

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ACTIVE THERMAL CONTROL FMEA NO 06-3C -0207 -1 REV:08/23/E  
ASSEMBLY : FREON THERMAL LOOP CRIT. FUNC: 15  
P/N RI : MC250-0001-0010/0610 CRIT. HDW: :  
P/N VENDOR: SV755519 VEHICLE 102 103 104  
QUANTITY : 1 EFFECTIVITY: X X X  
: ONE, DUAL LOOP OPERATION PHASE(S): PL LO X OO X DO X LS  
:

PREPARED BY: DES O. TRAN *O. Tran* APPROVED BY: REDUNDANCY SCREEN: A-PASS B-PASS C-PASS  
REL D. RISING *D. Rising* DES *Michael James Fuller* APPROVED BY (NASA): SSM *Bill Ritten*  
QE W. SMITH *W. Smith* PL'S QE *J. Loman* REL *J. Loman* QE *Jim D. ...*

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:

LEAKAGE, FREON 21 LOOP TO FC-40 LOOP.

CAUSE(S):

MECHANICAL SHOCK, VIBRATION, CORROSION.

EFFECT(S) ON:

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

(A) LOSS OF ONE FREON COOLANT LOOP. OVERPRESSURIZATION OF ONE FC-40 COOLANT LOOP DUE TO HIGHER PRESSURE IN FREON 21 LOOP.

(B) LOSS OF ONE FUEL CELL DUE TO POWER DOWN FOR LEAKING FUEL CELL SEALS (GREATER THAN 60 PSIA).

(C) POSSIBLE LOSS OF MISSION. EARLY MISSION TERMINATION FOR FIRST FAILURE.

(D) SECOND ASSOCIATED FAILURE (LOSS OF REDUNDANT 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 CONTAINS 147 STACKED PLATE-FIN STAINLESS STEEL PARTIAL 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 FREON OPERATING PRESSURE IS 110 PSIA). VIBRATION TESTED AT 0. 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 THE ATP.

OMRSD - FCL'S LEAKCHECKED PRIOR TO EACH FLIGHT. FC-40 COOLANT LOOP ULLAGE IS VERIFIED PRIOR TO EACH FLIGHT. FC-40 AND FREON 21 ARE CONTROLLED TO 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

ON-BOARD ALARM, FUEL CELL COOLANT PRESSURE, WILL PROVIDE INDICATION OF  
HARDWARE FAILURE. THE FREON LOOP WILL OPERATE NORMALLY. THE FUEL CELL  
WILL BE SHUT DOWN CAUSING AN EARLY END OF MISSION.