

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 06-3A-0803 -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- 04

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:**

RESTRICTED FLOW, LUBE OIL

MISSION PHASE:LO LIFT-OFF
DO DE-ORBIT

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

CAUSE:

CORROSION, EXCESSIVE CONTAMINATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREENA) PASS
B) PASS
C) PASS**PASS/FAIL RATIONALE:**

A)

B)

C)

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

LOSS OF FUNCTION - UNABLE TO PROVIDE LUBE OIL COOLING TO ONE APU LUBE OIL/HYD SYSTEM.

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(B) INTERFACING SUBSYSTEM(S):

POSSIBLE LOSS OR LIMITED RUN TIME OF ONE APU/HYD SYSTEM DUE TO LOSS OF APU LUBE OIL COOLING. 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 A SECOND APU/HYD SYSTEM.

-DISPOSITION RATIONALE-

(A) DESIGN:

25 MICRON FILTER IS INCORPORATED INTO THE APU SUBSYSTEM LUBE OIL CIRCUIT. THE WSB INCORPORATES TUBE-TYPE HEAT EXCHANGER WITH MULTI-PASSAGES (APU SECTION OF HEAT EXCHANGER INCORPORATES A MINIMUM OF 81 TUBES PER PASS). INDIVIDUAL TUBES ARE CONSTRUCTED OF 347 STAINLESS STEEL. NORMAL OPERATING PRESSURE OF APU LUBE OIL TUBES IS 40 - 60 PSIA. THE TUBES ARE 0.125 INCHES OUTSIDE DIAMETER WITH A WALL THICKNESS OF 0.010 INCHES. MINIMUM INNER DIAMETER OF CRIMPED TUBES IS 0.060 INCHES.

(B) TEST:

QUALIFICATION:

- PERFORMANCE RECORD TEST INCLUDES:
 - LUBE OIL FLOW AND PRESSURE DROP TEST-VERIFICATION OF 10 PSID MAX PRESSURE DROP OF LUBE OIL CIRCUIT AT 4.2 GPM AND 300 DEG F.

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- DESIGN POINT CHECK-VERIFICATION OF WSB SYSTEM OPERATING PARAMETERS DURING POOL BOILING (SEA LEVEL TESTING) AND SPRAY BOILING (AT ALTITUDE). PARAMETERS CHECKED INCLUDE IN/OUT LUBE OIL TEMPS AND LUBE OIL FLOW RATE.
- MISSION PROFILE TEST AT ALTITUDE-SIMULATION OF A BASELINE FLIGHT PROFILE AT MAXIMUM HEAT LOAD AND NORMAL OPERATION TO VERIFY PROPER WSB PERFORMANCE. PERTINENT PARAMETERS CHECKED: APU LUBE OIL HEAT LOADS AND FLOW RATES.

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 FLOW AND PRESSURE DROP TEST-VERIFICATION OF 10 PSID MAX PRESSURE DROP OF LUBE OIL CIRCUIT AT 4.2 GPM AND 300 DEG F.
- DESIGN POINT CHECK-VERIFICATION OF WSB SYSTEM OPERATING PARAMETERS DURING POOL BOILING (SEA LEVEL TESTING) AND SPRAY BOILING (AT ALTITUDE). PARAMETERS CHECKED INCLUDE IN/OUT LUBE OIL TEMPS AND LUBE OIL FLOW RATE.
- CLEANLINESS - VERIFICATION OF APU LUBE OIL SYSTEM CLEANLINESS BY CONTAMINATION SAMPLE UPON COMPLETION OF WSB ATP AND PREP FOR SHIPMENT (APU LUBE OIL-CLEANLINESS LEVEL 300).

PRELAUNCH.

- WSB IS OPERATING DURING PRELAUNCH PHASE AND INTEGRITY IS VERIFIED BEFORE LAUNCH USING VEHICLE INSTRUMENTATION.

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 (APU LUBE OIL) ARE SAMPLED FOR CLEANLINESS. CONTAMINATION CONTROL PROCESSES AND PLANS AND CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION. INTERNAL CLEANLINESS OF APU LUBE OIL LINES IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

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

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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:

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.

- APPROVALS -

EDITORIALLY APPROVED
TECHNICAL APPROVAL

: BNA
: VIA APPROVAL FORM

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