

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 06-3A-0602 -X**

SUBSYSTEM NAME: ACTIVE THERMAL CONTROL

REVISION: 0 02/04/88

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	WATER SPRAY BOILER	MC250-0019 ITEM 61 SV766500-4

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
WATER SPRAY BOILER ASSEMBLY

QUANTITY OF LIKE ITEMS: 3
THREE INDEPENDENT BOILER ASSEMBLIES

FUNCTION:
PROVIDES TRANSFER OF WASTE HEAT FROM ORBITER HYDRAULIC SYSTEM AND
AUXILIARY POWER UNIT LUBE OIL SYSTEM UTILIZING LATENT HEAT CAPACITY OF
WATER.

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NUMBER: 06-3A-0602- 04

REVISION#: 1 08/25/98

SUBSYSTEM NAME: ATCS - WATER SPRAY BOILER

LRU: WATER SPRAY BOILER ASSEMBLY

ITEM NAME: WATER SPRAY BOILER ASSEMBLY

CRITICALITY OF THIS

FAILURE MODE: 1R2

FAILURE MODE:

EXTERNAL LEAKAGE FROM LINES AND FITTINGS, APU LUBE OIL

MISSION PHASE:

LO LIFT-OFF

DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA

103 DISCOVERY

104 ATLANTIS

105 ENDEAVOUR

CAUSE:

CORROSION, POROSITY, VIBRATION, MECHANICAL SHOCK

CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES

RTLS RETURN TO LAUNCH SITE

REDUNDANCY SCREEN

A) PASS

B) PASS

C) PASS

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -**(A) SUBSYSTEM:**

NO EFFECT

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{B} INTERFACING SUBSYSTEM(S):

POSSIBLE LOSS OR LIMITED RUN TIME OF ONE APU/HYD SYSTEM DUE TO APU LUBE OIL DEPLETION RESULTING IN APU SHUTDOWN. LIMITED RUN TIME MAY NOT ALLOW APU/HYD SYSTEM TO SUPPORT ENTIRE POWERED FLIGHT OR ENTRY PHASE. LOSS OF HYDRAULIC CAPABILITY TO THROTTLE ONE MAIN ENGINE. LOSS OF HYDRAULIC LANDING GEAR DEPLOY AND NOSEWHEEL STEERING IF SYSTEM ONE LOST, AND LOSS OF ONE OF THREE ET UMBILICAL RETRACT ACTUATORS FOR EACH UMBILICAL PLATE. LOSS OF REDUNDANT HYDRAULIC POWER SYSTEM FOR FOUR TVC ACTUATORS. LOSS OF ONE OF THREE HYDRAULIC POWER SYSTEMS TO FLIGHT CONTROL SURFACES AND BRAKES.

{C} MISSION:

ABORT DECISION - REMAINING TWO SYSTEMS PROVIDE SAFE RETURN.

{D} CREW, VEHICLE, AND ELEMENT(S):

NO EFFECT

{E} FUNCTIONAL CRITICALITY EFFECTS:

FUNCTIONAL CRITICALITY EFFECTS - POSSIBLE LOSS OF CREW/VEHICLE WITH THIS FAILURE PLUS LOSS OF SECOND APU/HYD SYSTEM. CRIT 1 FOR SSME INDUCED RTLS IF LOSS OF APU/HYD SYSTEM OCCURS DURING MAX Q SSME THROTTLE DOWN PHASE DUE TO THIS WSB FAILURE.

-DISPOSITION RATIONALE-

{A} DESIGN:

LINES AND FITTINGS ARE CONSTRUCTED OF 347 CRES AND ALL JOINTS TO FITTINGS ARE WELDED (APU LUBE OIL DRAIN QD IS A DYNATUBE CONNECTION). DESIGN SAFETY FACTOR - PROOF PRESSURE OF 1.5 AND BURST OF 2.0. NORMAL OPERATING PRESSURE OF APU LUBE OIL LINES AND FITTINGS 40-60 PSIA.

{B} TEST:

QUALIFICATION:

- RANDOM VIBRATION TEST (BOILER AND VENT AREA) - ACCELERATION SPECTRAL DENSITY INCREASING AT RATE OF 6 DB/OCTAVE FROM 20 TO 50 HZ; CONSTANT AT 0.01 (G SQ)/HZ FROM 50 TO 2000 HZ FOR 48 MINUTES/AXIS (100 MISSION EQUIVALENCY). TEST PERFORMED WITH STORAGE TANK LOADED 100% AND AT MAX OPERATING PRESSURE. APU LUBE OIL CIRCUIT PRESSURIZED TO MAX OPERATING

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PRESSURE THROUGHOUT TEST. PASS/FAIL CRITERIA: NO DAMAGE OR PERMANENT DEFORMATION: NO ELECTRICAL CIRCUIT INTERRUPTIONS DURING TEST.

- **SHOCK TEST-(PER MIL-STD-810, METHOD 516.1, PROCEDURE 1) 18 SHOCKS TOTAL, 6 EACH AXIS, AT 20 G'S PEAK VALUE FOR 11 MS NOMINAL DURATION WITH FULL WATER LOAD. PASS/FAIL CRITERIA: UNIT MUST PASS SUBSEQUENT PERFORMANCE TESTS.**
- **PERFORMANCE RECORD TEST INCLUDES:**
 - **APU LUBE OIL CIRCUIT LEAK CHECK-TESTED FOR 1 HOUR AT 150 PSIG WITH LUBE OIL. PASS/FAIL CRITERIA: NO VISIBLE EVIDENCE OF EXTERNAL LEAK.**
 - **DESIGN POINT CHECK - VERIFICATION OF WSB SYSTEM OPERATING PARAMETERS (INCLUDING LUBE OIL TEMP/PRESS) DURING POOL BOILING (SEA LEVEL TESTING) AND SPRAY BOILING (AT ALTITUDE). TESTING INCLUDES A COMPLETE WATER LOAD EXPULSION TEST, PLUS A WATER CARRY OVER EFFICIENCY TEST WHICH COMPARES ACTUAL VS THEORETICAL WATER USAGE AT ALTITUDE ONLY WITH A KNOWN HEAT SINK.**
- **THERMAL CYCLE TEST - TESTED AT OPERATING CONDITIONS AT 70 TO 275 TO 70 DEG F WITH DWELL OF 10 MINUTES AT EACH LEVEL FOR 5 CYCLES. ALSO TESTED WITH WSB NOT OPERATING AT 70 TO -65 TO 70 DEG F WITH A DWELL OF 3 HOURS AT EACH LEVEL FOR 3 CYCLES. PASS/FAIL CRITERIA: NO DAMAGE OR PERMANENT DEFORMATION (INCLUDES APU LUBE OIL LINE/FITTING LEAKAGE).**
- **APU CIRCUIT BURST TEST-TESTED AT 300 PSIG FOR 1 MINUTE. PASS/FAIL CRITERIA: NO EVIDENCE OF LEAKAGE.**

ACCEPTANCE:

- **EXAMINATION OF PRODUCT - VERIFICATION OF WORKMANSHIP, FINISH, DIMENSIONS, CONSTRUCTION, CLEANLINESS, IDENTIFICATION, TRACEABILITY LEVEL AND PROCESSES PER DRAWINGS AND MC250-0019 (WATER SPRAY BOILER PROCUREMENT SPEC).**
- **LUBE OIL CIRCUIT PROOF PRESS TEST - TESTED FOR 15 MINUTES AT 225 PSIG WITH LUBE OIL. PASS/FAIL CRITERIA: NO EVIDENCE OF PERMANENT DEFORMATION AND PASSAGE OF SUBSEQUENT LEAK CHECK.**
- **LUBE OIL CIRCUIT LEAK CHECK - TESTED FOR 1 HOUR AT 150 PSIG WITH LUBE OIL. PASS/FAIL CRITERIA: NO VISIBLE EVIDENCE OF EXTERNAL LEAK.**
- **DESIGN POINT CHECK - VERIFICATION OF WSB SYSTEM OPERATING PARAMETERS (INCLUDING LUBE OIL TEMP/PRESS) DURING POOL BOILING (SEA LEVEL TESTING) AND SPRAY BOILING (AT ALTITUDE). TESTING INCLUDES A COMPLETE WATER LOAD EXPULSION TEST, PLUS A WATER CARRY OVER EFFICIENCY TEST WHICH COMPARES ACTUAL VS THEORETICAL WATER USAGE AT ALTITUDE ONLY WITH A KNOWN HEAT SINK.**
- **CLEANLINESS - VERIFICATION OF LUBE OIL SYSTEM CLEANLINESS BY CONTAMINATION SAMPLE UPON COMPLETION OF WSB ATP AND PREP FOR SHIPMENT (LUBE OIL - CLEANLINESS LEVEL 300).**

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GROUND TURNAROUND TEST

- ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIALS ARE VERIFIED BY LAB ANALYSIS. MATERIALS ARE VERIFIED BY INSPECTION PRIOR TO MACHINING.

CONTAMINATION CONTROL

ALL FLUIDS (APU LUBE OIL) ARE SAMPLED FOR CLEANLINESS. CONTAMINATION CONTROL OF HARDWARE IS VERIFIED BY INSPECTION. INTERNAL CLEANLINESS OF APU LUBE OIL LINES ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING, INSTALLATION AND ASSEMBLY OPERATIONS ARE VERIFIED BY INSPECTION. TORQUING PER DRAWING REQUIREMENTS AND CRITICAL DIMENSIONS IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

WELDING, HEAT TREAT, AND PASSIVATION ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

X-RAY AND PENETRANT INSPECTION ARE PERFORMED ON WELDS IN THE ASSEMBLY AND VERIFIED BY INSPECTION.

TESTING

ACCEPTANCE TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

ABSENCE OF PHYSICAL DAMAGE AND DEFORMATION ARE 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.

(E) OPERATIONAL USE:

ASCENT: SHUT DOWN AFFECTED APU/HYD SYSTEM AT AN APPROPRIATE TIME BASED ON FLIGHT PHASE AND SYSTEM TEMPERATURES.

ENTRY: SHUT DOWN AFFECTED APU/HYD SYSTEM OR DELAY APU START IF FAILURE KNOWN PRIOR TO DEORBIT.

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- APPROVALS -

EDITORIALLY APPROVED

: BNA

: J. Korman 8-25-98

TECHNICAL APPROVAL

: VIA APPROVAL FORM

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