EXPERIMENT TECHNICAL DOCUMENTATION

DOT-TSC-NASA-71-2

RELIABILITY AND QUALITY ASSURANCE PLAN

IN-FLIGHT AEROSOL ANALYSIS EXPERIMENT T003

DEPARTMENT OF TRANSPORTATION
TRANSPORTATION SYSTEMS CENTER
CAMBRIDGE, MASSACHUSETTS

RELIABILITY AND QUALITY ASSURANCE PLAN

for

SKYLAB EXPERIMENT T-003

December 1, 1970

Revision: 1

1.0 GENERAL

This plan describes the basic Reliability and Quality Assurance (R&QA) Program applicable to Experiment T-003, the Aerosol Analyzer (AA). The Biotechnology Division has the management and overall project responsibility. An R&QA engineer is designated to direct and assure the implementation of this R&QA plan (See Fig. 1).

2.0 FUNCTIONAL RESPONSIBILITIES

2.1 Reliability and Quality Assurance Engineer (R&QA Engineer)

The functional responsibilities of the R&QA engineer will be:

1. To monitor R&QA activity and determine whether it is sufficiently effective or requires more emphasis.

2. To act as the primary point of contact for project R&QA activity with NASA Headquarters Skylab Program Office or other Centers.

3. To act as the coordinator for R&QA aspects of in-house activities on the T-003 program.

4. To perform or witness in-house inspections and tests to verify compliance with specifications.

5. To assist design engineers in performance of Failure Mode and Effects Analysis (FMEA).

6. To perform, monitor or coordinate Transportation Systems Center (TSC) and/or contractor qualification testing, data collecting and status reporting.

7. To assist in parts selection and parts screening.

8. To aid in the establishment, administration, and evaluation of R&QA provisions for hardware procurements.

9. To act as the R&QA member of the in-house Materials Review Board (MRB).

10. To arrange for all calibration required by the inspection and test requirements of the T-003 End Item Specification.

11. To arrange for all inspections and tests required by purchase order instructions or Statements of Work for all hardware received.

12. To insure that all hardware procurements for the T-003 experiment are reviewed for inclusion of R&QA requirements.

2.2 The Biotechnology Division

The Biotechnology Division is responsible for the design and construction of the Aerosol Analyzer for implementing the T-003 experiment. Its responsibilities will be:

1. To perform any in-house fabrication and functional testing of the T-003 instrument.

2. To originate and control drawings and specifications.

3. To perform configuration management functions.

4. To originate End Item Specifications.

5. To originate Statements of Work for hardware procurements.

6. To originate the T-003 test program and coordinate, design, fabrication, test and delivery schedules.

7. To establish parts and materials lists.

8. To initiate FMEA efforts.

The project engineer assigned to the Skylab Experiment T-003 will act as the engineering member of the in-house Materials Review Board (MRB).

2.3 MSFC Field Engineer

The Northeast Marshall Space Flight Center (MSFC) field engineer will represent MSFC on the in-house MRB.

3.0 DRAWINGS & SPECIFICATIONS

3.1 Specification Review

Drawings and specifications will be reviewed to insure that quality and reliability characteristics have been included. Parts, materials, and subassemblies will be identified and characteristics, methods, and limits will be described as applicable.

3.2 Designs

Designs will be reviewed for all items to assure the selection of parts from preferred parts lists describing products which have met the performance, reliability, and quality needs of the end item criticality level.

3.3 Qualification Status Lists

Qualification status lists will be maintained for components, subassemblies showing completed and planned status of hardware. So far as

possible all parts, component-parts, and materials will have already been qualified to the Skylab requirements under prior program or test experience.

4.0 PARTS AND MATERIALS SELECTION

4.1 Design Specifications

Design specifications for electrical, electronic, or electromechanical parts will be selected using "ER" (established reliability) MIL Specs., "TX" (extra testing) MIL Specs., or other MIL specs. in that order of preference. The latter will have screening tests added as applicable. Screening must also be performed on the least rigorous specification category--the industry association specs.

4.2 Qualified Sources

Qualified sources, in order of descending desirability, will be Military QPL's, Apollo spacecraft parts and materials lists, Apollo Applications parts and materials lists, IDEP, FARADA, or qualifications by the suppliers. The R&QA engineer will aid in the determination of acceptable sources and minimum number of styles during the design reviews discussed above.

4.3 Nonmetallic Materials

Nonmatellic materials used in the T-003 Experiment will be screened and selected to the requirements of D-NA-002 for combustion rate, flash and fire point, odor, carbon monoxide, and metal organic outgassing. Materials acceptable to these requirements will be certified by their sources, verified by inspection before use and stored in a manner to protect their quality and identity.

4.4 Parts and Materials Variances

Whenever parts or materials will vary from provisions of 4.1, 4.2, and 4.3 above, approval of such difference will be obtained from MSFC via the Engineering Change Proposal (ECP) and the Engineering Change Notice (ECN) procedures of the Experiment General Specification.

4.5 MSFC Review

Based on the foregoing, the Biotechnology Division will prepare parts and materials lists for MSFC review. Applications of parts and materials to specific environments and functional stresses will be considered at each design review.

5.0 PROCUREMENT CONTROL

5.1 Parts and Materials

All purchases of parts, materials, or services for purposes of the T-003 Experiment will be accomplished by the statement below which will

be printed or stamped in bold face type on the purchase document: "FOR USE IN MANNED SPACE FLIGHT. MATERIALS, MANUFACTURING AND WORKMANSHIP OF HIGHEST QUALITY STANDARDS ARE ESSENTIAL TO ASTRONAUT SAFETY. IF YOU ARE ABLE TO SUPPLY THE DESIRED ITEMS WITH A QUALITY WHICH IS HIGHER THAN THAT OF THE ITEMS SPECIFIED OR PROPOSED, YOU ARE REQUESTED TO BRING THIS FACT TO THE IMMEDIATE ATTENTION OF THE PURCHASER."

5.2 Parts Inspections

All parts or materials received will be inspected and tested for all characteristics which affect or determine their identification fit or function. The R&QA engineer will perform or arrange for all inspections, certifications, and tests specified on the purchase documents and will insure impounding of material which fails to meet specifications.

5.3 Parts and Materials

From time of receipt to integration in the payload, parts and materials for T-003 will retain their identity in terms of part number, lot number, purchase order, serial number and inspection stage and status (i.e., inspected, waiting, in-process/accepted or rejected and reference to the inspection report). Storage conditions will protect the quality of parts and materials and prevent their damage, deterioration, loss or substitution.

5.4 The R&QA Engineer

The R&QA engineer will have a place in the initial stages of procurement activity. He will be responsible for the early definition of R&QA requirements suited to the particular procurement.

6.0 FAILURE MODE AND EFFECTS ANALYSIS

Failure mode and effects analysis will be conducted in accordance with instructions of MSFC 10M30111. "Procedure for Performing Systems Design Analysis" (Rev. A) and according to criticality level 3.

7.0 INSPECTIONS AND TESTS

7.1 End Item Specifications

Necessary details of inspections and tests will be contained in the End Item Specifications, or the Test Specifications/Procedures document. Available standards for soldering, microelectronics, and packaging will be utilized for workmanship and visual criteria.

7.2 Control of Special Processes

Control of special processes such as welding, soldering, heat treating and nondestructive testing will utilize certified personnel and approved procedures. Records of results will be kept for evidence of quality of end items and to possibly reduce end item inspection.

7.3 Evidence of Inspection Status

Evidence of inspection status will be on or with all parts and materials at all times and will be positive to the extent of their being a direct and obvious relationship between the article and its evidence. The evidence will not damage or in any way affect the quality of articles.

7.4 Packing and Shipping Arrangements

The packing and shipping arrangements for the T-003 Experiment instrument will be detailed in the End Item Specification (Part II). Provisions for protection of physical and functional integrity of the end item will be features of the final inspection of the system to ensure its safe arrival and readiness for flight.

7.5 Records of Inspection and Tests

Records of inspection and tests will be maintained for all parts, materials, and end items. They will contain evidence that required inspections and tests have been performed so that one may trace full identification, characteristics, results and status of the items.

7.5.1 Test Log

Each major component, subsystem or system of the T-003 experiment will have a separate log which is a continuous record of all events in the life of the item. It will account for all periods including idle periods, any movement of the item and parameter measurements including the approved test data sheets and test summary sheets required by paragraphs 8.6.31 and 8.6.3m of the Experiment General Specifications (EGS). It will include a detailed record of all operating and test time. It will include the record of maintenance and repair and all approved splicing records required by paragraph 4.4.3.2 of the EGS.

8.0 INSPECTION MEASURING TEST EQUIPMENT

The selection, maintenance and control of all inspection standards, gages, measuring and test equipment will be done in accordance with MIL-C-45662, "Calibration System Requirements".

9.0 NONCONFORMING MATERIAL

9.1 Material Review

Material review proceedings will take place following discovery of discrepant parts of materials.

9.1.1 Parts and Materials

Nonconforming parts and materials will be physically separated and identified in a manner to contrast it with material waiting or accepted. Identification will bear or be traceable to all information relating to the discrepancy or condition of the rejects.

9.1.2 The Material Review Board

The Material Review Board will consist of the R&QA engineer, the MSFC R&QA representative, and the Project engineer.

9.1.3 Dispositions

Dispositions by the MRB will be recorded, with logic of the decisions being evident or described. Dispositions will be concurrence of all three members and of one of three types: (a) scrap, (b) repair, (c) use as is. Repair disposition will require careful consideration of methods and effects and written precautions for persons doing the work. "Use as is" will only occur with minor nonconformance--that which does not affect safety, function, or interchangeability.

9.2 Subcontractor MRB

These provisions will be the same for contract or subcontract work except that delegation of MRB will be for minor nonconformance only. Major deficiencies will require decision of the group in 9.1.2.

10.0 DATA REPORTING AND CORRECTIVE ACTION

10.1 Reporting and Analysis

Reporting and analysis of all trouble, failure, and quality information will be transmitted and acted on in the shortest possible time to provide early indicators of design or fabrication shortcomings. Commonly these will result from material review cases and actions demanded in their dispositions.

10.2 Failure Analysis

Failure Analysis will be provided by the R&QA engineer on request of the Material Review Board. Results and recommendations will be recorded and identifiable to the parts or materials involved in the T-003 experiment.

10.3 Analysis and Examination of Data

After analysis of data and examination of failed article or material, the R&QA engineer or the Project engineer will be assigned an action date and responsibility to devise mechanisms, processes, tests or procedures which will prevent recurrence of the failure will be assigned.

11.0 TRAINING AND CERTIFICATION

Training and certification of personnel for special processes are available in-house or on service contract. These qualified operators will be utilized as applicable.

12.0 AUDIT OR R&QA PROGRAM PERFORMANCE

Audit of R&QA Program Performance shall be conducted on a bimonthly basis by the R&QA engineer. Results of comparison of requirements with evidence of their implementation and recommendations will be made to the Director of Technology or his designee.

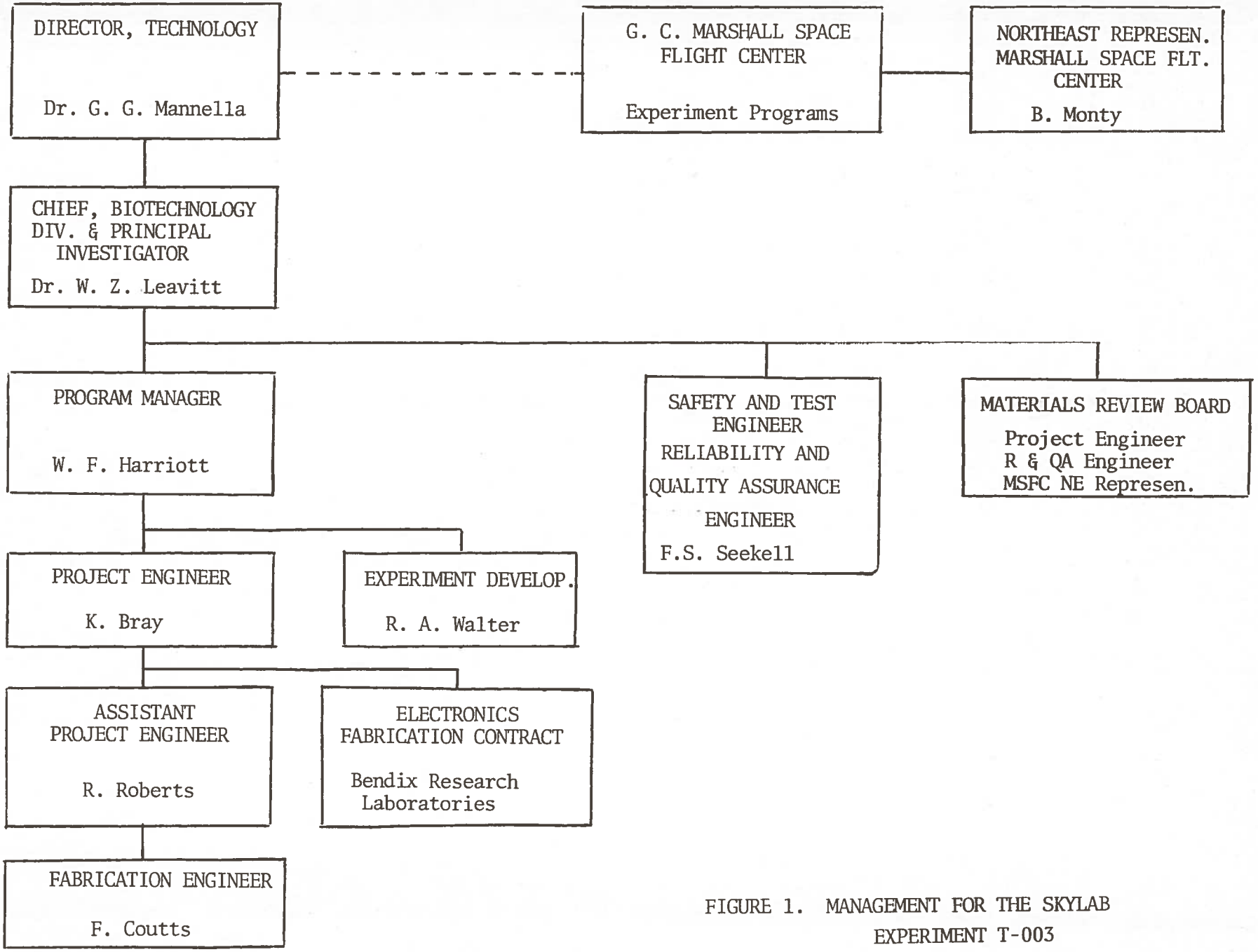

FIGURE 1. MANAGEMENT FOR THE SKYLAB EXPERIMENT T-003

DIRECTOR, TECHNOLOGY

Dr. G.G. Mannella

CHIEF, BIOTECHNOLOGY DIV.
& PRINCIPAL INVESTIGATOR

Dr. W.Z. Leavitt

PROGRAM MANAGER

W.F. Harriott

PROJECT ENGINEER

K.J. Bray

ASST. PROJECT ENGINEER

R. Roberts

FABRICATION ENGINEER

J. Thompson

NORTHEAST REPRESENTATIVE
OF MARSHALL SPACE FLIGHT
CENTER

B. Monty

RELIABILITY AND QUALITY
ASSURANCE ENGINEER:
SAFETY AND TEST ENGINEER

F.S. Seekell

MATERIALS REVIEW
BOARD

Project Engineer
R & QA Engineer
MSFC NE Representative

EXPERIMENT DEVELOPMENT

R.A. Walter

ELECTRONICS FABRICATION
CONTRACT

Bendix Research Laboratories

FIG. 1a TSC MANAGEMENT ORGANIZATIONAL
CHART FOR EXPERIMENT T-003