

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :AUXILIARY POWER (AFUS) FMEA NO 04-2 -S16A -1 REV:02/26/83

ASSEMBLY :FUEL SUPPLY CRIT. FUNC: 12
 P/N RI :ME360-0017-0008 CRIT. HDW: 3
 P/N VENDOR:SDC P/N 975-0399-008 VEHICLE 102 103 104
 QUANTITY :6 EFFECTIVITY: X X X
 :1 FOR PRIM HTR ELEM PHASE(S): PL X LO X OO X DO X LS
 :(S16B FOR SEC HTR ELEM)

REDUNDANCY SCREEN: A-PASS B-PASS C-PAS
 PREPARED BY: DES R STEDMAN APPROVED BY: [Signature] APPROVED BY (NASA):
 REL T R BOLTZ TRB REL [Signature] SSM [Signature]
 QE W J SMITH QE [Signature] REL [Signature] [Signature] [Signature]

ITEM:
 THERMOSTAT, FUEL SERVICING LINES (FILL AND TEST LINE).

FUNCTION:
 TO PROVIDE A CLOSED ELECTRICAL CIRCUIT AT 55 DEG F AND AN OPEN CIRCUIT
 65 DEG F (PLUS OR MINUS 5 DEG F). THE THERMOSTAT CONTROLS THE PRIMARY
 ELEMENTS OF THE FUEL SERVICING AND TEST LINE HEATERS. BOTH THE PRIMARY
 AND SECONDARY THERMOSTATS AND HEATERS ARE ACTIVATED PRIOR TO CRYO LOAD
 THROUGH T-0. HEATERS ARE OFF FOR ASCENT AND ONLY ONE HEATER ELEMENT WILL
 BE ACTIVATED DURING THE REMAINDER OF THE FLIGHT. (REFERENCE FMEA
 04-2-HR16 AND HR117).

FAILURE MODE:
 FAILS TO CLOSE, (FAILS OPEN)

CAUSE(S):
 INTERNAL PIECE-PART FAILURE, VIBRATION, BIMETAL DISC CRACK OR FATIGUE,
 LOSS OF HERMETIC SEAL, CONTAMINATION

EFFECT(S) ON:
 (A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE
 (A) NO EFFECT ON APU OPERATION. LOSS OF HEATER REDUNDANCY.
 (B) NO EFFECT.
 (C) LAUNCH SCRUB IF DETECTED.
 (D) NO EFFECT UNLESS FUEL FREEZES, LINE RUPTURES AND EXPOSED FUEL
 IGNITES. POSSIBLE LOSS OF CREW/VEHICLE.

DISPOSITION & RATIONALE:
 (A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE
 (A) DESIGN
 THE ELECTRICAL SYSTEM IS DESIGNED WITH (3) DRIVERS THROUGH (RPC) TO TURN
 ON THE HEATER. A (3) POLE SWITCH WHICH HAS (1) POLE TO EACH DRIVER
 ENERGIZES THE CIRCUIT. ANY TWO DRIVERS WILL ENERGIZE A HEATER; ONE
 DRIVER FAILING ON WILL NOT DELIVER POWER TO THE HEATER.

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SWITCH IS DESIGNED TO MEET THE REQUIREMENTS OF MIL-S-24236. IT IS ALL WELDED CONSTRUCTION, VIBRATION, AND CORROSION RESISTANT, SIMPLE, SNAP-ACTING THERMAL SWITCH, HERMETICALLY SEALED WITH DRY NITROGEN. IT IS RATED AT 5 AMPS AND WILL ONLY CARRY MILLIAMPS.

(B) TEST

PART ACCEPTANCE TEST INCLUDES CONTACT RESISTANCE, SEAL TEST, CREEP, AND 250 CYCLE RUN-IN.

IT IS QUALIFIED BY SIMILARITY TO LIKE MIL-S-24236 SWITCHES BUILT BY SUNDSTRAND DATA CONTROL. THE SWITCH WAS QUALIFICATION TESTED.

OMRSD: APU 1/2/3 HEATER TEST BY COCKPIT COMMAND VERIFIES THERMOSTATS FOR FIRST FLIGHT AND ON A CONTINGENCY BASIS THEREAFTER ANY TIME THE LINE, INSULATION, OR HEATER IS DISTURBED. THERMOSTATS ARE VERIFIED OPERATIONAL EVERY FLIGHT.

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIALS ARE CERTIFIED AND VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS REQUIREMENTS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING OPERATIONS ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PARTICLE IMPACT NOISE DETECTION (PIND) IS VERIFIED BY INSPECTION.

FLUOROCARBON LEAK CHECK IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

WELDING PER SPECIFICATION REQUIREMENTS IS VERIFIED BY INSPECTION.

TESTING

TEST EQUIPMENT CALIBRATION AND CERTIFICATION ARE VERIFIED BY INSPECTION. BURN-IN CYCLING IS VERIFIED BY INSPECTION. ATP IS WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE, AND SHIPPING PROCEDURES ARE VERIFIED.

(D) FAILURE HISTORY

CAR 07F005 AND 07F026 - THERMOSTATS FAILED OPEN. THESE LOW CURRENT APPLICATION SWITCHES HAVE SILVER CONTACTS AND ARE PRONE TO TARNISH AND FILM DEPOSITS. THIS LOW CURRENT IS SOMETIMES INSUFFICIENT TO OVERCOME THE TARNISH AND THE SWITCHES FAIL. CORRECTIVE ACTION MAY BE TO USE GOLD CONTACTS THAT HAVE A HIGH RESISTANCE TO FILMING.

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CAR 24FC12 - THERMOSTAT FAILED OPEN. ANALYSIS DISCLOSED CONTAMINANTS ON THE CONTACTS WHICH WERE DERIVED FROM THE BIMETAL DISC AND STRIKER PIN. THE CLEANING FILTRATION PROCESS HAS BEEN CHANGED AND THE STRIKER PIN NOW HAS A METAL CAP. THESE CHANGES WERE MADE TO ELIMINATE PARTICLE CONTAMINATION PROBLEMS AND TO REDUCE WEAR ON THE BIMETAL DISC AND STRIKER PIN.

(E) OPERATIONAL USE

MANUALLY SWITCH TO ALTERNATE HEATER.