

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE  
NUMBER: 02-6-G02-IM -X**

**SUBSYSTEM NAME: HYDRAULICS**

**REVISION: 3 07/24/98**

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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	VALVE, LANDING GEAR CONTROL	MC621-0029-0005

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

VALVE, LANDING GEAR CONTROL (EXTEND VALVE 1), SINGLE SOLENOID OPERATED 2 POSITION/3 WAY

**REFERENCE DESIGNATORS: 67V58LV11**

**QUANTITY OF LIKE ITEMS: 1**

**ONE IN HYDRAULIC POWER SYSTEM 1 EXTEND SIDE OF THE LANDING GEAR CIRCUIT**

**FUNCTION:**

CONTROLS POWER SYSTEM ONE IN THE LANDING GEAR CIRCUIT. ON "ARM AND DOWN" COMMANDS IT (LV11) DIRECTS PRESSURE TO THE MAIN LANDING GEAR UPLOCK AND STRUT ACTUATORS. IT ALSO DIRECTS PRESSURE TO THE NOSE LANDING GEAR UPLOCK AND STRUT ACTUATORS WHEN THE LANDING GEAR SWITCHING VALVE IS IN THE PRIMARY POSITION. WHEN THE VALVE IS CLOSED (DE-ENERGIZED), THE LANDING GEAR CIRCUIT IS VENTED TO RETURN 1 AND ISOLATED FROM SUPPLY PRESSURE. HYDRAULIC PRESSURE AND SOLENOID POWER ARE REQUIRED TO OPEN VALVE. WHEN VALVE IS OPEN (ENERGIZED) SUPPLY PRESSURE 1 IS PROVIDED TO THE LANDING GEAR CIRCUIT.

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SUBSYSTEM NAME: HYDRAULICS

LRU: VALVE, LANDING GEAR CONTROL

ITEM NAME: VALVE, LANDING GEAR CONTROL

CRITICALITY OF THIS  
FAILURE MODE: 1R2

## FAILURE MODE:

FAILS TO TRANSFER (STAYS CLOSED) UPON "ARM AND DOWN" COMMANDS

MISSION PHASE: DO DE-ORBIT

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

## CAUSE:

DEFECTIVE SOLENOID, JAMMED SPOOL (CONTAMINATION), FRACTURED SOLENOID VALVE PLUNGER

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN	A) PASS
	B) PASS
	C) PASS

## PASS/FAIL RATIONALE:

A)

B)

DETECTABLE LESS THAN 20 SECONDS PRIOR TO TOUCHDOWN. THIS IS INSUFFICIENT TIME TO REACT AND NO WORK AROUND EXISTS; HOWEVER, AN AUTOMATIC BACKUP EXISTS (PYROTECHNIC DEPLOY).

C)

## - FAILURE EFFECTS -

(A) SUBSYSTEM:

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LOSS OF HYDRAULIC POWER SYSTEM NUMBER ONE TO THE MAIN LANDING GEAR CIRCUIT. LOSS OF HYDRAULIC POWER REDUNDANCY TO THE NOSE LANDING GEAR CIRCUIT AND NOSE WHEEL STEERING

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

LOSS OF HYDRAULIC MAIN LANDING GEAR DEPLOYMENT (PYROTECHNIC BACKUP EXISTS)

**(C) MISSION:**

NO EFFECT

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

NO EFFECT

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

POSSIBLE LOSS OF CREW/VEHICLE DUE TO INABILITY TO DEPLOY MAIN LANDING GEAR AFTER TWO FAILURES THIS FAILURE PLUS FAILURE OF PYROTECHNIC DEPLOY BACKUP TO RELEASE GEAR.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

SUPPLIER STANDARD BALL TYPE DESIGN IS USED ON A VARIETY OF PROPRIETARY PILOT OPERATED FLUID CONTROLS FOR AIRCRAFT AND INDUSTRIAL APPLICATIONS. OVER 50,000 PILOT VALVE UNITS BUILT. SOLENOID COIL HERMETICALLY SEALED, ISOLATING IT FROM THE HYDRAULIC FLUID. PLUNGER IS 440C CRES. HYDRAULIC SYSTEM FILTER IS 5 MICRON NOMINAL, 15 MICRON ABSOLUTE.

**(B) TEST:**

**QUALIFICATION:**

ENDURANCE CYCLING TEST - 20,000 CYCLES AT RATED FLOW AND PRESSURE. 8,000 AT 35 DEG F, 2,000 AT 0 DEG F AND 10,000 AT 275 DEG F WITH A RATE OF 6 CYCLES/MINUTE

IMPULSE CYCLING TEST - 50,000 IMPULSE CYCLES AT 3,000-4,500-3,000 PSI AT 2 HZ.

BURST PRESSURE TEST - TESTED AT 7,500 PSI.

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**ACCEPTANCE:**

PROOF PRESSURE TEST - TESTED AT 4,500 PSIG PRESSURE PORT ONLY; 4,500 PSIG CYLINDER AND PRESSURE PORT; 2,250 PSIG RETURN PORT ONLY. PASS/FAIL CRITERIA: NO EXTERNAL LEAKAGE OR PERMANENT DEFORMATION.

**PERFORMANCE RECORD TEST:**

ELECTRICAL POWER TEST - 70 DEG F COIL TEMPERATURE, 24, 28, AND 32 VDC APPLIED TO COIL. PASS/FAIL CRITERIA: 0.714 AMPS AT 28 VDC (20 WATTS).

LOW VOLTAGE TEST - 3,000 PSIG AT PRESSURE PORT. PASS/FAIL CRITERIA: PULL-IN VOLTAGE SHALL NOT EXCEED 18 VDC, DROP-OUT VOLTAGE SHALL NOT EXCEED 3 VDC.

VALVE ACTUATION TEST - 100 PSIG AT PRESSURE PORT, SOLENOID ENERGIZED WITH 28 VDC THEN TO 0 VDC. PASS/FAIL CRITERIA: VALVE MUST ACTUATE WHEN ENERGIZED AND RETURN TO OFF POSITION WHEN DE-ENERGIZED.

RESPONSE TIME TEST - 2,400 PSIG AT PRESSURE PORT, SOLENOID ENERGIZED WITH 28 VDC THEN TO 0 VDC. PASS/FAIL CRITERIA: OPENING/CLOSING TIMES SHALL NOT EXCEED 0.10 SECONDS.

CLEANLINESS TEST - CLEANLINESS LEVEL OF 190 PER MA0110-301.

**GROUND TURNAROUND TEST**

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD

**(C) INSPECTION:**

**RECEIVING INSPECTION**

RECEIVING INSPECTION VERIFIES MATERIAL AND PROCESS CERTIFICATIONS (RAW MATERIAL, PLATING AND COATING). PROCURED PARTS ARE VERIFIED AT RECEIVING INSPECTION.

**CONTAMINATION CONTROL**

CLEANLINESS IS VERIFIED BY INSPECTION TO BE WITHIN SPECIFICATION REQUIREMENTS PER MA0110-301, LEVEL 190. CLEANLINESS OF SOLENOID IS VERIFIED BY INSPECTION TO BE WITHIN SPECIFICATION REQUIREMENTS. CLEANLINESS OF TEST FLUID USED DURING ACCEPTANCE TESTING IS VERIFIED BY INSPECTION TO BE WITHIN SPECIFICATION REQUIREMENTS.

**CRITICAL PROCESSES**

SURFACE TREATMENT (PASSIVATION) IS VERIFIED BY INSPECTION. HEAT TREATMENT AND SOLDERING ARE VERIFIED BY INSPECTION.

**ASSEMBLY/INSTALLATION**

SOLENOID BUILD-UP, IN-PROCESS TESTING, AND COMPLETED SOLENOID ASSEMBLY VERIFIED BY INSPECTION. CRITICAL DIMENSIONS VERIFIED BY INSPECTION.

**TESTING**

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ACCEPTANCE TESTS (PROOF PRESSURE, LEAKAGE, DIELECTRIC WITHSTANDING VOLTAGE, INSULATION RESISTANCE FUNCTIONS) ARE VERIFIED BY INSPECTION

HANDLING/PACKAGING  
HANDLING AND STORAGE OF COMPONENTS TO PREVENT EXTERNAL DAMAGE IS 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 DATA BASE. THE FAILURE HISTORY DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE.

(AB7781-010) (1980) VALVE FAILED TO OPEN DURING USE ON FLIGHT CONTROL HYDRAULICS LABORATORY (FCHL). PILOT SECTION PLUNGER FRACTURED FROM HIGH IMPACT LOADS. COMPRESSION SPRING REMOVED AND SOLID SHIM ADDED TO MINIMIZE FORCES. ALL VALVES WERE CHANGED.

**(E) OPERATIONAL USE:  
NONE**

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- APPROVALS -

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EDITORIALLY APPROVED  
TECHNICAL APPROVAL

: BNA  
: VIA APPROVAL FORM

*J. Kemura 7-30-98*  
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