

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: 04-2-LV14-X**

SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)

REVISION: 4 08/09/93

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: AUXILIARY POWER UNIT (APU) SUNDSTRAND	MC201-0001-02XX 729867XX/754949
LRU	: AUXILIARY POWER UNIT (APU) SUNDSTRAND	MC201-0001-03XX 729867XX/754949A
LRU	: AUXILIARY POWER UNIT (APU) SUNDSTRAND	MC201-0001-04XX X742211X
SRU	: SOLENOID VALVE, GN2 SUNDSTRAND	5902556 SAME

PART DATA

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SOLENOID VALVE, GN2**

**QUANTITY OF LIKE ITEMS: 3
ONE PER APU**

**FUNCTION:
PROVIDES GN2 TO PRESSURIZE LUBE OIL IN THE GEAR BOX IF GEAR BOX PRESSURE
DROPS BELOW 4 PSIA.**

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE
NUMBER: 04-2-LV14-01**

REVISION: 4 08/08/93

SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)

LRU: AUXILIARY POWER UNIT (APU)

ITEM NAME: SOLENOID VALVE, GN2

CRITICALITY OF THIS
FAILURE MODE: 1R3

FAILURE MODE:
FAILS CLOSED

MISSION PHASE:

PL PRELAUNCH
LO LIFT-OFF
OO ON-ORBIT
DO DE-ORBIT
LS LANDING SAFING

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

CAUSE:
OPEN COIL, LOSS OF ELECTRICAL SIGNAL, JAMMED.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:

A)

B)

COULD FAIL IN FLIGHT AND NOT BE DETECTED UNLESS GEARBOX PRESSURE DROPPED BELOW 4 PSIA.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF GEARBOX REPRESSURIZATION CAPABILITY FOR ONE APU. THIS HAS NO EFFECT UNLESS GEARBOX PRESSURE HAS DECAYED BELOW 4 PSIA. IF PRESSURE HAS DECAYED, APU MAY NOT RESTART.

(B) INTERFACING SUBSYSTEM(S):

FIRST FAILURE - NO EFFECT. SECOND FAILURE - GEARBOX LEAK WOULD CAUSE LOSS OF APU AND ASSOCIATED HYDRAULIC SYSTEM FOR REENTRY.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE
NUMBER: 04-2-LV14-01**

(C) MISSION:
NONE

(D) CREW, VEHICLE, AND ELEMENT(S):
FIRST FAILURE - NO EFFECT. SECOND APU OR HYDRAULIC SYSTEM FAILURE MAY CAUSE LOSS OF VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:
FIRST FAILURE - NO EFFECT.
SECOND FAILURE - GEARBOX LEAKAGE WOULD RESULT IN LOSS OF ONE APU (REF. FMEA 04-2-GT11-02).
THIRD FAILURE - LOSS OF A SECOND APU WOULD CAUSE POSSIBLE LOSS OF VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE VALVE IS AN OFF-THE-SHELF DESIGN PURCHASED BY SUNDSTRAND FROM WRIGHT AND IS SIMILAR TO DESIGN USED EXTENSIVELY IN AIRCRAFT APPLICATIONS.

(B) TEST:
ACCEPTANCE TESTED PRIOR TO INSTALLATION ON APU. ACCEPTANCE TESTED WITH ASSEMBLED APU.

QUALIFIED AS PART OF APU.

CERTIFICATION TESTS CONDUCTED WERE - 27 MISSION DUTY CYCLES, 41.7 HR, INCLUDING VIBRATION. IMPROVED APU OPERATED 374 HR WITH ONE VALVE.

OMRSD: A REQUIREMENT FOR TESTING THE GEARBOX GN2 PRESSURIZATION SOLENOID VALVE BY CREATING A LOW GEARBOX PRESSURE STIMULUS IS PERFORMED EVERY FIVE FLIGHTS WHICH IS CONSIDERED ADEQUATE. THE OMRSD REQUIREMENT FOR THIS COMPONENT IS CONSIDERED AN INVASIVE TEST BECAUSE IT REQUIRES REMOVAL OF THE APU INSULATION (WHICH IS DESTRUCTIVE TO THE INSULATION), AND DESERVICING AND RESERVICING OF THE APU GEARBOX PRESSURIZATION SYSTEM EACH TIME THE REQUIREMENT IS PERFORMED.

(C) INSPECTION:
RECEIVING INSPECTION
MATERIAL AND PROCESSES CERTIFICATIONS ARE VERIFIED. PARTS PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS TO LEVEL 100 IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MANUFACTURING, ASSEMBLY, AND INSTALLATION REQUIREMENTS ARE VERIFIED BY INSPECTION. ELECTRICAL BOND IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION IS VERIFIED BY INSPECTION.

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE
NUMBER: 04-2-LV14-01

CRITICAL PROCESSES
SOLDERING IS VERIFIED BY INSPECTION.

TESTING
ATP IS WITNESSED AND VERIFIED BY INSPECTION. PROOF AND LEAK TESTS ARE
VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING, PACKAGING, STORAGE, AND SHIPPING PROCEDURES ARE VERIFIED.

(D) FAILURE HISTORY:
FAILURE DURING OV-102 CHECKOUT, A TEARDOWN ANALYSIS OF ANOTHER VALVE
THAT HAD AN INTERMITTENT OPEN DURING VIBRATION TESTING OF APU S/N 201,
SHOWED POTTING COMPOUND CONTAMINATION AT THE CONNECTOR CAP TO VALVE
BODY JOINT AREA AND PREVENTED PROPER WETTING AND BONDING. STRICTER
POTTING CONTROL HAS BEEN IMPLEMENTED AND NO FLIGHT FAILURES HAVE
OCCURRED.

(E) OPERATIONAL USE:
ATTEMPT TO START APU WITH LOW GEAR BOX PRESSURE IF NECESSARY.

- APPROVALS -

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

John 9/8/93
John 9/17/93
: S50870L