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PRINT DATE: 06/28/95

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

NUMBER: 02-1B-053 -X

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

REVISION: 1 11/28/94

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	<b>PART NAME VENDOR NAME</b>	<b>PART NUMBER VENDOR NUMBER</b>
	: SKID CONTROL	
SRU	: EXCITER RING HYDRO-AIRE	V070-510594-004 40-90120

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**PART DATA**

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
EXCITER RING - WHEEL SPEED SENSOR ASSEMBLY

**QUANTITY OF LIKE ITEMS: 4**  
ONE EACH WHEEL

**FUNCTION:**  
EXCITER RING AND RETAINER RING ASSEMBLY ROTATE RELATIVE TO THE COILS TO  
PROVIDE WHEEL SPEED INFORMATION.

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NUMBER: 02-1B-053 - 01

SUBSYSTEM NAME: LANDING/DECELERATION - BRAKE/SKID CONTROL SYS  
LRU: MLG BRAKE SYSTEM  
ITEM NAME: MLG BRAKE SYSTEM  
REVISION# 2 06/28/95  
CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:  
STRUCTURAL FAILURE

MISSION PHASE:  
DO DE-ORBIT

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

CAUSE:  
MECHANICAL SHOCK, VIBRATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS  
B) FAIL  
C) PASS

PASS/FAIL RATIONALE:  
A)

B)  
SCREEN "B" FAILS BECAUSE CREW DOES NOT HAVE SUFFICIENT TIME TO  
INITIATE CORRECTIVE ACTION FOLLOWING ANT-SKID LIGHT ANNUNCIATION.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:  
LOSS OF WHEEL SPEED SIGNAL FOR ALL BRAKE CHAMBERS ON ONE MAIN WHEEL.

(B) INTERFACING SUBSYSTEM(S):  
LOSS OF 25% OF TOTAL BRAKING CAPABILITY.

(C) MISSION:  
POSSIBLE LOSS OF MISSION/CREW/VEHICLE AFTER TWO FAILURES ON THE SAME SIDE.

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

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SAME AS (C)

(E) FUNCTIONAL CRITICALITY EFFECTS:

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-DISPOSITION RATIONALE-

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(A) DESIGN:

THE EXCITER RING WAS DESIGNED AND FABRICATED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF MIL-W-5013. WHEEL SPEED SENSOR IS DESIGNED TO OPERATE AFTER BEING SUBJECTED TO A SAWTOOTH SHOCK PULSE OF 50-G PEAK MAGNITUDE FOR A DURATION OF 10 TO 12 MILLISECONDS. DESIGN MINIMUM FACTOR OF SAFETY IS 1.4 FOR STANDARD MATERIAL ALLOWABLES.

(B) TEST:

QUALIFICATION TEST: ENVIRONMENTAL TESTING INCLUDES; HUMIDITY, SALT FOG, VIBRATION ACCELERATION AND 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. LANDING ACCELERATION: WHEEL SPEED SENSORS ARE SUBJECTED TO 20G UP AND DOWN IN THE VERTICAL AXIS AND 20G AFT AND FORWARD IN THE LONGITUDINAL AXIS. THIS LANDING ACCELERATION IS MAINTAINED FOR A MINIMUM OF 5 MINUTES.

THE FOLLOWING IS A SUMMARY OF THE QUALIFICATION TESTING/CERTIFICATION OF THE ANTI-SKID BOX TO SPEEDS GREATER THAN 180 KNOTS:

QUAL TEST OF THE ANTI-SKID OPERATION FOR ORBITER HIGH SPEED BRAKING APPLICATIONS UP TO 250 KNOTS WAS COMPLETED ON 9/30/94 USING THE HYDRO-AIRE'S SIMULATION FACILITIES. THIS INCLUDED DUPLICATION OF THE ORBITER'S HYDRAULIC LINE LENGTHS, AND USED AN ACTUAL ORBITER REGULATOR, PRESSURE BRAKE VALVE, AND STRUCTURAL CARBON BRAKES. THIRTY (30) DIFFERENT CONFIGURATIONS WERE ASSESSED E.G., STRUT LOADS OF 25, 40, 77, & 230 KLBS, BRAKING PRESSURES OF 600, 800, & 1200 PSI, MAXIMUM RUNWAY/TIRE BRAKING FRICTION OF 0.5 AND 0.3 AND INITIAL VELOCITY OF 225 & 250 KNOTS. THE TESTS PROVED THE ANTI-SKID CONTROL BOX WILL PREVENT WHEEL LOCK UP DURING BRAKING AT THESE HIGHER SPEEDS. THE TESTS/SIMULATION DID NOT SHOW ANY SIGNS OF GEAR INSTABILITY. HOWEVER, AT LIGHT GEAR LOADS, DURING HIGH ANGLE OF ATTACK, IF BRAKE PRESSURE IS APPLIED TOO RAPIDLY, THERE WILL BE SIGNIFICANT ANTI-SKID ACTIVITY TO REMOVE EFFECTIVE BRAKING FOR ONE (1) TO TWO (2) SECONDS. ENOUGH SLIPPAGE OF THE TIRE COULD OCCUR TO CAUSE SOME ADDITIONAL TIRE WEAR, BUT NOT AS MUCH AS SPIN UP WEAR AT TOUCHDOWN. BASED ON THE RESULTS OF THESE QUAL TESTS THE ANTI-SKID CONTROL BOX IS CERTIFIED TO THE HIGHER SPEED OF 225 KNOTS, WHICH IS 45 KNOTS ABOVE THE PREVIOUS LIMIT OF 180 KNOTS.

ACCEPTANCE TEST INCLUDE VERIFICATION THAT CERTIFIED MATERIALS AND PROCESSES WERE USED. ACCEPTANCE TESTS ALSO VERIFIES DIMENSIONS, WEIGHTS, FINISH, CONSTRUCTION AND CLEANLINESS.

GROUND TURNAROUND TEST:

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

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(C) INSPECTION:

RECEIVING INSPECTION

MATERIALS AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS AND CORROSION PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

DESIGNATED SHUTTLE PROJECT FABRICATION AREA VERIFIED BY INSPECTION ACCEPTABLE PRIOR TO FABRICATION. FABRICATION IS CONTROLLED BY SEQUENCE AND VERIFIED BY INSPECTION.

CRITICAL PROCESSES

NICKEL PLATING PER HYDRO-AIRE SPECIFICATION HS35, TYPE I IS VERIFIED BY INSPECTION.

TESTING

ATP IS VERIFIED BY INSPECTION.

PACKAGING/HANDLING

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION

(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 DATABASE.

(E) OPERATIONAL USE:

CREW CAN COMPENSATE EITHER BY CHANGING BRAKING PROCEDURE AND/OR USE OF NWS TO MAINTAIN DIRECTIONAL CONTROL.

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- APPROVALS -

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EDITORIALLY APPROVED

: RI

EDITORIALLY APPROVED

: JSC

TECHNICAL APPROVAL

: VIA CR

: *[Signature]*  
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