FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 02-6-E03 -X

SUBSYSTEM NAME: HYDRAULICS

REVISION: 1 07/24/98

PART DATA

	PART NAME **VENDOR NAME**	**PART NUMBER** **VENDOR NUMBER**
LRU	RESERVOIR, HYDRAULIC ARKWIN	MC282-0062

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
RESERVIOR, HYDRAULIC

REFERENCE DESIGNATORS: 50V58TK4
50V58TK5
50V58TK6

QUANTITY OF LIKE ITEMS: 3
ONE IN EACH HYDRAULIC POWER SYSTEM

FUNCTION:
PROVIDE MEANS FOR THE COLLECTION, STORAGE AND DISTRIBUTION OF HYDRAULIC FLUID.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
NUMBER: 02-6-E03- 01

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SUBSYSTEM NAME: HYDRAULICS
LRU: RESERVOIR, HYDRAULIC
ITEM NAME: RESERVOIR, HYDRAULIC

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
LEAKAGE, EXTERNAL. LOW PRESSURE PISTON SWIVEL SEAL (DYNAMIC). RELIEF VALVE SEAT, OR LOW PRESSURE PISTON CYLINDER SEAL

MISSION PHASE:
LO LIFT-OFF
DO DE-ORBIT

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

CAUSE:
DAMAGED SEAL, BROKEN SPRING, SCORED SLEEVE OR CYLINDER WALL. CONTAMINATION

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:
POSSIBLE DEPLETION OF RESERVOIR RESULTING IN LOSS OF ONE HYDRAULIC SYSTEM.

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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 WILL CONTINUE TO OPERATE. LOSS OF REDUNDANT HYDRAULIC POWER 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 BOND.

(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:
STANDARD MIL-G-5514 (GENERAL REQUIREMENTS FOR HYDRAULIC PACKINGS AND GLAND DESIGN) SEAL DESIGN. MATERIALS. PROCESSES AND MANUFACTURING TECHNIQUES USED BY SUPPLIER FOR A-10, F-15 AND F-105 HYDRAULIC RESERVOIRS OF SIMILAR DESIGN. PISTON OPERATION RESULTS IN EXTREMELY LOW ANGULAR VELOCITY AND NO RADIAL MOVEMENT, BOTH OF WHICH LIMIT "O" RING ROLL LEAKAGE. INNER DIAMETER OF LOW PRESSURE CYLINDER IS TEFLON COATED. SPECIAL TECHNIQUE PRODUCES COATING WHICH WILL NOT CHIP OR PEEL.

(B) TEST:
QUALIFICATION:
- ENDURANCE CYCLING - 5000 CYCLES AT 50 PERCENT STROKE. 50,000 AT 10 PERCENT STROKE. 145,000 AT 2 PERCENT STROKE. 25 PERCENT OF EACH AT 275 DEGREES F WITH A RATE OF 1 HZ. PASS/FAIL CRITERIA: PASSAGE OF PERFORMANCE RECORD TEST.

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- IMPULSE CYCLING - HIGH PRESSURE CYLINDER: 50,000 CYCLES 3,000 - 4,500 3,000 PSI WITH A RATE OF 2 HZ. PASS/FAIL CRITERIA: PASSAGE OF PERFORMANCE RECORD TEST.
- BURST TEST - HIGH PRESSURE CYLINDER: 7,500 PSI. LOW PRESSURE CYLINDER: 320 PSI. PASS/FAIL CRITERIA. NO EXTERNAL LEAKAGE OR RUPTURE.

ACCEPTANCE:
- EXAMINATION OF PRODUCT - WEIGHT, WORKMANSHIP, FINISH, DIMENSIONS, AND CONSTRUCTION.
- PROOF PRESSURE TEST - TESTED AT 275 DEG F AND 4,500 PSIG PRESSURE AND 160 PSIG RETURN. PASS/FAIL CRITERIA: NO EXTERNAL LEAKAGE.
- PERFORMANCE RECORD TEST:
  - RELIEF VALVE OPERATION TEST - VERIFY CRACK FULL FLOW AND RESEAT PRESSURES.
  - LEAKAGE TEST - 25 FULL CYCLES, PRESSURE AS REQUIRED TO CYCLE RESERVOIR PORTS BLOCKED 3,000 PSIG TO PRESSURING CHAMBER. PASS/FAIL CRITERIA: INTERNAL LEAKAGE SHALL NOT EXCEED 2 CC/HR.
- RESERVOIR CLEANLINESS TEST - CLEANLINESS LEVEL 190 PER MA0110-301.

GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD

(C) INSPECTION:
RECEIVING INSPECTION
MATERIAL CERTIFICATION IS VERIFIED BY INSPECTION. PROCESS CERTIFICATION IS IMPOSED AND VERIFIED BY INSPECTION THREE SEAL PODS PER LOT ARE 100 PERCENT INSPECTED AND ALL DATA IS VERIFIED BY RECEIVING INSPECTION. T-TYPE SEAL SET OUTER AND INNER DIAMETER DIMENSIONS AND THICKNESS ARE INSPECTED AND DOCUMENTED BY RECEIVING INSPECTION

CONTAMINATION CONTROL
CONTAMINATION LEVEL OF 190, OR BETTER, IS MAINTAINED PER MA0110-301.

CRITICAL PROCESSES
COATING PROCESS IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
ALL SUPPLIER DRAWING CHARACTERISTICS ARE VERIFIED BY INSPECTION. SEAL INSTALLATION IS PER DRAWING/PLANNING TICKET AND VERIFIED BY INSPECTION. DATA PAK RECORDS AND ASSEMBLY PROCEDURES ARE VERIFIED BY INSPECTION.

TESTING
ATP AND POST ATP FLUID TESTS ARE VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

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(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. THE FAILURE HISTORY DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE.

(A4346-010) (1976) DURING QUALIFICATION TEST OF THE HYDRAULIC RESERVOIR AND FOLLOWING THE IMMERSION TEST, FLUID LEAKAGE WAS OBSERVED AT THE RELIEF VALVE SEAT DURING RESEAT PRESSURE CHECK. THE FAILURE WAS CAUSED BY THE O-RING SEAL NOT BEING CORRECTLY SEATED. THIS WAS CORRECTED BY REDUCING THE THICKNESS OF THE O-RING RETAINER WHICH WILL PROVIDE ADDITIONAL SQUEEZE ON THE O-RING.

(A4623-010) (1976) DURING DEAERATION OF THE FLIGHT CONTROL HYDRAULICS LABORATORY (FCHL) HYDRAULIC SYSTEMS. LEAKAGE WAS FOUND IN THE AMBIENT CAVITIES OF TWO RESERVOIRS (S/N 004 AND S/N 006). THIS FAILURE WAS AN ISOLATED CONDITION SINCE IT ONLY OCCURRED ON THE FCHL AND WAS DUE TO SYSTEM CONTAMINATION RESULTING IN IMPROPER DYNAMIC SEALING.

(E) OPERATIONAL USE:

NONE - IF LEAK RATE IS RAPID (HYDRAULIC SYSTEM WOULD BE DEPLETED BEFORE ACTION COULD BE TAKEN). IF LEAK RATE IS SLOW ENOUGH, PUMP MAY BE DEPRESSURIZED TO DECREASE THE LEAK RATE. TIMING OF THE ACTION WOULD BE DEPENDENT ON THE FLIGHT PHASE AND THE SYSTEM REQUIREMENTS.

- APPROVALS -

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