Bendix
Aerospace Systems Division

PSE Sensor Assembly Qualification
Status List - Apollo 15

ATM1000 | REV. NO.

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1.0 INTRODUCTION

1.1 This Technical Memo is in response to: Exhibit A, Statement of Work, Para. 6.0, Supplement Agreement 82S; CCP248A, MSC Ltr JC931/L404-70/T94 (0S0135); and CCP279, Item A, MSC Ltr JC931/L636-70/T95(0S0135), and supports the PSE Sensor Modification Plan for PSE Sensor No. 1.

1.2 The purpose of this ATM is to provide a qualification-by-similarity rational to SN03, the PSE model of the previous ALSEP System QSL. Qualification rationale of this model to previous flight models and to the original qualification model, SN02, was provided at the CARR of each successive ALSEP model. A chronological order of SN1 events as it was modified in accordance with SA 82S, CCP248A, and CCP 279 is also enclosed.

2.0 QUALIFICATION BY SIMILARITY RATIONALE

A number of changes have been incorporated in the PSE between Flight 4, SN 03 and Flight A-2, SN 01 as of April 16, 1971. These changes and the rationale for not affecting qual status are described below:

2.1 HEATER MODIFICATION CRD 58669, 58715, 58795

Two heater elements were added and circuit changes were made to the PSE temperature control system. These changes were made to allow the sensor to operate at a nominal +125° during lunar night. In a qualitative sense the circuit remains unchanged as the modification is limited to the substitution of parts of different rating but similar characteristics in the existing circuit other than the use of components in parallel to satisfy physical constraints which would not permit the use of a single component with the desired electrical characteristics.

2.1.1 Strip Heaters - P/N 2344709-1

Addition of two strip heaters was made to the sensor assembly to increase heating capacity of the thermal control system. These heaters are identical to the existing ones and do not affect qual status.

2.1.2 Transistors - (Thermal Control Circuit) P/N JANTX2N3499

Two transistors (Q18, Q21-2N222) in the thermal control circuit were replaced with transistors of higher rating and better quality. The new transistors do not affect qual status inasmuch as they are included in the "Acceptable Parts List" BSR 2857 P53 dated Feb. 13, 1970.

2.1.3 Transistor - Q25 P/N 2N2102

A transistor was added to the thermal control system in parallel with an existing power transistor Q24 to increase the current capabilities of the circuit. The added transistor is identical to the one currently used in the circuit. Therefore, the qual status is not affected.

2.1.4 Resistors - R38 & R39 P/N RWR 81S

One resistor was replaced and a new one added in the thermal control circuit. These resistors are specially selected and are used to control heater current at the emitters of transistors Q24 and Q25. They are of a better quality than the original component.

2.1.5 Heat Sinks - P/N 2344713 & 2344714
Spacers - P/N 2344701-1, 2344701-2, 2344702 & 2344712
Rivet, Tubular - P/N MS16535-24

Because of heat transfer requirements for transistors Q24 and Q25 of the thermal control circuit, heat sinks and spacers were added to the electronics boards. A method was used to thermally link the transistors to the system of bolts and spacers which support the electronic printed circuit boards and which of themselves constitute an adequate conductive path to the outer case. No materials were used in these parts which were not used elsewhere in the sensor, therefore, the qual status is not affected.

2.1.6 Stycast - P/N 2850GT-11
Catalyst - P/N 11

A berylium oxide wafer was used between the heat sink and transistor case. A thermally conductive epoxy (STYCAST) was used as an adhesive on each side of the wafer. The effectiveness of this arrangement is due to the berylium oxide which has the usual characteristics of being both a thermal conductor and electrical insulator. In the document SSED-485, "Pull Test on N_iB_eOCu Test Samples using 2850GT-11 EPOXY," 1 July 1970, the results of the special test qualify the epoxy as a satisfactory adhesive for this application.

A stress analysis was performed to evaluate the structural integrity of the heat sink installations and vibration induced loads. The results are presented in SSED-494, "Stress Analysis of heat sink assembly on W-BOARD, 13 July 1970."

2.2 SHORT PERIOD Z SEISMOMETER DELTA ROD MODIFICATION

CRD 58715 Delta Rod Modification

The short period seismometer six delta rods were replaced with modified ones. The modification consisted of assembling new delta rods with longer end pieces (approximately .276 inches). This is to assure that the end pieces are properly contained in the end piece holder. In addition, the delta rods were pre-tensioned during assembly to the SPZ seismometer. This modification did not require use of any material not used before. Qualification status is not affected by this modification.

3.0 PSE SENSOR TESTING

A chronological sequence of test history, reference Figure 1, describes: when PSE Sensor SN1 was received at BxA; where it was used; rework and modifications; how it was tested; what test procedures were used; and completion dates for tests.

4.0 COMMENTS

4.1 For historical reference and comparison prior PSE Qualificiation Status Lists are as follows:

1. EASEP, Apollo 11, ATM 765A, (9-20-68), ATM765B (10-15-68), ATM 765C (2-14-69), ATM 765D (3-12-69), FLT #2.

2. ALSEP, Apollo 12, ATM 773A, 20 September 1968, FLT #1.

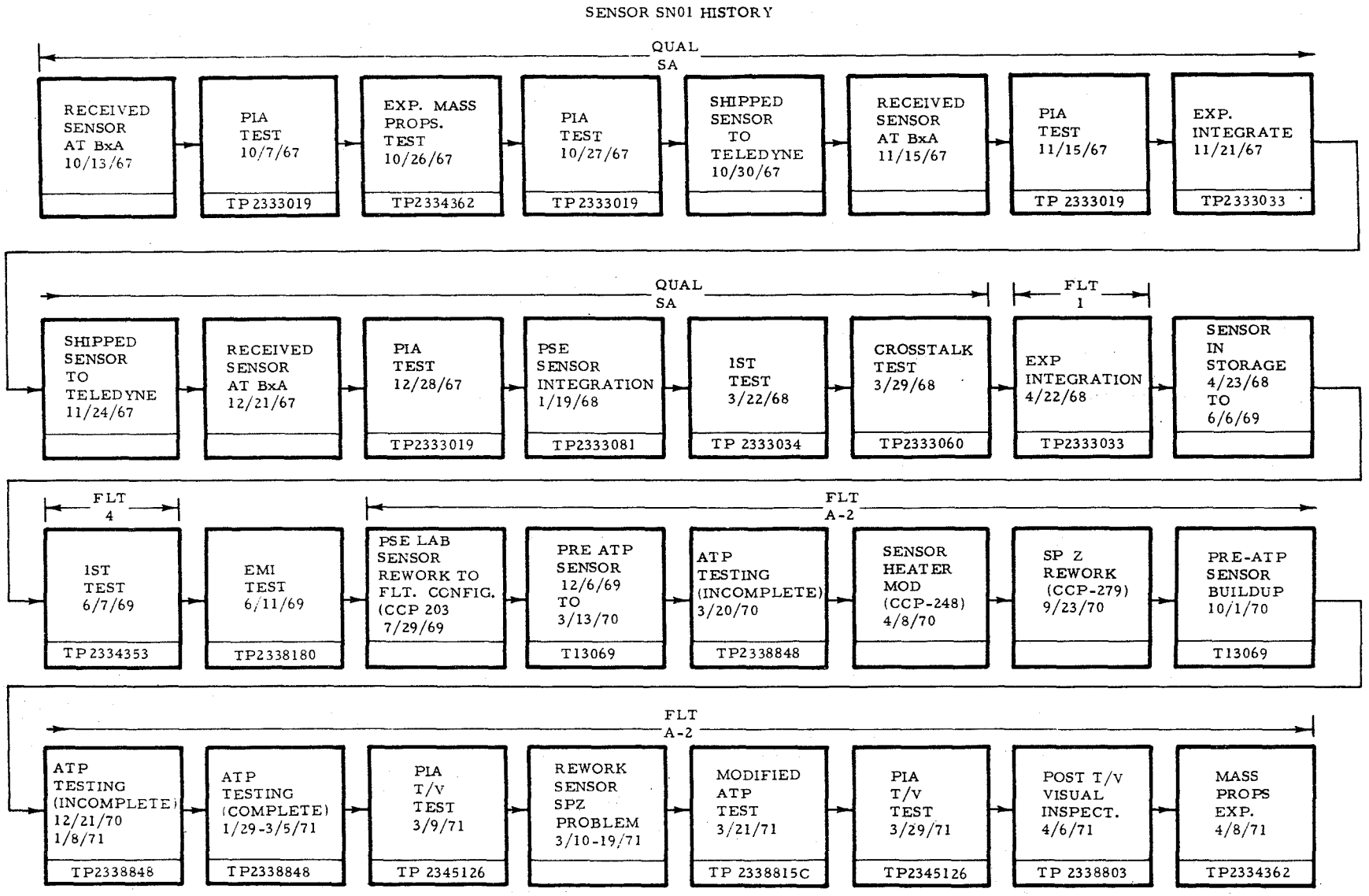
3. ALSEP, Apollo 13, ATM 825A, 16 May 1969, FLT #3.

4. ALSEP, Apollo 14, Memo 9783-10-3459, 12 May 1970.

4.2 FAR No. 285 remains as an open item against PSE Sensor SN3 while the later is utilized in support of integrated system testing of the A-2 and D Arrays, after which it will undergo modification to the latest flight configuration in accordance with CCP-279 whereupon FAR No. 285 will then be finalized and, and closed out.

4.3 The documentation herein is presented as the original and final update of material essential for the Apollo 15 PSE Sensor Qualification Status List.

Figure 1


SENSOR SN01 HISTORY
QUAL SA
RECEIVED SENSOR AT BxA 10/13/67
PIA TEST 10/7/67
TP2333019
EXP. MASS PROPS. TEST 10/26/67
TP2334362
PIA TEST 10/27/67
TP2333019
SHIPPED SENSOR TO TELEDYNE 10/30/67
RECEIVED SENSOR AT BxA 11/15/67
PIA TEST 11/15/67
TP 2333019
EXP. INTEGRATE 11/21/67
TP2333033
QUAL SA
FLT 1
SHIPPED SENSOR TO TELEDYNE 11/24/67
RECEIVED SENSOR AT BxA 12/21/67
PIA TEST 12/28/67
TP2333019
PSE SENSOR INTEGRATION 1/19/68
TP2333081
1ST TEST 3/22/68
TP 2333034
CROSSTALK TEST 3/29/68
TP2333060
EXP INTEGRATION 4/22/68
TP2333033
SENSOR IN STORAGE 4/23/68 TO 6/6/69
FLT 4
FLT A-2
1ST TEST 6/7/69
TP2334353
EMI TEST 6/11/69
TP2338180
PSE LAB SENSOR REWORK TO FLT. CONFIG. (CCP 203 7/29/69
PRE ATP SENSOR 12/6/69 TO 3/13/70
T13069
ATP TESTING (INCOMPLETE) 3/20/70
TP2338848
SENSOR HEATER MOD (CCP-248) 4/8/70
SP Z REWORK (CCP-279) 9/23/70
PRE-ATP SENSOR BUILDUP 10/1/70
T13069
FLT A-2
ATP TESTING (INCOMPLETE) 12/21/70 1/8/71
TP2338848
ATP TESTING (COMPLETE) 1/29-3/5/71
TP2338848
PIA T/V TEST 3/9/71
TP 2345126
REWORK SENSOR SPZ PROBLEM 3/10-19/71
MODIFIED ATP TEST 3/21/71
TP 2338815C
PIA T/V TEST 3/29/71
TP2345126
POST T/V VISUAL INSPECT. 4/6/71
TP 2338803
MASS PROPS EXP. 4/8/71
TP2334362