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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.

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NUMBER: 06-1B-0532-05**

REVISION# 4 08/25/93 R

SUBSYSTEM: ARS - COOLING
LRU: HUMIDITY CONTROL HEAT EXCHGR
ITEM NAME: HUMIDITY CONTROL HEAT EXCHANGER

CRITICALITY OF THIS
FAILURE MODE: 2/2

FAILURE MODE:
RESTRICTED FLOW, AIR

MISSION PHASE:
LO LIFT-OFF
OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:
MECHANICAL SHOCK, VIBRATION, CONTAMINATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:

- A)
- B)
- C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
REDUCED COOLING & HUMIDITY REMOVAL.

(B) INTERFACING SUBSYSTEM(S):
INCREASED TEMPERATURE AND HUMIDITY IN CABIN. DECREASED FLIGHT DECK
AVIONICS COOLING. INCREASED TEMPERATURE OF FLIGHT DECK AVIONICS LRU'S.

(C) MISSION:
POSSIBLE EARLY MISSION TERMINATION FOR SIGNIFICANT DECREASE OF AVIONICS
COOLING.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT. EARLY MISSION TERMINATION WILL PRECLUDE LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

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-DISPOSITION RATIONALE-

(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 TO ENHANCE SURFACE WETTING, TO PRECLUDE OBSTRUCTION OF THE PASSAGES BY WATER. "SLURPER" BARS 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 HEADERS. AIR FINS ARE 0.20 IN. HIGH X 0.002 IN. THICK X 16 FINS PER INCH. FUNGUS - UNIT MEETS RI SPEC MC999-0066 PARA. 3.23. MATERIAL SELECTION HAS PROVEN RESISTANCE TO THE TEMPERATURE, HUMIDITY AND SALT FOG 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). THERE IS NO SOURCE FOR SIGNIFICANT DEBRIS GENERATION BETWEEN THE LIQH OUTLET AND THE HEAT EXCHANGER WHICH COULD RESULT IN TOTAL HEAT EXCHANGER BLOCKAGE.

(B) TEST:

ACCEPTANCE TEST - EXAMINATION OF PRODUCT. AIR FLOW VS DELTA-P (0.8 IN H2O MAX) OF HEAT EXCHANGER IS VERIFIED. AIR FLOW PATH IS CLEANED TO HS1550 C1.

QUALIFICATION TEST - SHOCK TEST - 20G TERMINAL SAWTOOTH PULSE OF 11 MS DURATION IN EACH DIRECTION OF THREE ORTHOGONAL AXES. SUBJECTED TO RANDOM 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 AT 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.

OMRSD - CABIN FAN FILTERS ARE CLEANED EACH TURNAROUND AND LRU AVIONICS FILTERS ARE CLEANED EACH TURNAROUND AND ON A CONTINGENCY BASIS IN THE EVENT OF AN EXTENDED OPF/OMCF FLOW. THE THREE TYPES OF AVIONICS LRU FILTERS ARE CLEANED PER OMRSD. VISUAL INSPECTION OF THE HYDROPHILIC COATING IS PERFORMED EVERY TENTH FLIGHT. A BLOWDOWN AIR PRESSURE TEST IS CONDUCTED TO COLLECT CONTAMINANTS FROM THE SLURPER BARS ON A CONTINGENCY BASIS IF HUMIDITY SEPARATOR AIR FLOW RATE IS LESS THAN 37 LB/HR (PER AIR FLOW TEST PERFORMED EVERY THIRD FLIGHT). CONDENSATE WATER IS SAMPLED EVERY 5 FLIGHTS TO CHECK FOR MICROBIOLOGICAL GROWTH IN AIR PASSAGES.

(C) INSPECTION:

RECEIVING INSPECTION

RAW MATERIAL AND PURCHASED COMPONENTS REQUIREMENTS ARE VERIFIED BY INSPECTION. PARTS PROTECTION IS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

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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.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

NO FAILURE HISTORY APPLICABLE TO RESTRICTED FLOW, AIR FAILURE MODE. THE HUMIDITY CONTROL HEAT EXCHANGER HAS SUCCESSFULLY PERFORMED WITHOUT FAILURE THROUGH THE DURATION OF THE SHUTTLE PROGRAM.

(E) OPERATIONAL USE:

1. CREW ACTION

SYSTEMS PERFORMANCE TROUBLESHOOTING. VISUAL INSPECTION OF AREA WHERE ACCESS PERMITS.

2. TRAINING

CURRENT ECLSS TRAINING COVERS THE HIGH CABIN TEMPERATURE EFFECT OF THIS FAILURE.

3. OPERATIONAL CONSIDERATIONS

A. DOWNING OF LES FOR LOSS OF P/CO2 CONTROL IS NOT VIABLE FOR ALL PERIODS OF TIME (OXYGEN TOXICITY) DEPENDING ON CABIN PRESSURE.

B. REFERENCE LOSS/FAILURE FLIGHT RULES.

C. REAL TIME DATA SYSTEM ALLOWS FOR GROUND MONITORING

- APPROVALS -

EDITORIALLY APPROVED : RI
EDITORIALLY APPROVED : JSC
TECHNICAL APPROVAL : VIA CR

[Handwritten signatures and dates]
8/30/93
S502500