

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ACTIVE THERMAL CONTROL FMEA NO 06-3C -0301 -3 REV: 03/09 3

ASSEMBLY : FREON THERMAL LOOP  
P/N RI : MC250-0001-0015  
P/N VENDOR: SV729780  
QUANTITY : 1  
: ONE WITH DUAL LOOP

VEHICLE 102 103 104  
EFFECTIVITY: X X X  
PHASE(S): PL LO X OO X DO X LS

CRIT. FUNC: 1

CRIT. HDW:

REDUNDANCY SCREEN: A-PASS B-PASS C-PASS

PREPARED BY:

DES  
REL  
QE

O. TRAN SAT  
D. RISING V-REL  
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APPROVED BY (NASA):

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*[Handwritten signatures]* 4/15/81

ITEM:

HEAT EXCHANGER, HYDRAULICS.

FUNCTION:

PROVIDES HEATING OF HYDRAULIC FLUID DURING ON ORBIT PHASE.

FAILURE MODE:

INTERNAL LEAKAGE, FREON TO HYDRAULIC SYSTEM.

CAUSE(S):

CORROSION, MECHANICAL SHOCK, VIBRATION, STRUCTURAL DAMAGE.

EFFECT(S) ON:

(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE

(A) FREON 21 WILL LEAK INTO HYDRAULIC LOOP CAUSING LOSS OF ONE REDUNDANT FREON COOLING LOOP.

(B) MIXING OF HYDRAULIC FLUID AND FREON 21 WILL PRODUCE A THICK SLUDGE BUILD-UP THAT MAY CAUSE THE HYDRAULIC SPOOL VALVES TO STICK.

(C) ABORT MISSION AT NEXT PRIMARY LANDING SITE FOR LOSS OF ONE FREON COOLANT LOOP AND PRIOR TO BUILD-UP OF SLUDGE IN HYDRAULIC SYSTEM.

(D) SECOND ASSOCIATED FAILURE (LOSS OF REDUNDANT FREON COOLANT LOOP) CAN CAUSE LOSS OF VEHICLE COOLING AND RESULT IN LOSS OF CREW/VEHICLE. LOSS OF HYDRAULIC SPOOL VALVE CONTROL CAN CAUSE LOSS OF CREW/VEHICLE.

DISPOSITION & RATIONALE:

(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN

THE HEAT EXCHANGER IS MADE FROM STAINLESS STEEL AND NICKEL BRONZE ALLOYS WHICH ARE COMPATIBLE WITH FREON 21 AND HYDRAULIC FLUID, AND CONTAINS NO MOVING PARTS SUBJECT TO WEAR. THE FLOW HEADERS ARE MADE FROM A SINGLE PIECE BAR. THE HEADERS ARE WELDED TO THE CORE, WHICH IS MADE OF STACKED PLATE-FIN PARTING SHEETS (THICKNESS = 0.005 INCH). DESIGN PROOF PRESSURE IS 1.5 AND BURST PRESSURE IS 2.0 TIMES MAXIMUM OPERATING PRESSURE.

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(B) TEST

QUALIFICATION TEST - QUALIFICATION TESTED FOR 100 MISSION LIFE. THE HE EXCHANGER WAS SUBJECTED TO A PROOF/RUPTURE TEST FOR QUALIFICATION. DESIGN PROOF IS 575 PSIG AND UNIT DID NOT RUPTURE UNTIL 2440 PSIG (MAXIMUM HYDRAULICS OPERATING PRESSURE IS 75 PSIA). VIBRATION TESTED AT 0.075 G<sup>2</sup>/HZ FOR 52 MIN/AXIS, SHOCK TESTED AT +/- 20 G EACH AXIS.

ACCEPTANCE TEST - CORE IS LEAK TESTED PRIOR TO INSTALLING THE HEADERS A AGAIN IN ATP OF ITEM.

CONTAMINATION TEST - TEST REPORT NO. 424-2385, USING A MIXTURE OF HYDRAULIC FLUID, WATER, FREON TF AND IRON POWDER, SHOWED NO REACTION AFTER 5 DAYS.

OMRSD - PREFLIGHT CHECKOUT OF THE HYDRAULIC SYSTEM USING HYDRAULIC ACCUMULATOR QUANTITY AND PRE- AND POST-FLIGHT SAMPLING OF THE HYDRAULIC SYSTEM FLUID WILL DETECT THIS FAILURE. CONTINUOUS MONITORING OF THE FREON ACCUMULATOR QUANTITY MAY ALSO DETECT THIS LEAK. SYSTEM OPERATION VEHICLE INSTRUMENTATION WILL DETECT FAILURE. ATCS GROUND OPERATIONS: ACCUMULATOR QUANTITY, PUMP INLET PRESSURE, FLOW RATE CHECKS USED TO DETECT LEAKAGE.

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIAL AND PURCHASED COMPONENTS REQUIREMENTS ARE VERIFIED BY INSPECTION. PARTS PROTECTION IS VERIFIED BY INSPECTION

CONTAMINATION CONTROL

SYSTEMS FLUID ANALYSES FOR CONTAMINATION ARE VERIFIED BY INSPECTION. CONTAMINATION CONTROL PLAN IS VERIFIED BY INSPECTION. CONTAMINATION CONTROL PROCESSES AND CLEAN AREAS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING, INSTALLATION AND ASSEMBLY OPERATIONS ARE VERIFIED BY INSPECTION. SHEET METAL PARTS ARE INSPECTED AND VERIFIED BY INSPECTION SURFACE FINISHES VERIFIED BY INSPECTION. DIMENSIONS VERIFIED BY INSPECTION

CRITICAL PROCESSES

WELDING IS VERIFIED BY INSPECTION. ALL WELDS ARE STRESS RELIEVED AFTER WELDING, VERIFIED BY INSPECTION. BRAZING IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

HEADER WELDS TO THE TUBES ARE PENETRANT AND X-RAY INSPECTED. OTHER WEL (MOUNTING PADS AND HEADER WELDS TO THE CORES) ARE PENETRANT AND 10X MAGNIFICATION VISUALLY INSPECTED. BRAZES ARE VERIFIED BY PROOF AND LEAK TESTS.

TESTING

INSPECTION VERIFIES THAT RESULTS OF ACCEPTANCE TESTING AND FLOWRATES ARE WITHIN SPECIFIED LIMITS.

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HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

NO GENERIC FAILURES ON PRIOR PROGRAMS FOR THIS MODE. NO APPLICABLE FAILURE HISTORY.

(E) OPERATIONAL USE

ON-BOARD ALARM WILL PROVIDE INDICATION OF FAILURE. THE PUMP ON THE FAILED FREON COOLANT LOOP WILL BE DEACTIVATED. DEORBIT AT NEXT PRIMARY LANDING SITE.