

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**  
**NUMBER: 02-1B-023 -X**

**SUBSYSTEM NAME: LANDING/DECELERATION - BRAKE/SKID CONTROL SYS**  
**REVISION: 0 03/14/88**

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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>
	: BRAKE/SKID CONTROL	
LRU	: MLG BRAKE SYSTEM HYDRO-AIRE	MC621-0055 33-01727

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
SWITCHING VALVE

**QUANTITY OF LIKE ITEMS: 4**  
LEFT SIDE - TWO  
RIGHT SIDE - TWO

**FUNCTION:**  
PROVIDES A COMMON PRESSURE OUTLET AND SELECTS HYDRAULIC POWER SOURCE  
TO PROVIDE MODULE WITH OPERATING PRESSURE.

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

**NUMBER: 02-1B-023- 01**

**REVISION#: 1 12/20/96**

**SUBSYSTEM NAME: LANDING/DECELERATION - BRAKE/SKID CONTROL SYS**

**LRU: MLG BRAKE SYSTEM**

**CRITICALITY OF THIS**

**ITEM NAME: SWITCHING VALVE**

**FAILURE MODE: 1R2**

**FAILURE MODE:**

JAMMED BETWEEN DETENT - LOSS OF HYDAULIC FLUID FLOW TO SERVO VALVES.

**MISSION PHASE: DO DE-ORBIT**

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

**CAUSE:**

CONTAMINATION, PHYSICAL BINDING

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES**  
 TAL TRANS-ATLANTIC LANDING

**REDUNDANCY SCREEN**

- A) PASS
- B) FAIL
- C) PASS

**PASS/FAIL RATIONALE:**

A)

B)

FAILS SCREEN "B" BECAUSE THERE IS NO INDICATION OF THIS FAILURE UNTIL BRAKING IS APPLIED.

C)

**- FAILURE EFFECTS -**

**(A) SUBSYSTEM:**

LOSS OF HALF BRAKE PRESSURE COMMAND TO TWO BRAKES ON ONE STRUT. LOSS OF 25 PERCENT BRAKING CAPABILITY, EXTENDED ROLLOUT.

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

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SAME AS (A)

**(C) MISSION:**

NO EFFECT WITH FIRST FAILURE - SUFFICIENT BRAKING CAPABILITY (75%) REMAINS, WILL RESULT IN A LONGER ROLLOUT. PROBABLE LOSS OF MISSION/CREW/VEHICLE WITH A SECOND FAILURE (BRAKES, TIRES, WHEELS OR NWS) AS THAT WOULD CAUSE A FURTHER REDUCTION IN BRAKING CAPABILITY AND/OR LOSS OF DIRECTIONAL CONTROL - VEHICLE WILL DEPART RUNWAY.

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

SAME AS (C)

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

CRIT 1/1 FOR TAL ABORT SITES WITHOUT BARRIERS - THE THREE BRAKE HEATSINKS REMAINING WILL FAIL DURING ROLLOUT, DUE TO EXCEEDING THEIR MAXIMUM ENERGY CAPABILITY, AND CAUSE THE VEHICLE TO GO OFF THE END OF THE RUNWAY.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

THE BRAKE/SKID CONTROL MODULE IS DESIGNED TO BE A HIGH RESPONSE ELECTRO - HYDRAULIC PRESSURE CONTROL VALVE. IT IS DESIGNED AND FABRICATED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF MIL-H-5440, MIL-H-8775, AND MIL-V-5529. THE SWITCHING VALVE IS AN INTEGRAL PART OF THE BRAKE/SKID CONTROL MODULE, ALL MATING SURFACES ARE DESIGNED TO BE SUFFICIENTLY SMOOTH SO AS TO PRECLUDE BINDING. HYDRAULIC SYSTEM FILTER IS 5 MICRON ABSOLUTE AND IS SIZED TO FILTER THE BULK OF ANY CONTAMINANT(S). THE BRAKE/SKID CONTROL MODULE INLET FILTER IS A 5 MICRON NOMINAL AND 15 MICRON ABSOLUTE UNIT.

**(B) TEST:**

QUALIFICATION TEST: IMPULSE PRESSURE TESTING - PEAK PRESSURE 4500 PSI, FREQUENCY - 1 TO 3 HZ, MINIMUM PRESSURE 1500 PSI, TOTAL CYCLES-60,000, TEMPERATURE 200 DEG F FLUID, 275 DEG F AMBIENT. BURST PRESSURE TEST - 7500 PSIG FOR 3 TO 5 MINUTES - FLUID AND AMBIENT TEMPERATURE 275 DEG F. ENVIRONMENT TESTING INCLUDE; HUMIDITY, SALT FOG, VIBRATION ACCELERATION & SHOCK - TEST SPECIMEN ARE SUBJECTED TO FUNCTIONAL TESTS BEFORE AND AFTER EACH ENVIRONMENT TEST. EQUIPMENT NORMALLY OPERATING DURING EXPOSURE TO THESE ENVIRONMENTS ARE ALSO FUNCTIONALLY MONITORED DURING QUALIFICATION TESTING. THE BRAKE/SKID CONTROL SYSTEM IS SUBJECTED TO 10G UPWARD/7.5G DOWNWARD LANDING ACCELERATION IN THE VERTICAL AXIS AND 0.8 AFT/2G FORWARD IN THE LONGITUDINAL AXIS. THIS LANDING ACCELERATION IS MAINTAINED FOR A

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MINIMUM OF 5 MINUTES. HIGH TEMPERATURE TESTING IS PERFORMED ON ALL EQUIPMENT PER METHOD 501, PROCEDURE I, OF MIL-STD-810, TEST TEMP IS 275 DEGREES F. LOW TEMP TESTING IS CONDUCTED AT MINUS 80 DEGREES F AND MINUS 65 DEGREES F.

ACCEPTANCE TESTS ARE PERFORMED ON ALL UNITS DELIVERED FOR FUNCTIONAL USE THESE TESTS INCLUDE; COMPONENT FUNCTIONAL TESTS, PROOF PRESSURE TESTING AND FLUID CLEANLINESS. DURING ACCEPTANCE TESTING EACH UNIT IS SUBJECTED TO PROOF PRESSURE OF 4500 PSIG FOR 2 MINUTES. PASS CRITERIA IS NO EVIDENCE OF EXTERNAL LEAKAGE, DISTORTION, OR PERMANENT DEFORMATION.

OMRSD: FILTER DIFFERENTIAL PRESSURE INDICATION CHECKS; DURING THIS CHECK THE HYDRAULIC SYSTEM #1 FILTER IS CHECKED FOR CLEANLINESS (REPLACEMENT IS ACCOMPLISHED WHILE MAINTAINING CLEANLINESS TO LEVEL 190).

HYDRAULIC SWITCHING/CONTROL VALVES: THIS TEST CHECKS THE OPERATION OF THE SWITCHING VALVES BY SELECTING HYDRAULIC SYSTEMS, DEPRESSING THE BRAKE PEDALS AND VERIFYING THE BRAKE PRESSURE TO THE CORRESPONDING BRAKES.

FREQUENCY: ALL VEHICLES AT GROUND TURNAROUND.

**(C) INSPECTION:**

**RECEIVING INSPECTION**

MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION. RECEIVING INSPECTION VERIFIES FUNCTIONAL CHARACTERISTICS.

**CONTAMINATION CONTROL**

CONTAMINATION CONTROL AND CORROSION PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION.

**ASSEMBLY/INSTALLATION**

VALVE VISUALLY AND DIMENSIONALLY VERIFIED DURING FABRICATION. SEALS VERIFIED BY INSPECTION.

**CRITICAL PROCESSES**

EDM AND GRINDING ARE VERIFIED BY INSPECTION.

**NONDESTRUCTIVE EVALUATION**

INSPECTION VERIFIES X-RAY, PENETRANT, AND MAGNETIC PARTICLE INSPECTION OF VARIOUS PARTS.

**TESTING**

ACCEPTANCE TESTING INCLUDING PROOF PRESSURE FOR EXTERNAL LEAKS IS VERIFIED BY INSPECTION.

**PACKAGING/HANDLING**

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

**(D) FAILURE HISTORY:**

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NONE.

(E) OPERATIONAL USE:  
CREW CAN COMPENSATE EITHER BY CHANGING BRAKING PROCEDURE AND/OR USING  
NWS TO MAINTAIN DIRECTIONAL CONTROL.

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- APPROVALS -

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EDITORIALLY APPROVED : RI  
EDITORIALLY APPROVED : JSC  
TECHNICAL APPROVAL : VIA JSC

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:96-CIL-011