

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**

NUMBER: 02-2C-C01-SV-B -X

SUBSYSTEM NAME: FLIGHT CONTROL MECH

REVISION: 0

12/04/87

**PART DATA**

	<b>PART NAME</b>	<b>PART NUMBER</b>
	<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
LRU	:ELEVON ACTUATOR MOOG	MC621-0014
SRU	:SERVO VALVE	

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
SERVOVALVE

**QUANTITY OF LIKE ITEMS:** 16  
FOUR PER ACTUATOR

**FUNCTION:**

THE FOUR INDEPENDANT SERVOVALVES METER HYDRAULIC FLUID FLOW/PRESSURE TO THE POWER VALVE, IN PROPORTION TO THE INPUT CURRENT, TO CONTROL THE ACTUATOR OUTPUT.

## FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 02-2C-C01-SV-B-01

REVISION#: 1 08/20/98

SUBSYSTEM NAME: FLIGHT CONTROL - ELEVON ACTUATOR

LRU: ELEVON ACTUATOR

ITEM NAME: SERVO VALVE

CRITICALITY OF THIS

FAILURE MODE: 1R2

## FAILURE MODE:

FAILS AT NULL

## MISSION PHASE:

LO LIFT-OFF

DO DE-ORBIT

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

## CAUSE:

LOSS OF SIGNAL, DEFECTIVE TORQUE MOTOR, MECHANICAL FAILURE, JAMMED SPOOL, CONTAMINATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

## REDUNDANCY SCREEN

A) PASS

B) FAIL

C) PASS

## PASS/FAIL RATIONALE:

A)

B)

"B" SCREEN IS FAIL SINCE A NULL FAILURE DETECTION REQUIRES BOTH HIGH RATE AND HIGH HINGE MOMENT CONDITIONS.

C)

## - FAILURE EFFECTS -

## (A) SUBSYSTEM:

NONE

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**(B) INTERFACING SUBSYSTEM(S):**  
NONE

**(C) MISSION:**  
NONE

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

**(E) FUNCTIONAL CRITICALITY EFFECTS:**  
FUNCTIONAL CRITICALITY EFFECTS - POSSIBLE LOSS OF CREW/VEHICLE AFTER SECOND NULL FAILURE IF FIRST FAILURE IS UNDETECTED. LOSS OF FUNCTION CAN RESULT IN LOSS OF VEHICLE CONTROL.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**  
SPOOL AND SLEEVE ARE 440C MATERIAL, HARDENED AND LAPPED FOR A MATCHED SET. SPOOL IS GROOVED TO CLEAR SILTING. SERVOVALVE HYDRAULIC FLUID IS FILTERED BY A 5 MICRON HYDRAULIC SYSTEM FILTER, A 15 MICRON SERVOVALVE INLET FILTER AND A 35 MICRON SERVOVALVE FILTER.

**(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. VERIFIED THAT ALL PARTS WERE WITHIN ACCEPTABLE LIMITS DURING DISASSEMBLY AND INSPECTION AT COMPLETION OF QUALIFICATION.

ACCEPTANCE: PERFORMANCE RECORD AND SERVOVALVE PRESSURE GAIN TESTS VERIFY THAT THE POWER VALVE IS OPERATIONAL. FLUID FROM ACTUATOR IS VERIFIED TO MEET CLEANLINESS LEVEL 190 PER MAO110-301.

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ON-ORBIT CHECKOUT-THE FAILURE MODE MAY BE DETECTED AND THE FAILED CHANNEL ISOLATED DURING ON-ORBIT FLIGHT CONTROL SYSTEM CHECKOUT. NORMALLY PERFORMED THE DAY BEFORE LANDING.

**GROUND TURNAROUND TEST**

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

**(C) INSPECTION:****RECEIVING INSPECTION**

RAW MATERIAL CERTIFICATIONS ARE VERIFIED. SPECIAL MATERIAL REQUIREMENTS ARE IDENTIFIED IN CERTIFICATIONS.

**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.

**CONTAMINATION CONTROL**

ASSEMBLY AREA CLEANLINESS IS VERIFIED BY CONTAMINATION CONTROL PLAN. SERVOVALVE IS ASSEMBLED IN A CLASS 10,000 LAMINAR FLOW BENCH. COMPONENTS ARE PRECLEANED PRIOR TO ASSEMBLY. PARTS AND TOOLS/AIDS ARE CLEANED PRIOR TO ASSEMBLY. END ITEM FLUID SAMPLE IS VERIFIED PRIOR TO ACTUATOR DELIVERY.

**TESTING**

ATP IS VERIFIED BY INSPECTION AND IS PERFORMED AT BOTH THE COMPONENT AND ACTUATOR LEVELS. 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.

**(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.

(20F001-010) (1985, OV103) DURING PRELAUNCH, A FORCE FIGHT OCCURRED ON THE RIGHT INBOARD ELEVON ACTUATOR DURING LOW PRESSURE OPERATIONS. ANALYSIS OF ACTUATOR HYDRAULIC FLUID SAMPLE REVEALED CONTAMINANTS AND IT WAS DETERMINED THAT THESE CONTAMINANTS WERE BUILT INTO THE SERVOVALVE DURING ASSEMBLY. ASSEMBLY PROCEDURES WERE CHANGED TO MINIMIZE BUILT-IN CONTAMINANTS.

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NUMBER: 02-2C-C01-5V-B-01

(E) OPERATIONAL USE:  
NONE

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- APPROVALS -

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EDITORIALLY APPROVED  
TECHNICAL APPROVAL

: BNA  
: VIA APPROVAL FORM

: J. Korman 8-24-98  
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