FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 02-6-E24 -X

SUBSYSTEM NAME: HYDRAULICS

REVISION: 1 07/24/98

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	ACCUMULATOR, HYDRAULIC PARKER	MC284-0597

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ACCUMULATOR, BOOTSTRAP, HYDRAULIC

REFERENCE DESIGNATORS: 50V58AU10
50V58AU11
50V58AU12

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

FUNCTION:
PROVIDE RESERVOIR PRESSURIZATION FOR POSITIVE HEAD PRESSURE ON MAIN PUMP INLETS AT APU STARTUP IN ORBIT. ASSEMBLY INCLUDES A PRESSURE GAUGE FOR GROUND OPERATIONS AND A GAS FILL VALVE FOR CHARGING

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
NUMBER: 02-6-E24-05

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

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
CYLINDER RUPTURE

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

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

CAUSE:
MATERIAL DEFECT FATIGUE

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 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 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.

-DISPOSITION RATIONALE-

(A) DESIGN:
BURST FACTOR OF 3.75. MATERIAL IS 4130 STEEL, HEAT TREATED 150 TO 170 KSI. PROVIDES GOOD PHYSICAL PROPERTIES FOR HIGH ALLOWABLE STRESS. ALLOWABLE STRESS IS 190 KSI. THE ACTUAL CALCULATED CYLINDER HOOP STRESS (BURST 12,000 PSI) IS 180 KSI. THE MARGIN OF SAFETY IS 0.05. CYLINDER DESIGN AVOIDS STRESS RISERS AND SUDDEN CHANGES IN SECTION IN CRITICAL AREAS.

(B) TEST:
QUALIFICATION:
- OPERATING LIFE CYCLE TEST - 1,700 PSIG GN2 PRECHARGE AT 70 DEG F. PRESSURES VARYING 2,000 - 3,000 PSI. 50 000 CYCLES, 5/MINUTE AT 95 DEG F.
- BURST TEST - 11,250 PSI AT 275 DEG F. PASS/FAIL CRITERIA: NO EVIDENCE OF EXTERNAL LEAKAGE OR RUPTURE.

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ACCEPTANCE
- PRESSURE GAGE PROOFED TO 7,500 PSIG PRIOR TO INSTALLATION.
- ACCUMULATOR ASSEMBLY PROOFED TO 6,000 PSIG.
- EXAMINATION OF PRODUCT - WEIGHT, WORKMANSHIP, FINISH, DIMENSIONS AND CONSTRUCTION.
- PERFORMANCE RECORD TEST:
  - OPERATIONAL TEST - 500 PSIG GN2 PRECHARGE AT 70 DEG F, 200-3,000 PSIG FLUID PRESSURE; 700 PSIG MAXIMUM FLUID PRESSURE FOR 5 CYCLES. PASS/FAIL CRITERIA: VERIFY SEPARATOR MOVES AT OR BELOW MAXIMUM PRESSURE.
  - DYNAMIC LEAKAGE TEST - 1,700 PSIG GN2 PRECHARGE AT 95 DEG F, 2,000 3,000 PSIG FLUID PRESSURE FOR 20 CYCLES. PASS/FAIL CRITERIA: LEAKAGE FROM VENT PORT SHALL NOT EXCEED 10 CC/CYCLE GN2, 1 DROP/10 CYCLES HYDRAULIC FLUID.

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

(C) INSPECTION:
RECEIVING INSPECTION
RAW MATERIAL PURCHASES ARE MADE ONLY FROM MATERIAL APPROVED BY ROCKWELL. TEST REPORTS AND MATERIAL CERTIFICATIONS ARE MAINTAINED CERTIFYING MATERIAL AND PHYSICAL PROPERTIES.

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

CRITICAL PROCESSES
HEAT TREATMENT IS VERIFIED BY INSPECTION.

NDE
MAGNETIC PARTICLE INSPECTION IS PERFORMED AND RESULTS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
PARTS PROTECTION DURING FABRICATION OPERATION IS VERIFIED BY INSPECTION. MANUFACTURING/ASSEMBLY PROCESSES ARE VERIFIED BY INSPECTION. SEAL INSPECTION TO 3X MAGNIFICATION IS VERIFIED.

TESTING
PROOF PRESSURE TESTS ARE PERFORMED AS PART OF THE ACCEPTANCE TEST PROCEDURE AND ARE VERIFIED BY INSPECTION.

HANDLING/PACKAGING
INSPECTION VERIFIES PACKAGING PRIOR TO SHIPMENT.

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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.

(AB6094-010) (1980) DURING QUALIFICATION TESTING THE CYLINDER RUPTURED. CAUSE OF THE FAILURE WAS DEFICIENT MATERIAL STRENGTH DUE TO IMPROPER ROUGH MACHINED CYLINDER (EXCESSIVE WALL CROSS SECTION) PRIOR TO THE HEAT TREAT PROCESS. THE CORRECTIVE ACTION IS AS FOLLOWS. EACH HEAT TREAT LOT OF CYLINDER SECTIONS WAS COUPON TESTED FOR CONFORMANCE TO THE HEAT TREAT REQUIREMENT PRIOR TO ANY FINAL MACHINING OPERATIONS. ALSO, THE PRESSURE FOR THE BURST TEST WAS REVISED FROM 4 TIMES OVER THE OPERATING PRESSURE TO 3.75 TIMES.

(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