

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 06-3A-0603 -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 ASSEMBLY	MC250-0019 ITEM 633
SRU	: HEAT EXCHANGER ASSEMBLY	SV766503-2

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
HEAT EXCHANGER ASSEMBLY**

QUANTITY OF LIKE ITEMS: 3
ONE EACH BOILER ASSEMBLY

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-0603-01

REVISION#: 1 08/25/98

SUBSYSTEM NAME: ATCS - WATER SPRAY BOILER

LRU: WATER SPRAY BOILER ASSEMBLY

ITEM NAME: HEAT EXCHANGER ASSEMBLY

CRITICALITY OF THIS

FAILURE MODE: 1R2

FAILURE MODE:

INTERNAL LEAKAGE IN HEADER ASSEMBLY, HYDRAULIC OIL TO 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):

SUBSYSTEM DEGRADATION - DELTA P BETWEEN FLUIDS WOULD CAUSE HYDRAULIC FLUID TO BE FORCED INTO APU LUBE OIL, RESULTING IN APU SHUTDOWN. 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 SUBSYSTEMS PROVIDE SAFE RETURN.

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

NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECTS:

POSSIBLE LOSS OF CREW/VEHICLE WITH THIS FAILURE PLUS LOSS OF A 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:

HEADER IS CONSTRUCTED OF 347 CRES AND THE BARRIER BETWEEN THE HYDRAULIC AND LUBE OIL CIRCUITS IS 0.200 INCHES THICK. DESIGN SAFETY FACTOR - PROOF OF 1.5 AND BURST OF 2.5 (HYDRAULIC), 2.0 (LUBE OIL). HEAT EXCHANGER TUBES ARE CONSTRUCTED OF 347 STAINLESS STEEL AND ARE BRAZED INTO HEADER ASSEMBLY. NORMAL OPERATING PRESSURE OF HYDRAULIC FLUID CIRCUIT IN WSB IS 75 PSIA. NORMAL OPERATING PRESSURE OF APU LUBE OIL IN WSB IS 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%. APU LUBE OIL AND HYD CIRCUITS PRESSURIZED TO MAX OPERATING PRESSURES THROUGHOUT TEST. PASS/FAIL CRITERIA: NO DAMAGE OR PERMANENT DEFORMATION; NO ELECTRICAL CIRCUIT INTERRUPTIONS DURING TEST.

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- 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 HYD AND LUBE OIL CIRCUIT LEAK CHECKS.
- 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 (NO APU LUBE OIL OR HYDRAULIC LEAKAGE).
- PRESSURE IMPULSE TEST - HYDRAULIC CIRCUIT SUBJECTED TO 100,000 PRESSURE CYCLES FROM 0 TO 500 PSIG IN HEAT EXCHANGER MODE. PASS/FAIL CRITERIA: NO HYDRAULIC LEAKAGE.
- APU CIRCUIT BURST TEST-TESTED AT 300 PSIG FOR 1 MINUTE. PASS/FAIL CRITERIA: NO EVIDENCE OF LEAKAGE.
- HYDRAULIC SECTION BURST TEST - TESTED AT 3750 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).
- HYDRAULIC CIRCUIT PROOF PRESS TEST - TESTED FOR 5 MINUTES AT 2250 PSIG WITH HYDRAULIC FLUID. PASS/FAIL CRITERIA: NO EVIDENCE OF PERMANENT DEFORMATION AND PASSAGE OF SUBSEQUENT LEAK CHECKS.
- 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 CHECKS.
- HYDRAULIC CIRCUIT LEAK CHECK-TESTED FOR 1 HOUR AT 1500 PSIG WITH HYDRAULIC FLUID. PASS/FAIL CRITERIA: NO VISIBLE EVIDENCE OF EXTERNAL LEAK AND NO PRESSURE DECAY.
- LUBE OIL CIRCUIT LEAK CHECK-TESTED FOR 1 HOUR AT 150 PSIG WITH LUBE OIL. PASS/FAIL CRITERIA: NO VISIBLE EVIDENCE OF EXTERNAL LEAK OR PRESSURE DECAY.
- CLEANLINESS - VERIFICATION OF APU LUBE OIL AND HYD FLUID SYSTEMS CLEANLINESS BY CONTAMINATION SAMPLE UPON COMPLETION OF WSB ATP AND PREP FOR SHIPMENT (LUBE OIL - CLEANLINESS LEVEL 300; HYDRAULIC FLUID - CLEANLINESS LEVEL 190).

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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. VERIFICATION OF MATERIAL AND EQUIPMENT CONFORMING TO CONTRACTS IS PERFORMED BY INSPECTION.

CONTAMINATION CONTROL

ALL FLUIDS (HYDRAULIC FLUID AND APU LUBE OIL) ARE SAMPLED FOR CLEANLINESS. CONTAMINATION CONTROL PROCESSES AND PLANS AND CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION. INTERNAL CLEANLINESS OF BOILER ASSEMBLY IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

TORQUING PER DRAWING REQUIREMENTS IS VERIFIED BY INSPECTION. MANUFACTURING INSTALLATION AND ASSEMBLY OPERATIONS ARE VERIFIED BY INSPECTION. PART PROTECTION, COATING, AND PLATING ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES

BRAZING IS VERIFIED BY INSPECTION AS BEING IN ACCORDANCE WITH REQUIREMENTS.

NONDESTRUCTIVE EVALUATION

EXAMINATION OF WELDED AND BRAZED JOINTS FOR SURFACE AND SUB-SURFACE DEFECTS IS VERIFIED BY X-RAY AND PENETRANT INSPECTION.

TESTING

ACCEPTANCE TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PROPER HANDLING AND STORAGE ENVIRONMENT 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:

SHUT DOWN AFFECTED APU/HYD SYSTEM. DELAY SHUTDOWN ON ASCENT IF POSSIBLE TO SUPPORT POWERED FLIGHT.

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- APPROVALS -

EDITORIALLY APPROVED
TECHNICAL APPROVAL

: BNA
: VIA APPROVAL FORM

: *J. Kimura 8-25-98*
: 95-CIL-009_06-3A