

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 04-2-L4-X

SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)

REVISION : 0 01/05/89 W

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	DUCT, TURBINE EXHAUST	MC271-0080-0941 1808504
LRU :	DUCT, TURBINE EXHAUST	MC271-0080-0942 1808505
LRU :	DUCT, TURBINE EXHAUST	MC271-0080-0943 1808506

QUANTITY OF LIKE ITEMS: 3
ONE PER APU

DESCRIPTION/FUNCTION:
DIRECTS APU EXHAUST PRODUCTS OVERBOARD.

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SUMMARY

SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)
LRU DUCT, TURBINE EXHAUST

ITEM NAME: DUCT, TURBINE EXHAUST

FMEA NUMBER	ABBREVIATED FAILURE MODE DESCRIPTION	CIL PLG	CRIT	REN FL
04-2-L4-11	EXTERNAL LEAKAGE	X	1 1	

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 04-2-L4-11

SUBSYSTEM: AUXILIARY POWER UNIT (APU)
 LRU DUCT, TURBINE EXHAUST
 ITEM NAME: DUCT, TURBINE EXHAUST

REVISION: 0 01/05/99 W

CRITICALITY OF THIS
 FAILURE MODE: 1 1

 FAILURE MODE:
 EXTERNAL LEAKAGE

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

CAUSE:
 RUPTURE, SEAL OR WELDED-JOINT FAILURE, BELLOWS FAILURE, LEAKAGE OF
 EXHAUST PRESSURE AND TEMPERATURE PORTS.

CRITICALITY 1/1 DURING INTACT ABORT ONLY?

REDUNDANCY SCREEN A) N/A
 B) N/A
 C) N/A

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
 NO EFFECT ON APU OPERATION.

(B) INTERFACING SUBSYSTEM(S):
 AFT COMPARTMENT IS EXPOSED TO HOT EXHAUST PRODUCTS. HEAT MAY DAMAGE
 SURROUNDING HARDWARE.

(C) MISSION:

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NO EFFECT UNLESS DETECTED OR FAILURE PROPAGATES.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE DUE TO FIRE, EXPLOSION OR ADJACENT
EQUIPMENT DAMAGE CAUSING CRITICAL FAILURE MODES.

(E) FUNCTIONAL CRITICALITY EFFECTS
NONE

- DISPOSITION RATIONALE -

(A) DESIGN:
SEALS AT INTERFACE FLANGE WITH APU ARE REDUNDANT "E" SEALS. SEALS NEAR
EXITS WHERE THERE IS LOW DELTA PRESSURE FOR EXHAUST GAS LEAKAGE ARE
SINGLE "E" TYPE.

FACTOR OF SAFETY GREATER THAN 2. LOW DELTA PRESSURE DURING OPERATION
(MAXIMUM 13.1 PSI). DUCT MATERIAL IS 600 SERIES INCONEL PER MIL-N-6840.
INSULATION SHELL MATERIAL IS 321 CRES PER MIL-S-6721. BURST PRESSURE -
26.2 PSIG AT 1,000 DEG F.

(B) TEST:
PROOF PRESSURE TEST AT 32 PSIG AT AMBIENT. QUALIFICATION ACTUAL BURST
WAS 825 PSI AT AMBIENT ON SIMILAR DUCT. QUALIFICATION VIBRATION FOR
OV-102 OFT (10 HR AT 28.8 GRMS IN Y AXIS).

DUCT MATERIAL COMPATIBILITY WITH HYDRAZINE CERTIFICATION PROVIDED.
ENDURANCE: 350 DEFLECTION CYCLES AT 1,160 DEG F.

EACH DUCT PROOF-TESTED AND LEAK CHECKED AT SUPPLIER AND UPON
INSTALLATION. ACCUMULATED 9.5 HR AND 5 YR ON OV-102 DUCTS 2 AND 3 AND
200 HR ON ITA DUCT AT SUNDSTRAND. ALLOWABLE LEAK ON SEAL IS 320 CC/HR
GN2.

OMRSD: EXTERNAL VISUAL INSPECTION AND SEAL LEAK TESTS EVERY FLOW.
EXHAUST DUCT VISUAL INSPECTION AND EXTERNAL LEAK TEST WITH INSULATION
REMOVED IS PERFORMED EVERY FIVE FLIGHTS AND IS CONSIDERED ADEQUATE. THE
EXTERNAL LEAK INSPECTIONS ARE CONSIDERED INVASIVE INSPECTIONS BECAUSE
THEY REQUIRE REMOVAL OF THE EXHAUST DUCT INSULATION WHICH IS DESTRUCTIVE
TO THE INSULATION.

(C) INSPECTION:
RECEIVING INSPECTION
MATERIAL AND PROCESSES CERTIFICATIONS ARE VERIFIED.

CONTAMINATION CONTROL
CLEANLINESS REQUIREMENTS PER MA0110-301 ARE VERIFIED.

ASSEMBLY/INSTALLATION
MANUFACTURING, ASSEMBLY, AND INSTALLATION REQUIREMENTS ARE VERIFIED BY

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INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. SEALS AND BELLOWS ARE VERIFIED BY INSPECTION. INSTALLATION OF "E" SEALS AT APU/DUCT INTERFACE IS VERIFIED.

NONDESTRUCTIVE EVALUATION
PENETRANT AND RADIOGRAPHIC INSPECTION OF WELDS IS VERIFIED.

CRITICAL PROCESSES
WELDING 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.

(D) FAILURE HISTORY:
NO RUPTURE OR SEAL OR WELD FAILURES. VIBRATION FAILURE OF INSULATION DURING QUALIFICATION RESULTED IN REDESIGN TO A REMOVABLE TYPE RATHER THAN INTEGRAL INSULATION.

CIRCUMFERENTIAL CRACKS OCCURRED DURING VIBRATION QUALIFICATION TESTING (AT 75 HR), WHICH RESULTED IN LIMITING LIFE OF EXHAUST ASSEMBLY TO 50 MISSIONS OF APU OPERATING TIME. ANALYSIS DETERMINED THAT THE CRACKING WAS DUE TO FATIGUE (CAR AC4521).

OV-102 EXHAUST DUCT 3 REMOVED, LEAK TESTED, INSPECTED AND METALLURGICALLY EVALUATED. AFTER APPROXIMATELY 11 HR OF USE AND 7 FLIGHTS (5 YR), THE DUCT SHOWED NO CRACKS OR OTHER ANOMALIES.

THE ITA DUCT, USED IN TESTS OVER 10 YR AND 360 HR OF APU RUN TIME, HAS BEEN LEAK TESTED, SHOWING NO ANOMALIES.

(E) OPERATIONAL USE:
NONE.

- APPROVALS -

RELIABILITY ENGINEERING: T. R. BOLTZ
DESIGN ENGINEERING : J. R. MUNROE
QUALITY ENGINEERING : W. J. SMITH
NASA RELIABILITY :
NASA SUBSYSTEM MANAGER :
NASA QUALITY ASSURANCE :

T. R. Boltz
: T. R. Boltz 01/06/89
: J. R. Munroe 1-9-89
: W. J. Smith 1-14-89
: 1-9-89 for W. Smith
: 1-15-89