

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE

NUMBER: 06-3A-0618 -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
P-PART : LINES AND FITTINGS, WATER	

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

LINES AND FITTINGS, WATER

QUANTITY OF LIKE ITEMS: 3

ONE SET FOR EACH BOILER ASSEMBLY

FUNCTION:

PROVIDE FLOW OF WATER BETWEEN WATER TANK AND BOILER ASSEMBLY.

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REVISION#: 1 08/25/98

SUBSYSTEM NAME: ATCS - WATER SPRAY BOILER

LRU: WATER SPRAY BOILER

ITEM NAME: LINES AND FITTINGS, WATER

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:

EXTERNAL LEAKAGE

MISSION PHASE:

LO LIFT-OFF
DO DE-ORBIT

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

CAUSE:

MECHANICAL SHOCK, VIBRATION, CORROSION, POROSITY, WELD FLAW

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF WATER - UNABLE TO PROVIDE THERMAL CONTROL IN ONE APU/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 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 IS 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 EFFECT - POSSIBLE LOSS OF CREW/VEHICLE WITH THIS FAILURE PLUS LOSS OF A SECOND APU/HYD SYSTEM.

-DISPOSITION RATIONALE-

(A) DESIGN:

LINES AND FITTINGS ARE CONSTRUCTED OF 347 STAINLESS STEEL FOR CORROSION RESISTANCE AND COMPATIBILITY WITH WORKING FLUIDS. DESIGN SAFETY FACTOR - PROOF PRESSURE OF 1.5 AND BURST OF 2.0. N2 RELIEF VALVE PROVIDES OVERPRESSURIZATION PROTECTION.

(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 PRESURE. HYDRAULIC AND APU LUBE OIL CIRCUITS PRESSURIZED TO MAX OPERATING PRESSURE 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 15 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:
 - DESIGN POINT CHECK-VERIFICATION OF WSB SYSTEM OPERATING PARAMETERS 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 VERSUS THEORETICAL WATER USAGE AT ALTITUDE ONLY WITH A KNOWN HEAT SINK.
- MISSION PROFILE TEST AT ALTITUDE-SIMULATION OF A BASELINE FLIGHT PROFILE AT MAXIMUM HEAT LOAD AND NORMAL OPERATION TO VERIFY PROPER WSB PERFORMANCE.
- 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
- WATER CIRCUIT BURST TEST-TESTED AT 67 PSIG FOR 1 MINUTE MINIMUM. 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).
- WATER CIRCUIT PROOF CHECK-PROOFED TO 51 PSIG MIN WITH HELIUM. PASS/FAIL CRITERIA: NO EVIDENCE OF PERMANENT DEFORMATION AND PASSAGE OF SUBSEQUENT WATER AND NITROGEN CKT LEAK CHECKS.
- WATER CIRCUIT LEAK CHECK-AT MAX WATER OPERATING PRESS(33.5 PSIG) WITH HELIUM, 0.933 SCC/MIN MAX HELIUM LEAKAGE.
- CLEANLINESS-VERIFICATION OF WATER SYSTEM CLEANLINESS BY CONTAMINATION SAMPLE PRIOR TO FINAL ATP TESTING (WATER CLEANLINESS SPEC SE-S-0073, PARAGRAPH 6.1, TABLE 6.1)
- DESIGN POINT CHECK-VERIFICATION OF WSB SYSTEM OPERATING PARAMETERS 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 VERSUS THEORETICAL WATER USAGE AT ALTITUDE ONLY WITH A KNOWN HEAT SINK.

PRELAUNCH:

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- 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 SENT TO A TEST LAB FOR MATERIAL AND CHEMICAL ANALYSIS AND CERTIFICATION. SHOP TRAVELER INSPECTION IS PERFORMED FOR CORRECT RAW MATERIAL PRIOR TO MACHINING.

CONTAMINATION CONTROL

INSPECTION VERIFIES CONTAMINATION CONTROL ON SHOP TRAVELERS.

ASSEMBLY/INSTALLATION

IN-PROCESS INSPECTION IS REQUIRED FOR CRITICAL DIMENSIONS CERTIFICATION. FLUID CONNECTION TORQUE REQUIREMENTS ARE VERIFIED FOR PHYSICAL AND SEALING DAMAGE.

NONDESTRUCTIVE EVALUATION

X-RAY OF WELDS IS PERFORMED BY OUTSIDE VENDOR AND CERTIFICATION IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

WELDING IS PERFORMED BY OUTSIDE VENDOR AND CERTIFICATION IS VERIFIED BY INSPECTION. HEAT TREATMENT IS VERIFIED BY INSPECTION.

TESTING

LEAKAGE IS VERIFIED BY PROOF PRESSURE AND HELIUM TESTS.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS 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 SYTEM OR DELAY APU START IF FAILURE KNOWN PRIOR TO DEORBIT.

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- APPROVALS -

EDITORIALLY APPROVED

: BNA

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TECHNICAL APPROVAL

: VIA APPROVAL FORM

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