

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ACTIVE THERMAL CONTROL FMEA NO 06-3C -0207 -6 REV: 08/23/81

ASSEMBLY : FREON THERMAL LOOP CRIT. FUNC: 1  
 P/N RI : MC250-0001-0610 CRIT. HDW:  
 P/N VENDOR: SV755519  
 QUANTITY : 1 VEHICLE 102 103 104  
 EFFECTIVITY: X X X  
 : ONE, DUAL LOOP OPERATION PHASE(S): PL LO X OO X DO X LS

PREPARED BY: DES O. TRAN *O.T.* APPROVED BY: DES *Michael James Miller* REDUNDANCY SCREEN: A-PASS B-PASS C-PASS  
 REL D. RISING *D.R.* REL *[Signature]* APPROVED BY (NASA): SSM *[Signature]*  
 QE W. SMITH *W.S.* QE *[Signature]* REL *[Signature]* QE *[Signature]*

ITEM:  
 HEAT EXCHANGER, FUEL CELL - FC-40 COOLANT/FREON.

FUNCTION:  
 TRANSFERS HEAT FROM FUEL CELL COOLANT LOOPS TO FREON LOOPS SO THAT THE FUEL CELLS CAN BE COOLED TO THE PROPER OPERATING TEMPERATURE.

FAILURE MODE:  
 INTERNAL LEAKAGE, FREON 21 TO FREON 21.

CAUSE(S):  
 CORROSION, MECHANICAL SHOCK, VIBRATION.

EFFECT(S) ON:  
 (A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE  
 (A) THE TWO FREON COOLANT LOOPS BECOME INTERCONNECTED RESULTING IN TRANSFER OF COOLANT FROM ONE LOOP TO THE OTHER UNTIL PRESSURE IN BOTH LOOPS IS EQUALIZED.  
 (B) NO EFFECT.  
 (C) POSSIBLE LOSS OF MISSION. EARLY MISSION TERMINATION FOR FIRST FAILURE.  
 (D) SECOND ASSOCIATED FAILURE (EXTERNAL LEAKAGE OF EITHER FREON COOLANT LOOP) WILL CAUSE LOSS OF ALL VEHICLE COOLING AND MAY RESULT IN 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 CORROSION RESISTANT AND COMPATIBLE WITH FC-40 AND FREON 21, AND CONTAINS NO MOVING PARTS SUBJECT TO WEAR. THE FLOW HEADERS ARE MACHINED FROM A SINGLE PIECE STAINLESS STEEL BAR. THE HEADERS ARE WELDED TO THE CORE, WHICH IS MADE OF 147 STACKED PLATE-FIN STAINLESS STEEL 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 HEAT EXCHANGER WAS SUBJECTED TO A PROOF/RUPTURE TEST FOR QUALIFICATION. DESIGN PROOF IS 760 PSIG AND UNIT DID NOT RUPTURE UNTIL 2440 PSIG (NOMINAL FC-40 OPERATING PRESSURE IS 65 PSIA). VIBRATION TESTED AT 0.3 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 AND AGAIN IN ATP OF ITEM.

CMRSD - FCL'S LEAK CHECKED PRIOR TO EACH FLIGHT. FLUID USE CONTROLLED : SE-S-0073.

(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 WELDS (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.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

NO FAILURE HISTORY.

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(E) OPERATIONAL USE

GROUND CONTROLLER WILL IDENTIFY HARDWARE FAILURE. PUMP INLET PRESSURES CONVERGE AND ACCUMULATOR QUANTITIES DIVERGE. BOTH LOOPS WILL OPERATE NORMALLY. A LEAK IN EITHER LOOP WILL CAUSE LOSS OF BOTH LOOPS. THEREFORE, FAILURE IS TREATED AS LOSS OF ONE FREON LOOP. ENTRY AT NEXT PRIMARY LANDING SITE.