

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE  
 NUMBER: 04-2-FL12-X

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SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)

REVISION : 3 02/19/91

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ LRU	AUXILIARY POWER UNIT (APU)	MC201-2001-02XX
■	SUNOSTRAND	729867XX/754949
■ LRU	AUXILIARY POWER UNIT (APU)	MC201-2001-03XX
■	SUNOSTRAND	729867XX/754949
■ LRU	AUXILIARY POWER UNIT (APU)	MC201-2001-04XX
■	SUNOSTRAND	742211
■ SRU	FILTER	590446
■	WINTEC	SAME
■ SRU	FILTER	5904883
■	PURGLATOR	SAME

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 PART DATA  
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- EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
 FILTER, HIGH PRESSURE FUEL FEEDLINE

- QUANTITY OF LIKE ITEMS: 3  
 ONE PER APU

- FUNCTION:  
 TO COLLECT CONTAMINANTS IN FUEL AND PREVENT THEM FROM CAUSING FAILURE IN  
 DOWNSTREAM COMPONENTS. NOTE: REPLACEABLE PART OF FUEL PUMP (OUTLET).

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SUBSYSTEM: AUXILIARY POWER UNIT (APU)  
LRU :AUXILIARY POWER UNIT (APU)  
ITEM NAME: FILTER

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CRITICALITY OF THIS  
FAILURE MODE:R2

■ FAILURE MODE:  
OPEN (FACLS TO FILTER)

MISSION PHASE:

PL PRELAUNCH  
LO LIFT-OFF  
SO DE-ORBIT  
LS LANDING SAFING

■ VEHICLE/PAYLOAD/KIT EFFECTIVITY: 100 COLUMBIA  
: 100 DISCOVERY  
: 101 ATLANTIS  
: 100 ENDERVOUR

■ CAUSE:  
MATERIAL DEFECT

■ CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES  
ADA ABORT ONCE AROUND  
ATO ABORT TO ORBIT  
RTLS RETURN TO LAUNCH SITE  
TAL TRANS ATLANTIC ABORT

■ REDUNDANCY SCREEN A) FAIL  
■ B) FAIL  
■ C) PASS

PASS/FAIL RATIONALE:

- A)  
INSPECTION OF THE FILTER WOULD REQUIRE DISMANTLING THE APU FUEL PUMP.
- B)  
THE EFFECTS ARE READILY DETECTABLE; HOWEVER, IT WOULD BE IMPOSSIBLE TO ISOLATE THIS FAILURE MODE AS THE CAUSE DUE TO MULTIPLE FAILURE MODES WHICH CAUSE THE SAME EFFECT.
- C)

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- FAILURE EFFECTS -

- (A) SUBSYSTEM:  
PARTICULATE CONTAMINATES COULD CAUSE BEAM PO VALVE TO LEAK AT OUTPUT (CAUSING APU TO GO TO SECONDARY SPEED WITH SHUTOFF) OR LEAK TO BEAM (CAUSING APU TO SHUT DOWN).
- (B) INTERFACING SUBSYSTEM(S):  
NO EFFECT OF APL CONTROLS AT SECONDARY SPEED.
- (C) MISSION:  
POSSIBLE MISSION ABORT BECAUSE OF LOSS OF REDUNDANCY.
- (D) CREW, VEHICLE, AND ELEMENT(S): *NO EFFECT UNLESS SECOND APU LOSS*  
~~NO EFFECT UNLESS DAMAGE OCCURRED TO SHUT OFF VALVE AND CAUSES APU TO OVERSPEED. IF OVERSPEED OCCURS, POSSIBLE LOSS OF OPERATIONAL LIFE OF APU COULD BE SHUT DOWN DUE TO AUTO CLOSING OF THE ISOLATION VALVES.~~
- (E) FUNCTIONAL CRITICALITY EFFECTS:  
SAME AS (D).

- DISPOSITION RATIONALE -

- (A) DESIGN:  
5900448 (WINTEC) - THE FILTER RATING IS 10-MICRON NOMINAL, 25-MICRON ABSOLUTE. THE PRESSURE DROP IS 5 PSID AT RATED FLOW (1.5 GPM) (FLOW DIRECTION IS FROM INSIDE TO OUTSIDE).  
  
THE FILTER CAPACITY IS 0.9 GRAMS AC COARSE DUST WITH A MAXIMUM PRESSURE DROP OF 50 PSID AT RATED FLOW (EST).  
  
THE FILTER ELEMENT COLLAPSE PRESSURE IS 1300 PSID. THE FILTER IS DESIGNED FOR HYDRAZINE (MIL-P-26536C) SERVICE AT TEMPERATURES OF 45 TO 200 DEG F, NONOPERATING AND 45 TO 300 DEG F OPERATING.  
  
5904683 (PURGLATOR TECHNOLOGIES) - THE PERFORMANCE CHARACTERISTICS ARE THE SAME AS THE OTHER EXCEPT THAT THIS UNIT USES A SINTERED FILTER ELEMENT RATHER THAN THE WIRE CLOTH.  
  
THE SINTERED ELEMENT ALLOWS GAS TO PASS THROUGH THE PORES AT A LOWER PRESSURE ELIMINATING THE "BUBBLE TRAP" THAT CAUSED ERRATIC CHAMBER PRESSURE TO OCCUR WHEN THE TRAPPED BUBBLE WAS RELEASED DURING APU OPERATION.

Loss of one APU during powered flight will result in the associated SSME going into hydraulic lock-up and could result in loss of orbit capability of the cataphoric (with additional SSME valve failure) (see flight data 10-19)

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OVERSPEED SAFETY CIRCUITS WILL CLOSE TANK ISOLATION VALVES AUTOMATICALLY IN THE EVENT OF AN OVERSPEED/UNDERSPEED CONDITION.

## ■ (B) TEST:

CERTIFICATION TESTS CONDUCTED ARE 27 MISSION DUTY CYCLES, THERMAL VACUUM, BENCH SHOCK, FOR A TOTAL OF 407 HR OPERATION INCLUDING VIBRATIONS.

OMRSD: NONE. AS THE HIGH PRESSURE FUEL FILTER IS A COMPONENT INTERNAL TO THE APU FUEL PUMP, DIRECT OMRSD TESTING WOULD REQUIRE DISASSEMBLY OF THE FUEL PUMP WHICH IS ILLOGICAL AND INVASIVE.

## ■ (C) INSPECTION:

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO LEVEL 100 IS VERIFIED BY INSPECTION. FLUID SAMPLES ARE INSPECTED FOR CONTAMINATION. ULTRASONIC CLEANING IS VERIFIED BY INSPECTION. CORROSION PROTECTION IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

BURR INSPECTION IS VERIFIED BY INSPECTION. MANUFACTURING, ASSEMBLY, AND INSTALLATION PROVISIONS ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

BUBBLE TEST IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

WELDING PER SPECIFICATION REQUIREMENTS IS VERIFIED BY INSPECTION. SINTERING OF PUROLATOR FILTER ELEMENT PER SPECIFICATION REQUIREMENTS IS VERIFIED BY INSPECTION.

TESTING

TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. ATP IS WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE, AND SHIPPING PROCEDURES ARE VERIFIED BY INSPECTION.

## ■ (D) FAILURE HISTORY:

NO FAILURES

## ■ (E) OPERATIONAL USE:

NONE

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- APPROVALS -

RELIABILITY ENGINEERING : D. R. STAPLE  
DESIGN ENGINEERING : J. P. MURPHY  
QUALITY ENGINEERING : D. L. BUTNER  
NASA RELIABILITY :  
NASA SUBSYSTEM MANAGER :  
NASA QUALITY ASSURANCE :

*Robert E. Smith*  
*J.P. Murphy* 3/2/91  
*D.L. Butner* 3/2/91  
*W. Smith* 3/2/91  
*3/2/91*  
*For use FOR D. ENGELSKES, AM. SPACE CO., 8/19/91, 132*  
*W. Smith for W. Smith 6-10-91*  
*J.P. Murphy*