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

SUBSYSTEM NAME: FLIGHT CONTROL - ELEVON ACTUATOR
REVISION: 0 12/04/87

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:ELEVON ACTUATOR MOOG	MC621-0014

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ELEVON ACTUATOR, STRUCTURE

QUANTITY OF LIKE ITEMS: 4
ONE FOR EACH OF FOUR ELEVON PANELS

FUNCTION:
PROVIDE FORCE AND CONTROL FOR POSITIONING THE SPACE SHUTTLE ELEVONS.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
NUMBER: 02-2C-C01-CR-A- 01

REVISION#: 1 08/20/98

SUBSYSTEM NAME: FLIGHT CONTROL - ELEVON ACTUATOR
LRU: ELEVON ACTUATOR
ITEM NAME: ELEVON ACTUATOR

CRITICALITY OF THIS FAILURE MODE: 1/1

FAILURE MODE:
EXTERNAL LEAKAGE/COMPONENT RUPTURE

MISSION PHASE:
LO LIFT-OFF
DO DE-ORBIT

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

CAUSE:
MATERIAL DEFECT, FATIGUE (SWITCHING VALVE, SERVOVALVE, DIFFERENTIAL PRESSURE SENSORS, SOLENOID ISOLATION VALVES, MANIFOLDS, CYLINDER, ACTUATOR BODY, LEE PLUGS), LOSS OF MORE THAN ONE RETENTION BOLT, EACH COMPONENT. LOSS OF PISTON ROD GLAND RETENTION IN BODY.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF ALL ACTUATORS.

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(B) INTERFACING SUBSYSTEM(S):
POSSIBLE LOSS OF THREE HYDRAULIC SYSTEMS, RESULTING IN LOSS OF ALL HYDRAULICALLY ACTUATED FUNCTIONS.

(C) MISSION:
POSSIBLE LOSS OF MISSION, CREW/VEHICLE.

(D) CREW, VEHICLE, AND ELEMENT(S):
SAME AS (C)

-DISPOSITION RATIONALE-

(A) DESIGN:
ALL PRESSURE CONTAINING MEMBERS DESIGNED TO A BURST FACTOR OF 3 (9,000 PSIG). MAIN CYLINDER MATERIAL IS 17-4 PH STAINLESS STEEL MATERIAL, HEAT TREATED TO CONDITION H1025. HOOP STRESS MARGIN OF SAFETY (MS) FOR INBOARD IS 0.48 AND 0.15 FOR OUTBOARD. SERVOVALVES MS IS 1.22 MINIMUM (MIN), DIFFERENTIAL PRESSURE SENSORS MS IS 0.12 MIN, MANIFOLDS MS IS 0.33 MIN AND OTHER COMPONENTS DESIGNED SIMILARLY WITH FRACTURE MECHANICS APPLIED. BEARING AND ROD FRICTION FORCES TENDING TO LOOSEN GLAND ARE EXCEEDED BY THE COMBINATION OF FLUID PRESSURE FORCE AND RESIDUAL INSTALLATION FRICTION FORCES BY AN ACCEPTABLE MARGIN.

(B) TEST:
QUALIFICATION: ENDURANCE CYCLING - 400 MISSION DUTY CYCLES UNDER LOAD AT MAXIMUM TEMPERATURE OF 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. BURST PRESSURE OF 9,000 PSIG APPLIED AT SUPPLY PORTS; 4,500 PSIG AT 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, 2,400-3,800 PSIG APPLIED AT SUPPLY PORTS, (2) SIMULTANEOUSLY, 1,500 IMPULSE CYCLES, 0-

1,500 PSIG AT RETURN PORTS. PERFORMANCE TESTS VERIFY ALL ACTUATOR COMPONENTS ARE OPERATIONAL.

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

(C) INSPECTION:
RECEIVING INSPECTION
COMPONENT RAW MATERIAL CERTIFICATIONS ARE VERIFIED BY INSPECTION AND ANALYSIS.

NDE
PIECE PARTS EVALUATED BY SELECTED PENETRANT, MAGNETIC PARTICLE, ULTRASONIC, AND RADIOGRAPHIC INSPECTIONS.

SPECIAL PROCESSES
CRITICAL/CLOSE TOLERANCE DIMENSIONS AND FINISHES ARE 100 PERCENT INSPECTED FOLLOWING MACHINING.

ASSEMBLY/INSTALLATION
CLOSE TOLERANCE FITS AND ASSEMBLY TORQUES ARE VERIFIED BY INSPECTION. PERSONNEL ARE TRAINED/CERTIFIED IN THE USE OF SPECIALLY DESIGNATED TOOLS/FIXTURES WHICH ARE REQUIRED IN ASSEMBLY DOCUMENTATION.

TESTING
ATP IS VERIFIED BY INSPECTION. 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 THE CONTROL PLAN.

HANDLING/PACKAGING
HANDLING/PACKAGING PROCESSES UTILIZE SPECIALLY DESIGNED CONTAINERS AND INSERTS PROTECTING FROM STRUCTURAL/ENVIRONMENTAL DAMAGE.

(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

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- APPROVALS -

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