

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1B -0526 -2 REV:09/27/88
ASSEMBLY : HEAT EXCHANGER, LCG CRIT. FUNC: 1R
P/N RI : MC621-0008-0020 CRIT. HDW: 2
P/N VENDOR: SV729791 VEHICLE 102 103 104
QUANTITY : 1 EFFECTIVITY: X X X
: ONE PER S SYSTEM PHASE(S): PL LO OO X DO LS

REDUNDANCY SCREEN: A-PASS B-N/A C-PASS
PREPARED BY: APPROVED BY: APPROVED BY (NASA):
DES N. K. DUONG DES *[Signature]* SSM *[Signature]*
REL N. L. STEISSLINGER REL *[Signature]* REL *[Signature]*
QE D. STOICA QE *[Signature]* QE *[Signature]*

ITEM:
HEAT EXCHANGER, LIQUID COOLED GARMENT

FUNCTION:
PROVIDES COOLING FOR THE LIQUID COOLED GARMENT WATER LOOP. THERE ARE TWO GARMENT LOOPS PASSING THROUGH THIS HEAT EXCHANGER.

FAILURE MODE:
INTERNAL LEAKAGE, WCL TO GARMENT LOOP

CAUSE(S):
MECHANICAL SHOCK, VIBRATION, CORROSION

EFFECT(S) ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
(A) NO EFFECT UNTIL LCG IS CONNECTED TO ARS/LCG COOLANT LINES, THEN LOSS OF WATER FROM ONE ARS COOLANT LOOP THROUGH THE RELIEF VALVE IN THE LCG.
(B) ARS COOLANT WATER WOULD MIX WITH LCG COOLANT WATER. LOSS OF ONE ARS/LCG COOLANT FLOW PATH.
(C) EXTENDED EVA PORTION OF MISSION - ONLY ONE LCG CAN BE SUPPORTED BY ARS COOLING AT ONE TIME. POSSIBLE EARLY MISSION TERMINATION FOR LOSS OF ONE WATER COOLANT LOOP.
(D) REDUCED EVA CAPABILITY WITH FIRST FAILURE. LOSS OF EVA CAPABILITY WITH SECOND FAILURE OF SAME MODE IN SECOND LCG LOOP. POTENTIAL LOSS OF CREW/VEHICLE UPON LOSS OF REDUNDANT WATER COOLANT LOOP. SCREEN B IS N/A BECAUSE REDUNDANT LOOP IS INOPERATIVE UNTIL REQUIRED.

DISPOSITION & RATIONALE:
(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN
HEAT EXCHANGER IS A CRES BRAZED/WELDED PLATE-FIN ASSEMBLY. THE HEAT TRANSFER FLUID IS A HIGH PURITY/LOW OXYGEN CONTENT WATER AND THE SYSTEM CONTAINS A 10/25 MICRON FILTER. SYSTEM COMPONENTS AND SEALS ARE SELECTED TO BE COMPATIBLE WITH WATER AND ALCOHOL. THE FIN GEOMETRY IS 0.020 INCHES IN HEIGHT AND 0.002 INCHES THICK WITH 32 FINS PER INCH.

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(B) TEST

ACCEPTANCE TEST - PROOF PRESSURE TESTED AT 126-139 PSIG FOR 5 MINUTES. ALLOWABLE INTERNAL AND EXTERNAL GHE LEAKAGE RATE OF 3.2×10^{-5} SCF MAXIMUM AT 90 PSIG. ALLOWABLE PRESSURE DROP OF 2.1 PSI MAXIMUM AT 950 PPH FLOW. VISUAL INSPECTION OF TUBES.

QUALIFICATION TEST - QUALIFIED FOR STRESS AND LIFE BY ANALYSIS AND ALSO BY SIMILARITY TO THE GSE HEAT EXCHANGER. QUALIFIED FOR VIBRATION AND SHOCK BY SIMILARITY TO GSE HEAT EXCHANGER. SUBJECTED TO RANDOM VIBRATION SPECTRUM ENVELOPE OF 20 TO 80 HZ INCREASING AT 6 DB/OCTAVE TO 0.075 G**2/HZ, CONSTANT AT 0.075 G**2/HZ FROM 80 TO 700 HZ, DECREASING AT 6 DB/OCTAVE FROM 700 TO 2000 HZ FOR 48 MINUTES PER AXIS IN THREE ORTHOGONAL AXES. DESIGN SHOCK - THREE TERMINAL SAWTOOTH PULSES OF 20 G PEAK AMPLITUDE AND 11 MS DURATION APPLIED IN BOTH DIRECTIONS ALONG EACH OF THREE ORTHOGONAL AXES.

IN-VEHICLE TESTING - INTERLOOP LEAK TESTS ARE PERFORMED ON ALL HEAT EXCHANGERS.

OMRSD - WCL PRESSURE IS MONITORED IN THE EMU CHECKOUT, PERFORMED EVERY TURNAROUND.

(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.

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HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

NO FAILURE HISTORY APPLICABLE TO WCL TO LCG LEAKAGE FAILURE MODE. THE LCG HEAT EXCHANGER HAS SUCCESSFULLY PERFORMED WITHOUT FAILURE THROUGHOUT THE DURATION OF THE SHUTTLE PROGRAM.

(E) OPERATIONAL USE

TBS.