

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE  
NUMBER: 06-3A-0610 -X**

**SUBSYSTEM NAME: ACTIVE THERMAL CONTROL**

**REVISION: 0 02/04/88**

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**PART DATA**

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	<b>PART NAME</b>	<b>PART NUMBER</b>
	<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
LRU	: WATER SPRAY BOILER ASSEMBLY	MC250-0019 ITEM 612
SRU	: HYDRAULIC BYPASS/RELIEF VALVE	SV766502-2

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
HYDRAULIC BYPASS/RELIEF VALVE**

**QUANTITY OF LIKE ITEMS: 3**  
ONE EACH BOILER ASSEMBLY

**FUNCTION:**  
PROVIDES CAPABILITY TO BYPASS THE HYDRAULIC HEAT EXCHANGER SECTION  
DURING PERIODS WHEN HYDRAULIC COOLING IS NOT REQUIRED AND RELIEF VALVE  
LIMITS THE PRESSURE DROP ACROSS THE SPRAY BOILER FOR HIGH FLOW  
CONDITIONS.

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

NUMBER: 06-3A-0610-05

REVISION#: 1 08/25/98

SUBSYSTEM NAME: ATCS - WATER SPRAY BOILER

LRU: WATER SPRAY BOILER ASSEMBLY

ITEM NAME: HYDRAULIC BYPASS/RELIEF VALVE

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, DAMAGED SEAL

**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

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE****NUMBER: 06-3A-0610- 05****(B) INTERFACING SUBSYSTEM(S):**

SUBSYSTEM DEGRADATION - EXCESSIVE FLUID DEPLETION WOULD RESULT IN LOSS OR OVER HEATING OF ONE HYDRAULIC SYSTEM. POSSIBLE LOSS OR LIMITED RUN TIME OF ONE APU/HYD SYSTEM DUE TO LOSS OF HYDRAULIC FLUID AND/OR 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 SUBSYSTEMS 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. 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.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

VALVE BODIES ARE CONSTRUCTED OF 347 STAINLESS STEEL (SS) AND 17-4 PH SS AND THE BODIES ASSEMBLED WITH FASTENERS WITH LOCKING PROVISIONS. THE SEALS ARE VITON. DUAL "O" RINGS ARE USED ON ROTATING SHAFT. DESIGN SAFETY FACTOR - PROOF PRESSURE OF 1.5 AND BURST OF 2.5.

**(B) TEST:****QUALIFICATION:**

- BYPASS VALVE IS FUNCTIONALLY TESTED TO WITHSTAND 2000 OPERATING CYCLES (BYPASS-HX-BYPASS).
- RANDOM VIBRATION TEST (BOILER AND VENT AREA) - ACCELERATION SPECTRAL DENSITY INCREASING AT RATE OF 6 DB/OCTAVE FROM 20 TO 50 HZ; CONSTANT AT

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0.01 G SQ/HZ FROM 50 TO 2000 HZ FOR 48 MINUTES/AXIS (100 MISSION EQUIVALENCY). TEST PERFORMED WITH STORAGE TANK LOADED 100 PERCENT AND AT MAXIMUM OPERATING PRESSURE (FULL GN2 PRESSURE). 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.

- 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 (INCLUDING HYDRAULIC CIRCUIT PROOF AND 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. UNIT MUST PASS SUBSEQUENT PERFORMANCE TESTS (INCLUDING HYDRAULIC CIRCUIT PROOF AND LEAK CHECKS).

**ACCEPTANCE:**

- BYPASS VALVE COMPONENT TESTED PRIOR TO WSB ASSEMBLY AS FOLLOWS: HOUSING PROOF TESTING, HYDRAULIC LEAKAGE TEST (THE SHAFT SEALS ARE TESTED INDIVIDUALLY).
- EXAMINATION OF PRODUCT - VERIFICATION OF WORKMANSHIP, FINISH, DIMENSIONS, CONSTRUCTION, CLEANLINESS, IDENTIFICATION, TRACEABILITY LEVEL AND PROCESSES PER DRAWINGS AND MC250-0019 (WSB PROCUREMENT SPEC).
- HYDRAULIC CIRCUIT PROOF TEST - TESTED AT 2250 PSIG FOR 5 MINUTES MINIMUM WITH HYDRAULIC FLUID. PASS/FAIL CRITERIA: NO EVIDENCE OF PERMANENT DEFORMATION AND PASSAGE OF SUBSEQUENT HYDRAULIC CIRCUIT LEAK CHECKS.
- HYDRAULIC CIRCUIT LEAK CHECK - TESTED AT 1500 PSIG WITH HYDRAULIC FLUID. PASS/FAIL CRITERIA: NO VISIBLE EVIDENCE OF EXTERNAL LEAKAGE AND NO PRESSURE DECAY.

**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**

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VERIFY INTERNAL CLEANLINESS OF HYDRAULIC LINES PER SPECIFIED REQUIREMENTS. CONTAMINATION CONTROL PROCESSES AND PLANS AND CORROSION PROTECTION PROVISIONS ARE 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. SEALS ARE VERIFIED BY INSPECTION TO BE ASSEMBLED USING HYDRAULIC FLUID. VERIFICATION THAT SPOOL SEAL HAS NOT BEEN EXTRUDED AT LOWER LEVEL OF ASSEMBLY IS BY INSPECTION.

**CRITICAL PROCESSES**

WELDING IS VERIFIED BY INSPECTION.

**NONDESTRUCTIVE EVALUATION**

EXAMINATION OF SURFACE WELDS FOR SURFACE AND SUBSURFACE DEFECTS IS VERIFIED BY X-RAY AND DYE PENETRANT INSPECTION.

**TESTING**

INSPECTION POINTS PERFORMED DURING ATP ARE VERIFIED BY INSPECTION.

**HANDLING/PACKAGING**

PROPER HANDLING AND STORAGE ENVIRONMENT IS 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, ENTRY: SHUT DOWN AFFECTED APU/HYD SYSTEM. DELAY SHUT DOWN ON ASCENT IF POSSIBLE TO SUPPORT POWERED FLIGHT PHASE.

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**- APPROVALS -**

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EDITORIALLY APPROVED  
TECHNICAL APPROVAL

: BNA  
: VIA APPROVAL FORM

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