

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE  
NUMBER: 02-2A-011101 -X**

**SUBSYSTEM NAME: FLIGHT CONTROL - RUDDER SPEED BRAKE**  
**REVISION: 2** 07/18/94

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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>
LRU	: POWER DRIVE UNIT ASSEMBLY	MC621-0053-0068
SRU	: SWITCHING VALVE	MC621-0073-0001

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
VALVE, SWITCHING (PRESSURE SELECTOR VALVE ASSEMBLY)

**REFERENCE DESIGNATORS:**

**QUANTITY OF LIKE ITEMS: 1**  
ONE

**FUNCTION:**  
PRIORITY TYPE, PRESSURE ACTUATED VALVE ACCEPTS THREE HYDRAULIC SYSTEM PRESSURES AND PROVIDES HYDRAULIC POWER TO THE CONTROL SERVOS FROM ANY ONE OF THE IN-TOLERANCE SYSTEMS IN ORDER OF PRIORITY. (PROVIDES ELECTRICAL OUTPUT SIGNAL TO INDICATE SPOOL POSITION).

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

**NUMBER: 02-2A-011101-01**

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

**SUBSYSTEM NAME: FLIGHT CONTROL MECH - RUDDER SPEED BRAKE & BF**

**LRU: POWER DRIVE UNIT ASSEMBLY**

**CRITICALITY OF THIS**

**ITEM NAME: SWITCHING VALVE**

**FAILURE MODE: 1R2**

**FAILURE MODE:**

FAILS TO SWITCH FROM SECOND STANDBY POSITION TO FIRST STANDBY OR PRIMARY POSITION

**MISSION PHASE: DO DE-ORBIT**

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

**CAUSE:**

CONTAMINATION, JAMMED, SECONDARY SPOOL

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO**

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

**PASS/FAIL RATIONALE:**

A)

B)

C)

**- FAILURE EFFECTS -**

**(A) SUBSYSTEM:**

NONE. LOSS OF PRIMARY AND FIRST STANDBY HYDRAULIC SYSTEM REDUNDANCY.

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

**(C) MISSION:**  
NONE

**(D) CREW, VEHICLE, AND ELEMENT(S):**  
POSSIBLE LOSS OF CREW/VEHICLE AFTER TWO FAILURES - SWITCHING VALVE SECONDARY SPOOL FAILS TO SWITCH OUT OF SECOND STANDBY POSITION AND FAILURE OF SECOND STANDBY HYDRAULIC SYSTEM, RESULTING IN LOSS OF RUDDER OR SPEEDBRAKE FUNCTIONS. THIS FAILURE MODE IS A FAILURE OF STANDBY REDUNDANCY.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**  
SPOOL/SLEEVE 440C MATERIAL, HARDENED AND LAPPED FOR MATCHED SET. SPOOL GROOVED TO CLEAR SILTING. FORCE DEVELOPED ON SPOOL IS IN EXCESS OF 1,000 LBS. FAILURE OF SECONDARY SWITCHING VALVE TO MOVE TO PROPER POSITION IS IMMEDIATELY DETECTABLE VIA POSITION SWITCHES. 5 MICRON HYDRAULIC SYSTEM FILTRATION FOR REMOVAL OF POTENTIALLY JAMMING CONTAMINANTS.

**(B) TEST:**  
QUALIFICATION: 20,000 SWITCHING CYCLES PERFORMED. ACTUATOR WAS VIBRATED TO FLIGHT LEVELS AND TESTED AT -65 AND 275 DEGREES F. 100,000 PRESSURE IMPULSE CYCLES AT EACH SUPPLY AND RETURN PORT, AT 230 DEGREES F. SUPPLY PORTS WERE CYCLED FROM 3,000 TO 4500 PSIG TO 1500 PSIG TO 0 PSIG, BACK TO 750 PSIG. VERIFIED THAT ALL PARTS WERE WITHIN ACCEPTABLE LIMITS DURING DISASSEMBLY AND INSPECTION AT COMPLETION OF QUALIFICATION.

ACCEPTANCE: FOUR SWITCHING VALVE CYCLES AT HIGH (MAIN PUMP) AND LOW (CIRCULATION PUMP) PRESSURES. PERFORMANCE TEST VERIFIES SWITCHING VALVE IS 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.

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**(C) INSPECTION:**

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATION 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. 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

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.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED.

**(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  
TECHNICAL APPROVAL

: BNA  
: VIA APPROVAL FORM

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: 95-CIL-009\_02-2A