

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1C -0211 -1 REV:09/15/

ASSEMBLY : ATMOS VENTING CONTROL CRIT. FUNC: 1R
 P/N RI : MC250-0002-1001 CRIT. HDW: 2
 P/N VENDOR: 2664-0001-11 CARLETON VEHICLE 102 103 104
 QUANTITY : 1 EFFECTIVITY: X X X
 : PHASE(S): PL LO X OO X DO X LS
 : ONE PER SUBSYSTEM

PREPARED BY: DES M. PRICE *M. Price* APPROVED BY: *[Signature]* REDUNDANCY SCREEN: A-PASS B-PASS C-PASS
 REL N. L. STEISLINGER *N. L. Steisslinger* DES *[Signature]* APPROVED BY (NASA):
 QE S. MOR *S. Mor* REL *[Signature]* SSM *[Signature]*
 QE *[Signature]* REL *[Signature]* REL *[Signature]* QE *[Signature]*

ITEM:
 DECAY DETECTOR, CABIN PRESSURE

FUNCTION:
 A CAUTION AND WARNING DEVICE FOR CABIN PRESSURE CONDITION MONITORING WHICH PROVIDES AN EARLY WARNING SIGNAL WHEN CABIN PRESSURE DECAY (DP/DT) EXCEEDS 0.05 PSI PER MINUTE. USED TO MANAGE SYSTEM PERFORMANCE TO ESTABLISH THE EXTENT OF LEAKAGE. THIS MEASUREMENT OR CABIN PRESSURE IS REQUIRED DURING ASCENT TO ENABLE AN ABORT CALL.
 MML V61R2401A.

FAILURE MODE:
 OPEN (ELECTRICAL), SHORTED, OUT-OF-TOLERANCE

CAUSE(S):
 MECHANICAL SHOCK, VIBRATION, CORROSION, CONTAMINATION

EFFECT(S) ON:
 (A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
 (A) UNABLE TO DIRECTLY PROVIDE CABIN PRESSURE DECAY RATE.
 (B,C) NO EFFECT.
 (D) ADDITIONAL ACTION BY CREW TO MONITOR CABIN PRESSURE CHANGES.
 (E) FUNCTIONAL CRITICALITY EFFECT - SECOND ASSOCIATED FAILURE, LOSS OF CABIN TOTAL PRESSURE SENSOR, WOULD LOSE ABILITY TO MAKE A PROPER ABORT CALL BASED ON CABIN LEAKAGE AND MAY RESULT IN LOSS OF CREW/VEHICLE.

DISPOSITION & RATIONALE:
 (A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE
 (A) DESIGN
 THE HOUSING IS MADE OF 6061-T651 ALUMINUM ALLOY ANODIZED FOR CORROSION RESISTANCE. THE SENSOR COMPRISES A VIBRATING WIRE TRANSDUCER, LOCK-ON

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OSCILLATOR, FREQUENCY-TO-VOLTAGE CONVERTER, OFFSET AMPLIFIER, DIFFERENTIATOR, ISOLATION AMPLIFIER, DC-TO-DC CONVERTER, AND ASSOCIATED VOLTAGE REGULATORS. THE VIBRATING WIRE TRANSDUCER CONSISTS OF A TUNGSTEN WIRE, MAGNET ASSEMBLY, AND ANEROID ASSEMBLY. THE EVACUATED ANEROID IS DESIGNED FOR VERY LOW HYSTERESIS, IS HIGHLY SENSITIVE TO PRESSURE CHANGES AND HAS ENHANCED ACCURACY. THE SPECIALLY CHOSEN VIBRATING WIRE MATERIAL, TUNGSTEN, ASSURES HIGH SENSITIVITY.

(B) TEST

ACCEPTANCE TEST - PROOF PRESSURE OF 24.0 +/- 0.1 PSIA FOR A DURATION OF 3 MINUTES. TEMPERATURE TEST: THE TEMPERATURE IS LOWERED TO -12 F +/- 5 F FOR A MINIMUM OF FOUR HOURS AND RAISED TO 150 F +/- 5 F FOR A MINIMUM OF FOUR HOURS. THE SENSOR IS CALIBRATED FOR A RATE INCREASE/DECREASE FROM 18 TO 8 PSIA AT INTERVALS OF 2.PSI.

QUALIFICATION TEST - LIFE CYCLE TESTING - 200 CYCLES AT 18.0 +/- 0.5 PSIA. BURST PRESSURE 16.0 +/- 0.1 PSIA FOR A DURATION OF 3 MINUTES. SUBJECTED TO THE FOLLOWING AS PART OF THE N2/O2 CONTROL PANEL. RANDOM VIBRATION SPECTRUM - 20 TO 150 HZ INCREASING AT 6 DB/OCTAVE TO 0.03 G**2/HZ AT 150 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 FOR THREE ORTHOGONAL AXES. DESIGN SHOCK - 20 G TERMINAL SAWTOOTH PULSE OF 11 MS DURATION IN EACH DIRECTION OF THREE ORTHOGONAL AXES. ATP TO VERIFY LEAKAGE IS PERFORMED AFTER SHOCK AND VIBRATION TESTING.

OMRSD - DP/DT MEASUREMENT FUNCTIONAL CHECK IS PERFORMED EVERY TURNAROUND. A THREE POINT TRANSDUCER VERIFICATION IS PERFORMED BEFORE THE FIRST REFLIGHT OF EACH ORBITER AND AT INTERVALS OF FIVE FLIGHTS.

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIAL VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL

CORROSION PROTECTION PROVISIONS AND CONTAMINATION CONTROL PLAN VERIFIED BY INSPECTION. CLEANLINESS LEVEL 200A PER MA0110-301 AND 100 ML RINSE TESTS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

DIMENSIONAL CHECKS PERFORMED BY INSPECTION. MIPS ARE INCLUDED IN THE ASSEMBLY PROCEDURE. TORQUES VERIFIED BY INSPECTION. VISUAL INSPECTION USING 10X MAGNIFICATION ON SEAL RING VERIFIED BY INSPECTION.

CRITICAL PROCESSES

BRAZE AND SOLDER CONNECTIONS VERIFIED BY INSPECTION IN ACCORDANCE WITH SPECIFICATION NHBS100.4(3A). APPLICATION OF LUBRICANT ON SEAL RING VERIFIED BY INSPECTION.

TESTING

ATP VERIFIED BY INSPECTION.

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HANDLING/PACKAGING

PARTS ARE PLACED IN CLEAN BAGS AND HEAT SEALED. PACKAGING FOR SHIPMENT VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

SEVEN FAILURES HAVE OCCURRED:

A9591-010, 11/22/77. IN SUPPLIER QUAL TEST, THE SENSOR BECAME ERRATIC DURING X-AXIS RANDOM VIBRATION OF THE N202 CONTROL PANEL. A BROKEN WIRE WAS FOUND; IT HAD NOT BEEN INCLUDED IN A SUPPORTED WIRE HARNESS AND HAD FLEXED AND BROKEN DURING VIBRATION. CORRECTIVE ACTION - DRAWING WAS CHANGED TO SHOW CORRECT BUNDLING FOR THIS WIRE IN THE SUPPORTED WIRE HARNESS.

AB4781-010, 8/17/79. IN SUPPLIER ATP, DURING Y AXIS VIBRATION OUTPUT WAS 2.6 VDC, SHOULD BE 2.25 +/- 0.05 VDC. CAUSE WAS A BROKEN SOLDER JOINT. PROBLEM WAS ISOLATED TO SOLDERING OF COMPONENT LEADS ON BOTH SIDES OF THE PRINTED CIRCUIT BOARD - THIS RESULTED IN A POOR QUALITY SOLDER JOINT ON THE SIDE WHICH WAS SOLDERED FIRST AND THEN REHEATED BY THE SECOND SOLDERING. CORRECTIVE ACTION - SEVERAL DESIGN AND PROCEDURE CHANGES RELATING TO SOLDERING ON BOARD ASSEMBLIES WITH AND WITHOUT PLATED-THROUGH HOLES WERE IMPLEMENTED. REDUNDANCY FOR THE DP/DT SENSOR WAS PROVIDED BY A SOFTWARE CHANGE WHICH ADDED A COMPUTER ROUTINE TO COMPUTE A BACKUP DP/DT USING THE CABIN TOTAL PRESSURE SENSOR DATA VERSUS ELAPSED TIME.

AB4915-010, 9/6/79. IN SUPPLIER ATP, SENSOR OUTPUT VOLTAGE WAS 2.196 VDC. SHOULD BE 2.25 +/- 0.05 VDC. THE TEST SETUP DURING MANUFACTURING VERIFICATION AND ADJUSTMENT OF THE 2.25 +/- 0.05 VDC OPERATING POINT FOR ZERO PRESSURE CHANGE WAS DONE WITH THE OUTPUT "UNLOADED". SHOULD BE LOADED BY A 22 KOHM RESISTOR. DURING MANUFACTURING ASSEMBLY AN INCORRECT VALUE RESISTOR WAS INSTALLED AT CIRCUIT DESIGNATOR R69. THE VALUE WAS 470 OHM, SHOULD BE 47 OHM. SINCE R69 AND THE OUTPUT LOAD FORM A VOLTAGE DIVIDER, THE INCORRECT R69 AND THE UNLOADED TEST CONDITIONS WERE COMPLEMENTING ERRORS, MASKING THE INCORRECT R69 VALUE. ATP DISCLOSED THE PROBLEM BY LOADING THE OUTPUT CORRECTLY. CORRECTIVE ACTION-MANUFACTURING AND ATP TEST FIXTURE REVISED TO INCLUDE A DEDICATED 28 V POWER SUPPLY AND BUILT-IN LOAD RESISTOR. PERSONNEL WERE CAUTIONED TO FOLLOW WRITTEN PROCEDURES DURING TROUBLESHOOTING AND REWORK.

AB5631-010, 12/12/79. DURING EMI RETEST AT MCDONNELL DOUGLAS, ST LOUIS, DP/DT SENSOR HAD OUT OF SPEC OUTPUT. CORRECTIVE ACTION - THE EMI SUPPRESSION CIRCUITRY WAS REVISED. RFI BYPASS CAPACITORS AND FERRITE BEADS WERE ADDED TO THE 28 V, THE PLUS AND MINUS 15 V POWER SUPPLY LINES AND THE SIGNAL OUTPUT AND RETURN LINES.

AB9630-000, 6/10/81. IN SUPPLIER ATP, SENSOR INDICATED OUT OF SPEC DURING VIBRATION TEST IN THE X-AXIS. IT WAS FOUND THAT THE PRIMARY WINDING OF THE TRANSFORMER WAS INTERMITTENT. THE TRANSFORMER WAS EXPOSED TO 48 MINUTES VIBRATION PER AXIS PLUS 5 MINUTES PER AXIS WITHOUT FAILURE. THE AMOUNT OF VIBRATION INCLUDING THIS TEST EXCEEDED THE LIFE REQUIREMENTS. THE CONDITION WAS THUS CONSIDERED TO BE DUE TO OVER-TEST; NOT A FAILURE, NO CORRECTIVE ACTION.

AC0017-010, 7/27/81. DURING SUPPLIER ATP, SUBSEQUENT TO RANDOM VIBRATION TESTING (AFTER DELTA QUALIFICATION VIBRATION), RESISTANCE MEASUREMENTS

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DISCOVERED A BROKEN WIRE AT THE DP/DT OUTPUT TERMINAL OF THE ELECTRONICS ASSEMBLY PRINTED CIRCUIT BOARD. THE SPOT TIES ON THE WIRE BUNDLE CONTAINING THE DP/DT SIGNAL CONDITIONER OUTPUT LEAD WERE PLACED SUCH THAT MOST OF THE STRESS OF SECURING THE WIRE BUNDLE WAS IMPOSED ON THE DP/DT OUTPUT LEAD, AND THE BROKEN WIRE HAD BEEN TERMINATED ON THE TERMINAL WITH A SHARP BEND JUST OUTSIDE THE SOLDER JOINT, CONTRIBUTING TO VIBRATION FAILURE. CORRECTIVE ACTION - MANDATORY INSPECTION POINTS WERE ADDED DURING ASSEMBLY TO ENSURE PROPER ROUTING OF WIRE BUNDLE, LEADS AND PROPER WIRE STRIPPING AND PROPER SOLDER JOINTS.

AC3192-010, 5/27/82. IN SUPPLIER ATP, SENSOR FAILED CALIBRATION TEST. OUTPUT WAS 2.360 VDC. S/B 2.25 +/- 0.05 VDC. DEFECTIVE SOLDER JOINT WAS FOUND. CORRECTIVE ACTION - ASSEMBLY PERSONNEL WERE CAUTIONED AND RETESTED TO SOLDER TO CERT REQUIREMENTS.

(E) OPERATIONAL USE
TBS.