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PRINT DATE: 08/30/93

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: 06-1B-0532-X**

SUBSYSTEM NAME: ARS - COOLING

REVISION: 4 08/25/93

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: HUMIDITY CONTROL HEAT EXCHGR HAMILTON STANDARD	MC621-0008-0002 SV755504-4

PART DATA

QUANTITY OF LIKE ITEMS: 1

FUNCTION:

HEAT EXCHANGER, HUMIDITY CONTROL, REDUNDANT COOLANT LOOPS/SINGLE AIR LOOP

COOLS CABIN AIR BELOW DEW POINT TO CONDENSE EXCESS MOISTURE AND REMOVE EXCESS CABIN HEAT.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1B -0532 -1 REV: 09/07/2

ASSEMBLY : HK-HUM & TEMP CONTROL CRIT. FUNC: 1R
 P/N RI : MC621-0008-0002 CRIT. HDW: 2
 P/N VENDOR: SV753504-4 HAM STD VEHICLE 102 103 104
 QUANTITY : 1 EFFECTIVITY: X X X
 : DUAL LOOP PHASE(S): PL LO X OO X DO X LS
 : ONE PER SUBSYSTEM

PREPARED BY: DES N. K. DUONG
 REL N. L. STEISSLINGER
 QE D. STOICA

REDUNDANT SCREEN: A-PASS B-PASS C-PAS
 APPROVED BY: (NASA)
 SSM
 REL
 QE

ITEM: HEAT EXCHANGER - HUMIDITY CONTROL, REDUNDANT COOLANT LOOPS/SINGLE AIR LOOP

FUNCTION: COOLS CABIN AIR BELOW DEW POINT TO CONDENSE EXCESS MOISTURE AND REMOVE EXCESS CABIN HEAT.

FAILURE MODE: INTERNAL LEAKAGE, WCL TO WCL

CAUSE(S): MECHANICAL SHOCK, VIBRATION, CORROSION, MATERIAL DEFECT

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

(A) TRANSFER OF COOLANT FROM ONE WATER LOOP TO THE OTHER UNTIL PRESSURE IN BOTH LOOPS IS EQUALIZED.

(B) NO EFFECT.

(C) POSSIBLE EARLY MISSION TERMINATION FOR FIRST FAILURE.

(D) SECOND ASSOCIATED FAILURE (LEAKAGE OF ONE WATER COOLANT LOOP) WILL CAUSE LOSS OF ALL CABIN 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
 HEAT EXCHANGER IS A 347 CRES BRAZED ASSEMBLY; MINIMUM THICKNESS 0.030 IN. IT IS A CROSS COUNTER FLOW PLATE-FIN TYPE WITH A TWO PASS WATER SIDE AND SINGLE PASS AIR SIDE. HEAT EXCHANGER AIR PASSAGES HAVE HYDROPHILIC COATING (ON HALF OF THE AIR FLOW PATH, FROM MIDPOINT TO HEAT EXCHANGER OUTLET) TO ENHANCE SURFACE WETTING, TO PRECLUDE OBSTRUCTION OF THE PASSAGES BY WATER. A "SLURPER" BAR ON THE DOWNSTREAM SIDE OF THE HEAT EXCHANGER CONTAINS A SERIES OF HOLES MANIPOLDED TOGETHER AND CONNECTED TO AN AIR SUCTION SOURCE AND H2O SEPARATOR. MATERIALS OF CONSTRUCTION INCLUDE NICKEL WATER FINS AND 347 CRES AIR FINS, PARTING SHEETS AND HEADERS. AIR FINS ARE 0.20 IN. HIGH X 0.002 IN. THICK X 16 FINS PER

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INCH. FUNGUS - UNIT MEETS RI SPEC MC999-0096 PARA. 3.23. MATERIAL SELECTION HAS PROVEN RESISTANCE TO THE TEMPERATURE, HUMIDITY AND SALT F LEVELS TO WHICH THE UNIT MAY BE EXPOSED.

(B) TEST

ACCEPTANCE TEST - EXAMINATION OF PRODUCT. AIR FLOW VS DELTA-P (0.8 INCH MAX) OF HEAT EXCHANGER IS VERIFIED. INTERPATH LEAKAGE 0.00 CC/HR OF H₂ AT 90 +/- 5 PSID.

QUALIFICATION TEST - SHOCK TEST - 20G TERMINAL SAWTOOTH PULSE OF 11 MS DURATION IN EACH DIRECTION OF THREE ORTHOGONAL AXES. SUBJECTED TO RAND VIBRATION SPECTRUM ENVELOPE OF 20 TO 150 HZ INCREASING AT 6 DB/OCTAVE TO 0.03 G**2/HZ, CONSTANT AT 0.03 G**2/HZ FROM 150 TO 1000 HZ, DECREASING 6 DB/OCTAVE FROM 1000 TO 2000 HZ FOR 48 MINUTES PER AXIS IN THREE ORTHOGONAL AXES. AIR FLOW PATH PRESSURE DROP TEST UNDER THE FOLLOWING CONDITIONS: WITH WET AIR, 0.8 INCHES H₂O MAX AT 1411 LB/HR; WITH DRY AIR, 0.6 INCHES H₂O MAX AT 1411 LB/HR; WITH SLURPER WET, 2.3 INCHES H₂O MAX AT 9.5 CFM.

IN-VEHICLE TESTING - SYSTEM LEAK TEST IS PERFORMED AT 85 - 95 PSIG, 5 CC/MIN MAX LEAKAGE. LOOPS ARE SERVICED WITH A DELTA OF APPROXIMATELY 10% BETWEEN THEIR ACCUMULATOR QUANTITIES TO ENABLE DETECTION OF INTERLOOP LEAKAGE.

OMRSD - LOOPS ARE SERVICED WITH A DELTA OF APPROXIMATELY 10% BETWEEN THEIR ACCUMULATOR QUANTITIES AND 2 PSID DIFFERENTIAL BETWEEN THE LOOPS. TO ENABLE DETECTION OF INTERLOOP LEAKAGE. PUMP OUT PRESSURE AND ACCUMULATOR QUANTITY ARE MONITORED CONTINUOUSLY WHEN THE VEHICLE IS POWERED UP DURING EACH TURNAROUND. WATER IS SAMPLED PER SPEC SE-5-0073 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

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WELDS (MOUNTING PADS AND HEADER WELDS TO THE CORES) ARE PENETRANT AND 10X MAGNIFICATION VISUALLY INSPECTED. BRAZES ARE VERIFIED BY PPOOF 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 APPLICABLE TO INTERNAL LEAKAGE, WCL TO WCL FAILURE MODE. THE HUMIDITY CONTROL HEAT EXCHANGER HAS SUCCESSFULLY PERFORMED WITHOUT FAILURE THROUGH THE DURATION OF THE SHUTTLE PROGRAM.

(E) OPERATIONAL USE

TBS.