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PRINT DATE: 09/07/93

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: 02-1B-022-X**

**SUBSYSTEM NAME: LANDING/DECELERATION - BRAKE/SKID CONTROL SYS
REVISION: 5 08/20/93**

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: MLG BRAKE SYSTEM	MC621-0055
SRU	: LIMITER, DISPLACEMENT HYDRO-AIRE	33-017502

PART DATA

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
DISPLACEMENT LIMITER**

**QUANTITY OF LIKE ITEMS: 8
LEFT SIDE FOUR,
RIGHT SIDE FOUR**

**FUNCTION:
LIMITS LOSS OF HYDRAULIC FLUID IN THE EVENT OF A BRAKE LINE OR CHAMBER
FAILURE AT BRAKE PORT WITH WHICH IT IS ASSOCIATED.**

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**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE
NUMBER: 02-1B-022-01**

REVISION: 5 08/20/93 R
SUBSYSTEM NAME: LANDING/DECELERATION - BRAKE/SKID CONTROL SYS
LRU: MLG BRAKE SYSTEM
ITEM NAME: LIMITER, DISPLACEMENT
CRITICALITY OF THIS
FAILURE MODE: 1R3

FAILURE MODE:
FAILS TO CLOSE

MISSION PHASE:
DO DE-ORBIT

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

CAUSE:
PISTON JAMMED, ORIFICE ASSEMBLY PLUGGED, CONTAMINATION

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 DISPLACEMENT LIMITER FAILING TO CLOSE IS NOT
DETECTABLE WITHOUT ANOTHER FAILURE.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
FIRST FAILURE - NO EFFECT

(B) INTERFACING SUBSYSTEM(S):
FIRST FAILURE - NO EFFECT

(C) MISSION:
FIRST FAILURE - NO EFFECT

(D) CREW, VEHICLE, AND ELEMENT(S):
FIRST FAILURE - NO EFFECT

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(E) FUNCTIONAL CRITICALITY EFFECTS:

IF DISPLACEMENT LIMITER FAILED TO CLOSE AFTER A DOWNSTREAM HOSE/LINE RUPTURED, HYDRAULIC FLUID WILL DRAIN OUT THROUGH THE OPENING, AFTER MAIN GEAR TOUCHDOWN, CAUSING LOSS OF TWO HYDRAULIC SYSTEMS (1 & 3 OR 2 & 3). THIS WILL RESULT IN LOSS OF 50% BRAKING CAPABILITY.

CASE 1: POSSIBLE LOSS OF CREW/VEHICLE AFTER THE THIRD FAILURE (LOSS OF THE THIRD HYDRAULIC SYSTEMS) DUE TO INABILITY TO STOP THE VEHICLE AND PROVIDE DIRECTIONAL CONTROL.

CASE 2: POSSIBLE LOSS OF CREW/VEHICLE AFTER LOSS OF NOSE WHEEL STEERING AND ADDITIONAL DISPLACEMENT LIMITER FAILURE DUE TO INABILITY TO PROVIDE DIRECTIONAL CONTROL RESULTING IN VEHICLE DEPARTURE OF RUNWAY.

-DISPOSITION RATIONALE-

(A) DESIGN:

THE BRAKE DISPLACEMENT LIMITER IS MOUNTED ON THE BRAKE/SKID CONTROL VALVE, BRAKE PRESSURE PORT. IT IS DESIGNED TO PROVIDE ADEQUATE HYDRAULIC FLUID FOR BOTH NEW AND WORN BRAKE CAVITY DISPLACEMENT. THE BRAKE DISPLACEMENT LIMITER LIMITS FLUID LOSS (30 CU. IN., PLUS OR MINUS 3 CU. IN.) FROM THE HYDRAULIC SYSTEM, IN ACCORDANCE WITH MIL-F-5508, IN THE EVENT OF DOWN STREAM FAILURE. IT PROVIDES THIS PROTECTION WITHOUT INTERFERENCE WITH NORMAL BRAKING FUNCTIONS. HYDRAULIC SYSTEM FILTER IS 5 MICRON ABSOLUTE AND IS SIZED TO FILTER THE BULK OF ANY CONTAMINANT(S). THE BRAKE/SKID CONTROL MODULE HAS A 40 MICRON INTERNAL FILTER UNIT. ALL COMPONENTS ARE MADE OF EITHER ALUMINUM OR STAINLESS STEEL. INTERNAL SURFACES PROVIDING THE DISPLACEMENT LIMITER FUNCTION ARE TOTALLY IMMERSSED IN MIL-H-83282 HYDRAULIC FLUID WHICH PROVIDES ITS OWN CORROSION PROTECTION BARRIER. ALL PACKINGS AND GASKETS ARE CONSTRUCTED OF TEFLON AND RUBBER PER MS 28782, MS 28783, AND MS 28775.

(B) TEST:

QUALIFICATION TEST INCLUDES ENVIRONMENT TESTING: HUMIDITY, SALT FOG, VIBRATION, ACCELERATION & SHOCK, HIGH TEMPERATURE AND LOW TEMPERATURE (PER MC621-0055 SPEC) - TEST SPECIMENS 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.

ACCEPTANCE TESTING: EACH UNIT IS SUBJECTED TO PROOF PRESSURE TEST OF 4500 PSI FOR 2 MINUTES. PASS CRITERIA IS NO EVIDENCE OF EXTERNAL LEAKAGE, DISTORTION, OR PERMANENT DEFORMATION, IN EITHER THE OPEN OR CLOSED POSITION, AFTER THERMAL STABILIZATION AT 275 DEG F. BURST PRESSURE TEST - 7500 PSIG FOR 3 TO 5 MINUTES - FLUID AND AMBIENT TEMPERATURE 275 DEG F. EACH DISPLACEMENT LIMITER IS ALSO SUBJECTED TO THE INTERNAL LEAKAGE TEST WITH PRESSURE APPLIED AT 1500 PSI FOR 3 MINUTES. PASS CRITERIA IS LEAKAGE NOT TO EXCEED ONE DROP DURING THE LAST 1 MINUTE. THE PROCEDURE IS REPEATED AT 40 PSI (LEAKAGE NOT TO EXCEED 1 CC DURING LAST MINUTE.) FLOW CAPACITY IS VERIFIED AT .40 GPM AND SHOULD BE LIMITED TO BETWEEN 492 CC AND 984 CC.

GROUND TURNAROUND TEST

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DISPLACEMENT LIMITERS ARE BEING VERIFIED FUNCTIONALLY VIA "BRAKE HYD DISPLACEMENT LIMITER CK" BY APPLYING BRAKE PRESSURE, ALLOWING HYDRAULIC FLUID TO FLOW, AND DETERMINING VOLUME OF FLUID EXPELLED BEFORE LIMITER STOPS FLUID FLOW. TESTS ARE PERFORMED EVERY FLIGHT AND AFTER LRU REPLACEMENT PER TABLE V58Z00.000. HYDRAULIC SYSTEMS ARE ALSO VERIFIED CLEAN PER OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION:

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

CONTAMINATION CONTROL

ACCEPTANCE CONTAMINATION LIMIT IS VERIFIED VIA INSPECTION.

ASSEMBLY/INSTALLATION

DISPLACEMENT LIMITERS ARE VISUALLY AND DIMENSIONALLY VERIFIED DURING FABRICATION.

TESTING

ACCEPTANCE TESTING IS VERIFIED BY INSPECTION.

PACKAGING/HANDLING

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

NONE

(E) OPERATIONAL USE:

NONE

- APPROVALS -

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

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