

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1B -0505 -3 REV: 09/07/86

ASSEMBLY : WATER COOLANT LOOP CRIT. FUNC: 1R
P/N RI : MC250-0001-0440/0540 CRIT. HDW: 2
P/N VENDOR: SV755517

QUANTITY : 1	VEHICLE	102	103	104
: DUAL LOOP	EFFECTIVITY:	X	X	X
: ONE PER SUBSYSTEM	PHASE(S):	PL	LO X OO X DO X LS	

PREPARED BY: DES N. K. DUONG
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QE D. STOICA

REDUNDANCY SCREEN: A-PASS B-PASS C-PASS
APPROVED BY: (NASA):
DES *[Signature]* SSM
REL *[Signature]*
QE *[Signature]*

ITEM:
INTERCHANGER, WATER/FREON INTERFACE

FUNCTION:
TRANSFERS CABIN WASTE HEAT FROM EITHER THE PRIMARY OR SECONDARY WATER COOLANT LOOPS TO THE FREON COOLANT LOOPS FOR DISSIPATION.

FAILURE MODE:
INTERNAL LEAKAGE, FREON TO WATER

CAUSE(S):
MECHANICAL SHOCK, VIBRATION, CORROSION

EFFECT(S) ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE

(A) LEAKAGE OF FREON INTO WCL DUE TO HIGHER PRESSURE FROM FREON COOLANT LOOPS.

(B) NO EFFECT.

(C) POSSIBLE EARLY MISSION TERMINATION FOR FIRST FAILURE.

(D) SECOND ASSOCIATED FAILURE (LEAKAGE OF WATER COOLANT LOOP INTO CABIN WILL EXPOSE CREW TO TOXIC FREON-21 VAPOR 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 INTERCHANGER IS MADE FROM STAINLESS STEEL AND NICKEL BRONZE ALLOYS WHICH ARE CORROSION RESISTANT AND COMPATIBLE WITH FREON 21 AND WATER, 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 STACKED STAINLESS STEEL PLATE-FIN PARTING SHEETS (THICKNESS = 0.005 INCH). DESIGN PROOF PRESSURE OF 1.5 AND BURST PRESSURE OF 2.0 TIMES MAXIMUM OPERATING PRESSURE. TESTING PERFORMED BY RI INDICATED THAT, BASED ON THE WORST CASE CONDITIONS, IT TAKES 54 HOURS AFTER FREON IS INTRODUCED INTO THE WATER COOLANT LOOP TO REACH 10 PSI

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(MAX ALLOWABLE LIMIT) CONCENTRATION IN THE CABIN. THIS IS SUFFICIENT
TIME TO REACH THE FIRST PLS.

(B) TEST

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

QUALIFICATION TEST - QUALIFICATION TESTED FOR 100 MISSION LIFE. THE
INTERCHANGER WAS SUBJECTED TO A PROOF/RUPTURE TEST FOR QUALIFICATION.
DESIGN PROOF IS 575 PSIG AND UNIT DID NOT RUPTURE UNTIL 2440 PSIG.
(MAXIMUM WATER COOLANT LOOP OPERATING PRESSURE IS 90 PSIG). 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. INTERNAL LEAKAGE MAX OF 0.001 SCC/HR AT
70 F AND 320 PSID FOR BOTH FREON AND WATER.

IN-VEHICLE TESTING - SYSTEM LEAK TESTS ARE PERFORMED IN BOTH THE WATER
AND FREON LOOPS. PUMP OUT PRESSURE AND ACCUMULATOR QUANTITY ARE
CONTINUOUSLY MONITORED WHEN THE VEHICLE IS POWERED UP. LEAKAGE FROM
FREON TO WATER WOULD BE INDICATED BY INCREASING QUANTITY AND PRESSURE.

OMRSD - PUMP ACCUMULATOR QUANTITY AND OUTLET PRESSURE ARE CONTINUOUSLY
MONITORED WHILE THE VEHICLE IS POWERED UP DURING EACH TURNAROUND, AND
SERVE AS AN INDICATION OF LEAKAGE. WATER IS SAMPLED PER SPEC SE-S-0072
DURING SERVICING.

(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

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10X MAGNIFICATION VISUALLY INSPECTED. BRAZES ARE VERIFIED BY PROOF AIR
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 APPLICABLE TO INTERNAL LEAKAGE FAILURE MODE. T-
INTERCHANGER HAS SUCCESSFULLY PERFORMED WITHOUT FAILURE THROUGH T-
DURATION OF THE SHUTTLE PROGRAM.

(E) OPERATIONAL USE

TBS.