FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 02-6-A15 -X

SUBSYSTEM NAME: HYDRAULICS

REVISION: 1 07/24/98

PART DATA

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

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
HOSE AND SWIVEL ASSEMBLY, SSME TVC/HYDRAULIC SYSTEM

REFERENCE DESIGNATORS:
50V58FH74
50V58FH75
50V58FH76
50V58FH77
50V58FH78
50V58FH79

QUANTITY OF LIKE ITEMS: 6
ONE IN EACH SSME TVC/HYD SYSTEM PRESSURE AND RET LINE

FUNCTION:
TO COMPENSATE FOR 3-DIMENSIONAL DEFLECTIONS BETWEEN PRIMARY AND SECONDARY STRUCTURE.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
NUMBER: 02-6-A15- 01

REVISION#: 1 07/24/98

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:
MATERIAL DEFECT 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.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 02-6-A15- 01

(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 NOSE WHEEL STEERING AND HYDRULIC 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.

-DISPOSITION RATIONALE-

(A) DESIGN:
HOSE INNER CORE IS EXTRUDED TFE. REINFORCEMENT IS 304 STAINLESS STEEL WIRE BRAID. RETURN HOSE IS DOUBLE 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:

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 02-6-A15- 01

RETURN HOSE
- 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

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 02-6-A15-01

PROOF AND LEAK TESTS PERFORMED BY TEST LAB UNDER DELEGATION OF QUALITY ASSURANCE MANAGER. SWIVELS ARE TESTED TO RATED PRESSURE, TO ENSURE THAT 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 HYDRAULIC SYSTEM BEFORE ACTION COULD BE TAKEN.

- APPROVALS -

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