF LINE PRESSURES IN FLIGHT FOR EVIDENCE OF LEAKAGE WILL BE POSSIBLE WHEN PRESSURE TRANSDUCER INSTALLATION IN CROSSFEED LINE (MCR

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11110) IS IMPLEMENTED.

(C) INSPECTION:

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO LEVEL 200 FOR MMH AND 200A FOR NTO AND CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING, ASSEMBLY AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. MANDATORY INSPECTION POINTS ARE UTILIZED.

NONDESTRUCTIVE EVALUATION

INSPECTION VERIFIES ALL WELDS ARE PENETRANT INSPECTED PER MIL-I-6866 AND ALL BUTT WELDS ARE FURTHER INSPECTED BY X-RAY. INSPECTION VERIFIES ALL MACHINED PARTS ARE INSPECTED BY X-RAY.

CRITICAL PROCESSES

INSPECTION VERIFIES THAT WELDS MEET SPECIFICATION REQUIREMENTS.

TESTING

TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. ACCEPTANCE TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE AND SHIPPING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

CAR AB1493 RECORDS EXCESSIVE LEAK OF THIS FLEX HOSE ASSEMBLY DURING QUAL VIBRATION TEST. A CRACK IN THE CREST OF A CONVOLUTE NEAR THE HOSE CLAMP OCCURRED DUE TO STRESS CORROSION CRACKING ASSOCIATED WITH DOWN TIMES WHEREIN THE RESIDUAL FLUIDS WERE NOT PURGED FROM THE LINE. BALLOONING OF THE CONVOLUTES HAD ALSO OCCURRED DUE TO PRESSURE SPIKES FROM WATER HAMMER EFFECT DURING VIBRATION OF THE CLOSED LINE SECTION. THE TEST SET UP WAS MODIFIED TO DUPLICATE SYSTEM USAGE CONDITIONS INCLUDING USE OF INTERFACE COUPLINGS AND REMOVAL OF THE HOSE CLAMPS. THE QUAL TEST WAS REPEATED. THE UNIT SHOWED NO EVIDENCE OF DAMAGE FOLLOWING SUCCESSFUL COMPLETION OF QUAL TEST.

(E) OPERATIONAL USE:

PROCEDURE IN PLACE FOR VERIFICATION OF CROSSFEED LINE PRESSURE PRIOR TO PERFORMING INTERCONNECT OR NON-CRITICAL CROSSFEED OPERATION IN ORDER TO

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AVOID POTENTIALLY DAMAGING PRESSURE SURGES. EVIDENCE OF LEAKAGE WOULD  
RESULT IN ISOLATION OF CROSSFEED LINE AND NEXT PLS ENTRY.

- APPROVALS -

RELIABILITY ENGINEERING: J. N. HART  
DESIGN ENGINEERING : D. W. CARLSON  
QUALITY ENGINEERING : O. J. BUTTNER  
NASA RELIABILITY :  
NASA SUBSYSTEM MANAGER :  
NASA QUALITY ASSURANCE :

: J. N. Hart  
: D. W. Carlson  
: O. J. Buttner  
: 3/21/91  
: 3/21/91  
: 3-21-91  
: 3-20-91