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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 -4 REV: 09/07/8

ASSEMBLY : HX-HUM & TEMP CONTROL CRIT. FUNC: 1R
P/N RI : MCS21-0008-0002 CRIT. HOW: 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-PASS C-PAS
APPROVED BY: *[Signature]* APPROVED BY (NASA):
DES *[Signature]* SSM *[Signature]*
REL *[Signature]* REL *[Signature]*
QE *[Signature]* 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:
LEAKAGE, WATER TO AIR PASSAGE

CAUSE(S):
MECHANICAL SHOCK, VIBRATION, CORROSION

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

(A) LOSS OF REDUNDANCY - LOSS OF ONE WATER COOLANT LOOP.

(B) EXCESS WATER IN HUMIDITY SEPARATOR INLET LINE UNTIL SEPARATOR CAN DISPOSE OF THE WATER. POSSIBLE WATER CARRY-OVER INTO CABIN.

(C) POSSIBLE EARLY MISSION TERMINATION DUE TO LOSS OF ONE WATER COOLANT LOOP.

(D) POTENTIAL LOSS OF CREW/VEHICLE UPON SUBSEQUENT LOSS OF REDUNDANT WATER COOLANT LOOP.

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

(A) DESIGN
HEAT EXCHANGER IS A 147 CRES BRAZED ASSEMBLY; MINIMUM THICKNESS 0.030 I
IT IS A CROSS COUNTER FLOW PLATE-PIN TYPE WITH A TWO PASS WATER SIDE AN
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
AN AIR SUCTION SOURCE AND H2O SEPARATOR. MATERIALS OF CONSTRUCTION
INCLUDE NICKEL WATER FINS AND 147 CRES AIR PINS, 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 EXCHANGE IS THE 40/70 MICRON CABIN DEBRIS TRAP FILTER (AT INLET TO CABIN FANS). UPSTREAM ALSO, LIQH ELEMENTS SERVE AS DEBRIS FILTERS. THERE IS NO SOLE FOR DEBRIS GENERATION BETWEEN THE LIQH OUTLET AND THE HEAT EXCHANGER.

(B) TEST

ACCEPTANCE TEST - EXAMINATION OF PRODUCT. ~~TEST~~ TEST - WATER LOOP EXTERNAL AND WATER TO AIR: 3.2 X 10 EXP -4 SCCS GHE MAXIMUM OR 0.001 CC/HR OF WATER AT 91-109 PSIA.

QUALIFICATION TEST - SHOCK TEST - 20G TERMINAL SAWTOOTH PULSE OF 11 MS DURATION IN EACH DIRECTION OF THREE ORTHOGONAL AXES. SUBJECTED TO RANG VIBRATION SPECTRUM ENVELOPE OF 20 TO 150 HZ INCREASING AT 6 DB/OCTAVE T 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 DECAY TEST IS PERFORMED AT 85 - 95 PSIG, 6 CC/MIN MAX LEAKAGE. PUMP OUT PRESSURE AND ACCUMULATOR QUANTITY ARE CONTINUOUSLY MONITORED WHEN THE VEHICLE IS POWERED UP AND SERVE AS AN INDICATION OF EXTERNAL LEAKAGE.

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 EXTERNAL LEAKAGE. 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

SUBSYSTEM :ATMOSPHERIC REVIT. FMEA NO 06-1B -0532 -4 REV:09/07/8:

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 LEAKAGE, WATER TO AIR FAILURE MODE. HUMIDITY CONTROL HEAT EXCHANGER HAS SUCCESSFULLY PERFORMED WITHOUT FAILURE THROUGH THE DURATION OF THE SHUTTLE PROGRAM.

(E) OPERATIONAL USE

YES.