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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 -05J2 -2 REV: 08/15/81

ASSEMBLY : HX-HUM & TEMP CONTROL CRIT. FUNC: 12
 P/N RI : MC621-0008-0002 CRIT. HDW: 2
 P/N VENDOR: SV755504-4 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

REDUNDANCY SCREEN: A-PASS B-N/A C-PAS:
 APPROVED BY: DES *[Signature]* APPROVED BY (NASA):
 REL *[Signature]* SSM *[Signature]*
 REL *[Signature]* REL *[Signature]*
 MSQE *[Signature]* for J. COVASEN QE *[Signature]*

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:
 RESTRICTED FLOW, WCL

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

EFFECT(S) ON:
 (A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
 (A) REDUCED OR LOST COOLING CAPABILITY OF ONE WATER COOLANT LOOP.
 (B) NO EFFECT. REDUNDANT LOOP PROVIDES COOLING.
 (C) POSSIBLE EARLY MISSION TERMINATION FOR LOSS OF ONE WATER COOLANT LOOP FOR CABIN AND AVIONICS COOLING.
 (D) POTENTIAL LOSS OF CREW/VEHICLE UPON SUBSEQUENT 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 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 MANIFOLDED 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

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HEADERS. AIR FINS ARE 0.20 IN. HIGH X 0.002 IN. THICK X 16 FINS PER INCH. FUNGUS - UNIT MEETS RI SPEC MC999-0096 PARA. 3.23. MATERIAL SELECTION HAS PROVEN RESISTANCE TO THE TEMPERATURE, HUMIDITY AND SALT LEVELS TO WHICH THE UNIT MAY BE EXPOSED. UPSTREAM OF THE HEAT EXCHANGER IS THE 40/70 MICRON CABIN DEBRIS TRAP FILTER (AT INLET TO CABIN FANS). UPSTREAM ALSO, LIOH ELEMENTS SERVE AS DEBRIS FILTERS. THERE IS NO SCOT FOR DEBRIS GENERATION BETWEEN THE LIOH OUTLET AND THE HEAT EXCHANGER.

(B) TEST

QUALIFICATION TEST - SHOCK TEST - 20G TERMINAL SAWTOOTH PULSE OF 11 MS DURATION IN EACH DIRECTION OF THREE ORTHOGONAL AXES. VIBRATION TESTED UP TO 0.03 G**2/HZ IN THREE ORTHOGONAL AXES FOR 48 MINUTES PER AXIS. 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.

ACCEPTANCE TEST - EXAMINATION OF PRODUCT. AIR FLOW VS DELTA-P (0.8 INH MAX) OF HEAT EXCHANGER IS VERIFIED. H2O FLOW VS DELTA PRESSURE TEST - 1.40 PSID MAXIMUM AT 1009 +/-10/-0 LBS/HR.

IN-VEHICLE TESTING - PUMP CHECKS ARE PERFORMED AND PUMP OUT PRESSURE IS CONTINUOUSLY MONITORED WHEN THE VEHICLE IS POWERED UP; SERVES AS AN INDICATION OF BLOCKAGE IN THE LOOP.

OMRSD - PUMP OUTLET PRESSURE IS CONTINUOUSLY MONITORED WHEN THE VEHICLE IS POWERED UP DURING EACH TURNAROUND AND SERVES AS AN INDICATION OF BLOCKAGE IN THE LOOP. WATER IS SAMPLED PER SPEC SE-S-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.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

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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 APPLICABLE TO RESTRICTED FLOW, WCL FAILURE MODE. HUMIDITY CONTROL HEAT EXCHANGER HAS SUCCESSFULLY PERFORMED WITHOUT FAILURE THROUGH THE DURATION OF THE SHUTTLE PROGRAM.

(E) OPERATIONAL USE

TBS.