

PAGE: 1

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 -6 REV: 09/07/88

ASSEMBLY : HX - HUM & TEMP CONTROL CRIT. FUNC: 2
 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
 : PHASE(S): PL LO X OO X DO LS
 :

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

REUNDANCY SCREEN: A- B- C-
 APPROVED BY: 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:
 EXTERNAL LEAKAGE, AIR

CAUSE(S):
 MECHANICAL SHOCK, VIBRATION, CORROSION

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

(A) DECREASE IN CABIN FAN DELTA PRESSURE. REDUCED AIR COOLING.

(B) REDUCTION OF AIR FLOW THROUGH HUMIDITY CONTROL HEAT EXCHANGE RESULTS IN AIR QUALITY DEGRADATION (INCREASED CABIN TEMPERATURE AND HUMIDITY) AND REDUCTION OF FLIGHT DECK AVIONICS COOLING. INCREASE TEMPERATURE OF FLIGHT DECK AVIONICS LRU'S.

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

(D) NO EFFECT. EARLY MISSION TERMINATION WILL PRECLUDE LOSS OF CREW/VEHICLE.

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

(A) DESIGN
 HEAT EXCHANGER HOUSING IS A .347 GRES ASSEMBLY WITH HEADERS WELDED TO CORE. MINIMUM THICKNESS IS 0.030 IN. DESIGN FLOW RATE IS 432 - 152 LB/HR. HEAT EXCHANGER HAS NO MOVING PARTS AND OPERATES AT LOW PRESSURE

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ATMOSPHERIC REVIT. FMEA NO 06-1B -0512 -6 REV:09/07/88

SUCH THAT GROSS EXTERNAL LEAKAGE RESULTING IN LOSS OF AVIONICS COOLING CAPABILITY IS CONSIDERED REMOTE.

(B) TEST

ACCEPTANCE TEST - LEAKAGE TEST VERIFIES EXTERNAL LEAKAGE RATE OF LESS THAN 0.01 LB/MIN AIR AT 70 P AND DELTA P OF 5.0 - 5.2 INH2O. PROOF TEST AT 135 PSIG ON THE WATER SIDE WITH NO DEFORMATION.

QUALIFICATION TEST - RANDOM VIBRATION SPECTRUM OF 20 TO 150 HZ INCREASE 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. 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. ATP PERFORMED TO VERIFY LEAKAGE AFTER SHOCK AND VIBRATION TESTING.

IN-VEHICLE TESTING - CABIN FAN DELTA-P IS MONITORED CONTINUOUSLY WHEN THE VEHICLE IS POWERED UP.

OMRSD - CABIN FAN DELTA-P IS MONITORED CONTINUOUSLY WHEN THE VEHICLE IS POWERED UP DURING TURNAROUND AND SERVES AS AN INDICATION OF EXTERNAL LEAKAGE.

(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 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.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1B -0512 -6 REV:09/07/8

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

NO FAILURE HISTORY APPLICABLE TO EXTERNAL LEAKAGE, 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 RESPONSE

SYSTEMS PERFORMANCE TROUBLESHOOTING.

2. TRAINING

CURRENT ECLSS TRAINING COVERS THE LOW CABIN FAN DELTA-P EFFECT OF THE
FAILURE AND THE POTENTIAL RECONFIGURATION.

3. OPERATIONAL CONSIDERATIONS

A. REAL TIME DATA SYSTEM ALLOWS FOR GROUND MONITORING.

B. POTENTIAL REAL TIME IFM REPAIR ATTEMPT IF ACCESSIBILITY PERMITS.