

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : LIFE SUPPORT

FMEA NO 06-2F -311000-2 REV.10/29/87

ASSEMBLY : SMOKE DETECTION
 P/N RI : MC431-0127-0103/-1103
 P/N VENDOR:
 QUANTITY : 9
 : 3 IN CREW CABIN
 : 2 IN EACH OF 3 AV BAYS

CRIT. FUNC: 1R
 CRIT. HDW: 2
 VEHICLE 102 103 104
 EFFECTIVITY: X X X
 PHASE(S): PL X LO X CO X DO X LS X

PREPARED BY: DES D. WADA REL D. RISING QE W. SMITH

REDUNDANCY SCREEN: A-PASS B-PASS C-PASS
 APPROVED BY: DES *[Signature]* REL *[Signature]* QE *[Signature]*

APPROVED BY (NASA): SSM *[Signature]* 10/29/87
 REL *[Signature]* 10/29/87
 QE *[Signature]* 11-2-87

ITEM:
 SMOKE DETECTOR ASSEMBLY
 CABIN AND AVIONIC BAY AREAS.

FUNCTION:
 TO PROVIDE A WARNING TO CREW DURING THE INCIPIENT STAGE OF A POTENTIAL FIRE CONDITION. CONSISTS OF THREE DETECTOR HEADS IN THE CABIN AREA AND TWO IN EACH AVIONICS BAYS, EACH WITH A BUILT IN LOGIC DEVICE WHICH ACTUATES AN EXTERNAL ALARM.

FAILURE MODE:
 GENERATES FALSE ALARM.

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

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

(A) LOSS OF ONE OF TWO REDUNDANT SMOKE DETECTORS IN AVIONICS BAY OR CABIN.

(B) LOSS OF ONE OF TWO REDUNDANT SMOKE DETECTORS AND POSSIBLE TIME DELAY TO DETECT SMOKE.

(C) NO EFFECT.

(D) SECOND ASSOCIATED FAILURE (REDUNDANT SMOKE DETECTOR) WOULD RESULT IN LOSS OF ALL SMOKE DETECTION IN AVIONICS BAY. UNDETECTABLE FIRE MAY CAUSE LOSS OF CREW/VEHICLE.

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

(A) DESIGN
 CORROSION RESISTANT MATERIALS PER QQ-7-763 AND QQ-P-35; AIR INLET SCREEN - 50 MICRON AND LARGE SURFACE (2 1/2 " DIA); DUAL SENSE CHAMBERS TO COMPENSATE FOR ENVIRONMENTAL CHANGES - PRESSURE, TEMPERATURE, RADIATION; SELF-TEST CIRCUITRY - VERIFIES, ALARM LOGIC AND SIGNAL (VCO, LSI); HIGH

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RELIABILITY, SOLID STATE HARDWARE; EEE PARTS MEET MF0004-400 REQUIREMENTS; CLEANLINESS PER MC999-0096 (CLEAN ROOM 300,000); SOLDERING PER ATLANTIC RESEARCH SPEC. ST-41204; CONFORMAL COATING.

(B) TEST

QUALIFICATION TEST - QUALIFIED FOR 100 MISSION LIFE. ELECTRICAL BONDING; ACCELERATION - 5G; 20G SHOCK/AXIS AND 100 MISSION VIBRATION (0.09G SQ/HZ FOR 48 MIN/AXIS); RANDOM VIBRATION (.067G SQ/HZ FOR 5 MIN/AXIS), 5% SALT AND 85% RH FOR 120 HRS, 30-24 HR. TEMP. CYCLE TEST (65 TO 135 DEG.F).

ACCEPTANCE TEST - FUNCTIONAL TESTS, 48 HRS @ 24, 28, 32 VDC (INCLUDES SMOKE TESTS); DIELECTRIC STRENGTH AT 500 V/SEC MAX TO 1250 VOLTS RMS; INSULATION RESISTANCE AT 500 VDC; BURN-IN/RUN-IN ; VIBRATION (0.04G SQ/HZ FOR 0.5 MIN/AXIS).

TURNAROUND: SELF TEST EVERY FLIGHT; VISUAL INSPECTION OF INLET SCREEN FOR DEBRIS EVERY TEN FLIGHTS.

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIAL AND VENDOR PURCHASE COMPONENTS ARE VERIFIED BY RECEIVING INSPECTION.

CONTAMINATION CONTROL

CORROSION PROTECTION PROVISIONS AND CONTAMINATION CONTROL PLAN ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

PARTS PROTECTION, MANUFACTURING PROCESSES, INSTALLATION AND ASSEMBLY ARE VERIFIED BY INSPECTION. ENVELOPE AND INTERFACE DIMENSIONS ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES

SOLDERING IS VERIFIED BY INSPECTION. COATING AND PLATING PROCESSES ARE VERIFIED BY INSPECTION. CONFORMAL COATING IS VERIFIED BY INSPECTION.

TESTING

ACCEPTANCE TESTING IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

(1) PROBLEM: SMOKE DETECTOR, -0010, IN AVIONICS BAY 2A GAVE AN ERRONEOUS ALARM. TWO CONDUCTIVE PARTICLES WERE FOUND AFTER OPENING THE LSI.

CORRECTIVE ACTION - SMOKE DETECTORS, -0010, WILL BE REPLACED WITH THE NEW CONFIGURATION, -0103, AS THEY FAIL. (CAR #03F024)

(2) PROBLEM: SMOKE DETECTOR B IN AVIONICS BAY 3 TRIGGERED FALSE ALARMS DURING FLIGHT 61A (OV099). PARTICLE CONCENTRATION LEVELS WERE WELL BELOW ALARM THRESHOLD.

CORRECTIVE ACTION - NONE. NO CHANGE OF SMOKE CONCENTRATION LEVELS DETECTS FALSE ALARM. (CAR #30F001)

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(3) PROBLEM: SMOKE DETECTOR B IN AVIONICS BAY 1B TRIPPED DURING STS-8. AN INCREASE IN SMOKE CONCENTRATION WAS INDICATED. A COMPROMISED SOLDER JOINT BETWEEN THE FET GATE LEAD AND THE REFERENCE ION COLLECTOR PLATE WAS FOUND.

CORRECTIVE ACTION - VENDOR ADDED INSPECTION REQUIREMENTS. (CAR #08F001)

1. VERIFICATION OF STAKED ASSEMBLY.
2. VERIFICATION OF MECHANICAL INTEGRITY OF THE SOLDER JOINT JUNCTION OF THE FET LEAD TO THE ION COLLECTOR PLATE.
3. FIELD UNITS WERE INSPECTED FOR SOURCE PLATE RIGIDITY.

(E) OPERATIONAL USE

IF FALSE ALARM BECOMES A NUISANCE, THE CREW MAY OPEN THE CIRCUIT BREAKER POWERING THE DEFECTIVE SMOKE DETECTOR AND USE THE REDUNDANT DETECTOR FOR THE AFFECTED AREA.