

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

SUBSYSTEM NAME: HYDRAULICS

REVISION: 1 07/24/98

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
1	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

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

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
LOSS OF GAS CHARGE

MISSION PHASE: OO ON-ORBIT
 DO DE-ORBIT

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

CAUSE:
DEFECTIVE PISTON SEAL, SCORED BARREL OF ACCUMULATOR, DEFECTIVE CHARGING VALVE, LEAKING PRESSURE GAUGE, CONTAMINATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
 B) PASS
 C) PASS

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF BOOTSTRAP PRESSURE WITH CORRESPONDING LOSS OF RESERVOIR PRESSURE (LOSS OF MAIN PUMP RESTART CAPABILITY) RESULTING IN LOSS OF ONE HYDRAULIC SYSTEM. IF FAILURE OCCURS DURING MAIN PUMP ASCENT/ENTRY

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OPERATIONS. MAIN PUMP STILL WOULD BE USED TO COMPLETE FLIGHT PHASE. BUT CAPABILITY TO RESTART MAIN PUMP WOULD BE DOUBTFUL DUE TO LOSS OF BOOTSTRAP/RESERVOIR PRESSURE. HOWEVER, AUTOMATIC RECHARGE CAPABILITY IS AVAILABLE DURING MAJORITY OF ON-ORBIT PHASE.

(B) INTERFACING SUBSYSTEM(S):

NOSE WHEEL STEERING AND HYDRAULIC LANDING GEAR DEPLOYMENT CAPABILITY WOULD BE LOST IF SYSTEM ONE WAS LOST. LOSS OF ONE OF THREE HYDRAULIC POWER SYSTEMS TO FLIGHT CONTROL SURFACES AND BRAKES

(C) MISSION:

ASCENT/ENTRY - NO EFFECT FOR FIRST FAILURE. MAIN PUMP OPERATION WOULD MAINTAIN BOOTSTRAP PRESSURE. ORBIT - ABORT DECISION (POSSIBLE EARLY MISSION TERMINATION), OR COMMIT TO CONTINUOUS CIRCULATION PUMP OPERATION TO MAINTAIN PRESSURE IF POSSIBLE.

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

NO EFFECT FOR FIRST FAILURE - ADEQUATE FLIGHT CONTROL CAPABILITY.

(E) FUNCTIONAL CRITICALITY EFFECTS:

POSSIBLE LOSS OF CREW/VEHICLE WITH TWO FAILURES: THIS FAILURE, PLUS LOSS OF SECOND HYDRAULIC SYSTEM.

-DISPOSITION RATIONALE-

(A) DESIGN:

DUAL DYNAMIC SEALS WITH VENTING, STANDARD MIL-G-5514 (GENERAL REQUIREMENTS FOR GLAND DESIGN, PACKINGS, HYDRAULIC) SEAL DESIGN. EXTREMELY LOW ANGULAR VELOCITY. SMALL DIAMETER PISTON (2.6 DIAMETER). HYDRAULIC SYSTEM FILTER BETWEEN THE MAIN PUMP AND THE ACCUMULATOR IS 5 MICRON NOMINAL, 15 MICRON ABSOLUTE. 15 MICRON NOMINAL INTERNAL FILTRATION EXISTS IN THE UNLOADER VALVE BETWEEN THE CIRCULATION PUMP AND THE ACCUMULATOR.

(B) TEST:

QUALIFICATION:

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- 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.

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.
- CLEANLINESS TEST - LEVEL 190 PER MAO110-301.

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.

(A7713-010) (1977) LOW GN2 PRESSURE WAS FOUND IN THE ACCUMULATOR ON THE FLIGHT CONTROL HYDRAULICS LABORATORY (FCHL). TESTS FAILED TO IDENTIFY THE CAUSE OF THE PRESSURE LOSS, HOWEVER DISASSEMBLY REVEALED SEVERELY NIBBLED SEALS ON THE GAS AND OIL END OF THE PISTON. THE SEALS WERE REPLACED BY GREEN TWEED SEALS AND PASSED ENDURANCE REQUIREMENTS. ALL UNITS HAVE THE NEW SEAL INSTALLED.

(AB3790-010) (1979) DURING QUALIFICATION TESTING THE ACCUMULATOR EXHIBITED GN2 LEAKAGE FROM THE SEAL VENT CAVITY. THE LEAKAGE WAS CAUSED BY LOWER THAN REQUIRED TEMPERATURE IMPOSED DURING LIFE CYCLE TESTS CAUSING THE GN2 GAS SEAL TO LOSE SUFFICIENT RESILIENCY TO ALLOW THE LEAKAGE. THE PROCUREMENT SPECIFICATION WAS CHANGED TO RAISE THE LOW TEMPERATURE REQUIREMENT FROM -65 DEGREES F TO -50 DEGREES F.

(AB4746-010) (1979) DURING QUALIFICATION TESTING THE ACCUMULATOR EXHIBITED GN2 LEAKAGE FROM THE SEAL VENT CAVITY. THE LEAKAGE WAS CAUSED BY THE INABILITY OF THE "T" SEAL TO ADEQUATELY SEAL AT -65 DEGREES F DURING LIFE CYCLE TESTING. CORRECTIVE ACTION WAS THE GREEN TWEED "T" SEAL P/N 733 GIMR-987P3 WAS REPLACED BY THE GREEN TWEED SEAL P/N 733 GIMR-964P3.

(AB5151-010) (1979, OV102) DURING SUBSYSTEM CHECKOUT, THE SYSTEM NUMBER 1 ACCUMULATOR EXHIBITED INTERNAL LEAKAGE. THE LEAKAGE WAS CAUSED BY EROSION AND NIBBLING EFFECTS AS A RESULT OF THE COMPOUND 987 "T" SEALS INABILITY TO MEET THE ACCUMULATOR'S LIFE CYCLE REQUIREMENTS. CORRECTIVE ACTION WAS THE GREEN TWEED "T" SEAL P/N 733 GIMR-987P3 WAS REPLACED BY THE GREEN TWEED SEAL P/N 733 GIMR-964P3.

(AC3983-010) (1982, OV099) DURING SUBSYSTEM CHECKOUT, THE SYSTEM NUMBER TWO BOOTSTRAP GN2 CHARGE DECAYED. THE CAUSE OF THE FAILURE WAS ATTRIBUTED TO PITTING IN THE CYLINDER SHELL BORE WHICH LED TO DESTRUCTION OF THE BACKUP RING AND GOUGES IN THE SEAL. INSPECTION POINTS WERE ADDED AND THE MANUFACTURING ROUTE FOR THE ACCUMULATOR SHELL WAS CHANGED TO CONTROL INSPECTION AND PART PROTECTION DURING THE FABRICATION OPERATIONS.

(AC5702-010) (1983- OV099) POST STS-6, THERE WERE ERRATIC REPETITIVE DECAYS IN PRESSURE IN THE BOOTSTRAP CIRCUIT. THE LOSS OF PRESSURE WAS CAUSED BY IMPROPERLY CURED PISTON RINGS PRODUCED BY GREEN TWEED. THIS LOT OF SEALS WAS REMOVED FROM STOCK. SUBSEQUENT SEALS WILL HAVE A 3X INSPECTION PERFORMED WITH THE SEAL STRETCHED OVER A MANDREL.

(AD4065-010) (1987, OV103) DURING SUBSYSTEM CHECKOUT, SYSTEM NUMBER 2 BOOTSTRAP GN2 PRE-CHARGE DECAYED. THE CAUSE OF THE LEAKAGE WAS

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IMPROPERLY CURED SEALS. (SAME PROBLEM AS AC5702-010.) ACCUMULATOR SEALS WERE REPLACED. ACCUMULATOR WAS UPDATED TO A -0008 CONFIGURATION.

(E) OPERATIONAL USE:

RUN CIRCULATION PUMP TO ATTEMPT TO MAINTAIN BOOTSTRAP PRESSURE FOR MAIN PUMP START UP FOR ENTRY.

- APPROVALS -

EDITORIALLY APPROVED
TECHNICAL APPROVALT

. BNA
: VIA APPROVAL FORM

J. Kemura 7-30-98
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