

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE  
NUMBER: 02-6-A11 -X

SUBSYSTEM NAME: HYDRAULICS

REVISION: 1 07/24/98

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**PART DATA**


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PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
LRU : HOSE AND SWIVEL ASSEMBLY TITFLEX	MC277-0002

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
HOSE AND SWIVEL ASSEMBLY, TVC ACTUATOR

**REFERENCE DESIGNATORS:**

- 50V58FH1
- 50V58FH2
- 50V58FH5
- 50V58FH6
- 50V58FH7
- 50V58FH8
- 50V58FH9
- 50V58FH10
- 50V58FH13
- 50V58FH14
- 50V58FH15
- 50V58FH16
- 50V58FH19
- 50V58FH20
- 50V58FH21
- 50V58FH22
- 50V58FH25
- 50V58FH26
- 50V58FH27
- 50V58FH28
- 50V58FH31
- 50V58FH32
- 50V58FH33
- 50V58FH34

**QUANTITY OF LIKE ITEMS:** 24  
FOUR ON EACH TVC ACTUATOR

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**FUNCTION:**

THE HOSE ASSEMBLY TRANSMITS HYDRAULIC FLUID FROM THE HYDRAULIC SYSTEM  
HARDLINES TO THE SSME TVC ACTUATORS. THE HOSE ASSEMBLY INCORPORATES AN  
ANGULAR SWIVEL END PERMITTING CONICAL MOTION AND AXIAL MOTION IN ANY  
DIRECTION ABOUT THE HOSE ASSEMBLY CENTERLINE

## FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

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SUBSYSTEM NAME: HYDRAULICS

LRU: HOSE AND SWIVEL ASSEMBLY

ITEM NAME: HOSE AND SWIVEL ASSEMBLY

CRITICALITY OF THIS  
FAILURE MODE: 1R2

## FAILURE MODE:

RUPTURE, HOSE

## MISSION PHASE:

LO LIFT-OFF  
DO DE-ORBIT

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

## CAUSE:

DEFECTIVE MATERIAL OR MANUFACTURE

## CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES

RTLS RETURN TO LAUNCH SITE

REDUNDANCY SCREEN      A) PASS  
    B) PASS  
    C) PASS

## PASS/FAIL RATIONALE:

A)

B)

C)

## - FAILURE EFFECTS -

## (A) SUBSYSTEM:

LOSS OF ONE OF THREE HYDRAULIC SYSTEMS. LOSS OF VEHICLE'S HYDRAULIC  
SYSTEM REDUNDANCY.

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**(B) INTERFACING SUBSYSTEM(S):**

LOSS OF HYDRAULIC POWER FOR ENGINE VALVE CONTROL FOR ONE ENGINE, RESULTING IN LOSS OF ONE SSME THRUST CONTROL; HOWEVER ENGINE VALVES WILL LOCK INTO POSITION AND ENGINE WILL CONTINUE TO OPERATE. LOSS OF REDUNDANT HYDRAULIC POWER SYSTEM FOR FOUR TVC ACTUATORS. LOSS OF REDUNDANT NOSE WHEEL STEERING AND HYDRAULIC LANDING GEAR DEPLOYMENT CAPABILITY IF SYSTEM ONE IS LOST. LOSS OF ONE OF THREE HYDRAULIC POWER SYSTEMS TO FLIGHT CONTROL SURFACES AND BRAKES. LOSS OF ONE OF THREE ET UMBILICAL RETRACT ACTUATORS FOR EACH UMBILICAL PLATE. HYDRAULIC FLUID ON TPS SCREED MAY CAUSE DEGRADED TPS BONDS.

**(C) MISSION:**

ABORT DECISION OR POSSIBLE EARLY MISSION TERMINATION.

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

NONE

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

POSSIBLE LOSS OF CREW/VEHICLE WITH TWO FAILURES. THIS FAILURE, PLUS LOSS OF SECOND HYDRAULIC SYSTEM. CRITICALITY 1 FOR SSME INDUCED RTLS.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

HOSE INNER CORE IS EXTRUDED TFE. REINFORCEMENT IS 304 STAINLESS STEEL WIRE BRAID. RETURN HOSE IS SINGLE BRAID. PRESSURE HOSE IS SINGLE PLAITS OF SMALL DIAMETER, TIERED, TENSION CONTROLLED TYPE 304 STAINLESS STEEL WIRE BRAID. RETURN HOSE IS QUALIFIED TO MIL-H-25579, GENERAL REQUIREMENTS FOR HOSE ASSEMBLY - TFE, HIGH TEMPERATURE, MEDIUM PRESSURE. PRESSURE HOSE IS QUALIFIED TO MIL-H-38360, GENERAL REQUIREMENTS FOR AIRCRAFT HOSE ASSEMBLY - TFE, SYNTHETIC CARBON BASE, HIGH TEMPERATURE, HIGH PRESSURE. HOSE END-FITTINGS ARE TITANIUM PROGRESSIVE-SWAGED WITH POSITIVE BRAID LOCK AND CONFORM TO MIL-H-25579 AND MIL-H-38360. SWIVEL FITTINGS ARE STAINLESS STEEL AND TITANIUM WITH ALUMINUM BRONZE SWIVEL BEARINGS. ALUMINUM BRONZE IS ISOLATED FROM THE HYDRAULIC FLUID.

**(B) TEST:**

QUALIFICATION:  
RETURN HOSE

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- IMPULSE ENDURANCE CYCLING - 100,000 CYCLES 0-2,250-0 PSI AT 450 DEGREES F IN ACCORDANCE WITH FIGURE 3 MIL-H-25579, WITH A RATE OF 70 CYCLES/MIN.
- BURST PRESSURE - 6,000 PSI AT 70 DEGREES F

**PRESSURE HOSE**

- IMPULSE ENDURANCE CYCLING - 250,000 CYCLES 0-4,500-0 PSI IN ACCORDANCE WITH FIGURE 3 MIL-H-38360, WITH A RATE OF 70 CYCLES/MIN. 80 PERCENT AT 400 DEGREES F, 20 PERCENT AT 70 DEGREES F.
- BURST PRESSURE - 12,000 PSI AT 70 DEGREES F.

**HOSE AND SWIVEL**

- ENDURANCE CYCLING - 50,000 DEFLECTION CYCLES, 50 PERCENT AT 0 DEG F 50 PERCENT AT 275 DEGREES F, WITH A RATE OF 30 CYCLES/MIN. SIMULTANEOUSLY, IMPULSE CYCLES PER FIGURE 2 OF MIL-J-5513, GENERAL REQUIREMENTS FOR HYDRAULIC SWIVEL JOINTS.

**ACCEPTANCE:**

- PROOF PRESSURE - RETURN 3,000 PSI; PRESSURE 6,000 PSI.
- LEAK TEST - WITH OIL, 3,000 PSI INTERNAL PRESSURE APPLIED.
- LEAK TEST - WITH AIR UNDER WATER, 5-10 PSI INTERNAL PRESSURE APPLIED FOR NOT LESS THAN 2 MINUTES.

**GROUND TURNAROUND TEST**

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

**(C) INSPECTION:**

**RECEIVING INSPECTION**

INCOMING MATERIAL IS VERIFIED BY INSPECTION AND COMPANY METALLURGIST. INCOMING MATERIAL IS TESTED AND VERIFIED BY INSPECTION, ON A SAMPLING BASIS, TO ENSURE CERTIFICATION IS CORRECT.

**CONTAMINATION CONTROL**

CLEANLINESS LEVEL 190 PER MAO110-301 IS VERIFIED BY INSPECTION.

**CRITICAL PROCESSES**

WELDING AND SWAGING PROCESSES ARE VERIFIED BY INSPECTION.

**NDE**

RADIOGRAPHIC INSPECTION IS PERFORMED TO ENSURE THE FOLLOWING: HOSE AND BRAID ARE PROPERLY BOTTOMED IN END FITTING; BUTT WELD TUBING IS CHECKED FOR FREEDOM FROM CRACKS, POROSITY, INCLUSIONS, OR VOIDS. RADIOGRAPH IS EXAMINED UNDER MAGNIFICATION.

**ASSEMBLY/INSTALLATION**

MANUFACTURING AND ASSEMBLY PROCESSES VERIFIED BY INSPECTION.

**TESTING**

PROOF AND LEAK TESTS PERFORMED BY TEST LAB UNDER DELEGATION OF QUALITY ASSURANCE MANAGER. SWIVELS ARE TESTED TO RATED PRESSURE, TO ENSURE THAT

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FITTINGS' DEFLECTION AND EXCURSION ARE WITHIN SPECIFICATION ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING  
INSPECTION VERIFIES PACKAGING PRIOR TO SHIPMENT

**(D) FAILURE HISTORY:**

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE.

**(E) OPERATIONAL USE:**

NONE: RAPID LEAK RATE WOULD DEplete SYSTEM BEFORE ACTION COULD BE TAKEN.

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- APPROVALS -

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EDITORIALLY APPROVED : BNA : J. Kemura 7-30-98  
TECHNICAL APPROVAL : VIA APPROVAL FORM : 95-CIL-009\_02-6