

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE  
NUMBER: 06-3A-0616 -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>
	: WATER SPRAY BOILER	
LRU	. DISCONNECT, LUBE OIL DRAIN	MC621-0038-0300

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
DISCONNECT, LUBE OIL DRAIN

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

**FUNCTION:**  
PROVIDES CAPABILITY TO DRAIN LUBE OIL FROM BOILER ASSEMBLY. A CAP, WHICH PROVIDES A DUAL SEAL, IS INSTALLED DURING WSB OPERATION

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

NUMBER: 06-3A-0616- 02

REVISION#: 2 08/25/98

SUBSYSTEM NAME: ATCS - WATER SPRAY BOILER

LRU: DISCONNECT, LUBE OIL DRAIN

ITEM NAME: DISCONNECT, LUBE OIL DRAIN

CRITICALITY OF THIS

FAILURE MODE: 1R3

## FAILURE MODE:

INTERNAL LEAKAGE, PAST POPPET

## MISSION PHASE:

LO LIFT-OFF

DO DE-ORBIT

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

## CAUSE:

CORROSION, VIBRATION, MECHANICAL SHOCK, CONTAMINATION, DAMAGED SEAL/POPPET

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

## REDUNDANCY SCREEN

A) PASS

B) FAIL

C) PASS

## PASS/FAIL RATIONALE:

A)

"A" SCREEN IS PASSED SINCE SEALING CAP CAN BE REMOVED AND POPPET CAN BE INSPECTED DURING GROUND TURNAROUND.

B)

"B" SCREEN FAILS SINCE FLIGHT CAP WOULD MASK POPPET FAILURE DURING FLIGHT.

C)

## - FAILURE EFFECTS -

## (A) SUBSYSTEM:

NO EFFECT - CAP ON DISCONNECT WOULD PREVENT EXTERNAL LEAKAGE OF APU LUBE OIL.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE  
NUMBER: 06-3A-0616- 02**

**(B) INTERFACING SUBSYSTEM(S):**

FIRST FAILURE: NO EFFECT. SECOND FAILURE (LOSS OF SEALING CAP): POSSIBLE LOSS OR LIMITED RUN TIME OF ONE APU/HYD SYSTEM DUE TO LUBE OIL DEPLETION RESULTING IN 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:**

NO EFFECT

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

NO EFFECT

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

FUNCTIONAL CRITICALITY EFFECT - POSSIBLE LOSS OF CREW/VEHICLE WITH THREE FAILURES: THIS FAILURE, LEAKAGE OF ASSOCIATED FLIGHT CAP AND LOSS OF AN ADDITIONAL APU/HYD SYSTEM.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

DISCONNECT IS 17-4 PH STAINLESS STEEL WITH A FLUOROCARBON O-RING SEAL AND A TEFLON BACKUP RING SEAL. CAP IS 17-4 PH STAINLESS STEEL WITH A FLUOROCARBON O-RING SEAL. CAP IS INSTALLED BEFORE FLIGHT AND PROVIDES A SECONDARY SEAL TO DISCONNECT POPPET. POPPET IS SPRING LOADED CLOSED AND SYSTEM PRESSURE AIDS IN MAINTAINING IT CLOSED.

**(B) TEST:**

**QUALIFICATION:**

- FLUID CONNECTION TORQUE TEST - FOUR INSTALLATIONS AND REMOVALS WITH 62.5 FT-LBS. PASS/FAIL CRITERIA: NO EVIDENCE OF PHYSICAL OR FUNCTIONAL FAILURE SUCH AS GALLING, THREAD DAMAGE, OR DAMAGE TO SEALING SURFACE.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE  
NUMBER: 06-3A-0616-02**

- SIDE LOAD TEST - 1 MINUTE AT 80 IN-LBS TORQUE AT COUPLING STRUCTURE INTERFACE. MALE AND FEMALE QD'S COUPLED. PASS/FAIL CRITERIA: NO PERMANENT DISTORTION OF THE COUPLING.
- SAND AND DUST - MALE COUPLING WITH CAP INSTALLED SHALL WITHSTAND 28 HOURS OF REQUIRED SAND/DUST ENVIRONMENT. PASS/FAIL CRITERIA: SHALL PASS SUBSEQUENT COUPLING PERFORMANCE RECORD TEST AND CAP/PLUG PROOF/PERFORMANCE TEST.
- SALT AND FOG - MALE COUPLING WITH CAP INSTALLED SHALL WITHSTAND 30 DAYS OF REQUIRED SALT/FOG ENVIRONMENT. PASS/FAIL CRITERIA: SHALL PASS SUBSEQUENT COUPLING PERFORMANCE RECORD TEST AND CAP/PLUG PROOF/PERFORMANCE TEST.
- BENCH SHOCK TEST - DROP MALE COUPLING HALF WITH CAP INSTALLED 4 TIMES ON EACH END FOUR INCHES FROM BENCH TOP PER MIL-STD-810, METHOD 516.1, PROCEDURE V. PASS/FAIL CRITERIA: SHALL PASS SUBSEQUENT COUPLING PERFORMANCE RECORD TEST AND CAP/PLUG PROOF/PERFORMANCE TEST.
- BASIC DESIGN SHOCK TEST - MALE COUPLING HALF WITH CAP INSTALLED, TESTED AT 20 G PEAK FOR 11 MS DURATION PER MIL-STD-810, METHOD 516.1, PROCEDURE I. PASS/FAIL CRITERIA: SHALL PASS SUBSEQUENT COUPLING PERFORMANCE RECORD TEST AND CAP/PLUG PROOF/PERFORMANCE TEST.
- LANDING SHOCK TEST - MALE COUPLING HALF WITH CAP INSTALLED SHALL WITHSTAND SPECIFIED LANDING SHOCK PEAKS FOR REQUIRED DURATIONS. PASS/FAIL CRITERIA: SHALL PASS SUBSEQUENT COUPLING PERFORMANCE RECORD TEST AND CAP/PLUG PROOF/PERFORMANCE TEST.
- PERFORMANCE RECORD TEST INCLUDES:
  - APU LUBE OIL CIRCUIT LEAK CHECK - TESTED FOR 1 HOUR AT 150 PSIG WITH LUBE OIL. PASS/FAIL CRITERIA: NO VISIBLE EVIDENCE OF EXTERNAL LEAKAGE.
- BURST TESTS - COUPLING ASSEMBLY SHALL WITHSTAND 400 PSIG AT 155 DEG F FOR 2 MINUTES MINIMUM WITH NO RUPTURE IN THE FOLLOWING CONFIGURATIONS: MALE COUPLING ALONE, MALE AND FEMALE COUPLED, PRESSURE CAP ATTACHED TO TEST FIXTURE.
- WSB ASSEMBLY QUALIFICATION - INCLUDES RANDOM VIBRATION, SHOCK TEST, PERFORMANCE RECORD TEST (INCLUDING LUBE OIL CIRCUIT PROOF AND LEAK TESTS, AND DESIGN POINT CHECK), MISSION PROFILE TEST, THERMAL CYCLE TEST, AND LUBE OIL CIRCUIT BURST TEST (300 PSIG).

**ACCEPTANCE.**

- EXAMINATION OF PRODUCT - VERIFICATION OF WORKMANSHIP, FINISH, DIMENSIONS, CONSTRUCTION, CLEANLINESS, IDENTIFICATION, TRACEABILITY LEVEL AND PROCESSES PER DRAWINGS AND MC621-0038 (WATER BOILER QUICK DISCONNECT PROCUREMENT SPEC).

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- QD PROOF TEST - TESTED FOR 2 CYCLES AT 200 PSIG, 90 DEG F, FOR 2 MINUTES EACH IN FOLLOWING CONFIGURATIONS: MALE COUPLING HALF ALONE, FEMALE COUPLING HALF ALONE, MALE AND FEMALE COUPLED, AND PRESSURE CAP ALONE. PASS/FAIL CRITERIA: NO EVIDENCE OF EXTERNAL LEAKAGE, PERMANENT SET, OR ERRATIC COUPLING/UNCOUPLING.
- PERFORMANCE RECORD TEST - INCLUDES:
  - 5 PSIG APPLIED TO MALE HALF WITH FEMALE HALF PLUGGED. REPEATED AT 50 PSIG.
  - 5 PSIG APPLIED TO FEMALE HALF WITH MALE HALF CAPPED REPEATED AT 50 PSIG.
  - 5 PSIG APPLIED TO BOTH HALFS, UNCOUPLED. REPEATED AT 50 PSIG.PASS/FAIL CRITERIA: NO EVIDENCE OF EXTERNAL LEAKAGE WHEN COUPLED. UNCOUPLING FLUID LOSS SHALL NOT EXCEED 5 CC'S. MAX COUPLING/UNCOUPLING FORCE SHALL BE 50 LB.
- CLEANLINESS: LEVEL 300 PER SPEC MA0110-301.
- WSB ASSY ATP-INCLUDES LUBE OIL PROOF TEST (AT 225 PSIG/15 MIN) LUBE OIL LEAK CHECK (AT 150 PSIG/1 HR) AND DESIGN PT CHECK.

**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.

**CRITICAL PROCESSES**

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

**NONDESTRUCTIVE EVALUATION**

PARTS ARE PENETRANT INSPECTED AFTER WELDING OPERATION AND VERIFIED BY INSPECTION.

**TESTING**

LEAKAGE IS VERIFIED BY PROOF PRESSURE AND HELIUM LEAK TESTS.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE  
NUMBER: 06-3A-0616-02**

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:**

NONE

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**- APPROVALS -**

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EDITORIALLY APPROVED	: BNA	: <u>J. Kamura 8-25-98</u>
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 85-CIL-009_06-3A