FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 02-2C-C01-ES-C -X

SUBSYSTEM NAME: FLIGHT CONTROL MECH

REVISION: 0 12/04/87

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
LRU	:ELEVON ACTUATOR MOOG	MC621-0014
SRU	:SEAL, HYDRAULIC, TO ATMOSPHERE	

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SEAL, HYDRAULIC, TO ATMOSPHERE

QUANTITY OF LIKE ITEMS: 764
4 ACTUATORS, 191 SEALS PER ACT, TOTAL 764

FUNCTION:
PROVIDES A SEAL BETWEEN TWO MATING PARTS TO HOLD HYDRAULIC FLUID PRESSURE AND TO PREVENT HYDRAULIC FLUID FROM LEAKING OVERBOARD.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
NUMBER: 02-2C-C01-ES-C-06

REVISION#: 1 08/20/98

SUBSYSTEM NAME: FLIGHT CONTROL - ELEVON ACTUATOR
LRU: ELEVON ACTUATOR **CRITICALITY OF THIS**
ITEM NAME: SEAL, HYDRAULIC, TO ATMOSPHERE **FAILURE MODE:** 1R2

FAILURE MODE:
EXTERNAL LEAKAGE

MISSION PHASE:
LO LIFT-OFF
OO ON-ORBIT
DO DE-ORBIT

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

CAUSE:
CONTAMINATION, DETERIORATION, IMPROPER ASSEMBLY, IMPROPER SURFACE FINISH

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:
A)

B)
"B" SCREEN FAILS SINCE THE BARRIER SEALS LIMIT LEAKAGE SUCH THAT A SEAL FAILURE MAY BE UNDETECTABLE.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NONE

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(B) INTERFACING SUBSYSTEM(S):
LIMITED LOSS OF HYDRAULIC FLUID FROM ONE HYDRAULIC SYSTEM; HOWEVER, BARRIER SEAL LIMITS LEAKAGE.

(C) MISSION:
NONE

(D) CREW, VEHICLE, AND ELEMENT(S):
NONE

(E) FUNCTIONAL CRITICALITY EFFECTS:
POSSIBLE LOSS OF MISSION, CREW/VEHICLE AFTER TWO FAILURES: FAILURE OF SEAL AND BARRIER SEAL, RESULTING IN LOSS OF THREE HYDRAULIC SYSTEMS.

-DISPOSITION RATIONALE-

(A) DESIGN:
DYNAMIC ROD SEALS, DUAL ELASTOMERIC TYPE, WITH BACKUP RINGS. ALSO, BARRIOR SEAL (PISTON RING TYPE) LIMITS LEAKAGE TO 3 GALLONS/HOUR AT 3,000 PSI IN THE EVENT THE DYNAMIC SEALS FAIL. SINGLE STATIC SEALS HAVE BACKUP RINGS PLUS BARRIER TYPE SEAL. BARRIER SEALS LIMIT LEAKAGE TO 6 GALLONS/HOUR IN THE EVENT A STATIC SEAL FAILS.

(B) TEST:
QUALIFICATION: ENDURANCE CYCLING - 400 MISSION DUTY CYCLES UNDER LOAD AT MAXIMUM TEMPERATURE OF 250 DEGREES F. ACTUATOR WAS VIBRATED AT FLIGHT LEVELS AND TESTED AT -65 AND 250 DEGREES F. 100,000 PRESSURE IMPULSE CYCLES AT EACH SUPPLY AND RETURN PORT, AT 225 DEGREES F. SUPPLY PORTS WERE CYCLED FROM 3,000 PSIG TO 4,500 PSIG TO 1,500 PSIG, BACK TO 3,000 PSIG EACH CYCLE; RETURN PORTS, FROM 750 PSIG TO 1,500 PSIG TO 0 PSIG, BACK TO 750 PSIG. PERFORMANCE RECORD TESTS CONDUCTED AT 35 AND 225 DEGREES F FOLLOWING ENDURANCE TESTING. BURST PRESSURE OF 9,000 PSIG APPLIED AT SUPPLY PORTS; 4,500 PSIG, TO RETURN. VERIFIED THAT ALL PARTS WERE WITHIN ACCEPTABLE LIMITS DURING DISASSEMBLY AND INSPECTION AT COMPLETION OF QUALIFICATION.

ACCEPTANCE: PROOF PRESSURE OF 4,500 PSIG APPLIED AT SUPPLY PORTS. BURN-IN PRESSURE IMPULSE CYCLE TESTS AT 250 DEGREES F: (1) 1,500 IMPULSE CYCLES, 2,400-

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3,800 PSIG APPLIED AT SUPPLY PORTS, (2) SIMULTANEOUSLY, 1,500 IMPULSE CYCLES, 0-1,500 PSIG AT RETURN PORTS. STATIC LEAK CHECK AT NULL WITH NORMAL OPERATING PRESSURES AND NO EXTERNAL LOAD. ACTUATOR PERFORMANCE TESTS VERIFY ALL HYDRAULIC SEALS ARE OPERATIONAL. FLUID FROM ACTUATOR IS VERIFIED TO MEET CLEANLINESS LEVEL 190 PER MAO110-301.

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

(C) INSPECTION:
RECEIVING INSPECTION
EACH SEAL AND BACKUP RING IS 100 PERCENT INSPECTED FOR SIZE (ID, OD AND CROSS SECTION), FINISH (UNDER MAGNIFICATION) AND SELECTED MATERIAL PROPERTIES. VENDOR MATERIAL CERTIFICATIONS ARE VERIFIED.

SPECIAL PROCESSES
ALL SEALING SURFACES ARE 100 PERCENT INSPECTED FOR SIZE AND FINISH PER SPECIAL PROCEDURE. SELECTED CRITICAL SEALING SURFACES ARE VERIFIED BY ROCKWELL AND DCAS MANDATORY INSPECTION.

CONTAMINATION CONTROL
PARTS AND ASSEMBLY TOOLS/AIDS ARE CLEANED PRIOR TO ASSEMBLY. ASSEMBLY LUBRICANTS ARE WITHIN CLEANLINESS LEVELS AS PRESCRIBED BY DOCUMENTATION. TEST MEDIA VERIFIED BY MOOG CONTAMINATION CONTROL PLAN. END ITEM FLUID SAMPLE ANALYSIS VERIFIED PRIOR TO SHIPMENT.

ASSEMBLY/INSTALLATION ALL
SEALS AND MATING SURFACE FINISHES ARE INSPECTED PER SPECIAL PROCEDURE. O-RING AND BACKUP RING INSTALLATIONS ARE VERIFIED BY MANDATORY INSPECTION. TORQUES ARE VERIFIED BY MANDATORY INSPECTION. SHIM THICKNESSES ARE VERIFIED BY ASSEMBLER AND IN-PROCESS INSPECTOR. PHOTOGRAPHS OF SINGLE BACKUP RING SEAL INSTALLATIONS ARE TAKEN. CORRECT SEAL PART NUMBER VERIFIED, INSPECTION OF SEAL MATING PART SURFACE FINISHES AND COMPONENT INTEGRITY VERIFIED, SEALS AND MATING SURFACES ARE LUBRICATED PRIOR TO ASSEMBLY. SEAL INSTALLATIONS ARE PERFORMED IN CLEAN ROOM ENVIRONMENT, CERTIFIED PERSONNEL ARE UTILIZED, AND SPECIALLY DESIGNATED ASSEMBLY AIDS ARE REQUIRED.

TESTING
EXTERNAL LEAKAGE IS VERIFIED BY ATP TO BE WITHIN ACCEPTABLE LIMITS. ROCKWELL DESIGN AND QUALITY PERSONNEL, WITH NASA PARTICIPATION, CONDUCT A DETAILED ACCEPTANCE REVIEW OF THE HARDWARE AT THE VENDOR'S FACILITY, PRIOR TO THE SHIPMENT OF EACH END ITEM COVERED BY CONTROL PLAN. ATP VERIFICATION IS MIP FOR RI QA REPRESENTATIVE.

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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.

(E) OPERATIONAL USE:
NONE

- APPROVALS -

EDITORIALLY APPROVED	: BNA	: J. Kamura 8-24-98
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 95-CIL-009_02-2C