PRINT DATE: 09/21/94

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL HARDWARE
NUMBER: 04-2-CFH02-X

SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)

REVISION: 3 09/21/94

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	HOSE, FLEX TITEFLEX	ME271-0079-64XX 106056-XXXX

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
FLEX HOSE, GAS GENERATOR (GG) COOLING

QUANTITY OF LIKE ITEMS: 3
ONE PER APU

FUNCTION:
TRANSFERS COOLING WATER FROM CONTROL VALVE TO APU GAS GENERATOR (GG) INJECTOR TO LOWER INJECTOR TUBE BRANCH PASSAGE TEMPERATURES TO PREVENT HYDRAZINE DETONATION DURING APU HOT RESTART. GG INJECTOR COOLING MUST BE PERFORMED PRIOR TO APU START IF GG INJECTOR OR BED TEMPERATURE IS ABOVE 415 DEG F (DUE TO SOAKBACK) PER V46T0X74A OR V46T0X22A. CREW OPENS VALVE FOR 209 SECONDS (MINIMUM) WITH CONTROLLER POWER ON AND APU OPERATE SWITCH IN "INJECTOR COOL" POSITION. CREW MONITORS REAL-TIME DISPLAY TO CONFIRM INJECTOR TEMPERATURES ARE DECREASING. AT END OF COOLING PERIOD, CREW MUST CYCLE APU OPERATE SWITCH TO "START/RUN" POSITION IMMEDIATELY TO PREVENT REHEATING OF INJECTOR BRANCH PASSAGES.

INJECTOR COOLING CAN BE USED FOR BOTH PAD AND MISSION APU HOT RESTARTS (REFER TO THE FOLLOWING REFERENCE DOCUMENTS).

REFERENCE DOCUMENTS: NSTS-16007, LCC SECTIONS: APU-19, APU-20, APU-21, 2.2.
NSTS-08934, (VOL I) SODB SECTION 3.4.4.3.5
NSTS 12820, FLIGHT RULE SECTION 10-3

PRINT DATE: 09/21/94

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: 04-2-CFH02-01

REVISION# 3 **09/21/94**

SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)
LRU: HOSE, FLEX
ITEM NAME: HOSE, FLEX

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
EXTERNAL LEAKAGE, RESTRICTED FLOW

MISSION PHASE: PRELAUNCH
LO LIFT-OFF
OO ON-ORBIT
ENTRY

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

CAUSE:
RUPTURE, CRACKS, FITTING FAILURE, CONTAMINATION, PINCHED LINE

CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES
AOA ABORT ONCE AROUND

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

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO EFFECT FOR NOMINAL MISSION. GROSS WATER LEAKAGE OR RESTRICTED/IMPROPER FLOW OF THE FLEX HOSE RESULTS IN LOSS OF COOLING CAPABILITY TO THE AFFECTED APU'S. POSSIBLE HYDRAZINE DETONATION AT RESTART DUE TO EXCESSIVE GG BRANCH PASSAGE TEMPERATURE IF COOLING IS NOT AVAILABLE. APU'S CANNOT BE SAFELY RESTARTED WITHOUT WATER COOLING UNTIL GG INJECTOR OR BED TEMPERATURE (V46T0X74A OR V46T0X22A) FALLS BELOW 415 DEG F (APPROXIMATELY 4 HOURS AFTER SHUTDOWN).

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE NUMBER: 04-2-CFH02-01

(B) INTERFACING SUBSYSTEM(S):
NO EFFECT FOR NOMINAL MISSION. LOSS OF SHAFT POWER TO ASSOCIATED HYDRAULIC SYSTEM IF HOT RESTART CANNOT BE PERFORMED.

(C) MISSION:
NO EFFECT FOR NOMINAL MISSION. PRECLUDES SAFE APU RESTART IN THE EVENT OF CONTINGENCY ABORT, OR SYSTEM-INDUCED AOA WITHIN FOUR HOURS OF APU SHUTDOWN, IF INJECTOR COOLING NOT AVAILABLE, ABORTS POSSIBLY DELAYED UNTIL GG INJECTOR TEMPERATURES FALL WITHIN SAFE RANGE.
OR IF HOT RESTART IS REQUIRED DURING ENTRY.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT FOR NOMINAL MISSION. POSSIBLE LOSS OF CREW/VEHICLE DUE TO HYDRAZINE DETONATION IF HOT RESTART OF THE AFFECTED APU IS ATTEMPTED, WHICH GATE COOLING.

(E) FUNCTIONAL CRITICALITY EFFECTS:
NO EFFECT FOR NOMINAL MISSION. POSSIBLE HYDRAZINE DETONATION AT RESTART OF THE ASSOCIATED APU DUE TO EXCESSIVE GG BRANCH PASSAGE TEMPERATURE IF COOLING IS ~~NOT AVAILABLE~~ INADEQUATE.

-DISPOSITION RATIONALE-

(A) DESIGN:
MATURE HARDWARE USED ON MILITARY AIRCRAFT AND SPACE PROGRAMS.

HOSE INNER CORE IS EXTRUDED TFE. REINFORCEMENT IS 304 SS WIRE BRAID. HOSE IS SINGLE BRAID QUALIFIED TO MIL-H-25579.

HOSE END-FITTINGS ARE SS PROGRESSIVE-SWAGED WITH POSITIVE BRAID LOCK & CONFORM TO MIL-H-25579. ONE HOSE END IS 304L STRAIGHT TUBE AND THE OTHER END IS AN "AN" FITTING.

(B) TEST:
HOSE ASSEMBLY QUALIFICATION - IMPULSE ENDURANCE CYCLING (100,000 CYCLES, 0-1875-0 PSI AT 400 DEG F) IN ACCORDANCE WITH FIG 3 OF MIL-H-25579.

RATE - 70 CYCLES/MIN BURST PRESSURE, -04 SIZE, 8000 PSI AT 70 DEG F, 6000 PSI AT 450 DEG F.

SUPPLIER ACCEPTANCE - PROOF PRESSURE 3000 PSI.

GROUND TURNAROUND TEST:
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
RECEIVING INSPECTION AND CHEMICAL ANALYSIS PERFORMED ON ALL RAW MATERIALS. RECEIVING INSPECTION VERIFIES INCOMING RAW STOCK IS NOT RELEASED TO THE SHOP FOR USE UNTIL A SAMPLE OF THE MATERIAL HAS BEEN CERTIFIED AS ACCEPTABLE BY THE COMPANY METALLURGIST.

CONTAMINATION CONTROL

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: 04-2-CFH02-01

CLEANLINESS TO LEVEL 100 IS VERIFIED BY INSPECTION. CORROSION PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MANUFACTURING, ASSEMBLY AND INSTALLATION REQUIREMENTS ARE VERIFIED BY INSPECTION. DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. HOSE END FITTINGS ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
RADIOGRAPHIC INSPECTION OF SWAGED FITTINGS TO ASSURE THE HOSE AND BRAID ARE PROPERLY BOTTOMED IN THE END FITTING IS VERIFIED. RADIOGRAPHIC INSPECTION OF BUTT WELDED TUBING IS VERIFIED. EACH WELD RADIOGRAPH IS INSPECTED UNDER MAGNIFICATION TO ASSURE THE WELDS ARE FREE OF CRACKS, POROSITY, INCLUSIONS OR VOIDS.

CRITICAL PROCESSES
BUTT WELDING AND SWAGING ARE VERIFIED BY INSPECTION.

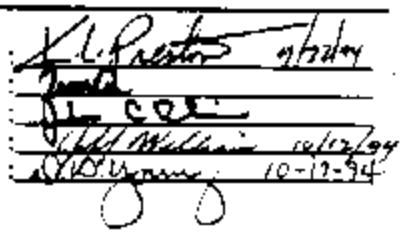
TESTING
TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. PROOF PRESSURE AND LEAK TEST OF EACH HOSE ASSEMBLY IS PERFORMED BY INSPECTION PERSONAL.

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

(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 DATABASE.

(E) OPERATIONAL USE:
NONE

- APPROVALS -

PAE MANAGER	: K. L. PRESTON	
PRODUCT ASSURANCE ENGR	: T. AI	
DESIGN ENGINEERING	: J. C. ROBINSON	
NASA SSMA	:	
NASA SUBSYSTEM MANAGER	:	