REVISION B
S4S-0-679B

APRIL 1972

PREPARED FOR NASA MANNED SPACECRAFT CENTER UNDER CONTRACT NAS9-11528, DRL 46, DRD TM-094T

END ITEM TEST PLAN

FOR THE

ULTRAVIOLET SPECTROMETER EXPERIMENT S169

The Johns Hopkins University
Applied Physics Laboratory
8621 Georgia Avenue
Silver Spring, Maryland

CR-128573

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Prepared for
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Prepared by: J. R. Giles
Payload Evaluation
Project, S4S-3

Approved by: L. D. Eckard, Jr.
Group Supervisor,
S4S

Approved by: E. L. Marshall
S169 Payload Engineer

Approved by: T. Wyatt
Project Engineer

Date: 20 April 1972

The Johns Hopkins University
Applied Physics Laboratory
8621 Georgia Avenue
Silver Spring, Maryland

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1.0 SCOPE

This test plan defines the tests to be conducted, identifies and describes all test items, and states the objectives of all tests required to verify that the performance and design goals of the Contract End Item Specification, 7232-0009, have been met and that flight hardware is acceptable.

Additionally, environmental conditions, testing time or cycles, allowable maintenance, logging requirements, manner of analysis and utilization of test results, disposition of test specimens, retest requirements, location of tests, facilities and support requirements, and the time phasing of the tests are presented.

This test plan has been prepared in accordance with MSC Number DRL 46, DRD TM-094T.

2.0 APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form a part of this plan to the extent specified herein. In the event of conflict between this plan and documents referenced herein, this plan shall take precedence.

2.1 NASA DOCUMENTS

MC 999-00020	Electromagnetic Interference Control for the Apollo Space System
NHB 5300.4(1B)	Quality Program Provisions for Space System Contractors

2.2 MILITARY DOCUMENTS

MIL-STD-810B (USAF)	Environmental Test Methods for Aerospace and Ground Equipment dtd. June 1967

2.3 APL/JHU DOCUMENTS

S4S-0-681B	Acceptance Test Plan, UVS Experiment S169
S4S-0-751	Acceptance Test Procedure, UVS Experiment S169
SOR-70-060	Contamination Control Program Plan for the UVS Experiment S169
SOR-71-002	System Safety Plan, UVS Experiment S169
SOR-70-031	Quality Program Plan, UVS Experiment S169
RQAM-8.002	APL Discrepancy Report System
7232-0009	CEI Specification for Flight and Qualification Units, UVS Experiment S169
S4S-0-680	Qualification Test Plan, UVS Experiment S169
S4S-0-750	Qualification Test Procedure, UVS Experiment S169
DRD JHU II UVS	Calibration Procedure for UVS Experiment
7232-0008	Specification for Shipping Container for Apollo S169 Experiment
S4S-0-673	Logistics Plan
SOR-70-030	Reliability Program Plan for the UVS Experiment
S3E-72-001	Electromagnetic Interference Test Plan for the UVS Experiment

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3.2.1.1 Experiment Ground Support Equipment

a. UVS Handling Fixture (Dwg. No. 7232-0409).

b. UVS Shipping Container (Dwg. No. 7232-0495).

c. Nylon Bagging Equipment.

d. Class 100 Clean Bench

3.2.1.2 Electronic Test Equipment

a. Oscilloscope, Tektronix 543A.

b. Digital Voltmeter, Dana Model 5400.

c. Pulse Generator, Data Pulse Model 10.

d. Junction Boxes (Dwg. Nos. 7232-3040, 7232-3050, 7232-3060).

e. Electronic Counter, Hewlett-Packard Model HP 5445L.

3.2.1.3 UVS Bench Test Equipment (Dwg. No. 7232-3000)

3.2.1.4 Mass Properties Test Equipment

Mass properties measuring equipment (Dwg. No. 7232-0500), UVS Test Fixture.

3.2.2 Facilities

The following APL and JHU/Physics Department facilities are required to perform the tests specified herein.

3.2.2.1 Class 10,000 Clean Room (APL)

3.2.2.2 Environmental Test Laboratory (APL)

a. Vibration exciter, Ling Model 350, Model 335 Driver and Model 1830 Team Table.

b. Vertical Thermal Vacuum Chamber (8' x 10')

(1) SIM Bay Simulator 7232-0430

(2) UVS Mounting Bracket (N.R.)

(3) Computer Controlled Heater Equipment, Honeywell DDP-516 RC

(4) Ultraviolet Source

3.2.2.3 Optical Test and Calibration Facility (JHU/Physics Department)

a. Calibration Test Equipment

b. Class 100 Clean Benches

3.2.2.4 Electromagnetic Interference Test Laboratories (Melpar, Inc., Vienna, Virginia)

3.2.2.5 Shock Test Laboratories

a. Dayton T. Brown; Bohemia, New York

b. General Test Laboratories; Springfield, Virginia

3.3 TEST CONDITIONS AND MEASUREMENTS

3.3.1 Test Area Conditions

3.3.1.1 During non-operational periods, the UVS will be protected within its storage container and/or a nylon bag purged with dry nitrogen.

3.3.1.2 When operational tests or environmental exposures of the UVS are required, the following test area ambient conditions shall prevail and be maintained whenever the UVS is

removed from its protective cover:

Ambient Temperature - 80°F (max.)

Relative Humidity - 60% (max.)

Dew Point Temperature - 55°F (min.)

All other environmental constraints are delineated in the UVS Contamination Control Program Plan (SOR-70-060) which forms an integral part of this test plan.

3.3.2 Measurements

All measurements shall be made with instruments whose accuracy is verified periodically and which have been calibrated within the time span specified for that instrument (at least each 12 months, preferably every 6 months). The time span shall encompass the duration of the test. All instruments and test equipment used in conducting the tests specified herein shall:

a. Conform to laboratory standards whose calibration is traceable to the prime standards at the U. S. Bureau of Standards.

b. Have an accuracy of at least one-third the tolerance for the variable to be measured. In the event of conflict between this accuracy and a requirement for accuracy in any one of the test methods of this plan, this plan shall take precedence.

c. Be appropriate for measuring the test parameters.

3.3.2.1 Tolerances - The maximum allowable tolerances for test conditions shall be as follows unless otherwise specified by the applicable section in the environmental test procedures:

a. Temperature: ±2.5°F (exclusive of accuracy of instruments).

b. Vibration Frequency: ±2% or 1/2 Hz below 20 Hz.

c. Random Vibration: Power spectral density, +1.5 dB, -4.5 dB anywhere in the frequency bandwidth; RMS; ±10%.

d. Additional Tolerances: Additional tolerances shall be as specified in the Acceptance Test Procedure, S4S-0-751.

3.3.2.2 Vacuum Gauges - The vacuum shall be indicated by a vacuum gauge whose sensing element is directly exposed to the environment of the chamber test space. The gauge shall measure the absolute pressure to which the UVS is exposed with a tolerance of ±1 decade, cantered about a reading of 10^{-6} torr.

3.3.3 Logistics

The UVS and BTE logistic support requirements are delineated in the Logistics Plan, S4S-0-673, which forms an integral part of this test plan.

4.0 QUALITY ASSURANCE PROVISIONS AND GENERAL REQUIREMENTS

4.1 DOCUMENTATION

4.1.1 Applicability of NHB 5300.4(1B)

The intent of NHB 5300.4(1B), "Quality Program Provisions for Space System Contractors", will be accomplished in accordance with the approved Quality Program Plan for the UVS Experiment S169, SOR-70-031. All performance parameters, tolerances, and tests shall be in accordance with the provisions of the UVS Experiment S169, Contract End Item Specification, APL Number 7232-0009.

4.1.2 Test Procedures

Test procedures are required for the performance of all tests and test operations. The test procedures shall describe the step-by-step procedure to be accomplished in detail and in their logical sequence as specified in the UVS Experiment S169 Acceptance and Qualification Test Procedures.

4.1.3 Data Sheets

Data sheets based on the test procedures will be used to enter all pertinent data obtained during the course of the testing program. Data sheets witnessed by the Test Conductor, the Reliability Engineer and the Government Inspector become part of the End Item Data Package for customer buy-off. Whenever practical, the data sheets shall be a part of the test procedures.

4.1.4 Product Assurance

Testing is subject to monitoring and validation by the SDD Reliability Office (SOR) and designated Manned Spacecraft Center (MSC) representatives.

4.1.5 Log Books

A log book will be issued for each end item and compiled in chronological order. Entered in the log books are items such as test identification, significant planned or unplanned events, operating cycles including flight connector mating and demating and UVS running time, discrepancies, and the signatures of the System Engineer and the witnessing SOR and government representative. The log books shall be delivered with the end item.

4.1.6 Environmental Exposure Log Sheet

An environmental exposure log sheet will be maintained by the cognizant environmental test engineer providing a detailed history of each environmental exposure. Vibration test records will be in the form of magnetic tape recordings of exciter input signals and accelerometer outputs. Accelerometer calibrations shall be recorded. All significant test events (such as test equipment anomalies, test chronology, deviations from procedures, successful implementation of tests, etc.) contained in the exposure log sheets are transmitted to the System Engineer for inclusion into the test report.

4.1.7 Setup Photographs

When possible, a photographic record of significant test setups will be included in the test report. These photographs will also be maintained and filed in the APL film library.

4.1.8 Discrepancy Reports

Discrepancy reports will be issued in accordance with the APL Discrepancy Report System, RQAM-8.0C2.

4.1.9 Test Report

A test report will be prepared upon completion of the test series and will be included in the acceptance data package.

4.2 SATISFACTORY OPERATION AND FAILURE CRITERIA

Satisfactory operation is defined as that operation in which the experiment maintains the proper input-output electrical or electro-optical relationship as defined in the S[illegible]9 CEI Specification, 7232-0009. No adjustments to compensate for environmental extremes are allowed.

4.3 SAFETY

It is essential that the exposure of both personnel and equipment to hazardous environments be avoided or at least minimized. NASA/MSC safety requirements and previous APL safety experience in test equipment design and in equipment handling and test operations, as specified in the System Safety Plan, SOR-71-002, will be utilized in the fullest.

5.0 TESTS

5.1 TEST OBJECTIVES

5.1.1 To qualify the design of the S169 Experiment unit under ambient conditions and under simulated environments expected to occur during mission operations with sufficient margin over acceptance test levels to account for tolerances in manufacturing, inaccuracies or measurement, variations in response, and limitations in predicting launch and orbital conditions.

5.1.2 To validate acceptability of end items for flight use by demonstrating performance and quality of manufacturing.

5.1.3 To provide developmental information on components critical to mission success in time to permit the design and fabrication of equipment capable of passing all qualification and acceptance tests.

5.1.4 To establish satisfactory operation of experiment elements and components when interconnected and operated as a system.

5.1.5 To evaluate and understand possible malfunctions in time to take remedial action.

5.1.6 To assure end item is ready for mission after installation in SIM.

5.2 TEST ITEMS

The tests described herein apply to one prototype item, one qualification item and two flight items.

5.3 TEST GROUND RULES AND CONSTRAINTS

All system-level tests will be conducted under the direct supervision and control of the UVS System Engineer. The System Engineer shall have responsibility and authority for the following.

5.3.1 Application of test procedures and use of associated data sheets. Deviations from the procedures will not be initiated without agreement of the System Engineer and concurrence of the Test Review Board (UVS Reliability Engineer and the designated MSC representative). Responsibility for proper application of environmental conditions shall reside with the Structures Engineer (vibration), Thermal Engineer (temperature/pressure),

or the Mechanical Engineer (mechanical tests and mass properties determinations). During each of these exposures, the engineer designated shall be the single point of contact providing directions to Environmental Test Laboratory personnel.

5.3.2 To determine the readiness of an end item to begin a test. Readiness shall comprise:

a. Satisfactory completion of previous milestones with signed records (data sheets, log books, process control card, etc.).

b. Availability of an approved test procedure.

c. Notification of the UVS Reliability Engineer and the designated MSC representative (government representative).

5.3.3 To stop a test and take other necessary precautions when it is apparent that a test item or test equipment is not operating correctly or that a failure is imminent.

5.3.4 Complete responsibility for the end items from the start of final assembly through pre-installation testing. This responsibility includes handling, operational testing, and system performance. The Mechanical Engineer shall be responsible for providing procedures for handling the units and will either monitor each experiment move for proper procedures or designate an alternate for this purpose. All other aspects of the UVS logistic support requirements are specified in the Logistics Plan, S4S-0-673.

5.3.5 To determine the procedure to be followed in the event that "troubleshooting" is required on flight equipment. All steps performed and test equipment used will be documented in detail in the log book.

5.3.6 To furnish the Test Review Board with reports of all anomalies in test and to act upon recommendations of that Board.

5.3.7 To carry out decisions of the Test Review Board regarding the amount of testing required when an assembly or component is replaced during test.

5.3.8 Compile and maintain a log book for each UVS and BTE.

5.3.9 Failures

5.3.9.1 The UVS end items being tested shall meet the requirements as specified in CEI Specification 7232-0009, and shall be within the specified limits, under the conditions and for the duration, as specified for each category of test as specified in Section 6.0 herein. Equipments not meeting these requirements shall be considered as failed equipment, and the failure circumstances recorded.

5.3.9.2 Flight equipment with physical deficiencies, including those from damage by any cause, as revealed by a

Quality Control inspection or by any other inspection shall be considered as failed equipment and reported as outlined in Section 5.3.9.1 herein.

5.3.9.3 The Test Review Board shall determine disposition of failed equipment.

5.3.9.4 Disassembly and troubleshooting shall not be done on a flight item except when directed by the UVS System Engineer as authorized by the Test Review Board. Corrective actions taken will be subject to approval by the Test Review Board.

5.3.9.5 Failure analysis reports will be submitted to MSC in accordance with the requirements of the Reliability Program Plan, SOR-70-030.

5.3.10 Government-furnished property will be handled in conformance with the provisions of the Contract End Item Specification.

5.3.11 All tests performed on deliverable hardware shall be accomplished in accordance with approved procedures, and the results recorded on approved data sheets. Any revisions to such procedures shall be considered as equipment failures unless previously approved per Section 5.3.9.1.

5.3.12 An equipment log book will be maintained by the System Engineering staff for each complete experiment to be tested as detailed in Section 4.1.5 herein.

5.3.13 Test techniques shall remain the same at all levels of test to permit correlation of data.

5.3.14 Alterations in parts or adjustments or modification of hardware shall not be permitted in order to pass a test unless the test procedure specifies same. Any such actions will be considered as equipment failures.

5.3.15 No tests other than acceptance tests shall be permitted on flight hardware.

5.3.16 Application of overstress to flight hardware shall make it automatically unacceptable for delivery as flight hardware unless ruled otherwise by the Test Review Board.

5.3.17 Deviations from an approved test sequence can only be accomplished with prior approval of the Test Review Board.

5.3.18 Experiment Retest

5.3.18.1 Disposition of Failures - The disposition of any failures during system-level assembly or testing prior to system-level environmental testing shall be in accordance with Section 5.3.9 herein.

5.3.18.2 Retest Criteria, Acceptance Tests

A. If a failure is detected during a vibration exposure and the test is stopped before completing the vibration profile, the following steps will be taken with the approval of the Test Review Board:

(1) The failed component will be replaced with a flight-qualified spare, or the failed unit will be repaired and retested at the component acceptance level.

(2) If the failed component can be replaced without alteration of the optical properties of the instrument, with the approval of the Test Review Board, a functional test will be run to determine whether satisfactory operation of the UVS has been reinstated. If the failed component replacement results in a compromise of the optical properties of the UVS, the UVS will be subjected to a complete electro-optical alignment followed by unoperational and optical reverification in the calibration test equipment. Having satisfactorily completed the above, the UVS will then be reinstated in the vibration test phase as follows.

(3) The reassembled experiment subsystem will be re-exposed to a flight-acceptance-level vibration.

If it can be conclusively demonstrated that failure was not due to previously completed vibration profiles, testing can be continued from the beginning of the profile during which the component failed.

B. Should a failure induced by vibration exposure not be detected until post-vibration testing, the following steps will be taken with the approval of the Test Review Board:

(1) The failed component will be replaced with a flight-qualified spare and retested as per Paragraph 5.3.18.2A(2).

(2) The reassembled experiment subsystem will be exposed to a flight-acceptance-level vibration exposure.

C. If a failure occurs during subsequent environmental exposures or after completion of the environmental series, the procedure of Section 5.3.18.2(B) will be followed.

5.4 TEST TYPES

5.4.1 Prototype Development Tests

Development testing will be performed on the prototype UVS as necessary for the determination of the

feasibility of the design approach, evaluation of hardware performance under simulated or active environmental conditions, evaluation of hardware fabrication or workmanship and/or evaluation of system or subsystem failure modes and safety margins.

The prototype UVS (serial number 01) will be identical in configuration and production processing to the qualification and both flight units. However, non-flightworthy components may be utilized in the prototype whenever schedule delays would otherwise result.

5.4.2 Acceptance Testing

All four UVS instruments, the prototype, qualification and both flight units will be subjected to the Acceptance Test Program in accordance with the Acceptance Test Plan, S4S-0-681B.

5.4.2.1 Inspection - Inspection of the UVS is performed by the UVS Quality Engineer and UVS System Engineer during and subsequent to the assembly of the instrument. Final approval during this operation will be rendered by the MSC representative and duly recorded on an itemized parts list which is an integral part of the UVS Acceptance Test Procedure, S4S-0-785.

5.4.2.2 Mass Properties - The final weight and center of gravity of each UVS instrument will be determined by measurement and analysis by the Mechanical Analyses Engineer at the Applied Physics Laboratory. The resulting data will be recorded within the Acceptance Test Procedure, S4S-0-785.

5.4.2.3 Operational Verification - This test will be performed as specified by the UVS Acceptance Test Procedure by the UVS System Engineer or his alternate using the UVS Bench Test Equipment and other peripheral equipment as required. The Operational Verification will confirm satisfactory operation of the electronic subsystems within the UVS at ambient conditions.

5.4.2.4 Optical Verification - This test can only be performed in the Calibration Test Equipment (CTE) located at the JHU Physics Department in Baltimore, Maryland or the Vertical Optical Bench (VOB) located at GSFC.

Optical verification is a minimal operation with which the overall optical efficiency of the UVS can be measured. This test is required to confirm satisfactory optical performance after environmental exposure.

This test will be conducted by the Principal Investigator using the CTE and BTE equipments as specified by the ATP.

5.4.2.5 Optical Calibration - Absolute calibration of the UVS will be performed in the CTE at the Physics Department of JHU. The overall transfer characteristics of the UVS will be determined by comparison to secondary standard photoelectric sensors traceable to the National Bureau of Standards.

The above calibration will be conducted by the Principal Investigatory as specified in the "Calibration Procedures for the UVS" (DRD JHU II - UVS).

a. The prototype UVS, serial number 01, and qualification UVS, serial number 02, will be calibrated prior to and subsequent to environmental exposure.

b. The two flight UVS instruments will be calibrated just prior to Acceptance Review and again before launch.

The Acceptance Test Plan is designed primarily to evaluate the workmanship or quality of each end item and encompasses the following operations:

a. Inspection

b. Mass Properties

c. Operational Verification

d. Optical Calibration

e. Vibration

f. Operational Verification

g. Optical Verification

h. Thermal Vacuum

i. Optical Calibration

5.4.3 Qualification Tests

Tests simulating the environments to which the UVS will be exposed are performed to ensure that the experiment hardware is capable of complying with its performance requirements, Section 3.1 of the CEI Specification for the UVS.

A flight type instrument, serial number 02, Qualification Unit, will be subjected to the qualification tests specified in Section 3.1.8 of the Contract End Item Specification for the UVS.

5.4.3.1 Ground Handling

5.4.3.1.1 Non-Operating Environment - The UVS will operate within its specification limits after being exposed to the environment described in Paragraph 4.2.1 of Exhibit B of the UVS Technical Specification provided it (UVS) has been suitably protected within its shipping container (7232-0495). See Shipping Container Specification 7232-0008.

When subjected to the mechanical environments specified in Exhibit B, the isolation mounting provided in the shipping container will reduce the shock and vibration input to the UVS to the following levels.

a. Shock

15g sawtooth pulse
50 ms rise time

b. Vibration

5-9 Hz	0.75 inches D.A.
9-11 Hz	3.2 g's (peak)
11-15 Hz	1.4 g's (peak)
15-20 Hz	0.6 g's (peak)

5.4.3.1.2 Ground Environment Testing

a. Shock - Nonoperating - The UVS will be subjected to the shock test method described in MIL-STD-810B, Method 516.1, Procedure I and using the configuration and tolerance shown in 516.1-1. The peak acceleration will be 15 g with a duration of 0.05 seconds.

APL will contract with an outside agency to supply the required facilities to perform the above test.

b. Vibration - The UVS will be tested to the following sinusoidal vibration levels in three axes (x, y, z) relative to the UVS.

5-9 Hz	0.75 inches D.A.
9-11 Hz	3.2 g's (peak)
11-15 Hz	1.4 g's (peak)
15-20 Hz	0.6 g's (peak)

Sweep Rate - Two minutes per octave.

The above test will take place at the Applied Physics Laboratory in conjunction with the flight level vibration testing.

5.4.3.2 Flight Environments

5.4.3.2.1 Acceleration - The spectrometer will not be subjected to centrifuge testing since it can be shown analytically that the vibration loads will be several times more severe than the expected 6g maximum acceleration environment.

5.4.3.2.2 Vibration

a. The spectrometer will be vibrated in accordance with Method 514.1, Procedure VI, Part 1 of MIL-STD-810B, and the Qualification Test Procedure for the UVS.

b. The UVS will be energized during the stimulation period of the test in order to uncover anomalies caused by "flicker" shorts, intermittent connections, et al.

c. Upon completion of the vibration excitation, an operational verification will be performed to confirm that the electronic subsystems of the UVS are still operating within specifications.

d. Having successfully performed item (b) above, the UVS will undergo an optical verification to ensure that the overall efficiency of the UVS has not been influenced by the vibration testing.

e. Equipment will be tested to the limits given in Paragraph 3.1.9.1.3 of the Contract End Item Specification as follows:

Sinusoidal

X and Y Axes

5 to 35 Hz 0.25g peak

Z Axis

5 to 14 Hz	0.25g peak
14 to 18 Hz	0.025 in D.A.
18 to 20 Hz	0.4g peak
20 to 35 Hz	0.25g peak

Rate: 3 octave/minute sweep rise and fall each axis.

Random

Y Axis

20 to 200 Hz	+6 db/octave
200 to 1000 Hz	0.07 g^2/Hz
1000 to 2000 Hz	-9 db/octave

X and Z Axes

20 to 60 Hz	+3 db/octave
60 to 160 Hz	0.03 g^2/Hz
160 to 240 Hz	+12 db/octave
240 to 1000 Hz	0.15 g^2/Hz
1000 to 2000 Hz	-9 db/octave

Duration: 1.5 minutes per axis.

In order to demonstrate capability to withstand transonic flight conditions, the unit will withstand the above spectra increased by a factor of 2.5 for ten seconds in each axis.

In addition, the unit will withstand the following inputs:

All Axes

20 to 80 Hz	+3 db/octave
80 to 350 Hz	0.067 g^2/Hz
350 to 2000 Hz	-3 db/octave

Duration: 3 minutes per axis.

5.4.3.2.3 Pyrotechnic Shock - The spectrometer will be exposed to the following shock spectra based on a 1/6 octave band analysis and Q = 10:

20 to 900 Hz	+12 db/octave
900 to 10,000 Hz	2400g peak

Shock will be applied in each of the X, Y and Z axes.

5.4.3.2.4 Thermal Vacuum - The spectrometer will be thermal-vacuum tested to the environment specified in Figure 1 in accordance with Space Simulation Test Method 517.1, Procedure II of MIL-STD-810B as follows:

a. Prior to the thermal vacuum test, the spectrometer will be tested under ambient conditions for operation within specifications.

b. Moon radiation and albedo will be simulated.

c. Rotational modes in which the SIM operning will be pointed at the moon, the sun or space will be simulated. The internal environment of the SIM compartment will also be simulated for surfaces facing the SIM walls.

d. UVS operation will be tested one hour after thermal stabilization at the temperature extremes of the temperature cycling test at both hot and cold temperatures. During the mission simulation qualification test operational duty cycles will be as specified in ICD MH01-12463-434, CSM/UV Spectrometer Functional Requirements.

e. Test durations will be as follows:

(1) Temperature Cycle Test - Four and one-half cycles between maximum temperature limits with a four-hour soak at each extreme. (See Figure 1.)

(2) Mission Simulation Test - Simulation of 15.3 day mission.

f. During operational periods, the instrument will be excited by simulated radiation input and the data and housekeeping outputs will be monitored for operation within specifications.

5.4.3.2.5 EMI - The spectrometer will be tested for electromagnetic interference and susceptibility using the methods and to the limits given in applicable parts of Specification MC 999-0002C, Electromagnetic Interference Control for the Apollo Space System, as follows:

a. Conducted Interference, Tests A-1 and A-2.

b. Radiated Interference, Tests B-1 and B-2.

c. Conducted RF Susceptibility, Test D-1.

d. Conducted AF Susceptibility, Test D-2.

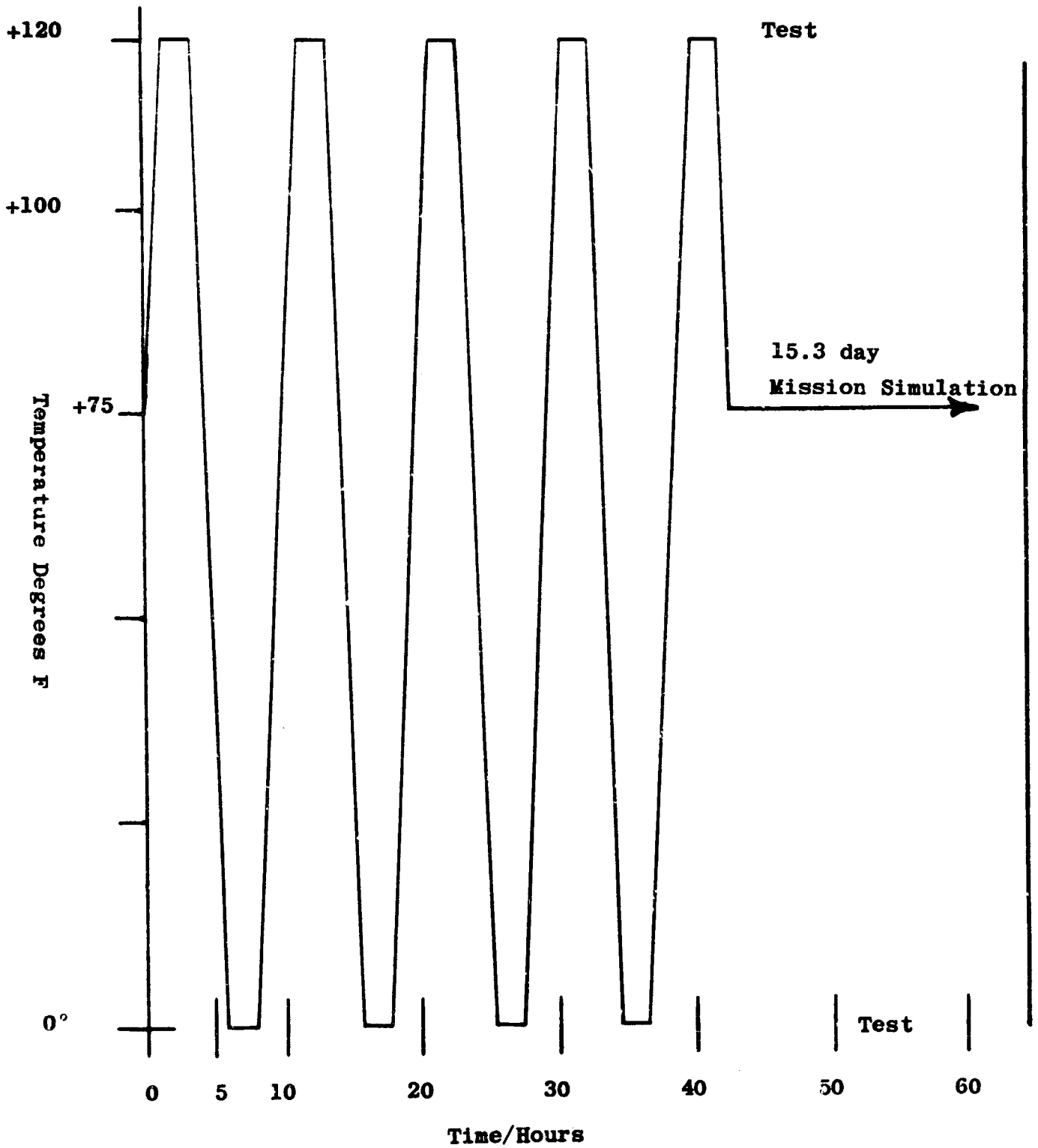
e. Conducted Transient Susceptibility, Test D-3.

f. Radiated RF Susceptibility, Test D-4.

g. Induced AF Susceptibility, Tests D-7 and D-8.

FIGURE 1

UVS QUALIFICATION TEST



5.4.3.3 Vibration Testing - The following vibration test program will be conducted at APL on each UVS as specified in the UVS ATP.

a. Range - Acceleration spectral density increasing at 3 db/octave from 20 to 80 Hz, constant at 0.04 g^2/Hz from 80 to 350 Hz, and decreasing at 3 db/octave from 350 to 2000 Hz.

b. Duration - Thirty seconds per axis (including equalization time).

5.4.3.4 Thermal Vacuum Test - Each UVS will be exposed to the following thermal vacuum environments at the Applied Physics Laboratory (APL) Environmental Test Laboratory (ETL):

a. Vacuum - 1×10^{-6} torr.

b. Temperature Range - 0° to 100° F.

c. Duration - One and one-half cycles of the temperature extremes with a four-hour soak period at each extreme.

d. Operation - The equipment will be tested for operation within specifications during the soak period at each temperature extreme.

5.4.4 Preinstallation Tests

The Applied Physics Laboratory, The Johns Hopkins University, will recommend inspection and functional test procedures to be performed at KSC to verify that the hardware

has not been damaged during handling, storage, or shipment after the acceptance tests and that the performance capability has not deteriorated. This plan will be prepared in accordance with DRL 54 of the contract statement of work. APL/JHU will review the final Preinstallation Test Procedures (prepared by the Integrating Contractor or designated NASA Center) for adequacy.

5.4.5 Integrated System Tests

The integrated system tests will be performed with the UVS installed in the SIM on the KSC launch pad to verify that the experiment is functionally and operationally compatible when integrated with the CSM systems hardware. These tests will include:

a. A detailed functional checkout to demonstrate that the UV sensor, timing and control, scientific data processing, housekeeping monitors, and internal power systems operate within specification.

b. Simulated mission operation. During these tests the experiment will be powered and controlled from the CSM with monitoring provided by the portable BTE and the CSM data system. The Applied Physics Laboratory, Johns Hopkins University will review the final Integrated System Test Procedures (prepared by the Integrating Contractor or NASA center assigned to conduct the tests) for adequacy.

5.4.6 Prelaunch Tests

Prelaunch tests will demonstrate that the experiment is operating normally during the countdown demonstration. The Applied Physics Laboratory, Johns Hopkins University will review the Prelaunch Test Procedures (prepared by the NASA center assigned to conduct the tests) for adequacy.

5.5 PERFORMANCE/DESIGN VERIFICATION PROGRAM

Verification methods and test types to verify that the hardware items meet the performance/design requirements of Section 3 of the Contract End Item Specification shall be as shown on the verification matrix (Table I). Satisfactory verification by implementation of the verification methods and by satisfactory completion of all specified tests will be the basis for acceptance of hardware.

5.5.1 Verification Methods

5.5.1.1 Similarity - Verification by similarity will be used if it can be shown that the article is substantially similar or identical in design, manufacturing processes, and quality control to another article that has been previously qualified to equivalent or more stringent criteria. Verification by similarity may pertain to characteristics, such as material, configuration, functional element, or assembly, and can be applied selectively for applicable environments.

Previous qualification tests conducted on articles for other programs will be applicable provided:

a. There are no changes in:

(1) Design and specifications including operating limits, weight, dimensions, materials, performance and tolerance, reliability, and quality.

(2) Fabrication methods.

(3) Inspection techniques.

(4) Manufacturing environment and tests up to the point where qualification tests would normally be initiated.

(5) Electromagnetic interference.

b. Present articles are from the same manufacturing continuous-built lot as the qualified article.

c. Present articles are interchangeable with previously qualified articles.

A change in any of the above provisions shall be reported by the contractor. Validation is required by an engineering analysis or test report that the changes do not adversely affect the qualification of the article.

A certification of compliance will be required from the manufacturer confirming the items listed above.

5.5.1.2 Analysis - Verification by analysis shall be used in lieu of testing whenever it can be shown by generally accepted analytical techniques that an article will meet the applicable performance/design requirements. A report of each such analysis shall be submitted.

5.5.1.3 Inspection - Verification by inspection shall be used whenever it can be shown that inspection techniques are adequate to assure that the article will meet the applicable performance/design requirements. Inspection will be used to verify the construction features, compliance with drawings, workmanship, and physical condition of the article.

5.5.1.4 Demonstration - Verification by demonstration shall be used whenever it can be shown that demonstration is adequate to assure that the article will meet the applicable performance/design requirements. Demonstration will be used to verify such requirements as service and access, handling, convenience, and ease of operation.

5.5.1.5 Test - Verification by test will be used whenever the verification methods of Sections 5.3.1.1 through 5.3.1.4 above are not applicable. The test types shall be as defined in Section 5.0.

5.5.1.6 Verification Test Schedule - The tests specified herein shall be performed in accordance with the schedules in Tables II, III and IV.

TABLE I. PERFORMANCE/DESIGN VERIFICATION MATRIX

VERIFICATION METHOD:

NA — Not Applicable
1 — SIMILARITY
2 — ANALYSIS
3 — INSPECTION
4 — DEMONSTRATION
5 — TEST

TEST TYPES:

A — DEVELOPMENT
B — QUALIFICATION
C — ACCEPTANCE
D — PRE-INSTALLATION
E — INTEGRATED SYSTEMS
F — PRE-LAUNCH
G — OTHER

Section 3.0 Contract End Item Spec Reference	Verification Method						Test Type								Test Notes
	NA	1	2	3	4	5	A	B	C	D	E	F	G		
3.0	X														
3.1	X														
3.1.1	X														
3.1.1.1						X	X	X	X						CTE Testing
3.1.1.2			X												Ray Trace
3.1.1.3			X												CTE Calibration
3.1.1.4						X	X	X	X						
3.1.1.5			X			X	X	X	X						
3.1.1.6				X											
3.1.2	X														
3.1.2.1				X											
3.1.2.2						X	X	X	X						Mass Properties
3.1.2.3						X	X	X	X						Mass Properties
3.1.2.4				X											
3.1.2.5						X	X	X	X						

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E — INTEGRATED SYSTEMS
F — PRE-LAUNCH
G — OTHER

Section 3.0 Contract End Item Spec Reference	Verification Method							Test Type									Test Notes
	NA	1	2	3	4	5		A	B	C	D	E	F	G			
3.1.2.6				X													
3.1.2.7				X													
3.1.2.7.1				X													
3.1.2.7.2				X													
3.1.2.7.3			X														Ray Trace
3.1.2.7.4				X													
3.1.2.7.5				X													
3.1.2.8			X														Ray Trace
3.1.2.9				X													
3.1.3	X																
3.1.3.1	X																
3.1.3.2				X		X								X			Acceptance test at parts level.
3.1.3.3				X		X								X			Acceptance test at parts level.
3.1.3.4				X		X								X			Acceptance test at parts level.
3.1.3.5				X													

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Section 3.0 Contract End Item Spec Reference	Verification Method						Test Type							Test Notes
	NA	1	2	3	4	5	A	B	C	D	E	F	G	
3.1.3.6			X											Ray Trace
3.1.4	X													
3.1.4.1				X		X	X	X	X					
3.1.4.2				X		X							X	Acceptance test at parts level.
3.1.4.3						X	X	X	X					
3.1.4.3.1						X	X	X	X					
3.1.4.3.2						X	X	X	X					
3.1.4.3.3						X	X	X	X					
3.1.4.3.4						x	x	x	x					
3.1.4.3.5						X	X	X	X					
3.1.4.4						X	X	X	X					
3.1.4.4.1			X			X	X	X	X					

TABLE I. PERFORMANCE/DESIGN VERIFICATION MATRIX

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Section 3.0 Contract End Item Spec Reference	Verification Method						Test Type							Test Notes
	NA	1	2	3	4	5	A	B	C	D	E	F	G	
3.1.4.4.2			X			X	X	X	X					Analysis will be a transfer function and calibration for each TM point
3.1.4.4.3			X			X	X	X	X					
3.1.4.4.4			X			X	X	X	X					
3.1.4.4.5			X			X	X	X	X					
3.1.4.4.6			X			X	X	X	X					
3.1.4.5						X	X	X	X					
3.1.4.6	X													
3.1.4.6.1						X	X	X	X					
3.1.4.6.2						X	X	X	X					
3.1.4.6.3						X		X						EMI
3.1.4.6.4						X	X	X	X					
3.1.4.6.5						X							X	TSTD during harness fab.
3.1.4.7			X											FMEA
3.1.5	X													

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D — PRE-INSTALLATION
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F — PRE-LAUNCH
G — OTHER

Section 3.0 Contract End Item Spec Reference	Verification Method							Test Type								Test Notes
	NA	1	2	3	4	5		A	B	C	D	E	F	G		
3.1.5.1						X	-	X								T-V Thermal Model
3.1.5.1, Qual		X				X	-		X							EMI
3.1.6	X															
3.1.6.1, Qual						X			X							Useful Life
3.1.6.1, Proto						X		X								Vibration
3.1.6.2, Proto						X		X								T-V
3.1.7	X															
3.1.7.1			X			X			X							
3.1.8	X															
3.1.8.1	X															
3.1.8.1.1						X			X							
3.1.8.1.2						X								X		Shipping Container Pressurization Test
3.1.8.1.3						X			X							
3.1.8.1.4						X			X							

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C — ACCEPTANCE
D — PRE-INSTALLATION
E — INTEGRATED SYSTEMS
F — PRE-LAUNCH
G — OTHER

Section 3.0 Contract End Item Spec Reference	Verification Method							Test Type									Test Notes
	NA	1	2	3	4	5		A	B	C	D	E	F	G			
3.1.9	X																
3.1.9.1	X																
3.1.9.1.1						X			X								
3.1.9.1.2						X			X								
3.1.9.1.3						X			X								
3.1.9.1.4						X			X								
3.1.9.1.5						X			X								
3.1.9.1.6			X														
3.1.9.2	X																
3.1.9.2.1						X			X								
3.1.9.2.2						X			X								
3.1.9.2.3			X														
3.1.9.2.4						X			X	X							
3.2	X																
3.2.1				X													
3.2.2				X													
3.2.3				X													

TABLE II - S169 EXPERIMENT PROTOTYPE TEST SCHEDULE

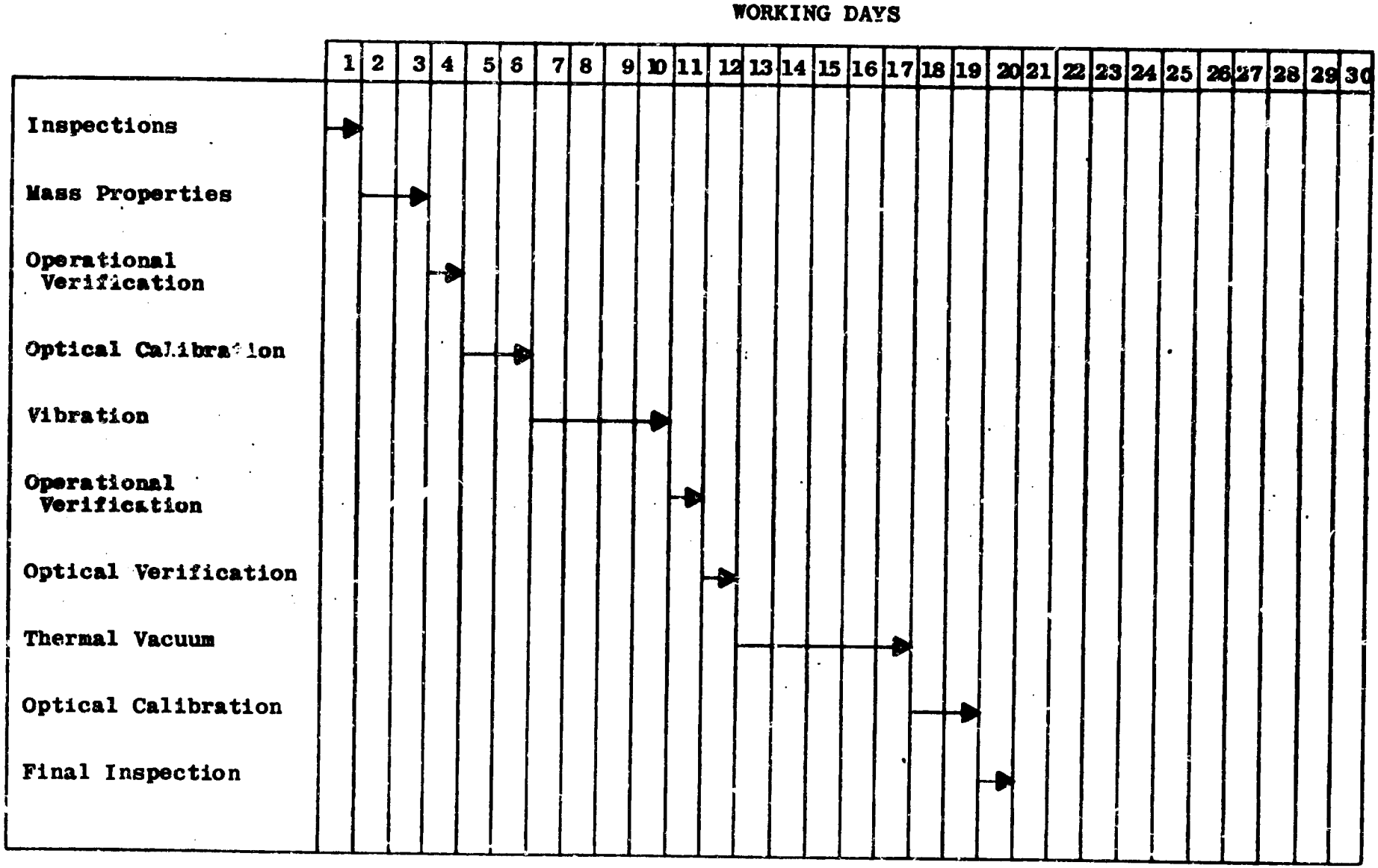
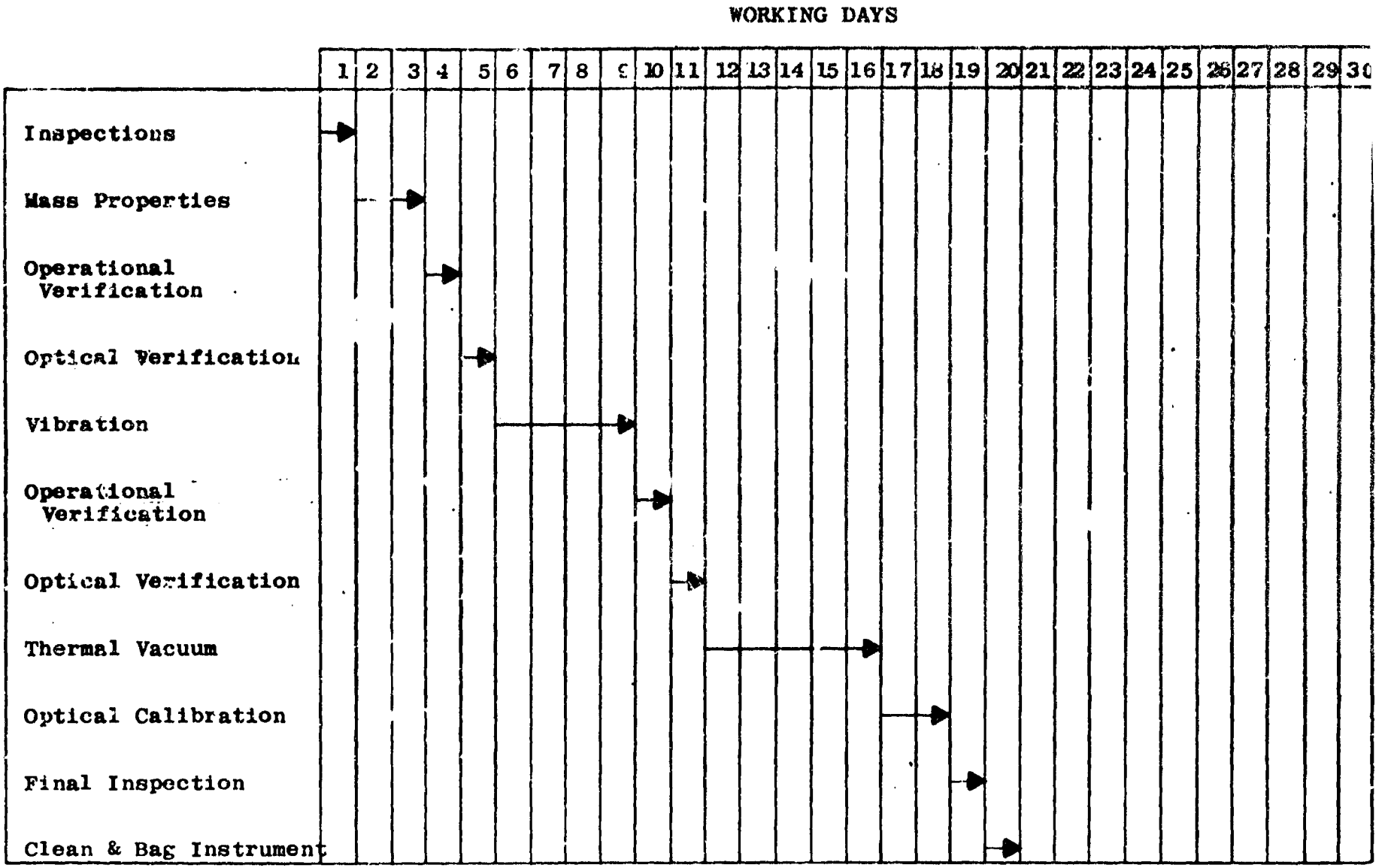
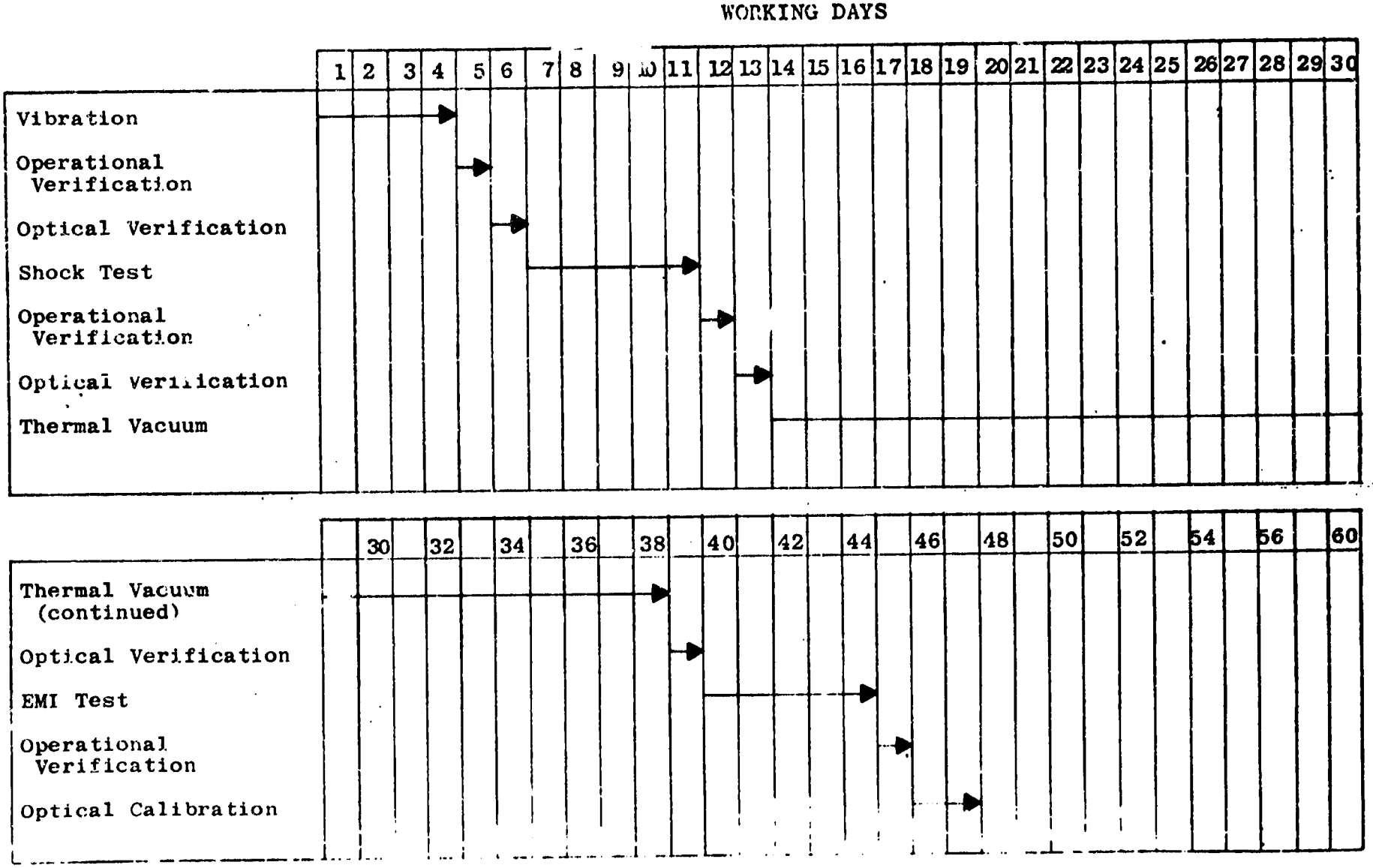


TABLE III - S169 EXPERIMENT ACCEPTANCE TEST SCHEDULE



(Refer to UVS Acceptance Test Plan, S4S-0-681; and UVS Acceptance Test Procedure, S4S-0-751.)

TABL. IV - 5169 EXPERIMENT QUALIFICATION TEST SCHEDULE



(Refer to UVS Qualification Test Plan, S4S-0-680; and UVS Qualification Test Procedure, S4S-0-750.)