

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE  
NUMBER: 02-2A-011104 -X**

**SUBSYSTEM NAME: FLIGHT CONTROL MECH - RUDDER SPEED BRAKE BF  
REVISION: 0 02/02/88**

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**PART DATA**

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	<b>PART NAME</b>	<b>PART NUMBER</b>
	<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
ASSY	: RUDDER/SPEEDBRAKE (R/SB)	MC621-0053-0068
	SUN	5004918
SRU	: SERVOVALVE, 4 CHANNEL	

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
SERVOVALVE, 4 CHANNEL

**REFERENCE DESIGNATORS:**

**QUANTITY OF LIKE ITEMS: 2**  
ONE PER RUDDER & SPEEDBRAKE

**FUNCTION:**

FOUR CHANNEL SERVO RECEIVES ELECTRICAL SIGNALS FROM AVIONICS AND METERS  
FLOW TO POSITION RUDDER AND SPEEDBRAKE POWER VALVES. TRANSDUCERS  
SENSE DELTA PRESSURE ACROSS EACH SERVO VALVE AND OUTPUT ELECTRICAL  
SIGNALS TO AVIONICS.

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

**NUMBER: 02-2A-011104- 03**

**REVISION#: 1 08/07/98**

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**LRU:**

**CRITICALITY OF THIS**

**ITEM NAME: SERVOVALVE, 4 CHANNEL**

**FAILURE MODE: 1R2**

**FAILURE MODE:**

ERONEOUS OUTPUT (UNDETECTED BY ASA)

**MISSION PHASE: DO DE-ORBIT**

<b>VEHICLE/PAYLOAD/KIT EFFECTIVITY:</b>	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**

<b>REDUNDANCY SCREEN</b>	A) PASS
	B) FAIL
	C) PASS

**PASS/FAIL RATIONALE:**

A)

B)

FAILS REDUNDANCY SCREEN "B" SINCE A FAILURE MAY NOT BE DETECTED BY ASA (ONE FAILED SERVOVALVE CHANNEL MAY NOT CREATE A STRONG ENOUGH FORCE FIGHT TO DEGRADE THE AEROSURFACES SUFFICIENTLY FOR DETECTION).

C)

**- FAILURE EFFECTS -**

**(A) SUBSYSTEM:**

POSSIBLE DEGRADATION IN AEROSURFACE PERFORMANCE. REDUCTION IN SERVOVALVE REDUNDANCY.

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**(B) INTERFACING SUBSYSTEM(S):**

NONE.

**(C) MISSION:**

NONE.

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

POSSIBLE LOSS OF MISSION, CREW/VEHICLE AFTER TWO UNDETECTED SERVOVALVE FAILURES - WHEN THE ERRONEOUS FAILURES ARE HARDOVER AND OPPOSITE IN POLARITY TO COMMAND (FORCE FIGHT BETWEEN TWO GOOD CHANNELS AND TWO ERRONEOUS CHANNELS).

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

SPOOL AND SLEEVE ARE 440C MATERIAL, HARDENED AND LAPPED FOR MATCHED SET. SPOOL GROOVED TO CLEAR SILTING. 35 MICRON FILTER UPSTREAM OF ORIFICES. 5 MICRON HYDRAULIC SYSTEM FILTRATION. SERVO VALVE IS PROTECTED BY 15 MICRON FILTER IN POWER VALVE MANIFOLD. 5 MICRON HYDRAULIC SYSTEM FILTRATION.

**(B) TEST:**

QUALIFICATION TESTS: POWER DRIVE UNIT (PDU) QUALIFICATION TEST THERMAL CYCLE (-40 DEG F TO +275 DEG F), FULL LIFE/LIMIT LOAD (400 MISSION DUTY CYCLES), RANDOM VIBRATION (20-2,000 HZ), PROOF PRESSURE (1.5 X OPERATING PRESSURE), ULTIMATE LOAD, 100,000 PRESSURE IMPULSE CYCLES (1.5 X OPERATING PRESSURE), BURST (2.5 X OPERATING PRESSURE AT +275 DEG F).

ACCEPTANCE TESTS: OPERATING HINGE MOMENT AND SURFACE, CHANNEL IMBALANCE, LOW RATE GAIN, LINEARITY AND FRICTION, FREQUENCY RESPONSE.

**GROUND TURNAROUND TEST**

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

**(C) INSPECTION:**

RECEIVING INSPECTION

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

NONDESTRUCTIVE EVALUATION  
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.

**(E) OPERATIONAL USE:**

NONE.

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**- APPROVALS -**

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EDITORIALLY APPROVED : BNA : J. Kumura 8-18-98  
TECHNICAL APPROVAL : VIA APPROVAL FORM : 95-CIL-009\_02-2A