

**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.

FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE

NUMBER: 06-3A-0603-06

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, HYDRAULIC OIL

MISSION PHASE: 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 SCREEN

- A) FAIL
- B) FAIL
- C) PASS

PASS/FAIL RATIONALE:

A)

"A" SCREEN FAILS SINCE HYDRAULIC FLUID FLOW BYPASSES THE HEAT EXCHANGER UNTIL HYDRAULIC FLUID TEMPERATURE REACHES 210 DEG F. THIS TEMPERATURE IS REACHED ONLY DURING THE FINAL PHASES OF ENTRY. THEREFORE FAILURE IS NOT GROUND DETECTABLE, PLUS FAILURE DOES NOT ALLOW TIME FOR WORKAROUND DURING ENTRY.

B)

"B" SCREEN FAILS SINCE HYDRAULIC FLUID FLOW BYPASSES THE HEAT EXCHANGER UNTIL HYDRAULIC FLUID TEMPERATURE REACHES 210 DEG F. THIS TEMPERATURE IS REACHED ONLY DURING THE FINAL PHASES OF ENTRY. THEREFORE FAILURE IS NOT GROUND DETECTABLE, PLUS FAILURE DOES NOT ALLOW TIME FOR WORKAROUND DURING ENTRY.

C)

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
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- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF FUNCTION - UNABLE TO PROVIDE HYDRAULIC FLUID COOLING TO ONE HYD SYSTEM. INADEQUATE COOLING WOULD CAUSE EXCESSIVE SPRAYING AND POSSIBLE WATER DEPLETION.

(B) INTERFACING SUBSYSTEM(S):

POSSIBLE LOSS OR LIMITED RUN TIME OF ONE APU/HYD SYSTEM DUE TO LOSS OF HYDRAULIC FLUID COOLING. LIMITED RUN TIME MAY NOT ALLOW APU/HYD SYSTEM TO SUPPORT ENTIRE ENTRY PHASE. LOSS OF HYDRAULIC LANDING GEAR DEPLOY AND NOSEWHEEL STEERING IF SYSTEM ONE IS LOST. LOSS OF ONE OF THREE HYDRAULIC POWER SYSTEMS TO FLIGHT CONTROL SURFACES AND BRAKES.

(C) MISSION:

NO EFFECT - COMMITTED.

(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.

-DISPOSITION RATIONALE-

(A) DESIGN:

5 MICRON FILTER IS INCORPORATED INTO THE HYDRAULIC SUBSYSTEM CIRCUIT. THE WSB INCORPORATES A TUBE-TYPE HEAT EXCHANGER WITH MULTI-PASSAGES (HYDRAULIC SECTION OF HEAT EXCHANGER INCORPORATES A MINIMUM OF 214 TUBES PER PASS). INDIVIDUAL TUBES ARE CONSTRUCTED OF 347 STAINLESS STEEL. NORMAL OPERATING PRESSURE OF HYDRAULIC FLUID TUBES IS 75 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:

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- PERFORMANCE RECORD TEST INCLUDES:
 - DESIGN POINT CHECK-VERIFICATION OF WSB SYSTEM OPERATING PARAMETERS DURING POOL BOILING (SEA LEVEL TESTING) AND SPRAY BOILING (AT ALTITUDE). PARAMETERS MONITORED INCLUDE IN/OUT HYD FLUID TEMPS AND HYD FLUID 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: HYDRAULIC FLUID IN/OUT TEMPS, HYDRAULIC 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).
- HYDRAULIC FLOW AND PRESSURE DROP TEST - VERIFICATION OF PRESSURE DROP OF HYDRAULIC CIRCUIT AT VARIOUS FLOW RATES AND TEMPERATURES WHILE IN THE HEAT EXCHANGER POSITION AND THE BYPASS POSITION.
- DESIGN POINT CHECK-VERIFICATION OF WSB SYSTEM OPERATING PARAMETERS DURING POOL BOILING (SEA LEVEL TESTING) AND SPRAY BOILING (AT ALTITUDE). PARAMETERS MONITORED INCLUDE IN/OUT HYD FLUID TEMPS AND HYD FLUID FLOW RATE.
- CLEANLINESS - VERIFICATION OF SYSTEM CLEANLINESS BY CONTAMINATION SAMPLE UPON COMPLETION OF WSB ATP (HYDRAULIC FLUID-CLEANLINESS LEVEL 190).

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

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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:

ENTRY: DEPRESSURIZE SYSTEM TO REDUCE HEAT LOAD INTO HYDRAULIC SYSTEM. RETURN TO "NORM" PRESSURE AT TAEM. IF HEAT LOAD NOT REDUCED - SHUT DOWN AFFECTED HYDRAULIC SYSTEM.

- APPROVALS -

EDITORIALLY APPROVED
TECHNICAL APPROVAL

: BNA
: VIA APPROVAL FORM

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