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APOLLO APPLICATIONS PROGRAM (AAP)
PAYLOAD INTEGRATION

General Test Plan
Combined Mission, Flights AAP 1/2/3/4

Volume III
Payload Integration Development Plan

Contract No. NAS8-21004

MARTIN MARIETTA CORPORATION
DENVER DIVISION

FOREWORD

This document is submitted under DRL Line Item 20 of Exhibit C of Contract NAS8-21004 for the use of MSFC. This document is the forty-ninth submitted under this contract.

This is Volume III of four volumes containing the General Test Plan.

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1. INTRODUCTION

1.1 Purpose - The purpose of this plan is to define the AAP integrated module development and qualification test programs for which MSFC has prime responsibility. This plan will be used as the basic planning document when preparing subsequent test implementation documentation for the tests outlined in this plan.

1.2 Scope - This plan describes the development and qualification test programs for those integrated modules for which MSFC has prime responsibility. In addition, this plan describes those intercarrier verification tests required to demonstrate the compatibility of all launch and orbit experiment module configurations. This plan does not describe the subsystem development and qualification test programs or the flight article test program. The support subsystem development and qualification test program is described in Volume II, and the flight article integration and prelaunch test program is described in Volume IV of this document.

1.3 Flights AAP 1/2/3/4 Test Program Summary - The Combined Mission, Flights AAP 1/2/3/4 Test Program is designed to develop and qualify the integrated experiment modules utilized during the mission and to verify their compatibility in the various launch and orbit configurations.

This test program has been divided into three main test categories: development testing, qualification testing, and intercarrier verification testing. Test articles involved in this program are at the carrier and integrated experiment module level.

1.3.1 Development Tests - The present Apollo spacecraft is not adequate to attain the objectives of the Combined Mission flights. New modules and modifications to existing modules will have to be developed to conduct the experiment program associated with this mission. Specific module development tasks include:

a. Lunar Mapping and Scientific Survey (LM&SS) development
b. Airlock Module (AM) development
c. Orbital Module development
d. Multiple Docking Adapter (MDA) development
e. Resupply Module (RM) development
f. Lunar Module/Apollo Telescope Mount (LM/ATM) development

Included in the integrated experiment module development test program are tests to verify man-machine compatibility, experiment integration and integrated experiment module compatibility under ambient and selected environmental conditions.

1.3.2 Qualification Tests - The qualification test program for the Combined Mission, Flights AAP 1/2/3/4, will demonstrate the performance of all new hardware and modified hardware when operated in a mission sequence under ambient and environmental conditions. Existing carriers, i.e., S-IVB, Spacecraft LM Adapter (SLA), and Instrument Unit (IU), will be tested for modifications only, with maximum utilization being made of previous ground and flight test data during formulation of the ground test program, and when substituting analysis for test.

New carriers, i.e., LM&SS Rack, MDA, RM and ATM/Rack, will be tested for performance evaluation within the full spectrum of storage, transportation, launch and orbit environments, and life cycle requirements.

The module development and qualification test programs will be closely coordinated to obtain maximum data with the minimum number of tests.

All qualification testing will be performed of flight configured modules that contain flight type hardware.

1.3.3 Intercarrier Verification Tests - Intercarrier verification tests will be performed on the various launch and orbital cluster configurations to verify the electrical, electronic, mechanical, fluid, data, and physical compatibility between the integrated experiment modules. (Two orbital configurations are shown in Figures 1 and 2.) The integrated experiment modules will be capable of performing all operations possible within the constraint of the ground environment, to demonstrate the cluster system compatibility and experiment module interfaces.

This test program is designed to verify that the following mission objectives can be accomplished utilizing the Flights AAP 1/2/3/4 integrated experiment modules.

a. Conduct a low altitude, low inclination earth orbital mission with a crew of three men, using a spent S-IVB stage as an Orbital Workshop (OWS).

b. Provide for the reactivation and reuse of the Orbital Workshop during subsequent missions.

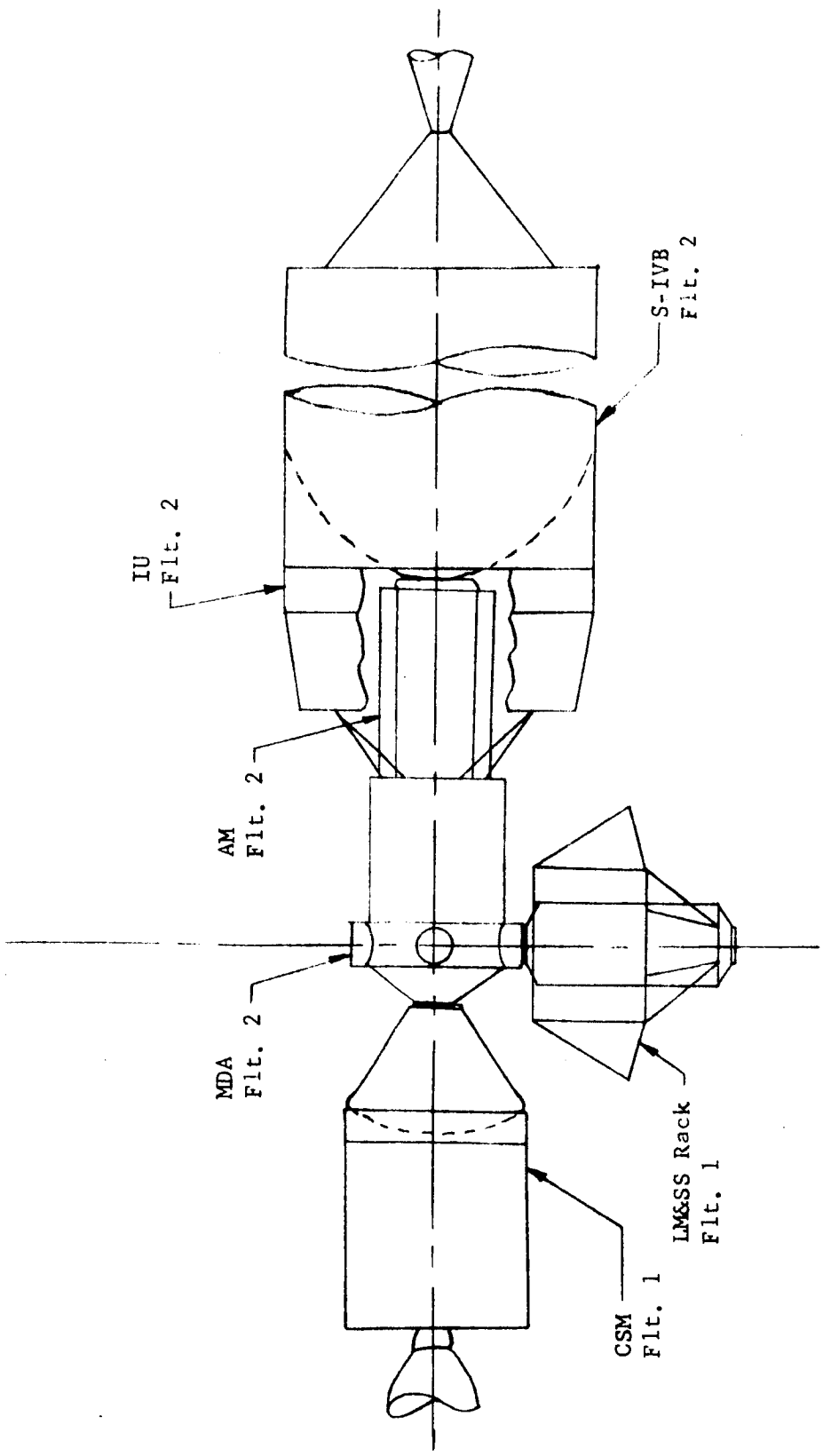
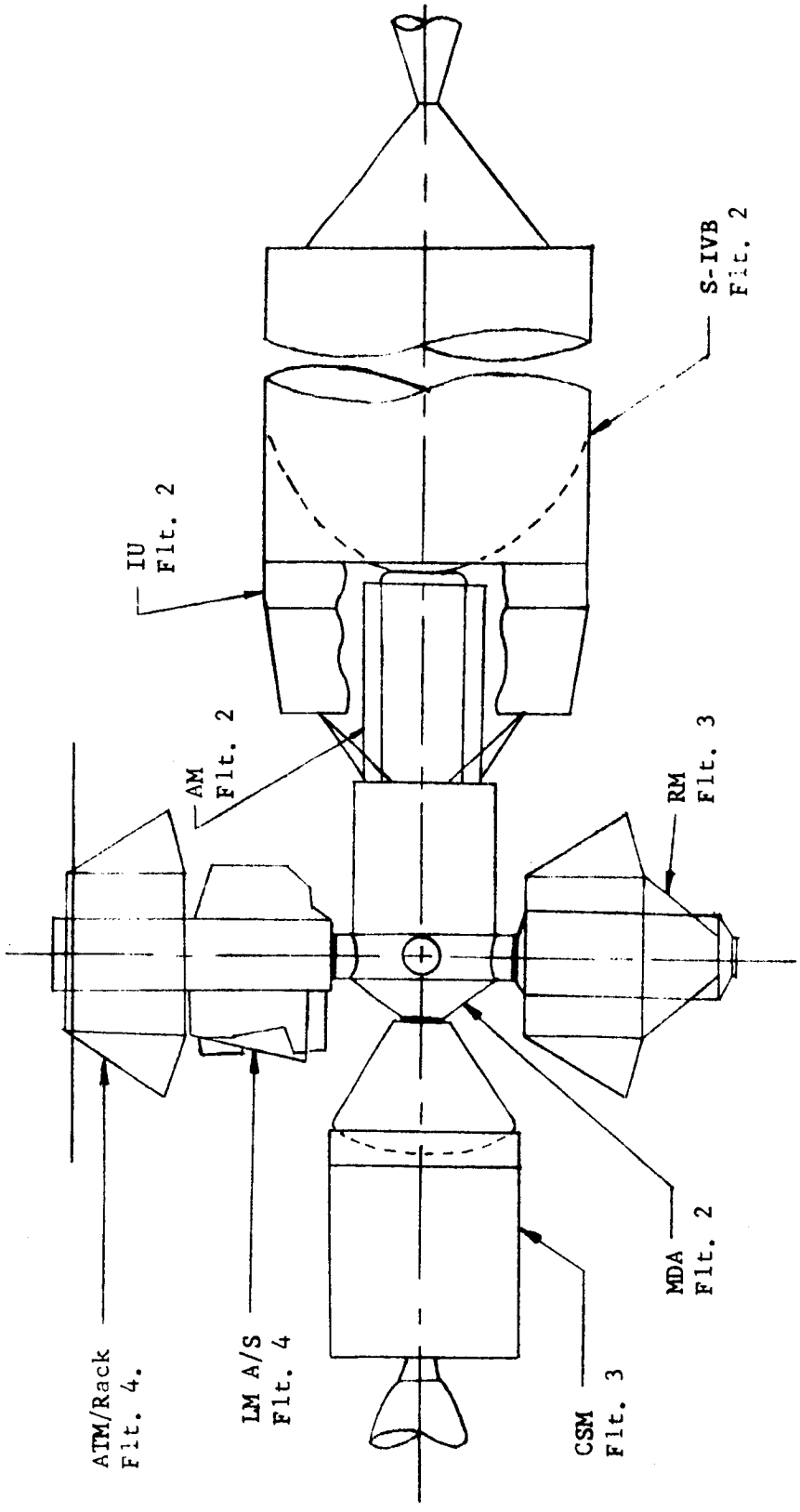


Figure 1. Mission AAP 1/2 Orbit Configuration



Note: LM&SS/Rack from Flight 1 is omitted for clarity

Figure 2. Combined Mission, Flights AAP 1/2/3/4 Orbit Configuration

c. Conduct inflight experiments in the areas of science, applications, technology and engineering.

d. Qualify men, evaluate their support requirements and determine human task performance capability on long duration manned space flight missions.

e. Evaluate feasibility of space station resupply.

f. Conduct stellar observations with the ATM/Rack and evaluate capability of space station attitude control.

1.4 General Considerations - The considerations and ground rules contained in this section deal only with the integrated carrier development and qualification test program. Description of the total test program consideration and ground rules, not unique to this volume, are discussed in Volume I of this plan. The following considerations and ground rules were used in the formulation of the Combined Mission, Flights AAP 1/2/3/4 development and qualification test program.

1.4.1 General

a. No on-orbit operation will be performed during the mission that has not been verified by ground checkout.

b. Life test qualification requirements will be satisfied at the component level. Subsystem and integrated experiment module qualification tests shall include more real time sequences than flight article tests, but will not be constrained to real time qualification for inactive mission segments.

c. When commercial test equipment or prototype tools are used in place of nonavailable GSE, the methods of test will adhere, as close as possible, to the proposed methods and sequences to which the GSE has been designed.

d. Carrier, support subsystem, and experiment hardware shall be designed to accommodate ground test and checkout requirements.

e. Test requirements placed against one hardware configuration can be satisfied through tests performed on lower configuration levels when it is expeditious to do so and when test validity is not affected.

f. No testing will be planned exclusively for reliability demonstration.

g. Maximum utilization of qualification data from previous test programs and flight tests will be made. Similarly, maximum effort will be made to utilize analysis and/or similarity in place of testing.

h. Structural load qualification tests will be held to an absolute minimum by the general philosophy of utilizing conservative design margins of safety.

i. All cluster configurations, experiment modules, components and experiments will be subjected to Electromagnetic Interference (EMI) tests. The EMI test program will implement specifications requirements of MIL-E-6051C, MIL-I-6181D, and MIL-B-5087D.

j. Cluster configuration, integrated experiment module, and experiment checkout will be conducted utilizing on-orbit mission sequences, while minimizing real time checkout.

k. Where practical, during integrated experiment module and cluster configuration tests, the erectable structures shall be deployed to confirm interexperiment and inter carriercompatibility.

l. Qualification requirements are imposed against the integrated experiment module, critical components and experiments (contract end items).

1.4.2 Cluster Configurations

a. The cluster configuration test program involving Flights AAP 1, 2, 3 and 4 is an MSFC responsibility.

b. Testing in the cluster configuration is not a qualification requirement, but a system design verification requirement.

c. Interface compatibility testing of the CSM and LM&SS (Flight AAP 1) will be the responsibility of MSC.

d. The ground support equipment required for the cluster configuration test program will be as austere as possible and still allow a simulated mission operation to be performed. In addition, this equipment will be required to perform a check-out of the individual carriers to verify their proper operation prior to their use in the cluster test program. Only those systems required to verify cluster system compatibility and carrier interfaces will be required to operate during the cluster test program.

e. No environmental testing (EMC excepted) will be performed on any full scale cluster configuration.

f. EMC testing will be required on all on-orbit cluster configurations.

g. Verification testing of the orbit configurations of Flights AAP 1,2,3 and 4 will be complete prior to launch of Flight AAP 1. This test is required to verify all Flight AAP 2 hardware interfaces.

1.4.3 Integrated Experiment Modules

a. At least one prototype of each carrier, with experiments, will be built for development/qualification testing.

b. Development and qualification of the AM, SLA, CSM, LM&SS & LM carriers are not considered to be under MSFC responsibility, and are not included in the test program.

c. Thermal vacuum qualification testing will not be performed on flight articles.

d. GSE will be utilized to the fullest extent possible during the carrier development and qualification test program, dependent on its fabrication and acceptance schedule.

e. The complete integrated experiment modules will not be subjected to centrifuge tests.

f. The ATM package is a separate end item and will require a qualification program at this level.

1.4.4 Experiments

a. All experiments will be qualified by the experiment contractor.

b. Experiments to be used for integrated experiment module qualification testing and for the cluster configuration design verification tests will be capable of operation under specified environments. These environments to be determined by the specific carrier test program.

c. The experiment hardware contractor and/or Principal Investigator will furnish the GSE and special test equipment necessary to support test, checkout, and handling of his individual experiment.

2. DEVELOPMENT TEST PROGRAM

2.1 General - New or modified hardware will have to be developed for the Mission AAP 1 through 4 flight program to attain the objectives of the mission. Existing modules and hardware will be utilized to the maximum extent possible and modified as required to meet these objectives. When existing modules and hardware cannot be utilized, new hardware will be developed.

The Mission AAP 1 through 4 development test program will include the following tasks.

a. LM&SS development
b. Orbital workshop development
c. Airlock module development
d. Multiple docking adapter development
e. Resupply module development
f. Lunar Module/Apollo telescope mount (LM/ATM) development
g. Man-machine compatibility
h. Integration of experiment into carriers
i. Compatibility testing of the integrated experiment modules

The integrated experiment module development test program is designed to confirm the subsystem and system design, to verify that the integrated experiment module will satisfy the compatibility and performance requirements of launch and orbital operations, and to verify readiness of the integrated experiment module to progress into the qualification test program. In addition to these basic objectives, this test program will provide basic system operation criteria to assist in later test and operations analysis, provide additional data for system reliability evaluation, and verify electrical and mechanical GSE compatibility. Maximum use of the data derived from the tests performed in this phase shall be made to satisfy formal qualification requirements.

The development test articles will be subjected to specific functional and margin of safety test requirements which will be used for early evaluation of production hardware capabilities. These conditions will be more severe than the anticipated orbit conditions in order to provide more assurance of fault isolation. The tests will not exceed reasonable safety margins or excite unrealistic modes of failure.

Scale model or full-scale thermal model tests will be performed on any carrier where analysis cannot be substituted for test. The tests will be conducted to obtain actual thermal data to substantiate analysis and provide design and experiment criteria. This data will also provide information to conduct the qualification or flight article thermal vacuum test.

The instrumentation required for the development test program will include sufficient measurements of the test facility and test article to analyze system operation during each test. Additional measurements will be provided as necessary to accomplish design evaluation and evaluation of inflight instrumentation.

In addition to the development test articles, nonfunctional experiment module mockups will be fabricated to verify space allocation, equipment distribution and location, cable routing, accessibility and interface location between the various carrier segments. These mockups will be full scale but will not simulate weight and mass distribution.

2.2 Nonfunctional Mockups - Nonfunctional mockups will be required of all integrated experiment modules involved in Combined Mission, Flights AAP 1/2/3/4. These mockups will be full scale with the size, shape and interfaces of all components, experiments and experiment modules accurately simulated.

These mockups will be assembled into the various launch and orbit configurations to accomplish the following objectives.

a. Experiment configuration grouping studies

b. Determination of preliminary experiment, support subsystem, and carrier interfaces

c. Experiment module configuration verification

d. Mechanical (size, shape, volume) modification kit development

e. Studies of man-machine relationships (i.e., lighting requirements, mobility and locations, etc.)

f. Evaluation of handling and transport fixtures

g. Evaluation of experiment and subsystem access for calibration, servicing, etc.

h. Evaluation of docking clearances

i. Evaluation of umbilical locations

The mockups of Flights AAP 1 and 2 will be assembled first, with concentration on the S-IVB and AM combination, due to the large amount of interfaces between these two modules when the OWS is activated.

The remaining modules of Mission AAP 1 through 4 will be assembled into the orbit configurations indicated in figure 2.

The nonfunctional mockup test program is depicted in the following test flow diagram (figure 3) and the accompanying test descriptions (Table I).

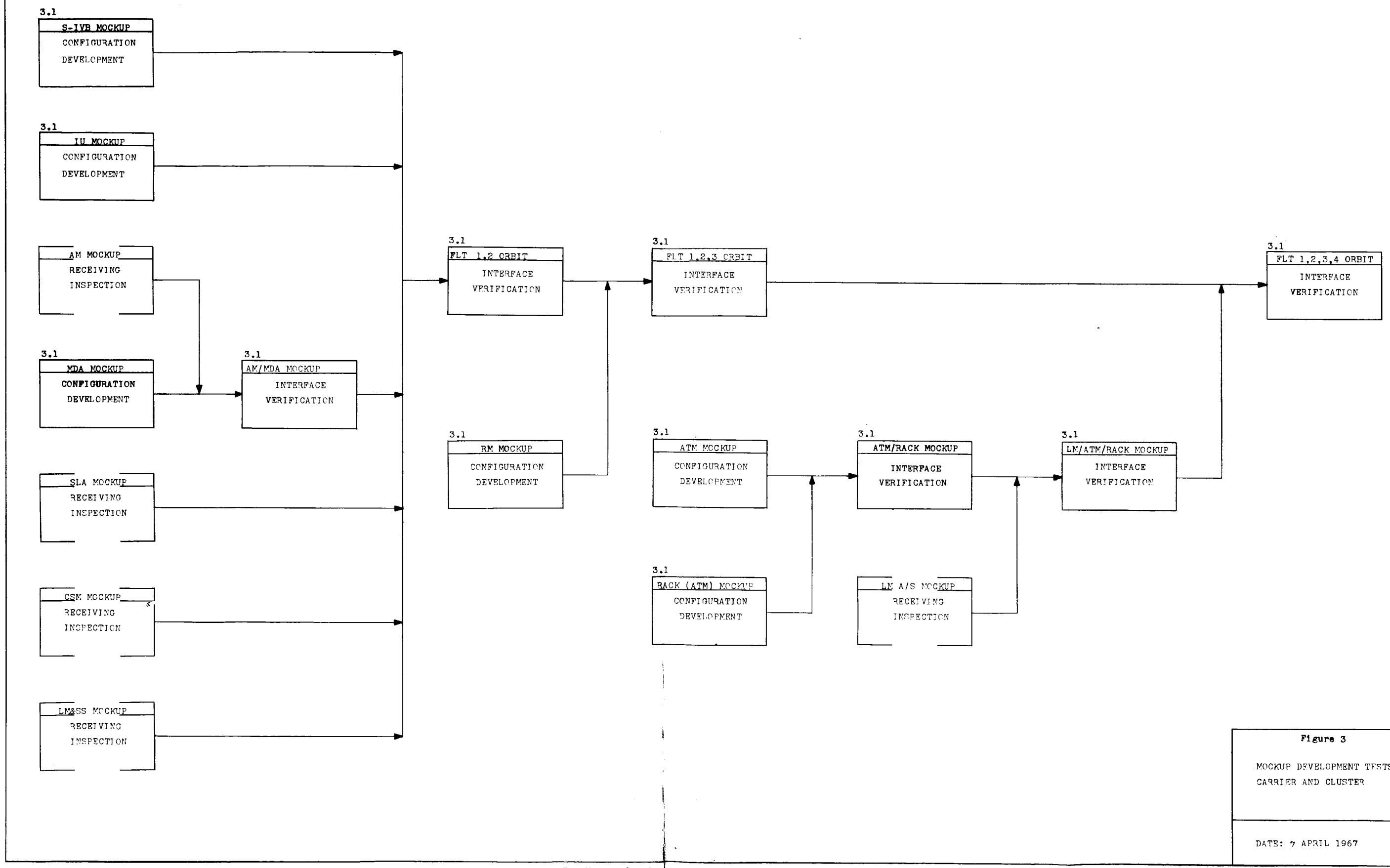


Figure 3. Mockup Development Tests - Carrier and Cluster

FOLDOUT FRAME 1

FOLDOUT FRAME

FOLDOUT FRAME 2

Table I. Test Descriptions for Figure 3

TEST TITLE	TEST NUMBER
Mockup Development Tests	3.1

TEST OBJECTIVE

Perform configuration development tests on the individual carriers and verify interface compatibility between carriers in the cluster configurations.

TEST CONFIGURATION

Cluster carrier nonfunctional mockups: S-IVB, IU, AM, MDA, SLA, LM&SS, CSM, RM, LM, ATM/Rack.

TEST DESCRIPTION

PREPARATION
Nonfunctional mockups will be constructed of each carrier that will have the carrier interfaces to the latest configuration and will contain nonfunctional mockups of all experiments and subsystem elements. These mockups will be mounted on fixtures that will allow horizontal assembly of the cluster configurations.

OPERATION
Two basic levels of nonfunctional testing will be performed: configuration development of the integrated experiment module level, and interface verification at the cluster segment and full cluster level.

1. Configuration Development - Integrated experiment module configuration development tests will be performed to verify space allocations, equipment distribution and location, cable routing, accessibility, man-machine compatibility, and to develop operation sequences.

2. Interface Verification - Interface verification will be performed on carrier combinations. Interface physical fit and compatibility will be verified, intercarrier interference checks made and man-machine relationships determined.

CRITERIA FOR SUCCESS

1. Modifications for proper layout will be determined and operations sequence developed.

Table I (Cont.)

Mockup Development Tests (continued)

2. Intercarrier interferences eliminated and man-machine relationship verified.

SUPPORT REQUIREMENTS

GSE
1. Mockup handling and transport equipment.

SPECIAL TEST EQUIPMENT
1. Fixtures to hold mockups in various carrier combinations.
2. Internal work platforms.

FACILITIES
1. Area to hold cluster carriers in horizontal position.
2. External work platform.

2.3 Carrier Development

2.3.1 LM&SS Rack Development - The rack will be a new structure and a full scale structural test program will be performed. The rack will be the basic structure used for assembly of the LM&SS experiment and support subsystems, the RM support subsystems and the ATM support subsystems and experiments.

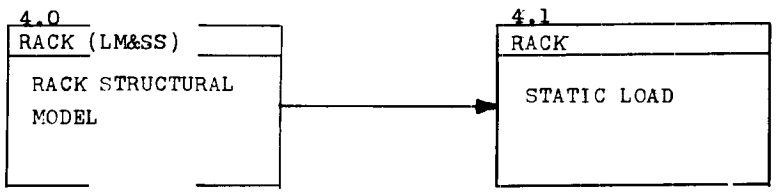
This program will consist of the tasks necessary to structurally test the basic rack for the following g-load conditions:

a. Loading encountered during transportation and handling of the rack and attached equipment.

b. G-loading encountered during the boost phase of the flight.

Dynamics testing for the fully assembled LM&SS Rack (i.e., acoustic, shock and vibration) will be the responsibility of MSC.

The details of the LM&SS Rack development program are described in the following test flow diagram (figure 4) and the accompanying test description (Table II).



NOTE: PARTIAL BLOCKS ARE FOR REFERENCE ONLY

FIGURE 4

RACK (LM&SS)

DEVELOPMENT TEST HARDWARE FLOW

DATE: 7 APRIL 1967

Figure 4. RACK (LM&SS) Development Test Hardware Flow

Table II. Descriptions for Figure 4

TEST TITLE	TEST NUMBER
Rack (LM&SS) Static Load	4.1

TEST OBJECTIVE

Verify stress resulting from simulated transportation and launch g loads are within those predicted by analysis.

TEST CONFIGURATION

Rack (LM&SS) structural model

TEST DESCRIPTION

PREPARATION
This test will be performed in two sections: one to simulate the transportation loads encountered and the second to simulate launch g loads.

1. Remove rack outrigger truss members (4 each) and install center section of rack in horizontal position on a static load test stand. A fixture will be utilized to simulate the transporter attach points. Instrumentation will be installed at selected locations to determine simulated transportation stress.

2. Set rack in vertical position on a static load test stand. A fixture will be utilized to simulate the SLA attach points. Instrumentation will be installed at selected locations to determine simulated launch stress.

OPERATION
Static loads will be applied to critical load points and the resulting stress will be determined. Visual inspection, X-ray and dye check shall show no damage resulting from the static load.

CRITERIA FOR SUCCESS

1. Stress levels shall be within those predicted by analysis.
2. No damage shall result from the applied static loads.

Table II (Cont.)

Rack (LM&SS) Static Load (continued)

SUPPORT REQUIREMENTS

GSE
1. Rack handling and transport GSE

SPECIAL TEST EQUIPMENT
1. Instrumentation to monitor stress
2. X-ray inspection equipment
3. Equipment to apply static loads at specified points
4. Fixture to simulate the transporter attach points
5. Fixture to simulate the SLA attach points

FACILITIES
1. Area to perform static load test with the LM&SS rack in vertical position or horizontal position.

2.3.2 S-IVB Carrier - The S-IVB carrier has been previously qualified and flight tested and only the modifications to the S-IVB will require developmental testing.

The basic S-IVB development testing will be performed on the full scale mockup, partial prototype (enough to do passivation, activation and pressurization), components, subsystems and scale models.

The objectives of the S-IVB development test program are to develop and confirm methods and hardware to perform the following mission operations:

a. Passivation of the S-IVB tankage and ordnance.

b. Activation and subsequent reactivation of the OWS. (This includes all tasks necessary to enter and make the S-IVB hydrogen tank a habitable workshop.

c. Store, transfer, install and activate and activate the experiments of Flight AAP 2.

d. Support OWS operations during the mission. (This includes items such as thermal control, leakage rates, etc.).

e. Deactivation of the OWS.

During the S-IVB development test program, the control, functioning, monitoring, and procedural methods utilized during modification and test shall be developed and confirmed.

The details of the S-IVB OWS development program are described in the following test flow diagrams (figure 5) and accompanying test descriptions (Table III).

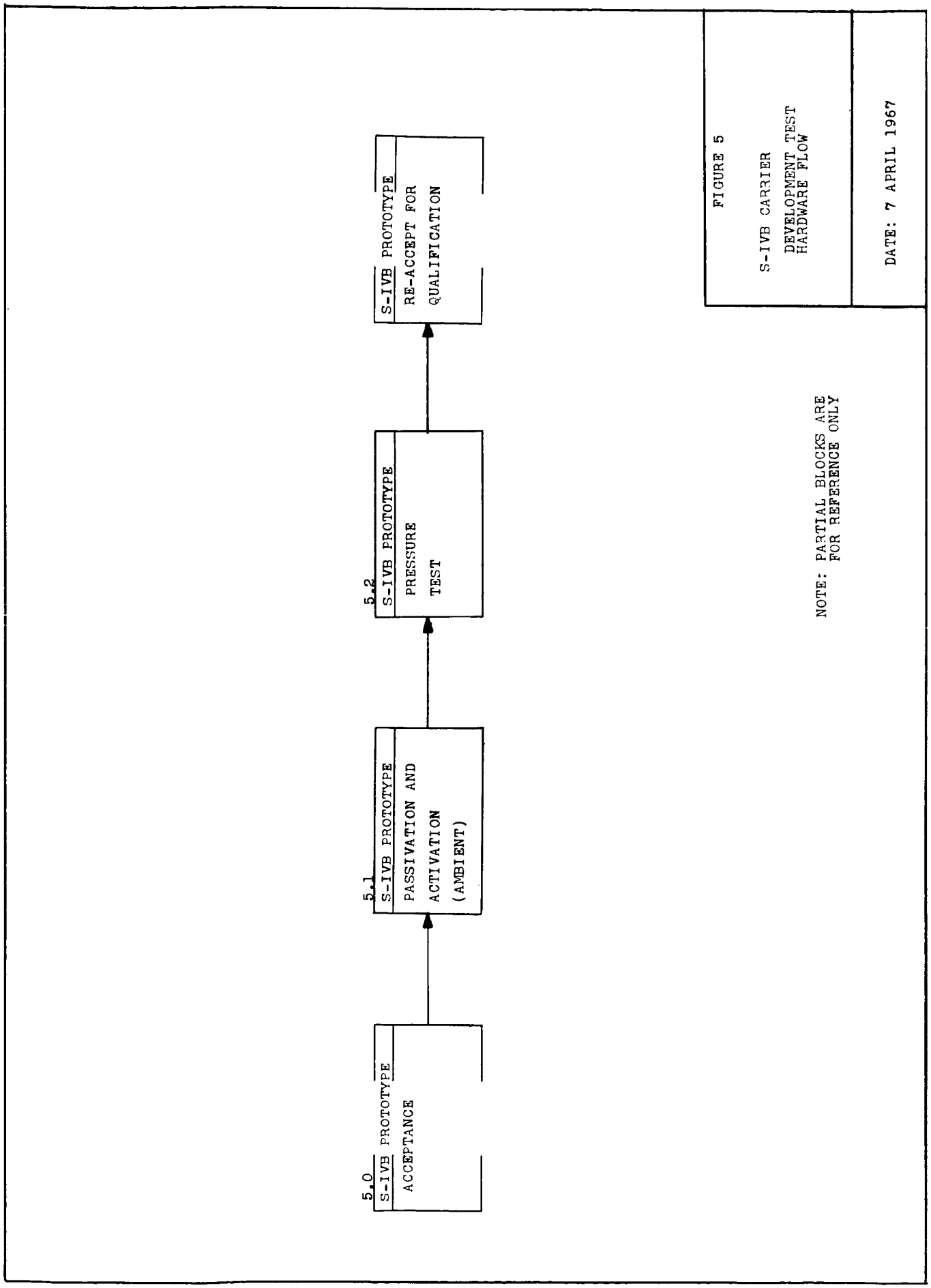


Figure 5. S-IVB Carrier Development Test Hardware Flow

Table III. Test Descriptions for Figure 5

TEST TITLE	TEST NUMBER
S-IVB Passivation and Activation	5.1

TEST OBJECTIVE

Verify S-IVB passivation (vent and dump of propellant tanks and ordnance safing) and tank sealing.

TEST CONFIGURATION

Prototype flight configured S-IVB.

TEST DESCRIPTION

PREPARATION

The S-IVB prototype will be mounted in a horizontal position on a handling fixture which will allow the S-IVB to be rotated. An IU simulator to provide the power necessary to activate systems in S-IVB shall be installed. Ordnance will be simulated.

OPERATION

This test will be performed in three segments:

1. Vent and dump of propellant tanks - This test is basically a functional check of the systems associated with dumping and vent of propellant tanks. System compatibility and power characteristics shall be checked.

2. The safing of the ordnance will be performed in a mission sequence. Power will be applied to the S-IVB to simulate the conditions at the start of normal safing operations.

3. The S-IVB hydrogen tank will be entered and seals and plugs will be installed in all areas requiring them. Accessibility to all areas shall be verified. Mission sequence and timelines shall be developed.

CRITERIA FOR SUCCESS

Prototype carrier S-IVB operates to flight specifications under simulated conditions.

Table III (Cont.)

S-IVB Passivation and Activation (continued)

SUPPORT REQUIREMENTS

GSE

1. Handling and transportation GSE
2. Ground station

SPECIAL TEST EQUIPMENT

1. Fixture to hold S-IVB in horizontal position and capable of S-IVB rotation
2. IU functional interface simulator
3. Platforms to place inside the S-IVB for accessibility
4. Ordnance simulators

FACILITIES

1. Facility large enough to hold S-IVB and allow for a reasonable working area.
2. Exterior work platforms.

Table III (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Pressure Test	5.2

TEST OBJECTIVE

Verify that after tank sealing has been accomplish the required OWS pressure (proof and operational) can be maintained.

TEST CONFIGURATION

Prototype flight configured S-IVB with tank sealing devices installed

TEST DESCRIPTION

PREPARATION
The S-IVB shall be placed in the horizontal position in an area where tank pressurization may be accomplished. The tank entry and sealing process shall have been accomplished. A fixture will be installed to simulate the AM/S-IVB interface capable of maintaining the required pressure.

OPERATION
The S-IVB shall be pressurized to 6 ± 1 psig with a nitrogen/helium mixture gas and a mass spectrometer leak test will be performed in all areas that were sealed in the tank sealing process. The S-IVB will then be pressurized to proof pressure (orbit) and leakage and structure integrity verified.

CRITERIA FOR SUCCESS

The leakage as determined by mass spectrometer shall be within the minimum allowed by design specifications. Sealed areas shall withstand proof pressure.

SUPPORT REQUIREMENTS

GSE
None

SPECIAL TEST EQUIPMENT
1. Fixture to hold S-IVB in horizontal position
2. AM interface simulator
3. Mass spectrometer
4. Pressurization panel capable of supplying an H_e/N_2 mixture

Table III (Cont.)

S-IVB Pressure Test (continued)

SPECIAL TEST EQUIPMENT (continued)
5. Equipment to monitor S-IVB pressure

FACILITIES
1. Area to perform S-IVB proof pressure and leak check
2. Exterior work platforms

2.3.3 Instrument Unit (IU) - The IU has been previously qualified and the modifications required are small, therefore a full-scale flight-configured prototype development test is not required. Except for the verification of the system during the intermodule verification test program, development will be done on the subsystem and component level. Experiment placement will be performed on the full-scale mockup.

2.3.4 Multiple Docking Adapter (MDA) Development - The MDA will be a new carrier and a full-scale development and verification test program will be performed. This program will consist of the tasks necessary to develop the MDA as follows:

a. Provide passageways between the AM, CSM, RM and LM.

b. Provide docking interfaces for the RM, CSM, LM&SS and LM/ATM.

c. Provide mechanical and electrical connections between the AM, RM, CSM, LM&SS and LM/ATM.

d. Provide storage space for AAP experiments.

e. Support AM thermal control subsystem (radiator).

A large portion of the MDA development test program can be performed without the AM. The complexity of the thermal control interface between the AM and MDA will require that the radiator section of the MDA be developed during the AM development program.

A structural test program utilizing a structural model will be performed to verify the capability of the MDA structure to withstand launch and transport G - loading.

A dynamic test program will be performed utilizing a dynamic model to confirm analysis of the anticipated vibration, shock and acoustic levels at selected points on the MDA.

The qualification functional prototypes of the AM/MDA combination will be subjected to prequalification tests under ambient conditions to verify the MDA module interfaces and to provide assurance that the MDA is ready for qualification testing.

The details of the MDA development program are described in the following test flow diagram (figure 6) and accompanying test descriptions (Table IV).

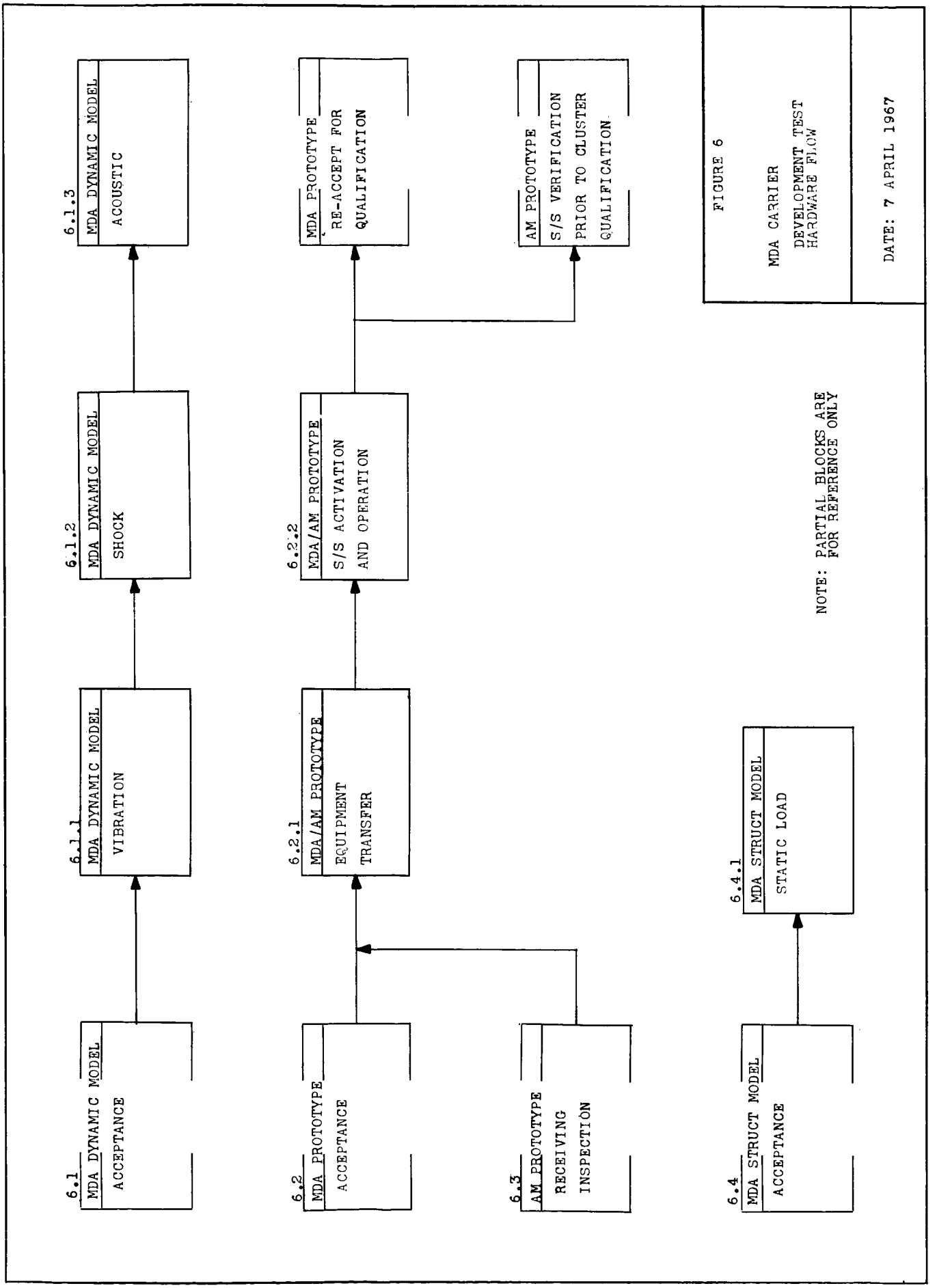


Figure 6. MDA Carrier Development Test Hardware Flow

Table IV. Test Descriptions for Figure 6

TEST TITLE	TEST NUMBER
MDA Vibration (Launch)	6.1.1

TEST OBJECTIVE

1. Verify that the MDA can survive vibrations encountered during launch.
2. Verify that the vibration levels do not exceed those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured MDA structure with mass simulators for subsystem components and experiments.

TEST DESCRIPTION

PREPARATION
The MDA will be mounted on an electrodynamic shaker utilizing a structure simulator for the AM. This structure simulator will provide the MDA/AM attach points, simulate the AM structure and provide attachment to the shaker table. Prior to the test, all subsystem component and experiment simulators will be installed.

OPERATION
The MDA will be subjected to vibration in three axis to the criteria specified in the MDA CEI specification. The MDA subsystem and experiment simulators will be in the same configuration as at launch. Vibration levels will be monitored. After the test is complete, the MDA will be inspected to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

1. The MDA shall sustain no damage during the vibration test.
2. Vibration levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. MDA handling and transport GSE

Table IV (Cont.)

MDA Vibration (Launch) (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shaker table and simulate SLA/AM structure and attach points for MDA
2. Instrumentation to monitor MDA vibration at selected locations.

FACILITIES

1. Shaker system to vibrate the MDA in single axis, random vibration.

Table IV (Cont.)

TEST TITLE	TEST NUMBER
MDA Shock (Transportation and Handling) - Part 1	6.1.2.1

TEST OBJECTIVE

1. Verify that the MDA can survive the shock encountered during transport and handling.
2. Verify that the shock load-levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured MDA with subsystem component and experiment mass simulators.

TEST DESCRIPTION

PREPARATION
The MDA will be installed on a shock table with a fixture that will simulate the transporter and attach points. The MDA will be positioned in the normal transportation position. Prior to the test all experiment and component mass simulators will be installed.

OPERATION
The MDA will be subjected to a transport and handling shock to the levels and axis specified in the MDA CEI specification. During the test all systems and experiments will be in the stored mode. Shock levels will be monitored. After the shock test, the MDA will be inspected to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

1. The MDA shall sustain no damage during the shock test.
2. Shock load levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. MDA handling and transport GSE

Table IV (Cont.)

MDA Shock (Transportation and Handling) - Part 1 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shock table and simulate transporter and attach points for MDA
2. Instrumentation to monitor shock levels at selected locations.

FACILITIES

1. Facility to perform shock test.
2. Shock table capable of holding the MDA in transport position.

Table IV (Cont.)

TEST TITLE	TEST NUMBER
MDA Shock (Launch) - Part 2	6.1.2.2

TEST OBJECTIVE

1. Verify that the MDA can survive the shock encountered during launch.
2. Verify that the shock load levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured MDA with subsystem component and experiment mass simulators.

TEST DESCRIPTION

PREPARATION
The MDA will be installed on a shock table with a fixture that will simulate the AM/SLA structure and provide the MDA/AM attach points for the MDA. The MDA will be positioned in the launch position. Prior to the test, all component and experiment mass simulators will be installed.

OPERATION
The MDA will be subjected to a launch shock to the levels and axis to the criteria specified in the MDA CEI specification. During the test all systems and experiments will be in the launch configuration. Shock levels will be monitored. After the shock test, the MDA will be inspected to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

1. The MDA shall sustain no damage during the shock test.
2. Shock load levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. MDA handling and transport GSE

Table IV (Cont.)

MDA Shock (Launch) - Part 2 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shock table and simulate the AM/SLA structure and attach points.
2. Instrumentation to monitor shock levels at selected locations.

FACILITIES

1. Facility to perform shock test.
2. Shock table capable of holding the MDA-AM/SLA simulator in launch position.

Table IV (Cont.)

TEST TITLE	TEST NUMBER
MDA Shock (Docking) - Part 3	6.1.2.3

TEST OBJECTIVE

1. Verify that the MDA can survive the shock encountered during docking of various modules.
2. Verify that the shock load levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured MDA with subsystem component and experiment mass simulators.

TEST DESCRIPTION

PREPARATION
The MDA will be rigidly mounted on a fixture simulating the AM attachment point, in the vertical position (CSM docking collar position is up). Prior to the test, all component and experiment mass simulators will be installed.

OPERATION
The test will be performed under the following modes: (1) End port docking shock loads, (2) Side port docking shock loads, (3) End port reaction shock loads caused by a docked module during a second module docking maneuver, (4) Side port reaction shock load.

An interface docking simulator will be attached to either the end port or one of the side ports. The shock ordnance will be installed behind this simulator to induce a shock through the docking collar to represent either docking or reaction shock to the levels specified in the MDA CEI specification.

Shock levels will be monitored during the test. At the completion of each shock test the MDA will be inspected to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

1. The MDA shall sustain no damage during the shock test.
2. Shock load-levels shall be within those predicted by analysis.

Table IV (Cont.)

MDA Shock (Docking) - Part 3 (continued)

SUPPORT REQUIREMENTS

GSE

1. MDA handling and transport GSE

SPECIAL TEST EQUIPMENT

1. Fixture to simulate AM and provide MDA attach point.
2. Instrumentation to monitor the shock levels at specified locations.

FACILITIES

1. Facility to perform shock test with MDA mounted on AM simulator.

Table IV (Cont.)

TEST TITLE	TEST NUMBER
MDA Acoustic	6.1.3

TEST OBJECTIVE

1. Verify that the MDA can survive the acoustic vibrations encountered during launch.
2. Verify that the acoustic vibration levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured MDA with component and experiment mass simulators.

TEST DESCRIPTION

PREPARATION
The MDA will be installed in an acoustic test area utilizing an AM structure/SLA panel simulator. Prior to the acoustic test, all component and experiment mass simulators will be installed.

OPERATION
The MDA/AM/SLA shall be subjected to the launch acoustic vibrations as specified in the MDA CEI specification. This test may be performed in more than one part if required. The acoustic sound pressure shall be induced through the SLA panels to the MDA. After the acoustic test, the MDA will be inspected to verify that no damage has resulted from the acoustic vibration.

CRITERIA FOR SUCCESS

1. The MDA shall sustain no damage during the acoustic test.
2. Acoustic vibration levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. MDA handling and transport GSE

Table IV (Cont.)

MDA Acoustic (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to simulate the SLA panels.
2. Instrumentation to monitor acoustic vibration levels at specified locations.

FACILITIES

1. Facility to perform MDA/AM/SLA acoustic test.

TEST TITLE	TEST NUMBER
MDA/AM Equipment Transfer	6.2.1

TEST OBJECTIVE

Verify capability of removing stored equipment from MDA and movement through the AM into S-IVB. Transfer sequence will be determined for qualification testing.

TEST CONFIGURATION

1. Prototype flight configured MDA (with experiment mockups).
2. Prototype flight configured AM.

TEST DESCRIPTION

PREPARATION
MDA and AM will be mounted on fixtures in the horizontal position. The fixtures will be capable of allowing the MDA/AM to be rolled. Temporary platforms will be installed in the interior for access to the various areas.

OPERATION
The equipment will be removed from the storage location on the MDA and transported through the AM. Transfer sequence and timelines will be verified and/or revised as required.

CRITERIA FOR SUCCESS

1. Verify capability to remove equipment from stored location and moved through the AM.
2. Verify mission sequence and timelines.

SUPPORT REQUIREMENTS

GSE
1. MDA and AM transport and handling GSE

SPECIAL TEST EQUIPMENT
1. Fixtures to hold AM and MDA in horizontal position.
2. Temporary platforms inside carriers.
3. Experiment mockups.

FACILITIES
1. Area to perform equipment transfer with MDA/AM horizontal.

TEST TITLE	TEST NUMBER
MDA Support Subsystem Activation and Operation	6.2.2

TEST OBJECTIVE

Verify support subsystem intercarrier compatibility between MDA and various carriers.

TEST CONFIGURATION

Prototype flight configured MDA. Prototype flight configured AM.

TEST DESCRIPTION

PREPARATION

MDA and AM will be mounted on fixtures in the horizontal position. All AM/MDA interfaces will be connected. CSM, RM, LM and IM&SS functional interface simulators will be connected to the MDA. GSE will be checked out and connected. All MDA pretests shall be performed, such as single point ground, resistance checks, etc. Electrical loads will be simulated.

OPERATION

Each MDA subsystem will be functioned individually:

1. Display and Control
   a. Functional
2. Thermal Control Radiators
   a. Thermal Characteristics
   b. Power Characteristics
3. D&C Sensors
   a. Functional
   b. Calibration
   c. Noise and Ripple
4. Docking Aids (mechanical and optical)
   a. Alignment

All other subsystems which interface with the MDA but pass through to another carrier will be checked for continuity to verify proper mate.

CRITERIA FOR SUCCESS

All subsystems shall operate within design specifications.

Table IV (Cont.)

MDA Support Subsystem Activation and Operation (continued)

SUPPORT REQUIREMENTS

GSE

1. MDA and AM transport and handling GSE
2. Equipment to functionally check each MDA system
3. CSM, RM, LM and LM&SS functional interface simulators

SPECIAL TEST EQUIPMENT

1. Fixtures to hold MDA and AM in horizontal position

FACILITIES

1. Area to perform MDA S/S functional
2. Temporary platforms. (external and internal)

Table IV (Cont.)

TEST TITLE	TEST NUMBER
MDA Static Load	6.4.1

TEST OBJECTIVE

Verify stress resulting from simulated Launch "G" loads are within those predicted by analysis.

TEST CONFIGURATION

MDA structural model

TEST DESCRIPTION

PREPARATION
Set MDA in vertical position on a static load test stand. A fixture will be utilized to simulate the AM attach points. Instrumentation will be installed at selected locations to determine stress.

OPERATION
Static loads will be applied to critical load points and the resulting stress will be determined. Visual inspection, X-ray and dye check shall show no damage resulting from the static load.

CRITERIA FOR SUCCESS

1. Stress levels shall be within those predicted by analysis
2. No damage shall result from the applied static loads

SUPPORT REQUIREMENTS

GSE
1. MDA handling and transport GSE

SPECIAL TEST EQUIPMENT
1. Instrumentation to monitor stress
2. X-ray inspection equipment
3. Equipment to apply static loads at specified points

FACILITIES
1. Area to perform static load test with MDA in vertical position.

2.3.5 Resupply Module (RM) Development - The RM will be a new carrier and a full scale development and verification test program will be performed. This program will consist of the tasks necessary to develop the RM as follows:

a. Provide the commodities required to permit extended operation of Flight AAP 2 spacecraft modules during Mission AAP 3/4.

b. Provide a means of transferring these commodities.

c. Provide docking, electrical, and mechanical interfaces for the CSM and MDA.

d. Provide space for storage of experiments and commodities that can be pressurized after RM docking and accessible from the MDA.

The details of the RM development program are described in the following test flow diagram (figure 7) and accompanying test descriptions (Table V).

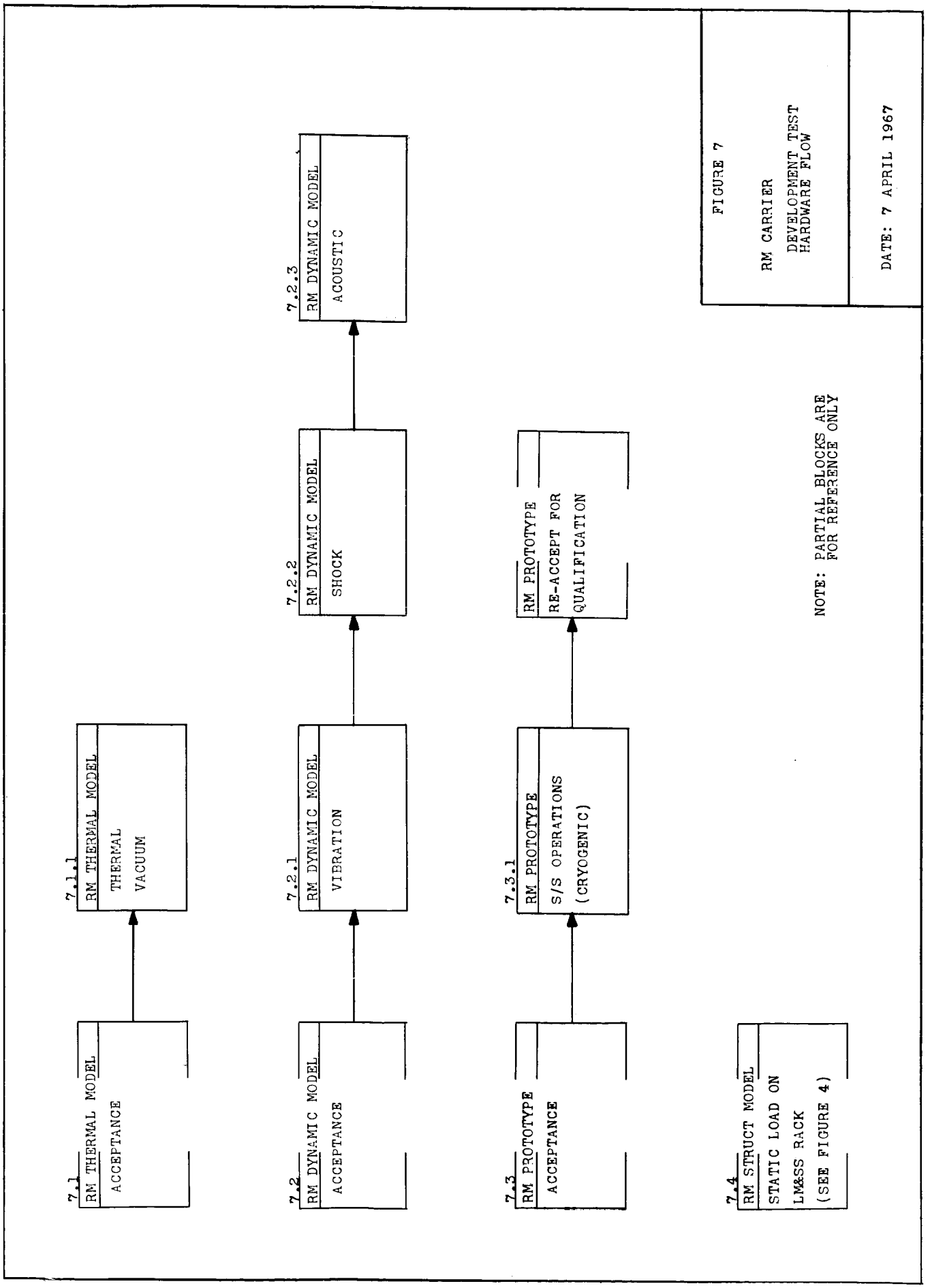


Figure 7. RM Carrier Development Test Hardware Flow

Table V. Test Descriptions for Figure 7

TEST TITLE	TEST NUMBER
RM Thermal Vacuum	7.1.1

TEST OBJECTIVE

1. Verify that the RM can survive and operate in a simulated space environment.
2. Verify that the temperature levels do not exceed those predicted by analysis.
3. Determine temperature monitoring locations for qualification article.

TEST CONFIGURATION

Prototype flight configured RM with subsystem component thermal mass simulators.

TEST DESCRIPTION

PREPARATION
Prior to installation of the RM, the IR cages will be calibrated and checked out. The RM will be installed in a thermal vacuum chamber on a fixture that is capable of moving the RM to simulate the various sun angles as observed in orbit. Simulated propellants will be loaded. Shadowing will be provided to simulate various cluster configurations.

OPERATION
The RM will be subjected to a simulated orbit (sun angles and shadowing) and a mission operations sequence simulated. Each operation will be performed long enough to allow temperature stabilization. The basic phases are:
1. Simulated liftoff to demonstrate altitude changes
2. Orbit transfer
3. Cluster operations
4. Special

CRITERIA FOR SUCCESS

1. All component thermal simulators will remain within the predicted temperatures during the simulated mission.
2. Temperature monitoring locations shall be determined for the qualification article.

Table V. (Cont.)

RM Thermal Vacuum (continued)

SUPPORT REQUIREMENTS

GSE

1. RM handling and transport GSE

SPECIAL TEST EQUIPMENT

1. Support and rotation fixture for the RM
2. Solar panel shadowing simulator
3. Instrumentation to monitor the component thermal simulators on the RM.
4. Thermal simulators.

FACILITIES

1. Facility that contains a thermal vacuum chamber large enough to allow rotation of the RM inside the chamber and has full solar and IR capability.
2. IR cage for RM.

Table V. (Cont.)

TEST TITLE	TEST NUMBER
RM Vibration (Launch) - Part 1	7.2.1.1

TEST OBJECTIVE

1. Verify that the RM can survive vibrations encountered during launch.
2. Verify that the vibration levels do not exceed those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured RM with mass simulators for subsystem components.

TEST DESCRIPTION

PREPARATION
The RM will be installed on an electrodynamic shaker utilizing an SLA structure simulator. The SLA structure simulator will provide the SLA attach points, simulate the structure and provide attachment to the shaker table. Prior to the test, all subsystem and experiment mass simulators will be installed. Liquids will be simulated.

OPERATION
The RM will be subjected to vibration in three axis (one at a time) to the criteria specified in the RM CEI specification. The RM subsystem and experiment mass simulators will be in the same configuration as launch. Vibration levels will be monitored. After the vibration test is complete, a visual inspection will be performed on the RM to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

1. The RM shall sustain no damage during the vibration test.
2. Vibration levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE

Table V. (Cont.)

RM Vibration (Launch) - Part 1 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shaker table and simulate SLA structure and attach points for RM
2. Instrumentation to monitor RM vibration at selected locations
3. Mass simulators

FACILITIES

1. Shaker system to vibrate the RM in single axis, random vibration.

Table V. (Cont.)

TEST TITLE	TEST NUMBER
RM Vibration (Orbit Transfer) - Part 2	7.2.1.2

TEST OBJECTIVE

1. Verify that the RM can survive vibrations encountered during orbit transfer.
2. Verify that the vibration levels do not exceed those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured RM with mass simulators for subsystem components.

TEST DESCRIPTION

PREPARATION
The RM will be suspended from several selected attach points. A CSM interface simulator will be attached to the docking collar, and the RM will be subjected to orbit transfer vibrations through this docking collar. Prior to the test, all subsystem mass simulators will be installed.

OPERATION
The RM will be subjected to vibrations in three axis to the criteria specified in the RM CEI specification. The RM subsystems will be inspected to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

1. The RM shall sustain no damage during the vibration test.
2. Vibration levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE

SPECIAL TEST EQUIPMENT
1. Fixture to suspend the RM
2. CSM interface simulator
3. Instrumentation to monitor the RM vibration at selected locations
4. Mass simulators

Table V. (Cont.)

RM Vibration (Orbit Transfer) - Part 2 (continued) FACILITIES 1. Area to suspend the RM 2. Shaker system to induce the vibration in single axis, random vibration

Table V. (Cont.)

TEST TITLE	TEST NUMBER
RM Shock (Transportation and Handling) - Part 1	7.2.2.1

TEST OBJECTIVE

1. Verify that the RM can survive the shock encountered during transport and handling.
2. Verify that the shock load levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured RM with subsystem component mass simulators.

TEST DESCRIPTION

PREPARATION
The RM will be installed on a shock table with a fixture that will simulate the transporter and attach points. The RM will be positioned in the normal transportation position. Prior to the test all experiment and component mass simulators will be installed.

OPERATION
The RM will be subjected to a transport and handling shock to the levels and axis criteria specified in the RM CEI specification. During the test all subsystem simulators will be in the stored mode. Shock levels will be monitored. After the shock test, the RM will be inspected to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

1. The RM shall sustain no damage during the shock test.
2. Shock load levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE

Table V. (Cont.)

RM Shock (Transportation and Handling) - Part 1 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shock table and simulate transporter and attach points for RM.
2. Instrumentation to monitor shock levels at selected locations.
3. Mass simulators.

FACILITIES

1. Facility to perform shock test.
2. Shock table capable of holding the RM in transport position.

Table V. (Cont.)

TEST TITLE	TEST NUMBER
RM Shock (Launch) - Part 2	7.2.2.2

TEST OBJECTIVE

1. Verify that the RM can survive the shock encountered during launch.
2. Verify that the shock load levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured RM with subsystem component mass simulators.

TEST DESCRIPTION

PREPARATION
The RM will be installed on a shock table with a fixture that will simulate the SLA structure and provide the SLA attach points for the RM. The RM will be positioned in the launch position. Prior to the test, all component and experiment mass simulators will be installed. Liquids will be simulated.

OPERATION
The RM will be subjected to a launch shock to the levels and axis specified in the RM CEI specification. During the test all systems and experiments will be in the launch configuration. Shock levels will be monitored. After the shock test, the RM will be inspected to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

1. The RM shall sustain no damage during the shock test.
2. Shock load levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE

Table V. (Cont.)

RM Shock (Launch) - Part 2 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shock table and simulate the SLA structure and attach points.
2. Instrumentation to monitor shock levels at selected locations.
3. Mass simulators

FACILITIES

1. Facility to perform shock test
2. Shock table capable of holding the RM-SLA simulator in launch position.

Table V. (Cont.)

TEST TITLE	TEST NUMBER
RM Shock (Orbit) - Part 3	7.2.2.3

TEST OBJECTIVE

1. Verify that the RM can survive the shock encountered during orbit transfer and docking.
2. Verify that the shock load levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured RM with subsystem component mass simulators.

TEST DESCRIPTION

PREPARATION

The RM will be suspended in the horizontal position with slings around the barrel section of the RM. A CM docking interface simulator will be positioned at one end and an MDA docking interface simulator on the other end. Prior to the test, all subsystem mass simulators will be installed. Liquids shall be simulated.

OPERATION

The test will be performed in two parts:

1. The first part will verify orbit transfer. The CM interface simulator will be attached to the suspended RM. Ordnance for shock will be placed behind this simulator to induce a shock through the docking collar to simulate orbit transfer shock to the levels specified in the RM CEI specification.
2. The second part will verify docking to the MDA. A CM interface docking simulator will be attached to one end of the RM and an MDA simulator will be attached to the other end. The shock ordnance will be installed on the MDA end and the shock induced will simulate maximum docking shock as specified in the RM CEI specification.

Shock levels will be monitored during the test. At the completion of each shock test, the RM will be inspected to verify that no damage has resulted from the induced shock.

Table V. (Cont.)

RM Shock (Orbit) - Part 3 (continued)

CRITERIA FOR SUCCESS

1. The RM shall sustain no damage during the shock test.
2. Shock load-levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE

1. RM handling and transport GSE

SPECIAL TEST EQUIPMENT

1. Fixture to suspend the RM
2. Instrumentation to monitor the shock levels at specified locations
3. Mass simulators
4. CM and MDA docking interface simulators

FACILITIES

1. Facility to perform shock test with RM suspended in horizontal position.

Table V. (Cont.)

TEST TITLE	TEST NUMBER
RM Acoustic	7.2.3

TEST OBJECTIVE

1. Verify that the RM can survive the acoustic vibrations encountered during launch.
2. Verify that the vibration levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured RM with subsystem component mass simulators.

TEST DESCRIPTION

PREPARATION
The RM will be installed in an acoustic test area utilizing an SLA simulator. The SLA simulator will consist of mounting provisions for the RM and will simulate the SLA structure and panels. Prior to the acoustic test, all component and experiment mass simulators will be installed.

OPERATION
The RM/SLA shall be subjected to the launch acoustic vibrations as specified in the RM CEI specification. This test may be performed in more than one part if required. The acoustic sound pressure shall be induced through the SLA panels to the RM. After the acoustic test, the RM will be inspected to verify that no damage has resulted from the acoustic vibration.

CRITERIA FOR SUCCESS

1. The RM shall sustain no damage during the acoustic test.
2. Acoustic vibration levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE.

Table V. (Cont.)

RM Acoustic (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to simulate the SLA panels and RM attach points and structure.
2. Instrumentation to monitor acoustic vibration levels at specified locations.
3. Mass simulators.

FACILITIES

1. Facility to perform RM/SLA acoustic test.

Table V. (Cont.)

TEST TITLE	TEST NUMBER
RM Support Subsystem Operations (Cryogenic)	7.3.1

TEST OBJECTIVE

Verify that the RM pressure and cryogenic systems operate within design criteria.

TEST CONFIGURATION

Prototype flight configured RM.

TEST DESCRIPTION

PREPARATION
The RM will be in a vertical position mounted on a propellant/pressurization test stand. All subsystems will have been electrically demonstrated prior to the propellant transfer test. Individual components will have been subjected to proof pressures. Fluid and electrical lines will be connected to an AM/MDA simulator.

OPERATION
The cryogenic transfer test program will be performed as follows:
1. Pressurize and leak check all fluid and pressure systems.
2. Proof pressure all fluid and pressure systems.
3. Load all fluids (LO_2, LN_2 and LH_2); verify GSE compatibility.
4. Perform transfer of these fluids in an abbreviated mission sequence; verify:
   a. Flow rate
   b. Response time
5. Unload and clean systems.

CRITERIA FOR SUCCESS

1. All fluid and pressure systems shall operate within design specifications.

SUPPORT REQUIREMENTS

GSE
1. Propellant and servicing GSE
2. Equipment to functionally check electrical systems.

Table V. (Cont.)

RM Support Subsystem Operations (Cryogenic) (continued)

SPECIAL TEST EQUIPMENT

1. AM/MDA mechanical fluid and electrical interface simulator.
2. Mounting fixture for RM on test stand.

FACILITIES

1. Test stand to mount RM, provide the necessary commodities and allow system pressurization and cryogenic transfer.

2.3.6 ATM/Rack Development - The ATM/Rack will be a new carrier and a full scale development and verification test program will be conducted.

This development program will be divided into three parts; the ATM package development, the rack (and associated subsystems) development, and the integrated ATM/rack verification.

2.3.6.1 The ATM Package Development - The ATM package is considered as a separate Contract End Item (CEI) and as such will have its own development program. This program will consist of the tasks necessary to develop the ATM as follows:

a. Provide the enclosure, thermal control, and the support structure for a specific group of experiments.

b. Provide the power, data management, and display and control interfaces between the ATM rack and the experiments.

c. Provide the vernier pointing system for the orientation of the ATM package during mission operations.

The details of the ATM package development program are described in the ATM/Rack test flow diagram (Figure 8) and accompanying test descriptions (Table VI).

2.3.6.2 Rack and Subsystem Development - The rack and subsystems will be developed separate from the ATM package. After the basic systems of the rack have been developed, the ATM package will be included in the ATM rack tests for total systems testing.

The rack (ATM) and support subsystems development program will consist of the tasks necessary to develop it as follows:

a. Provide structural support for the ATM package and allow it to gimbal a specified number of degrees.

b. Provide a fine pointing control system during ATM operations.

c. Provide power to the ATM and LM from batteries and solar arrays. Control and distribute this power.

d. Provide storage for the LM life support cryogenics.

e. Provide a communications system, with internal support subsystem interfaces, an outside antenna(s) and an LM interface.

f. Provide a data management system for the rack support subsystems and experiments.

g. Provide the following interfaces with the LM: power, structural, communications, ECS, data management, and display and controls.

h. Provide a system to restrain the ATM package during launch and allow it to gimbal after the LM/ATM are attached to the cluster configuration.

The details of the ATM rack and support subsystems development program are described in the ATM/rack test flow diagram (Figure 8) and accompanying test descriptions (Table VI).

2.3.6.3 ATM/Rack Verification - After the ATM package and the rack with associated subsystems have been developed, they will be tested as a combined unit. Their systems operation and interface compatibility will be verified prior to starting the qualification program.

The details of the ATM/rack verification program are described in the ATM/rack test flow diagrams (Figure 8) and accompanying test descriptions (Table VI).

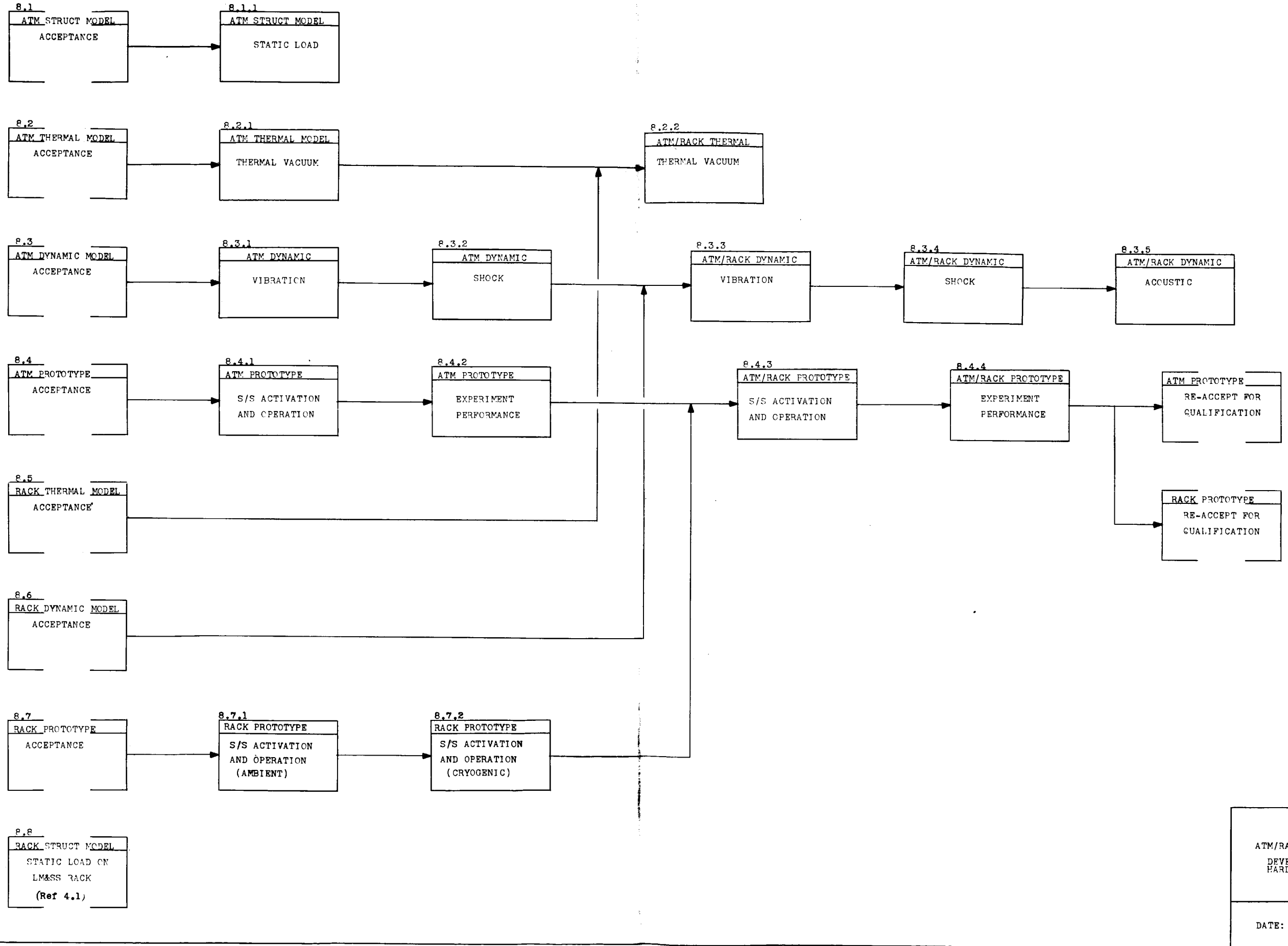


Figure 8. ATM/Rack Carrier Development Test Hardware Flow

FOLDOUT FRAME 1

FOLDOUT FRAME 1

FOLDOUT FRAME 2

Table VI. Test Descriptions for Figure 8

TEST TITLE	TEST NUMBER
ATM Package Static Load	8.1.1

TEST OBJECTIVE

Verify stress resulting from simulated launch "G" loads are within those predicted by analysis.

TEST CONFIGURATION

ATM package structural model.

TEST DESCRIPTION

PREPARATION
Set ATM package in vertical position on a static load test stand. A fixture will be utilized to simulate the rack attach points. Instrumentation will be installed at selected locations to determine stress.

OPERATION
Static loads will be applied to critical load points and the resulting stress will be determined. Visual inspection, X-ray and dye check shall show no damage resulting from the static load.

CRITERIA FOR SUCCESS

1. Stress levels shall be within those predicted by analysis.
2. No damage shall result from the applied static loads.

SUPPORT REQUIREMENTS

GSE
1. ATM package handling and transport GSE.

SPECIAL TEST EQUIPMENT
1. Instrumentation to monitor stress.
2. X-ray inspection equipment.
3. Equipment to apply static loads at specified points.

FACILITIES
1. Area to perform static load test with ATM package in vertical position.

TEST TITLE	TEST NUMBER
ATM Package Thermal Vacuum	8.2.1

TEST OBJECTIVE

1. Verify that the ATM package can survive and operate in a simulated space environment.
2. Verify that the temperature levels do not exceed those predicted by analysis.
3. Determine temperature monitoring locations for qualification article.

TEST CONFIGURATION

Prototype flight configured ATM package with component and experiment thermal mass simulators.

TEST DESCRIPTION

PREPARATION

Prior to installation of the ATM package, the IR cages will be calibrated and checked out. The ATM will be installed in a thermal vacuum chamber on a fixture that allows the ATM to be rotated to two positions - pointed directly at the solar source and rotated 90°. Shadowing will be provided to simulate the rack and deployment of the solar panels.

OPERATION

The ATM/rack will be subjected to the following conditions:

1. With the ATM pointed directly toward the solar source and solar panel shadowing and power supply simulated, each system and experiment simulator will be monitored to verify no adverse effects from the solar simulation.
2. The ATM/rack will be rotated so that the side of the ATM package will be subjected to the maximum calculated solar flux.

The thermal control system will be monitored to verify that it is capable of maintaining desired temperatures of the ATM package component and experiment thermal simulators.

CRITERIA FOR SUCCESS

1. All component and experiment thermal simulators will remain within the predicted temperatures during the simulated mission.
2. Temperature monitoring locations shall be determined for the qualification article.

Table VI. (Cont.)

ATM Package Thermal Vacuum (continued)

SUPPORT REQUIREMENTS

GSE

1. ATM package handling and transport GSE.

SPECIAL TEST EQUIPMENT

1. Support and rotation fixture for ATM package.
2. Solar panel shadowing simulator.
3. Instrumentation to monitor the component and experiment thermal simulators on the ATM/rack.
4. Rack thermal control simulator.
5. Component and experiment thermal simulators.

FACILITIES

1. Facility that contains a thermal vacuum chamber large enough to allow 90° rotation of the ATM package inside the chamber and has full solar and IR capability.
2. IR cage for ATM rack.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Thermal Vacuum	8.2.2

TEST OBJECTIVE

1. Verify that the ATM/Rack can survive and operate in a simulated space environment.
2. Verify that the temperature levels do not exceed those predicted by analysis.
3. Determine temperature monitoring locations for qualification article.

TEST CONFIGURATION

Prototype flight configured ATM/Rack with component and experiment thermal mass simulators except for the thermal control system which will be active.

TEST DESCRIPTION

PREPARATION

Prior to installation of the ATM/Rack, the IR cages will be calibrated and checked out. The ATM/Rack will be installed in a thermal vacuum chamber on a fixture that allows the ATM to be rotated 90°. Shadowing will be provided to simulate the deployment of the solar panels.

OPERATION

The ATM/Rack will be subjected to the following conditions:

1. With the ATM pointed directly toward the solar source and solar panel shadowing and power supply simulated, each system and experiment simulator will be monitored to verify no adverse effects from the solar simulation.
2. The ATM/Rack will be rotated so that the side of the ATM package will be subjected to the solar source.

The thermal control system will be monitored to verify that it is capable of maintaining desired temperatures of the ATM package component and experiment thermal simulators.

CRITERIA FOR SUCCESS

1. All component and experiment thermal simulators will remain within the predicted temperatures during the simulated mission.

Table VI. (Cont.)

ATM/Rack Thermal Vacuum (continued)

2. Temperature monitoring locations shall be determined for the qualification article.

SUPPORT REQUIREMENTS

GSE

1. ATM handling and transport GSE
2. Equipment to functionally operate the ATM/Rack thermal control system.

SPECIAL TEST EQUIPMENT

1. Support and rotation fixture for the ATM/Rack.
2. Solar panel shadowing simulator.
3. Instrumentation to monitor the component and experiment thermal simulators on the ATM/Rack.

FACILITIES

1. Facility that contains a thermal vacuum chamber large enough to allow 90° rotation of the ATM/Rack inside the chamber and has full solar and IR capability.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Vibration (Launch) - Part 1	8.3.1.1

TEST OBJECTIVE

1. Verify that the ATM package can survive vibrations encountered during launch.
2. Verify that the vibration levels do not exceed those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured ATM package with mass simulators for subsystem components and experiments.

TEST DESCRIPTION

PREPARATION
The ATM will be installed on an electrodynamic shaker utilizing a rack structure simulator. The simulator will provide the ATM/rack attach points, simulate the structure and provide attachment to the shaker table. Prior to the test, all component and experiment simulators will be installed.

OPERATION
The ATM package will be subjected to vibration in three axis to the criteria specified in the ATM CEI specification. The ATM subsystem and experiment simulators will be in the same configuration as at launch. Vibration levels will be monitored. After the test is complete, the ATM/rack will be inspected to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

1. The ATM package shall sustain no damage during the vibration test.
2. Vibration levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. ATM handling and transport GSE

Table VI. (Cont.)

ATM Package Vibration (Launch) - Part 1 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shaker table and simulate rack structure and attach points for ATM package.
2. Instrumentation to monitor ATM package vibration of selected locations.
3. Mass simulators.

FACILITIES

1. Shaker system to vibrate the ATM package in single axis, random vibration.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Vibration (Orbit Transfer) - Part 2	8.3.1.2

TEST OBJECTIVE

1. Verify that the ATM package can survive vibrations encountered during orbit transfer.
2. Verify that the vibration levels do not exceed those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured ATM package with mass simulators for subsystem components and experiments.

TEST DESCRIPTION

PREPARATION
The ATM package will be installed in a rack simulator which will provide attach points for ATM. The ATM/rack simulator will then be suspended from several selected attach points. The ATM will be subjected to orbit transfer vibrations through the rack attach points. The vibration input to the rack will simulate the vibration imparted to the ATM through the LM. Prior to the test, all component and experiment simulators shall be installed.

OPERATION
The ATM/rack will be subjected to vibrations in three axis to the criteria specified in the ATM CEI specification. The ATM package subsystem and experiment simulators will be in the same configuration as during orbit transfer. Vibration levels will be monitored. After the test is complete, the ATM package will be inspected to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

1. The ATM package shall sustain no damage during the vibration test.
2. Vibration levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. ATM package handling and transport GSE

Table VI. (Cont.)

ATM Package Vibration (Orbit Transfer) - Part 2 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to simulate rack structure and attach points and provide point for vibration input.
2. Instrumentation to monitor ATM vibration levels at selected locations.
3. Mass simulators.

FACILITIES

1. Area to suspend the ATM package.
2. Shaker system to induce the vibration.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Shock (Transportation and Handling) - Part 1	8.3.2.1

TEST OBJECTIVE

1. Verify that the ATM package can survive the shock encountered during transport and handling.
2. Verify that the shock load levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured ATM package with component and experiment mass simulators.

TEST DESCRIPTION

PREPARATION
The ATM package will be installed on a shock table with a fixture that will simulate the transporter and attach points. The ATM will be positioned in the horizontal position. Prior to the test all experiment and component mass simulators will be installed.

OPERATION
The ATM package will be subjected to a transport and handling shock to the levels and axis criteria specified in the ATM CEI specification. During the test, all system and experiment simulators will be in the stored mode. Shock levels will be monitored. After the shock test, the ATM package will be inspected to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

1. The ATM package shall sustain no damage during the shock test.
2. Shock load levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. ATM package handling and transport GSE.

Table VI. (Cont.)

ATM Package Shock (Transportation and Handling) - Part 1 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shock table and simulate transporter and attach points.
2. Instrumentation to monitor shock levels at selected locations.
3. Mass simulators.

FACILITIES

1. Facility to perform shock test.
2. Shock table capable of holding the ATM package in transport position.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Shock (Launch) - Part 2	9.3.2.2

TEST OBJECTIVE

1. Verify that the ATM package can survive the shock encountered during launch.
2. Verify that the shock load levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured ATM package with component and experiment mass simulators.

TEST DESCRIPTION

PREPARATION
The ATM will be installed on a shock table with a fixture that will simulate the rack structure and provide the rack attach points for the ATM. The ATM will be positioned in the launch position. Prior to the test, all component and experiment mass simulators will be installed.

OPERATION
The ATM package will be subjected to a launch shock to the levels and axis specified in the ATM CEI specification. During the test all systems and experiments will be in the launch configuration. Shock levels will be monitored. After the shock test, the ATM will be inspected to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

1. The ATM package shall sustain no damage during the shock test.
2. Shock load levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. ATM package handling and transport GSE.

Table VI. (Cont.)

ATM Package Shock (Launch) - Part 2 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shock table and simulate the rack structure and attach points.
2. Instrumentation to monitor shock levels at selected locations.
3. Mass simulators.

FACILITIES

1. Facility to perform shock test.
2. Shock table capable of holding the ATM in launch position.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Shock (Orbit) - Part 3	8.3.2.3

TEST OBJECTIVE

1. Verify that the ATM package can survive the shock encountered during orbit transfer and docking.
2. Verify that the shock load levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured ATM package with component and experiment mass simulators.

TEST DESCRIPTION

PREPARATION
The ATM will be mounted in a fixture that will simulate the rack structure and provide the rack attach points for the ATM. This ATM/rack simulator will then be suspended in the horizontal position with slings attached to selected points on the rack simulator. Prior to the test, all component and experiment mass simulators shall be installed.

OPERATION
The test will be performed in two parts:
1. The first part will verify orbit transfer. Ordnance will be placed at a point that will simulate the shock load induced by the CSM propulsion system start. The shock level will be to the criteria specified in the ATM CEI specification.
2. The second part will verify docking to the MDA. Ordnance will be placed at a point that will simulate the shock load induced by the maximum docking impact as specified in the ATM CEI specification.

Shock levels will be monitored during the test. At the completion of each shock test the ATM package will be inspected to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

1. The ATM package shall sustain no damage during the shock test.
2. Shock load levels shall be within those predicted by analysis.

Table VI. (Cont.)

ATM Package Shock (Orbit) - Part 3 (continued)

SUPPORT REQUIREMENTS

GSE

1. ATM package handling and transport GSE.

SPECIAL TEST EQUIPMENT

1. Fixture to suspend the ATM package.
2. Instrumentation to monitor the shock levels at specified locations.
3. Mass simulators.

FACILITIES

1. Facility to perform shock test with ATM package suspended in horizontal position.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Vibration (Launch) - Part 1	8.3.3.1

TEST OBJECTIVE

1. Verify that the ATM/Rack can survive vibrations encountered during launch.
2. Verify that the vibration levels do not exceed those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured ATM/Rack with mass simulators for subsystem components and experiments.

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be installed on an electrodynamic shaker utilizing an SLA structure simulator. The SLA simulator will provide the SLA attach points, simulate the structure and provide attachment to the shaker table. Prior to the test, all subsystem and experiment simulators will be installed. Liquids will be simulated.

OPERATION
The ATM/Rack will be subjected to vibration in three axis to the criteria specified in the ATM/Rack CEI specification. The ATM/Rack subsystem and experiment simulators will be in the same configuration as at launch. Vibration levels will be monitored. After the test is complete, the ATM/Rack will be inspected to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

1. The ATM/Rack shall sustain no damage during the vibration test.
2. Vibration levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. ATM handling and transport GSE.

Table VI. (Cont.)

ATM/Rack Vibration (Launch) - Part 1 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shaker table and simulate SLA structure and attach points for ATM/Rack.
2. Instrumentation to monitor ATM/Rack vibration of selected locations.
3. Mass simulators.

FACILITIES

1. Shaker system to vibrate the ATM/Rack in single axis, random vibration.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Vibration (Orbit Transfer) - Part 2	8.3.3.2

TEST OBJECTIVE

1. Verify that the ATM/Rack can survive vibrations encountered during orbit transfer.
2. Verify that the vibration levels do not exceed those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured ATM/Rack with mass simulators for subsystem components and experiments.

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be suspended from several selected attach points. An LM interface simulator will be attached to the LM/ATM interface to provide the point for vibration input. The vibration input to the ATM/Rack will simulate the vibration imparted to the ATM through the LM. Prior to the test, all subsystem and experiment mass simulators will be installed. Liquids will be simulated.

OPERATION
The ATM/Rack will be subjected to vibrations in three axis to the criteria specified in the ATM/Rack CEI specification. The ATM/Rack subsystems will be in the same configuration as during orbit transfer. Vibration levels will be monitored. After the test is complete, the ATM/Rack will be inspected to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

1. The ATM/Rack shall sustain no damage during the vibration test.
2. Vibration levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. ATM/Rack handling and transport GSE.

Table VI. (Cont.)

ATM/Rack Vibration (Orbit Transfer) - Part 2 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to suspend the ATM/Rack
2. LM interface simulator.
3. Instrumentation to monitor the ATM/Rack vibration at selected locations.
4. MASS simulators.

FACILITIES

1. Area to suspend the ATM/Rack.
2. Shaker system to induce the vibration.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Shock (Launch) - Part 1	8.3.4.1

TEST OBJECTIVE

1. Verify that the ATM/Rack can survive the shock encountered during launch.
2. Verify that the shock load levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured ATM/Rack with component and experiment mass simulators.

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be installed on a shock table with a fixture that will simulate the SLA structure and provide the SLA attach points for the ATM/Rack. The ATM/Rack will be positioned in the launch position. Prior to the test, all component and experiment mass simulators will be installed.

OPERATION
The ATM/Rack will be subjected to a launch shock to the levels and axis specified in the ATM/Rack CEI specification. During the test all systems and experiments will be in the launch configuration. Shock levels will be monitored. After the shock test, the ATM/Rack will be inspected to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

1. The ATM/Rack shall sustain no damage during the shock test.
2. Shock load levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. ATM/Rack handling and transport GSE.

Table VI. (Cont.)

ATM/Rack Shock (Launch) - Part 1 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shock table and simulate the SLA structure and attach points.
2. Instrumentation to monitor shock levels at selected locations.
3. Mass simulators.

FACILITIES

1. Facility to perform shock test.
2. Shock table capable of holding the ATM/Rack-SLA simulator in launch position.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Shock (Orbit) - Part 2	8.3.4.2

TEST OBJECTIVE

1. Verify that the ATM/Rack can survive the shock encountered during orbit transfer and docking.
2. Verify that the shock load levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured ATM/Rack with component and experiment mass simulators.

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be suspended in the horizontal position with slings attached to several selected positions. Prior to the test, all component and experiment mass simulators will be installed. Liquids will be simulated.

OPERATION
The test will be performed in two parts:
1. The first part will verify orbit transfer. Ordnance will be placed at a point that will simulate the shock load induced by the CSM propulsion system start. The shock level will be to the criteria specified in the ATM/Rack CEI specification.
2. The second part will verify docking to the MDA. Ordnance will be placed at a point that will simulate the shock load induced by the maximum docking impact as specified in the ATM/Rack CEI specification.

Shock levels will be monitored during the test. At the completion of each shock test the ATM/Rack will be inspected to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

1. The ATM/Rack shall sustain no damage during the shock test.
2. Shock load levels shall be within those predicted by analysis.

Table VI. (Cont.)

ATM/Rack Shock (Orbit) - Part 2 (continued)

SUPPORT REQUIREMENTS

GSE

1. ATM handling and transport GSE.

SPECIAL TEST EQUIPMENT

1. Fixture to suspend the ATM/Rack combination.
2. Instrumentation to monitor the shock levels at specified locations.
3. Mass simulators.

FACILITIES

1. Facility to perform shock test with ATM/Rack suspended in horizontal position.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Acoustic	8.3.5

TEST OBJECTIVE

1. Verify that the ATM/Rack can survive the acoustic vibrations encountered during launch.
2. Verify that the ATM/Rack vibration levels are within those predicted by analysis.

TEST CONFIGURATION

Prototype flight configured ATM/Rack with component and experiment mass simulators.

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be installed in an acoustic test area utilizing an SLA simulator. The SLA simulator will consist of mounting provisions for the ATM/Rack, and will simulate the SLA structure and panels. Prior to the acoustic test, all component and experiment mass simulators will be installed.

OPERATION
The ATM/Rack/SLA shall be subjected to the launch acoustic vibrations as specified in the ATM Rack CEI specification. This test may be performed in more than one part if required. The acoustic sound pressure shall be induced through the SLA panels to the ATM. After the acoustic test, the ATM/Rack will be inspected to verify that no damage has resulted from the acoustic vibration.

CRITERIA FOR SUCCESS

1. The ATM/Rack shall sustain no damage during the acoustic test.
2. Acoustic vibration levels shall be within those predicted by analysis.

SUPPORT REQUIREMENTS

GSE
1. ATM/Rack handling and transport GSE.

Table VI. (Cont.)

ATM/Rack Acoustic (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to simulate the SLA panels, ATM attach points and structure.
2. Instrumentation to monitor acoustic vibration levels at specified locations.
3. Mass simulators.

FACILITIES

1. Facility to perform ATM/Rack/SLA acoustic test.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Support Subsystem Operations	8.4.1

TEST OBJECTIVE

Verify that all subsystems operate within design specifications.

TEST CONFIGURATION

Prototype flight configured ATM package.

TEST DESCRIPTION

PREPARATION

The ATM package will be in the vertical position. GSE will be checked out and connected. All ATM pre-tests shall be performed such as single point ground, resistance measurements, etc. Electrical loads will be simulated. A simulator will be utilized to provide LM/ATM and rack/ATM interfaces.

OPERATION

Each system will be functioned individually:

1. Fine Pointing System
   a. Response time
   b. Ambient functional
   c. Alignment
2. Electrical Distribution
   a. Noise and ripple
   b. Power characteristics
3. Display and Control
   a. Ambient functional
   b. Man-machine
4. Data Management
   a. Power characteristics

CRITERIA FOR SUCCESS

All subsystems shall operate within design specifications.

SUPPORT REQUIREMENTS

GSE

1. ATM handling GSE.
2. Equipment to functionally check the ATM systems (portable).

Table VI. (Cont.)

ATM Package Support Subsystem Operations (continued)

SPECIAL TEST EQUIPMENT

None

FACILITIES

1. Area to contain ATM and support equipment for an ambient functional.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Experiment Performance	8.4.2

TEST OBJECTIVE

Verify that ATM package experiments will operate within design specifications.

TEST CONFIGURATION

Prototype flight configured ATM package.

TEST DESCRIPTION

PREPARATION
The ATM will be in the vertical position. GSE will be checked out and connected. All ATM pre-tests shall be performed such as alignment, single point ground, resistance measurements, etc. Electrical loads will be simulated. LM and Rack interface simulators will be utilized for D&C, power and data management.

OPERATION
The experiments will be operated individually in conjunction with the support subsystems. Alignment will be verified to be within tolerances for experiment operation. The experiments to be verified are:

- S020 - UV X-ray solar photography
- S052 - White light coronography
- S053A - UV Coronal spectrograph
- S053B - UV spectrograph
- S054 - X-ray spectrographic telescope
- S055A - UV spectrometer
- S055B - UV spectrometer (UV spectroheliometer)
- S055C - UV spectrometer - Hα telescope
- S056 - X-ray telescope

(Refer to the Section 5 for details on the individual experiment integration test requirements.)

CRITERIA FOR SUCCESS

The experiments will operate within design specifications when operated in conjunction with the support subsystems.

Table VI. (Cont.)

ATM Package Experiment Performance (continued)

SUPPORT REQUIREMENTS

GSE

1. ATM handling GSE.
2. Equipment to support the operation of the ATM experiments.
3. Equipment to operate each subsystem.

SPECIAL TEST EQUIPMENT

1. LM interface simulator for display and controls.
2. Rack interface simulator for power and data management.

FACILITIES

1. Area to contain ATM and support equipment for ambieng functional.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Support Subsystem Operations	8.4.3

TEST OBJECTIVE

Verify that ATM/Rack subsystems will operate within design specifications.

TEST CONFIGURATION

Prototype flight configured ATM/Rack.

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be in the vertical position. GSE will be checked out and connected. An LM simulator will be utilized to provide interfaces between LM and ATM/Rack. All ATM/Rack pretests shall be performed, such as single point ground, resistance measurements, etc. Electrical loads will be simulated. The solar panels will be simulated.

OPERATION
Each subsystem will be functioned individually, except the ECLS system:

1. Pointing Control System
   a. Response Time
   b. Ambient Functional
   c. Alignment
2. Fine Pointing System
   a. Response Time
   b. Ambient Functional
   c. Alignment
   d. ATM package gimbal release system
3. Electrical Distribution System
   a. Noise and ripple
   b. Power characteristics
   c. Power control and selection
4. EPS Batteries
   a. Power characteristics
5. Communication, Data Management and Display and Control
   a. Power characteristics
   b. Ambient functional

Table VI. (Cont.)

ATM/Rack Support Subsystem Operations (continued)

CRITERIA FOR SUCCESS

All subsystems shall operate to design criteria.

SUPPORT REQUIREMENTS

GSE
1. ATM/Rack handling and transport GSE.
2. Equipment to functionally check the ATM systems (portable).

SPECIAL TEST EQUIPMENT
1. LM interface simulator.
2. Solar array simulator.

FACILITIES
Area to contain ATM/Rack and support equipment for an ambient functional.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Experiment Performance	8.4.4

TEST OBJECTIVE

Verify that ATM/Rack experiments will operate to design criteria.

TEST CONFIGURATION

Prototype flight configured ATM/Rack.

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be in the vertical position. GSE will be checked out and connected. An LM simulator will be utilized to provide interfaces between LM and ATM/Rack. All ATM/Rack pretests shall be performed such as alignment, single point ground, resistance measurements, etc. Electrical loads will be simulated. The solar array will be simulated.

OPERATION
The experiments will be operated individually in conjunction with the various support subsystems. The experiments to be verified are:

- S020 - UV X-ray solar photography
- S052 - White light coronography
- S053A - UV coronal spectrograph
- S053B - UV spectrograph
- S054 - X-ray spectrographic telescope
- S055A - UV spectrometer
- S055B - UV spectrometer (UV spectroheliumeter)
- S055C - UV spectrometer - Hα telescope
- S056 - X-ray telescope

(Refer to the Section 5 for details on the individual experiment integration test requirements.)

CRITERIA FOR SUCCESS

The experiments will operate within design specifications when operated in conjunction with the support subsystems.

Table VI. (Cont.)

ATM/Rack Experiment Performance (continued)

SUPPORT REQUIREMENTS

GSE

1. ATM/Rack handling and transport GSE.
2. Equipment to support the operation of the ATM experiments.
3. Equipment to operate each subsystem.

SPECIAL TEST EQUIPMENT

1. LM interface simulator
2. Solar array simulator

FACILITIES

1. Area to contain ATM/Rack and support equipment for ambient functional.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
Rack Support Subsystem Operation (Ambient)	8.7.1

TEST OBJECTIVE

Verify the compatibility and operation of the support subsystems installed in the rack.

TEST CONFIGURATION

Prototype rack with all subsystems installed.

TEST DESCRIPTION

PREPARATION
The rack will be in the vertical position with all subsystems (except cryogenics) installed. All rack pre-tests shall be performed such as single point ground, resistance measurements, etc. ATM package loads will be simulated. A simulator will be utilized to provide LM/Rack interfaces. The solar array power supply will be simulated. GSE will be checked out and connected.

OPERATION
Each subsystem will be functioned individually:

1. Solar Array Deployment
   a. Response time
   b. Ambient functional
2. Pointing Control System
   a. Response time
   b. Ambient functional
   c. Alignment
3. Electrical Distribution System
   a. Noise and ripple
   b. Power characteristics
   c. Power control and selection
4. EPS Batteries
   a. Power characteristics
5. Communication
   a. Power characteristics
   b. Ambient functional
6. Data Management
   a. Power characteristics
   b. Ambient functional

Table VI. (Cont.)

Rack Support Subsystem Operation (Ambient) (continued)

CRITERIA FOR SUCCESS

All subsystems shall operate to design criteria.

SUPPORT REQUIREMENTS

GSE

1. Equipment to support the rack support subsystem operations.
2. Rack handling and transport GSE.

SPECIAL TEST EQUIPMENT

1. Simulated loads for the support subsystems.

FACILITIES

1. Area to contain rack (ATM) and support equipment for an ambient functional.
2. Temporary external scaffolding and work platforms.

Table VI. (Cont.)

TEST TITLE	TEST NUMBER
Rack Support Subsystem Operations (Cryogenic)	8.7.2

TEST OBJECTIVE

Verify that the rack pressure and cryogenic systems operate within design specifications.

TEST CONFIGURATION

Prototype rack with cryogenic subsystem installed.

TEST DESCRIPTION

PREPARATION

The rack will be in a vertical position mounted on a propellant/pressurization test stand. All subsystems will have been electrically demonstrated prior to the propellant transfer test. Individual components will have been subjected to proof pressures. An LM simulator will be utilized to provide mechanical, fluid and electrical interfaces.

OPERATION

The cryogenic test program will be performed as follows:

1. Pressurize and leak check all fluid and pressure systems.
2. Proof pressure all fluid and pressure systems.
3. Load LO_2.
4. Perform transfer of LO_2 in an abbreviated mission sequence; verify:
   a. Flow rate
   b. Response time
5. Unload and clean systems

CRITERIA FOR SUCCESS

All fluid and pressure systems shall operate within design specifications.

SUPPORT REQUIREMENTS

GSE

1. Propellant and servicing GSE.

Table VI. (Cont.)

Rack Support Subsystem Operations (Cryogenic) (continued)

SPECIAL TEST EQUIPMENT

1. LM mechanical, fluid, and electrical control interface simulator.
2. Mounting fixture for RM on test stand.
3. Mass spectrometer for leak check.

FACILITIES

1. Test stand to mount RM, provide the necessary commodities and allow system pressurization and cryogenic transfer.

2.4 Cluster Development

2.4.1 Scale Model Antenna - These tests are performed on a scale model of the cluster and antennas and will provide data to aid in antenna design and location for the various orbit configurations.

The details of the antenna test program are described in the following test flow diagram (Figure 9) and the accompanying test descriptions.

2.4.2 Scale Model Thermal Vacuum - These tests are performed on a scale model of the cluster and are to provide the following: 1) Data to support analysis, 2) Instrumentation locations for full scale test, and 3) Qualification criteria for individual carriers. The tests will cover manned flight simulation and OWS storage.

The details of the scale model thermal vacuum test program are described in the following test flow diagram (Figure 9) and the accompanying test descriptions (Table VII).



FIGURE 9

SCALE MODEL
DEVELOPMENT TESTS

DATE: 7 APRIL 1967

Figure 9. Scale Model Development Tests

Table VII. Test Descriptions for Figure 9

TEST TITLE	TEST NUMBER
Cluster Scale Model Antenna Test	9.1

TEST OBJECTIVE

Provide data to aid in antenna design and location.

TEST CONFIGURATION

1/10 scale model of cluster carriers and scale model VHF antennas.

TEST DESCRIPTION

PREPARATION
The desired cluster configuration (Flight 1/2 or 3/4) will be installed in an antenna pattern test area.

OPERATION
Operate antennas in mission simulation and determine whether existing and added antennas provide sufficient gain to assume routine signal margins in all directions.

CRITERIA FOR SUCCESS

Optimum antenna design and location shall be determined for cluster configurations.

SUPPORT REQUIREMENTS

GSE
None

SPECIAL TEST EQUIPMENT
1. Support equipment to operate antennas.
2. Instrumentation to monitor antenna strength and patterns.

FACILITIES
1. Antenna pattern test area of sufficient size to contain a 1/10 scale model of flight 3/4 cluster.

Table VII. (Cont.)

TEST TITLE	TEST NUMBER
Cluster Thermal Scale Model Tests	9.2

TEST OBJECTIVE

1. Obtain data to support analysis.
2. Determine instrumentation locations for full scale test.
3. Determine qualification criteria for individual carriers.

TEST CONFIGURATION

1. View factor scale model - 1/4th scale
2. Shadow factor scale model - 1/25th scale

TEST DESCRIPTION

PREPARATION

1. View factor scale model - the model will be installed on a fixture that will allow the photographing of each surface of interest from a minimum of 18 inches. The entire model will be brightly lighted (artificial lighting or sunlight)
2. Shadow factor scale model - the model will be installed on a fixture that will allow orientation of the entire model in the desired orbital attitude within a collimated light beam which simulates the sun.

OPERATION

1. View factor scale model - this model will be used in determining radient or heat transfer view factors between the various external surfaces of any cluster configuration. The technique used involves photographing each surface of interest from a point no less than 18 inches away.
2. Shadow factor scale model - this model will be used to photographically determine the reduction of solar heat input to external surfaces due to shadowing by other surfaces. The technique used is to orient the entire model in the desired orbital attitude within a collimated light beam which simulates the sun. Photographs of the model from various angles provides the necessary data.

Table VII. (Cont.)

CRITERIA FOR SUCCESS

Data shall be obtained to support analysis and further thermal vacuum testing.

SUPPORT REQUIREMENTS

GSE

SPECIAL TEST EQUIPMENT

1. Fixtures to mount 1/4th and 1/25th models
2. Photography equipment to support test
3. Collimated light source

FACILITIES

1. Area with sufficient light to perform view factor test
2. Area for performance of shadow factor test with collimated light source.

2.4.3 OWS Thermal Vacuum - This test is performed on a full scale test article and is to verify that a proper thermal balance is maintained within the S-IVB while simulating the space environments and vehicle attitudes associated with Flights AAP 2, 3 and 4. The test will cover manned flight simulation and OWS storage.

The details of the OWS thermal vacuum test are described in the following flow diagram (Figure 10) and accompanying test description (Table VIII).

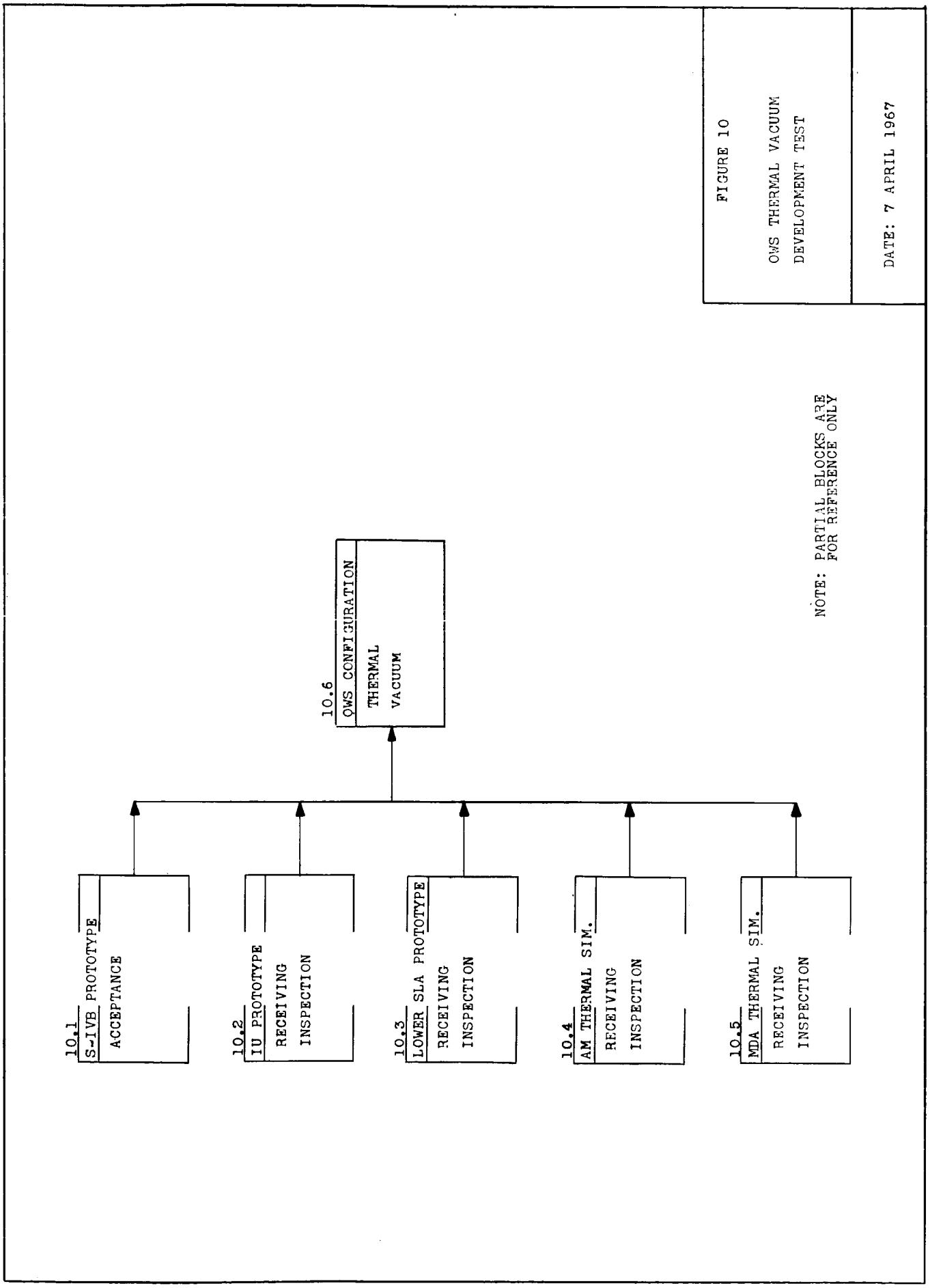


Figure 10. CWS Thermal Vacuum Development Test

Table VIII. Test Descriptions for Figure 10

TEST TITLE	TEST NUMBER
OWS Thermal Vacuum	10.6

TEST OBJECTIVE

Verify that a proper thermal balance is maintained within the S-IVB while simulating the space environment and vehicle attitudes associated with the AAP missions 2, 3 and 4.

TEST CONFIGURATION

1. S-IVB prototype with all support subsystems installed.
2. IU prototype with equipment thermal simulators.
3. Lower SLA prototype.
4. AM thermal mass simulator with egress/access to S-IVB.
5. MDA thermal mass simulator.
6. Thermal mass simulators will be utilized for all experiments.

TEST DESCRIPTION

PREPARATION

The OWS will be mounted on a fixture in the chamber in the vertical position. An IR cage with approximately 50 zones of lamps will be calibrated and checked out and placed around the OWS. Instrumentation will be calibrated and installed to monitor temperature, pressure, etc. Internal work platforms will be installed. GSE to control and monitor subsystems will be checked out and installed. The AM ECS will be simulated to provide purified air to the OWS interior. TV monitors for OWS interior will be provided.

OPERATION

The test will be performed in two operations:

1. Run 1 will simulate the manned portion of the mission and will require that a man be in the chamber with a hot wire anemometer to determine air velocity characteristics at various locations within the S-IVB.
2. Run 2 simulates the storage period and will be unmanned. Heat flux simulation shall consider the OWS so oriented that the MDA thermal simulator is continuously earth oriented.

CRITERIA FOR SUCCESS

Proper thermal balance shall be maintained within the S-IVB during the manned and unmanned portions of the simulated mission.

Table VIII. (Cont.)

OWS Thermal Vacuum (continued)

SUPPORT REQUIREMENTS

GSE

1. Equipment to support the support subsystem operation.
2. Equipment to support the experiment operation.

SPECIAL TEST EQUIPMENT

1. AM and MDA thermal mass simulators.
2. Instrumentation to monitor test.
3. Experiment thermal mass simulators.
4. Fixture to hold OWS in vertical position.
5. OWS internal work platforms.
6. Air purifier for OWS interior.
7. TV monitor for OWS interior.

FACILITIES

1. Thermal chamber capable of holding OWS in vertical position.
2. Access platforms to gain entry to S-IVB.
3. IR cage and control system.

3. QUALIFICATION TEST PROGRAM

3.1 General - The AAP qualification test program is designed to demonstrate the performance and compatibility of the integrated experiment module, the experiment support subsystems, and experiments when operated in a mission sequence under ambient and prescribed environmental conditions. In addition, the qualification test program will verify and demonstrate that:

a. The functional performance of the equipment being tested meets the design specification requirements necessary to assure that the item is qualified to meet the life, parametric and reliability standards which its particular application demands.

b. The values of subsystem and experiment uncertainties are not additive to the extent that system level specifications are exceeded.

c. The ground support and flight equipment are compatible.

Each of the following carriers used on this mission shall be subjected to certain qualification performance and environmental tests, as defined in the Qualification Test Requirement Matrix, figure 11.

a. S-IVB
b. AM
c. MDA
d. SLA
e. CSM
f. LM
g. ATM Rack
h. LM&SS Rack
i. IU
j. Nose Cone

To satisfy the qualification test requirements the following methods will be employed:

a. Analysis
b. Test
c. Demonstration
d. Inspection

Test Requirement Matrix Definitions

The following definitions were utilized when formulating the test requirements matrix:

A. Chart Definitions

1. The left hand column shows the test requirements imposed on each cluster configuration, carrier, component and experiment. The top row contains a list of environments from which specific tests are chosen to satisfy the particular test requirement.

2. The "X" in the matrix signifies that the test requirement will be satisfied by a specific test at the level indicated.

3. The "A" in the matrix signifies that the test requirement will be satisfied by analysis, previous or similar tests, and tests performed at a lower level, such as materials and piece part testing.

4. "Integrated Carrier" refers to several carriers mated in an orbital or launch configuration. Intercarrier tests are for verification of interfaces between carriers.

5. "Carriers" are specified by name and tests required in this category are for qualification of a specific carrier.

6. "Components" refer to a group of components, black boxes, and complete experiment packages.

B. Test Environment Definitions

1. Vibration tests refer to forced vibration as induced by transportation or launch and free resonant vibration as induced by orbit maneuvers, as indicated by $\frac{R}{X}$.

2. Temperature indicates high and low temperature extremes.

3. Vacuum refers to orbital vacuum.

4. Altitude refers to aircraft transportation and pressure rate change during launch.

5. Thermal vacuum refers to temperature stability in a temperature extreme and vacuum environment.

Figure 11. Qualification Test Requirement Matrix Combined Mission, Flights AAP 1,2,3 and 4 (Sheet 1 of 5)

6. EMI indicates electromagnetic interference.

7. Solar radiation tests are performed primarily to identify any deterioration effects on materials, piece parts and components.

8. Meteoroids refers to material penetration resistance.

9. Acceleration refers to forces generated by transportation or launch.

10. Acoustic refers to sonic vibrations.

11. Thermal shock indicates a sudden extreme temperature change induced by a natural environment or sudden contact with a cryogenic fluid.

12. Fungus, salt spray, humidity, dust, etc. refers to storage environment.

13. Ozone refers to equipment deterioration when exposed to a concentration of ozone.

14. Dynamic pressure refers to testing for aerodynamic characteristics.

15. Atomic radiation refers to particle radiation as encountered in space.

16. Zero g refers to orbital conditions of weightlessness.

17. O_2 atmosphere refers to an O_2 rich atmosphere inside spacecraft.

18. H_2 atmosphere refers to an H_2 rich atmosphere or liquid around cryogenic system for fuel cell operation.

19. Hypergolic propellant atmosphere - propellant contamination by SM orbit operation.

Figure 11. Qualification Test Requirement Matrix
Combined Mission, Flights AAP 1, 2, 3 and 4
(Sheet 2 of 5)

TEST ENVIRONMENT / HARDWARE	QUALIFICATION TEST REQUIREMENTS																			
	VIBRATION	TEMPERATURE	VACUUM	THERMAL VACUUM	EMI	SOLAR RADIATION	METEOROIDS	ACCELERATION	ACOUSTIC	SHOCK	THERMAL SHOCK	FUNGUS, RAIN, DUST, HUMIDITY	OZONE	DYNAMIC PRESSURE	ATOMIC RADIATION	ZERO "G"	O_2 ATMOSPHERE	H_2 ATMOSPHERE	HYPERGOLIC ATMOSPHERE	ALTITUDE
FLIGHT 1																				
1. Storage Environments																				
a. Rack Structure (LM&SS)																				
2. Transportation & Handling																				
a. Rack Structure (LM&SS)	A									X										
3. Launch Environment																				
a. Rack Structure (LM&SS)	X	A						X	A	X										
b. SLA																				
(1) Carrier																				
(2) Component																				
4. Orbit Environment																				
a. Rack Structure		A	A				A													
FLIGHT 2																				
1. Storage Environment																				
a. Component		X										X								
2. Transportation & Handling																				
a. Carrier	A	A								X										A
b. Component	X	X						X		X										X
3. Launch Environment																				
a. Integrated Carrier	A	A			X			A	A	A		A		A						A
b. S-IVB																				
(1) Carrier	A	A			A			A	A	A		A		A			A	A		A
(2) Component	X	X			X			X		X	X	A					X	X		X
c. AM																				
(1) Carrier	X	A			X			A	X	X		A					A	A		X
(2) Component	X	X			X			X		X	X	A					X	X		X
d. MDA																				
(1) Carrier	X	A						A	X	X		A					A	A		X
(2) Component	X	X						X		X	X	A					X	X		X
e. SLA																				
(1) Carrier	X	A			X			A	X	X		A		A						A
(2) Component	X	X			X			X		X	X	A								X
f. IU																				
(1) Carrier	A	A			X			A	A	A		A		A			A	A		A
(2) Component	X	X			X			X		X	X	A					X	X		X
g. Nose Cone																				
(1) Carrier	X	X						A	X	X		A		X			A	A		X
(2) Component	X	X						X		X	X	A					X	X		X
h. Materials												X					X	X		

Figure 11. Qualification Test Requirement Matrix
Combined Mission, Flights AAP 1, 2, 3, and 4
(Sheet 3 of 5)

TEST ENVIRONMENT / HARDWARE	VIBRATION	TEMPERATURE	VACUUM	THERMAL VACUUM	EMI	SOLAR RADIATION	METEOROIDS	ACCELERATION	ACOUSTIC	SHOCK	THERMAL SHOCK	FUNGUS, RAIN, DUST, HUMIDITY	OZONE	DYNAMIC PRESSURE	ATOMIC RADIATION	ZERO "G"	O_2 ATMOSPHERE	H_2 ATMOSPHERE	HYPERGOLIC ATMOSPHERE	ALTITUDE
FLIGHT 2 (cont)																				
4. Orbit Environment																				
a. Integrated Carrier	A	A	A	A	X	A	A	A			A		A		A	A	A	A		
b. S-IVB																				
(1) Carrier	A	A	A	A	X	A	A	A			A		A		A	A	A	A		
(2) Component		X	X	X	X	X	A	X			X				A	A	X	X		
c. AM	R																			
(1) Carrier	X	A	X	X	X	A	A	A			X		A		A	A	A	A		
(2) Component		X	X	X	X	X	A	X			X				A	A	X	X		
d. MDA	R																			
(1) Carrier	X	A	X	X	A	A	A	A			X		A		A	A	A	A		
(2) Component		X	X	X	X	X	A	X			X				A	A	X	X		
e. SLA																				
(1) Carrier	A	A	A	A	A	A	A	A			A		A		A	A	A	A		
(2) Component		X	X	X	X	X	A	X			X				A	A	X	X		
f. IU																				
(1) Carrier	A	A	A	A	A	A	A	A			A		A		A	A	A	A		
(2) Component		X	X	X	X	X	A	X			X				A	A	X	X		
g. CSM																				
(1) Carrier	A	A	A	A	X	A	A	A			A		A		A	A	A	A		
(2) Component		X	X	X	X	X	A	X			X				A	A	X	X		
h. LM&SS																				
(1) Carrier													A							
(2) Component																				
i. Material/Piece Parts				X		X	X						X		X		X	X		
FLIGHT 3																				
1. Storage Environments																				
a. Components		X										X								
2. Transportation & Handling																				
a. Carrier	A	A								X										A
b. Component	X	X						X		X		X								X
3. Launch Environment																				
a. Integrated Carrier	A	A			X			A	A	A		A		A						A
b. RM																				
(1) Carrier	X	A						A	X	X										X
(2) Components	X	X						X	X	X									X	X
c. SLA																				
(1) Carrier																				
4. Orbit Environments																				
a. Integrated Carrier																				
b. RM	R																			
(1) Carrier	X	A	X	X	X	A	A				A					A				
(2) Component		X	X	X		A	A				X		A		A	A			X	

Figure 11. Qualification Test Requirement Matrix
Combined Mission, Flights AAP 1,2, 3, and 4
(Sheet 4 of 5)

TEST ENVIRONMENT / HARDWARE	QUALIFICATION TEST REQUIREMENTS																			
	VIBRATION	TEMPERATURE	VACUUM	THERMAL VACUUM	EMI	SOLAR RADIATION	METEOROIDS	ACCELERATION	ACOUSTIC	SHOCK	THERMAL SHOCK	FUNGUS, RAIN, DUST, HUMIDITY	OZONE	DYNAMIC PRESSURE	ATOMIC RADIATION	ZERO "G"	O_2 ATMOSPHERE	H_2 ATMOSPHERE	HYPERGOLIC ATMOSPHERE	ALTITUDE
FLIGHT 4																				
1. Storage Environments																				
a. Components		X										X								
2. Transportation & Handling																				
a. Carrier	A	A						A		X		A								A
b. Component	X	X						X		X		X								X
3. Launch Environment																				
a. Integrated Carrier	A	A			X			A	A	A		A		A					A	A
b. LM																				
(1) Carrier	A	A			X			A	A	A		A							A	A
(2) Component	X	X			X			X	A	X		X							X	X
c. ATM/Rack																				
(1) Carrier	X	A			X			A	X	X		A							A	X
(2) Compoent	X	X			X			X	X	X		X							X	X
d. SLA																				
(1) Carrier	A	A			X			A	A	A		A		A					A	A
(2) Component	X	X			X			X	X	X		A							X	X
e. Nose Cone (Qual. on Flt. 2)																				
(1) Carrier	A	A						A	A	A		A		A					A	A
(2) Component	X	X						X		X	X	A							X	X
f. Materials												X								
4. Orbit Environment																				
a. Integrated Carrier	A	A	A	A	X	A	A	A			A		A		A	A			A	
b. CSM																				
(1) Carrier	A	A	A	A	X	A	A	A			A				A	A			A	
(2) Component																				
c. LM																				
(1) Carrier	A	A	A	A	X	A	A	A			A		A		A	A			A	
(2) Component		X	X	X	X	X	A	X			X		X		A	A			X	
d. ATM/Rack	R																			
(1) Carrier	X	A	X	X	X	A	A	A			X		A		A	A			A	
(2) Component		X	X	X	X	X	A	X			X		X		A	A			X	

Figure 11. Qualification Test Requirement Matrix
Combined Mission, Flights AAP 1, 2, 3, and 4
(Sheet 5 of 5)

Satisfaction of test requirements by analysis will be accomplished when minor or no modifications are made to previously qualified articles. This method shall not be used to qualify critical components.

Satisfaction of test requirements by qualification testing will be accomplished on all new items or items with extensive modifications incorporated. All critical components shall be qualified by test.

Satisfaction of the qualification test requirements by demonstration shall be accomplished on items which are non-critical and have only minor nonfunctional modifications incorporated.

Satisfaction of test requirements by inspection shall occur on flight hardware that is qualified from previous test programs and is being used unmodified, for the same or similar function on this program.

When qualification is accomplished by test, the test data will be presented in a formal test report. When qualification is accomplished by design analysis or utilization of previously qualified articles, the basis for qualification will be appropriately defined, documented, and presented in a formal report.

All qualification testing shall be accomplished on flight type production hardware accepted to the proposed flight article specification. These tests shall provide an overall performance evaluation of the test article within the full spectrum of storage, transportation, launch and on-orbit environments and life cycle requirements. Qualification test requirements shall be levied on the integrated experiment module level, and on all critical components level. In the case that individual qualified experiments would not be available for the integrated module qualification program, prototype experiments or certified simulators shall be used.

The existing carriers will be tested for the modifications only and in most cases, this test program is not too involved, with limited environmental testing. Maximum utilization of qualification data from previous test programs and flight tests will be utilized in formulation of the qualification test program. Existing prototypes from other programs or other existing carriers will be utilized whenever possible. Integrated experiment module qualification will not be complete until all components

and experiments (contract end items) have been qualified. In addition, whenever GSE is utilized in the qualification test program, compatibility between the GSE and Qualification test article will be demonstrated.

All flight hardware (i.e., experiments, components and integrated experiment modules) shall be flight qualified prior to that item's first flight.

The qualification test program defined herein delineates the qualification testing at the integrated experiment module level.

3.2 Carrier Qualification

3.2.1 S-IVB Carrier - The S-IVB qualification will be performed in two parts:

a. The flight S-IVB will be utilized to qualify the S-IVB in the launch configuration.

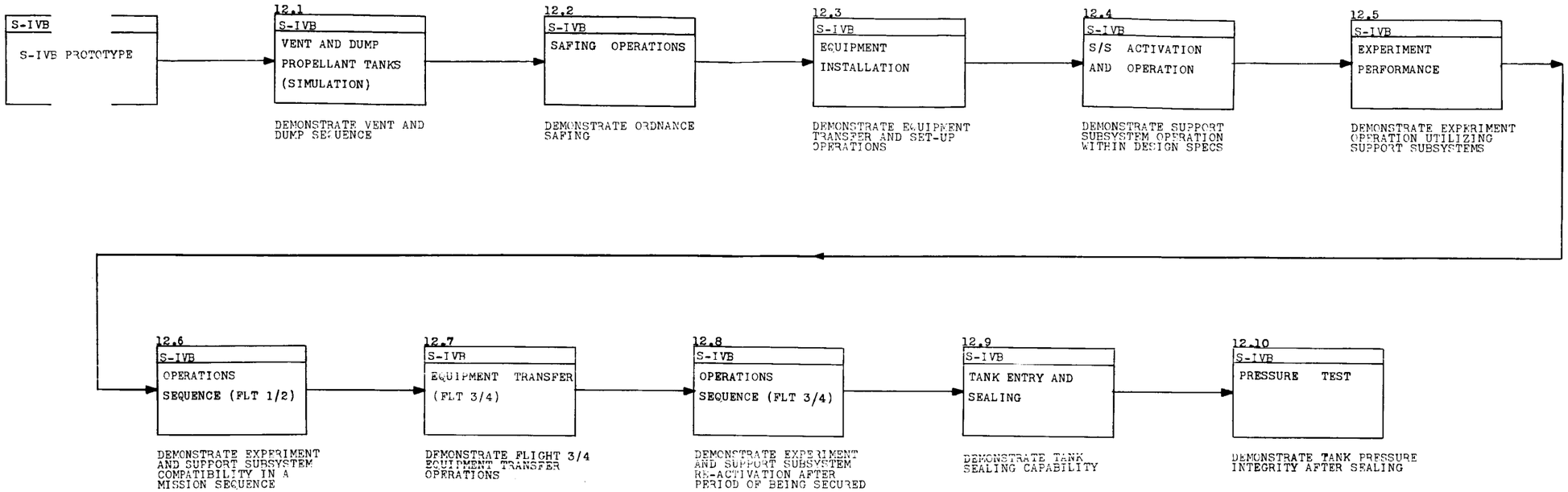
b. A prototype S-IVB will be utilized to quality the S-IVB in the orbit configuration.

The qualification of the S-IVB will mainly be for the qualification of the S-IVB modifications.

The S-IVB prototype utilized for the qualification test program will be complete except for the engine assemblies. Enough of the engine assembly will be included to perform S-IVB pressurization and to perform actuation operations on the propellant feed lines.

The details of the S-IVB qualification program are described in the following test flow diagram (figure 12) and accompanying test descriptions (Table IX).

PROTOTYPE TEST ARTICLE



FLIGHT ARTICLES

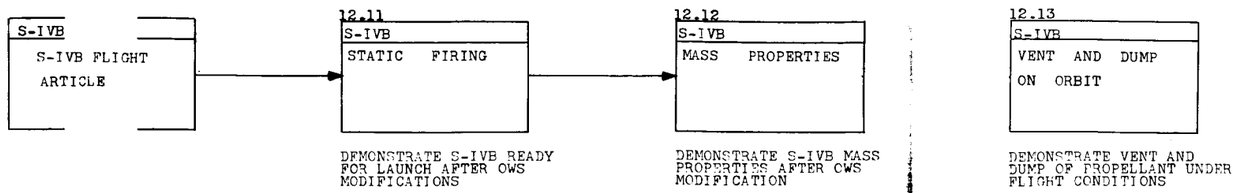


Figure 12

S-IVB CARRIER

QUALIFICATION TEST HARDWARE FLOW

DATE: 7 APRIL 1967

Figure 12. S-IVB Carrier Qualification Test Hardware Flow

FOLDOUT FRAME 1

FOLDOUT FRAME

FOLDOUT FRAME 2

Table IX. Test Descriptions for Figure 12

TEST TITLE	TEST NUMBER
S-IVB Passivation (Vent and Dump)	12.1

TEST OBJECTIVE

Demonstrate vent and dump of propellant tank sequence.

TEST CONFIGURATION

Prototype flight configured S-IVB.

TEST DESCRIPTION

PREPARATION

S-IVB will be in the horizontal position. Cryogenics will not be used or simulated. An IU simulator to provide the power necessary to activate systems in S-IVB shall be installed.

OPERATION

The vent and dump of propellant will have been accomplished in orbit on a previous flight. This test is basically an electrical functional check of the systems associated with dumping and vent of propellant tanks. System compatibility and power characteristics shall be verified.

CRITERIA FOR SUCCESS

All systems will operate properly during the simulated vent and dump sequence under ambient conditions.

SUPPORT REQUIREMENTS

GSE

1. Transportation and handling equipment.

SPECIAL TEST EQUIPMENT

1. IU functional interface simulator.
2. S-IVB horizontal holding fixture (rotatable).
3. Equipment to functionally check out S-IVB.

FACILITIES

1. Scaffolding, temporary structures to facilitate work on S-IVB.

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Passivation (Safing)	12.2

TEST OBJECTIVE

Demonstrate ordnance safing on flight configured hardware.

TEST CONFIGURATION

Prototype flight configured S-IVB.

TEST DESCRIPTION

PREPARATION
The S-IVB prototype will be mounted in a horizontal position on a holding fixture which will allow the S-IVB to be rotated. Ordnance will be simulated.

OPERATION
The safing of the ordnance will be performed in a mission sequence. Power will be applied to the S-IVB to simulate the conditions at the start of normal safing operations.

CRITERIA FOR SUCCESS

Capability of deactivating ordnance in specific sequence and time span without activation of the ordnance system. Man-machine compatibility will also be demonstrated.

SUPPORT REQUIREMENTS

GSE
1. S-IVB transport and handling GSE.

SPECIAL TEST EQUIPMENT
1. IU and AM simulators
2. Ordnance simulators
3. S-IVB horizontal holding fixture (rotatable)
4. Equipment to functionally check out S-IVB

FACILITIES
1. Scaffolding, temporary structures to facilitate work on the S-IVB

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Equipment Installation and Activation	12.3

TEST OBJECTIVE

Demonstrate that the support subsystems and experiment can be set up in the S-IVB Prototype OWS.

TEST CONFIGURATION

S-IVB prototype

TEST DESCRIPTION

PREPARATION
The S-IVB will be in the vertical position with access platforms to the hatch. The inside of the S-IVB shall have temporary work platforms to allow installation of subsystems and experiments.

OPERATION
The support subsystems and experiments will be installed in a mission sequence. Interference and fit checks will be made during this installation.

CRITERIA FOR SUCCESS

The experiments and support subsystems shall be installed in the mission sequence without interference from previous installed equipment or S-IVB structure.

SUPPORT REQUIREMENTS

GSE
1. S-IVB transport and handling GSE

SPECIAL TEST EQUIPMENT
1. Prototype experiments and support subsystems
2. AM mechanical interface simulator
3. Internal work platforms
4. Vertical holding fixture

FACILITIES
1. Test position to hold the S-IVB in a vertical position
2. Temporary platforms and access platforms to the hatch (external)

Table IX. (Cont.)

TEST TITLE

S-IVB Support Subsystem Operation

TEST NUMBER

12.4

TEST OBJECTIVE

Demonstrate the compatibility and operation of the support subsystems installed in the S-IVB.

TEST CONFIGURATION

Prototype S-IVB with all subsystems installed (configuration after OWS activation)

TEST DESCRIPTION

PREPARATION
The S-IVB will be in the vertical position with all subsystems installed. The AM interface will be simulated to provide normal AM interface requirements.

OPERATION
Each subsystem will be tested individually as indicated below.

Support System \ Test	Continuity	Resistance	Leak Check	Flow Rate	VSWR & Insertion Loss	Functional
Solar Array Cabling	X	X				
Electrical Power	X	X				X
Display and Control	X	X				X
Communication	X	X			X	X
Data Management	X	X				
TV Monitor	X	X				X
Lighting	X	X				X
Thermal Control	X	X				X
Camera Units	X	X				X
Compressed Air			X	X		X
Oxygen Supply			X	X		X
Waste Management			X	X		X
Vacuum			X	X		X
Water Supply			X			

Table IX. (Cont.)

S-IVB Support Subsystem Operation (continued)

During this test, compatibility will be demonstrated with any GSE utilized to support this program.

Interface simulators will be utilized to provide loads, and provide and monitor interface signals. Electrical interfaces will be demonstrated within specification by use of these simulators during subsystem operation.

CRITERIA FOR SUCCESS

All subsystems will operate within design specifications

SUPPORT REQUIREMENTS

GSE

1. GSE to support the S-IVB support subsystem operations and evaluation

SPECIAL TEST EQUIPMENT

1. Simulated loads for the support subsystems
2. AM interface simulator
3. Instrumentation for support subsystem monitoring
4. S-IVB internal work platforms

FACILITIES

1. Test position to hold the S-IVB in a vertical position
2. Temporary external ladders and access platforms

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Experiment Performance	12.5

TEST OBJECTIVE

Demonstrate experiments individually, utilizing the support subsystems

TEST CONFIGURATION

S-IVB prototype with support subsystems and experiments installed.

TEST DESCRIPTION

PREPARATION

The S-IVB will be in a configuration after the OWS has been activated; an AM simulator will be used to provide the interfaces to the S-IVB from the rest of the cluster configuration.

OPERATION

The following experiments will be operated individually in conjunction with the support subsystems.

- D018 - Integrated Maintenance
- D019 - Suit Donning and Sleep Station Evaluation
- D020 - Evaluation of Alternate Restraints for Mobility and Maintenance
- D022 - Expandable Structures for Recovery
- M018 - Vectorcardiogram
- M050 - Metabolic Cost of Inflight Tasks
- M051 - Inflight Assessment of Cardiovascular Function
- M052 - Bone and Muscle Changes
- M053 - Human Vestibular Function
- M054 - Neurological Study
- M055 - Time and Motion Study
- M464 - Onboard Checkout Equipment
- M466 - Spacesuit and Lunar Surface Experiment Hardware
- M469 - ST-124 Removal
- M479 - Zero g Flammability
- M486 - EVA Equipment and Hardware Evaluation
- M487 - Crew Quarters
- M488 - High Pressure Air Expulsion
- M489 - Heat Exchanger Service
- M492 - Joining Tubular Assemblies in Space Environment

Table IX. (Cont.)

S-IVB Experiment Performance (continued)

M493	-	Electron Beam Welding
T003	-	Nephelometer Experiment
T013	-	Crew Activity Vehicle Disturbances
T020	-	Jet Shoes
T023	-	Collection of Surface Absorbed Materials
MSFC-57	-	Gravity Simulation Workbench

Refer to section 5 for experiment integration test requirements of these experiments.

CRITERIA FOR SUCCESS

Each experiment will operate within design specifications when operated in conjunction with the support subsystem.

SUPPORT REQUIREMENTS

GSE

1. Equipment to support the operation of each experiment
2. Equipment to operate each subsystem

SPECIAL TEST EQUIPMENT

1. AM interface simulator
2. Instrumentation system to monitor experiment operation

FACILITIES

1. Test position to hold the S-IVB in the vertical position
2. Temporary external ladders and access platforms

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Operation Sequence - Flights AAP 1 and 2	12.6

TEST OBJECTIVE

Demonstrate that the experiments and subsystems are compatible when operated in a mission sequence

TEST CONFIGURATION

S-IVB prototype with support subsystems and experiments installed.

TEST DESCRIPTION

PREPARATION
The S-IVB will be in an OWS configuration after the equipment has been installed and activated. An AM simulator will be used to provide the interfaces from the rest of the cluster configuration. The support subsystem operation and each experiment operation shall have been demonstrated prior to this test.

OPERATION
Each subsystem and experiment will be operated in the sequence that they would be operated during the mission.

CRITERIA FOR SUCCESS

The experiments and subsystems will perform within specification when operated to the mission sequence.

SUPPORT REQUIREMENTS

GSE
1. Equipment to support the operation of each of the experiments
2. Equipment to operate each subsystem

SPECIAL TEST EQUIPMENT
1. AM interface simulator
2. Internal platform and mobility aids
3. Instrumentation system to evaluate subsystem and experiment operation

FACILITIES
1. Test position to hold the S-IVB in the vertical position
2. Temporary external ladders and access platforms

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Equipment Transfer - Flights AAP 3 and 4	12.7

TEST OBJECTIVE

1. Demonstrate that equipment transfer from Flights AAP 3 and 4 carriers to the S-IVB can be accomplished.

TEST CONFIGURATION

Prototype orbit configures S-IVB.

TEST DESCRIPTION

PREPARATION
The S-IVB will be in the vertical position. Platforms will be installed inside to provide access to various areas where equipment will be stowed.

OPERATION
The equipment will be transported through the S-IVB manhole to the proper areas in the OWS and stored. Mission sequence and timelines shall be utilized and verified.

CRITERIA FOR SUCCESS

The equipment provided by Flights AAP 3 and 4 shall be installed in the S-IVB per specified mission sequence and timelines.

SUPPORT REQUIREMENTS

GSE
None

SPECIAL TEST EQUIPMENT
1. Internal work platforms and mobility aids

FACILITIES:
1. Facility to hold S-IVB in vertical position
   Work platforms for the S-IVB exterior

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Operations Sequence - Flight 3, 4	12.8

TEST OBJECTIVE

Demonstrate S-IVB experiment and support subsystems reactivation after period of being secured

TEST CONFIGURATION

Prototype orbit configured S-IVB

TEST DESCRIPTION

PREPARATION

The S-IVB will be in an OWS configuration after the equipment has been installed and activated. The Operations Sequence test for Flights AAP 1 and 2 shall have been performed and the experiment and support subsystems deactivated.

OPERATION

Utilize equipment supplied by Flights AAP 3 and 4 carriers to replenish expendables for S-IVB experiments and subsystems. Re-activate OWS subsystems and experiments in a mission sequence.

CRITERIA FOR SUCCESS

Experiment and support subsystems should operate within design specification after simulated secured period

SUPPORT REQUIREMENTS

GSE

1. S-IVB handling and transport GSE

SPECIAL TEST EQUIPMENT

1. AM functional interface simulator with support equipment for ambient functional
2. Internal work platforms and mobility aids

FACILITIES

1. Area to contain the S-IVB in the vertical position
2. Work platforms for the S-IVB interior

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Tank Entry and Sealing	12.9

TEST OBJECTIVE

1. Demonstrate access to the LH_2 tank during tank sealing operations.
2. Demonstrate that sealing of the LH_2 penetrations can be accomplished.

TEST CONFIGURATION

Prototype flight configured S-IVB

TEST DESCRIPTION

PREPARATION
The S-IVB shall be placed in the horizontal position on a support fixture capable of rotation. Internal work platforms will be installed.

OPERATION
The S-IVB hydrogen tank will be entered and seals and plugs will be installed in all areas requiring them. Accessibility to all areas shall be demonstrated. Mission sequence and timelines shall be utilized and verified. Mechanical fit of all plugs and seals shall be demonstrated.

CRITERIA FOR SUCCESS

Access to all LH_2 tank penetrations shall be demonstrated and capability to install sealing devices in a mission sequence per specified timelines shall be shown.

SUPPORT REQUIREMENTS

GSE
1. S-IVB handling and transport GSE

SPECIAL TEST EQUIPMENT
1. Special platforms to place inside the S-IVB for accessibility
2. S-IVB horizontal support fixture capable of rotation

FACILITIES
1. An area to contain the S-IVB in the horizontal position
2. Platforms to allow entry of S-IVB and reach outside areas

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Pressure Test	12.10

TEST OBJECTIVE

Demonstrate that after tank sealing has been accomplished the required OWS pressure can be maintained.

TEST CONFIGURATION

Prototype flight configured S-IVB

TEST DESCRIPTION

PREPARATION
The S-IVB shall be placed in the horizontal position in an area where tank pressurization may be accomplished. The tank entry and sealing process shall have been accomplished. The mass spectrometer will be calibrated prior to the leak test.

OPERATION
The S-IVB shall be pressurized to 6 ± 1 psig with a nitrogen/helium mixture gas and a mass spectrometer leak test will be performed in all areas that were sealed in the tank sealing process. The S-IVB will then be pressurized to proof pressure (for OWS) and leakage and structure integrity of the sealed areas verified.

CRITERIA FOR SUCCESS

The leakage as determined by mass spectrometer shall be within the minimum allowed by design specifications. Sealed areas shall withstand proof pressure.

SUPPORT REQUIREMENTS

GSE
1. S-IVB handling and transport GSE
2. S-IVB support fixture capable of rotation

SPECIAL TEST EQUIPMENT
1. Mass spectrometer for leak test

FACILITIES
1. Area to perform S-IVB pressurization
2. External platforms for access

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Static Firing	12.11

TEST OBJECTIVE

Demonstrate that OWS prelaunch modifications do not affect the S-IVB launch capabilities.

TEST CONFIGURATION

Flight S-IVB with OWS prelaunch modifications. Flight IU

TEST DESCRIPTION

PREPARATION
The S-IVB and IU will be mounted in a static firing test stand. GSE to support the static firing will be checked out and connected.

OPERATION
The S-IVB will be loaded with propellants and a static firing will be performed utilizing normal techniques for the Apollo program. Instrumentation will be monitored to verify that proper propellant flow characteristics are maintained and no anomaly exists because of the OWS modifications installed inside the S-IVB LH_2 tank.

CRITERIA FOR SUCCESS

OWS modifications shall not affect the launch capabilities of the S-IVB vehicle.

SUPPORT REQUIREMENTS

GSE
1. GSE required to perform static firing of S-IVB

SPECIAL TEST EQUIPMENT
1. Instrumentation to monitor any suspected problem areas

FACILITIES
1. S-IVB static firing test stand

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Mass Properties	12.12

TEST OBJECTIVE

Demonstrate that the mass properties of the S-IVB meet design specifications.

TEST CONFIGURATION

Launch configured flight S-IVB

TEST DESCRIPTION

PREPARATION
The load cells slings and S-IVB attach rigging will be calibrated and checked out prior to the mass properties test.

OPERATION
The S-IVB mass properties will be performed with all modifications installed that will be required for launch. Mass properties will include weight, CG (2-axis) and mass moment of inertia (2-axis).

CRITERIA FOR SUCCESS

Mass properties of the S-IVB shall agree with the engineering analysis.

SUPPORT REQUIREMENTS

GSE
1. S-IVB handling and transport GSE

SPECIAL TEST EQUIPMENT
1. Mass properties equipment

FACILITIES
1. Area to perform mass properties test

Table IX. (Cont.)

TEST TITLE	TEST NUMBER
S-IVB Passivation (Vent and Dump)	12.13

TEST OBJECTIVE

Demonstrate vent and dump of propellant tanks under flight conditions.

TEST CONFIGURATION

S-IVB and IU articles from flight prior to AAP-2.

TEST DESCRIPTION

PREPARATION

Vent and dump of S-IVB propellants will be sequenced into an IU computer on an Apollo article prior to Flight AAP-2. The IU and S-IVB will be modified to incorporate passivation and monitoring circuitry and systems tested and qualified prior to flight.

OPERATION

The vent and dump sequence will be monitored by telemetry to verify proper operation. Manual override from ground station will be performed to demonstrate ground or orbit control of venting operation.

CRITERIA FOR SUCCESS

Expulsion of the propellant from the S-IVB tanks to a safety level that would allow tank entry, as controlled by the IU computer and ground control.

SUPPORT REQUIREMENTS

GSE

Flight GSE

SPECIAL TEST EQUIPMENT

Instrumentation to monitor and record test events

FACILITIES

Ground station

3.2.2 IU Carrier - The IU qualification will be for the delta modifications to the IU required to perform S-IVB passivation. This qualification will be performed during the integration and checkout of the flight article. As indicated on the qualification test requirements matrix, only ambient testing is required for qualification which allows usage of the flight article.

A prototype of the IU will be built for use in the cluster configuration. This prototype will have an IU structure with enough of the electronics to perform S-IVB passivation. All other components will be mockups to allow the IU to be used for cluster fit and interference checks.

The details of the IU flight article qualification program are described in the following test flow diagram (figure 13) and accompanying test descriptions (Table X).

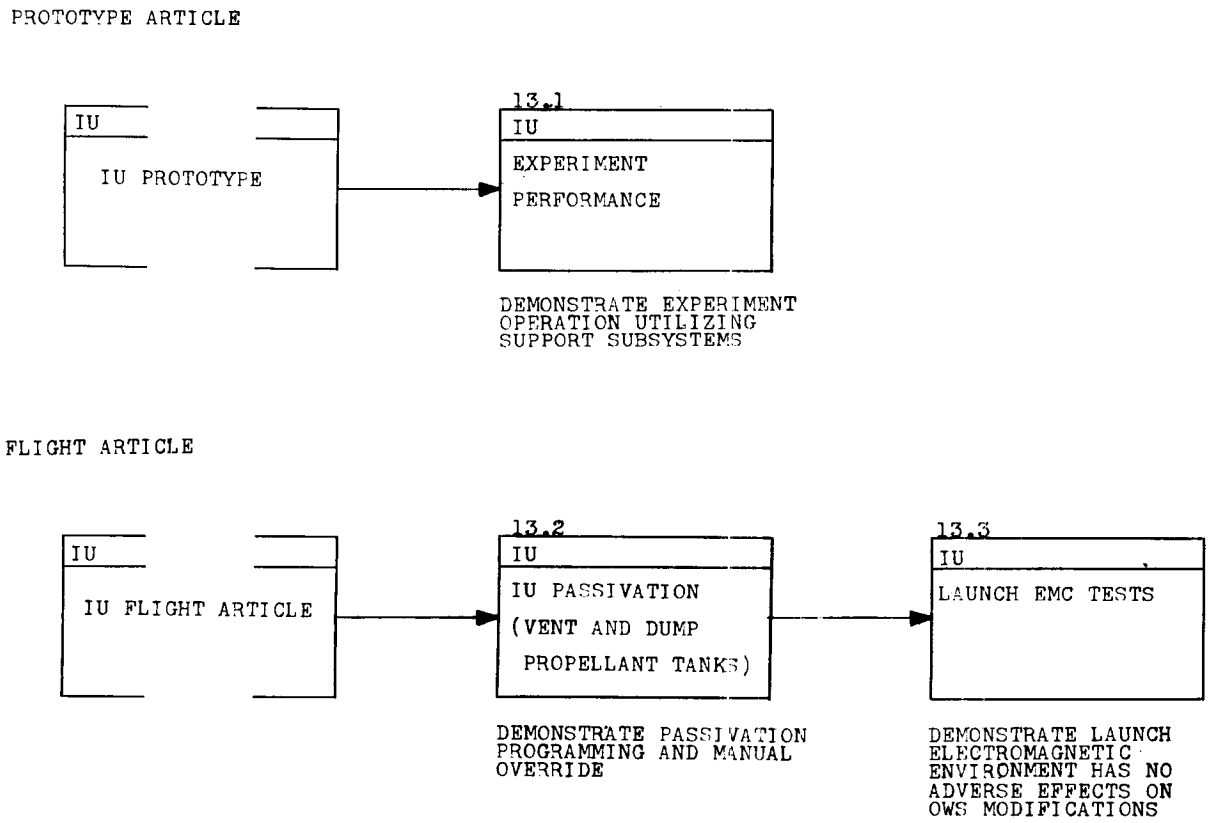


Figure 13. IU Carrier Qualification Test Hardware Flow

Table X. Test Descriptions for Figure 13

TEST TITLE	TEST NUMBER
IU Experiment Performance	13.1

TEST OBJECTIVE

Demonstrate experiments one at a time, utilizing the support subsystems.

TEST CONFIGURATION

IU prototype with support subsystems and experiments installed.

TEST DESCRIPTION

PREPARATION
The IU will be in an orbit configuration. S-IVB AM simulators will provide any necessary interfaces to the rest of the cluster configuration.

OPERATION
The following experiments will be operated individually in conjunction with the support subsystems. Refer to section 5 for experiment integration test requirements of these experiments:

M469 - ST-124 Removal (Flight AAP 2)
S027 - X-Ray Astronomy (Flight AAP 3)
T018 - Precision Optical Tracking (Flight AAP 4)
T022 - Heat Pipe (Flight AAP 4)
M423 - Hydrostatic Gas Bearing (Flight AAP 4)
M425 - Tracking and Navigation (Flight AAP 4)

CRITERIA FOR SUCCESS

Each experiment will operate within design specification when operated in conjunction with the support subsystem.

SUPPORT REQUIREMENTS

GSE
1. Equipment to support operation of each experiment
2. Equipment to operate each subsystem
3. Fixture to support the IU in the vertical position.

Table X. (Cont.)

IU Experiment Performance (continued)

SPECIAL TEST EQUIPMENT

1. Instrumentation to monitor subsystem and experiments
2. S-IVB electrical simulator
3. AM Electrical simulator

FACILITIES

1. Test position to hold IU in the vertical position

Table X. (Cont.)

TEST TITLE	TEST NUMBER
IU Passivation (Vent and Dump Tanks)	13.2

TEST OBJECTIVE

1. Demonstrate that the programmer discretes for passivation are in proper sequence and duration.
2. Demonstrate that the manual override (electrical) can be activated.

TEST CONFIGURATION

IU Flight Article

TEST DESCRIPTION

PREPARATION
This test will be performed during the acceptance test program for the IU. Simulated loads will be provided for the IU passivation discretes and instrumentation will be provided for monitoring these discretes.

OPERATION
Perform an acceptance test on the IU that will include initiation of the S-IVB passivation discretes and initiation of the passivation discrete override.

CRITERIA FOR SUCCESS

1. The S-IVB passivation discretes shall be initiated in the proper sequence and within the proper timelines.
2. Termination of the discretes shall be accomplished by the override.

SUPPORT REQUIREMENTS

GSE
1. Acceptance GSE for IU

SPECIAL TEST EQUIPMENT
1. Monitoring equipment for the IU passivation and override discretes
2. Simulated loads for the IU passivation discretes

FACILITIES
1. IU acceptance area

Table X. (Cont.)

TEST TITLE	TEST NUMBER
IU Launch EMC Tests	13.3

TEST OBJECTIVE

Demonstrate that launch EMI environment has no adverse effects on IU OWS modifications.

TEST CONFIGURATION

Launch configured Flight IU

TEST DESCRIPTION

PREPARATION
The IU will be placed in a screen room. Test equipment will be set up to induce specified levels of electromagnetic interference. EMC monitoring equipment will be installed at specified locations.

OPERATION
The effects of launch EMI on the IU modifications will be monitored during the simulated launch sequence.

CRITERIA FOR SUCCESS

The launch environment shall have no adverse effects on the IU modifications.

SUPPORT REQUIREMENTS

GSE
1. IU handling and transport GSE

SPECIAL TEST EQUIPMENT
1. Equipment to induce EMI
2. EMC monitoring equipment

FACILITIES
1. Screen room to contain IU

3.2.3 MDA Carrier - The MDA is a new carrier required for the AAP program and will undergo a complete qualification program. This qualification program will be performed on a prototype MDA capable of performance in the specified environments called for in the qualification requirement matrix. In addition to the prototype MDA, an AM prototype will be required for the thermal vacuum test program due to the complex thermal interface.

The details of the MDA qualification program are described in the following test flow diagram (figure 14) and accompanying test descriptions (Table XI).

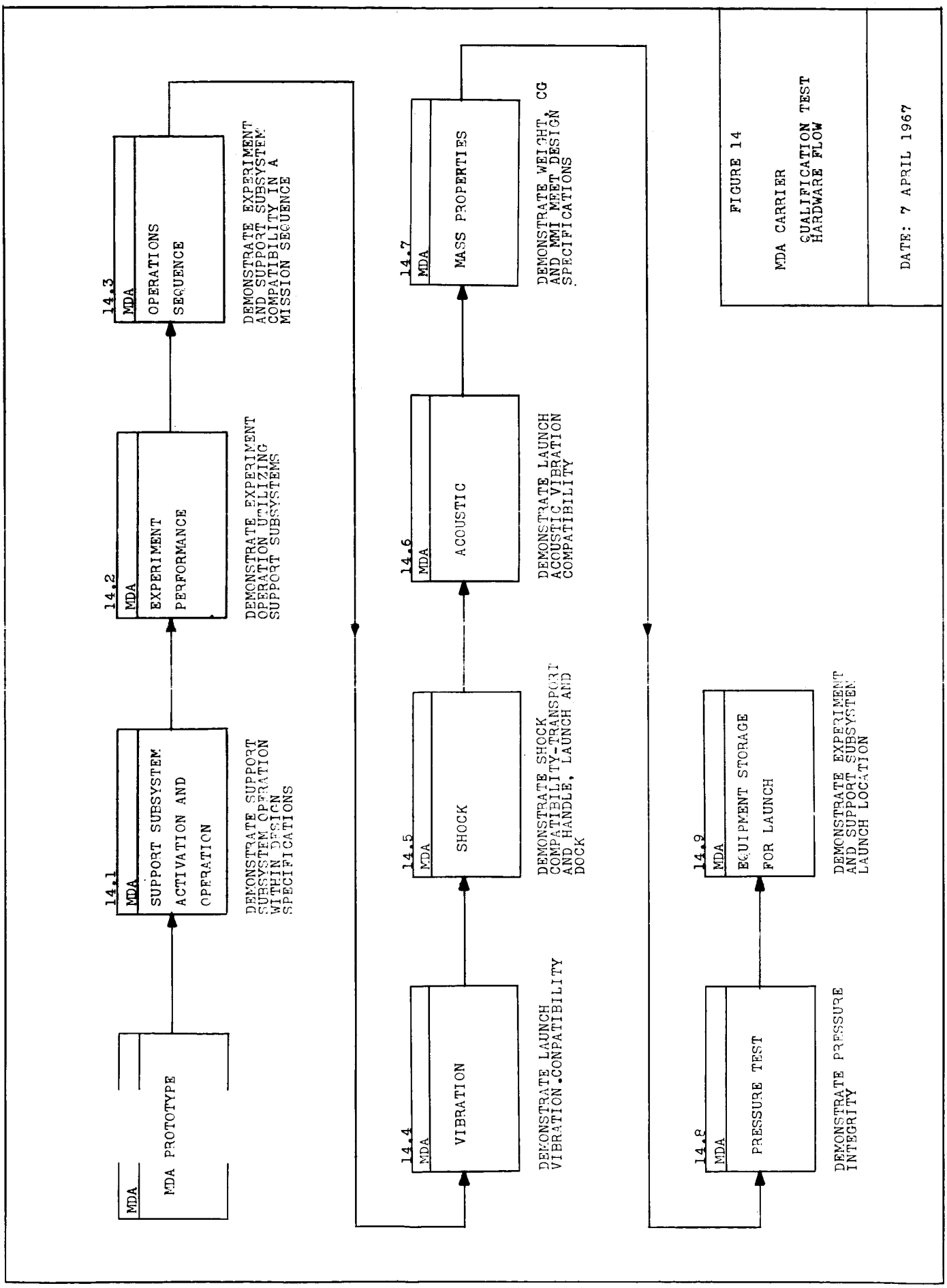


Figure 14. MDA Carrier Qualification Test Hardware Flow

Table XI. Test Descriptions for Figure 14

TEST TITLE — TEST NUMBER

MDA Support Subsystem Activation and Operation — 14.1

TEST OBJECTIVE

1. Demonstrate that all subsystems operate within design specifications

TEST CONFIGURATION

Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION
The MDA will be in the horizontal position. GSE will be checked out and connected. All MDA pretests shall be performed; such as single point ground, resistance measurements, etc. Electrical loads will be simulated.

OPERATION
Each subsystem will be tested individually.

Support Subsystem \ Test	Continuity	Resistance	Leak Check	Flow Rate	Functional
Electrical Power Cable Routing	x	x			
Display and Control	x	x			x
Sensors					x
Thermal Control	x	x	x	x	x

During this test, compatibility will be demonstrated with any GSE utilized to support this program.

Interface simulators will be utilized to provide loads, and provide and monitor interface signals. Electrical interfaces will be demonstrated within specification by use of these simulators during subsystem operation.

Table XI. (Cont.)

MDA Support Subsystem Activation and Operation (continued)

CRITERIA FOR SUCCESS

1. All systems shall operate within design specifications

SUPPORT REQUIREMENTS

GSE

1. MDA handling and transport GSE
2. Ground support equipment to functionally check the MDA system

SPECIAL TEST EQUIPMENT

1. AM, LM, RM, CM and LM&SS interface simulators
2. Internal work platforms for the MDA

FACILITIES

1. Area to contain MDA and support equipment for an ambient functional
2. Test position to hold the MDA in horizontal position
3. Temporary external ladders and access platforms

Table XI. (Cont.)

TEST TITLE	TEST NUMBER
MDA Experiment Performance	14.2

TEST OBJECTIVE

1. Demonstrate that experiments will operate within design specification

TEST CONFIGURATION

1. Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION
The MDA will be in the horizontal position. GSE will be checked out and connected. All MDA pretests shall be performed such as single point ground, resistance measurements, etc. Electrical loads will be simulated.

OPERATION
The following experiments will be operated individually in conjunction with the support subsystems. Refer to section 5 for experiment integration test requirements of these experiments:

D021 - Expandable Airlock - Flight AAP 2
S063 - UV Airglow Horizon Photography - Flight AAP 4
T017 - Meteoroid Impact and Erosion - Flight AAP 2
T021 - Meteoroid Velocity and Impact into Aluminum - Flight AAP 2

CRITERIA FOR SUCCESS

The experiments will operate within specification when operated in conjunction with the support subsystems.

SUPPORT REQUIREMENTS

GSE
1. Equipment to support the operation of the experiments
2. Equipment to operate each support subsystem

Table XI. (Cont.)

MDA Experiment Performance (continued)

SPECIAL TEST EQUIPMENT

1. AM, IM, RM, CM, and LM&SS interface simulators
2. Internal work platforms for the MDA

FACILITIES

1. Area to contain MDA and support equipment for ambient functional
2. Test position to hold MDA in horizontal position
3. Temporary external ladders and access platforms

Table XI. (Cont.)

TEST TITLE	TEST NUMBER
MDA Operation Sequence	14.3

TEST OBJECTIVE

Demonstrate that all MDA subsystems and experiments are compatible when operated in a mission sequence.

TEST CONFIGURATION

1. Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION
The MDA will be in the horizontal position. The individual subsystems and experiments will have been verified prior to this operations sequence test.

OPERATION
The subsystems on the MDA will be operated in a mission sequence in compressed time. The operation will start with launch, proceed thru docking of various modules and performance of all operations to occur during missions.

CRITERIA FOR SUCCESS

Demonstrate compatibility of all subsystems and experiments during their operation in a mission sequence.

SUPPORT REQUIREMENTS

GSE
1. MDA transport and handling GSE
2. Equipment to operate each subsystem
3. Equipment to support the operation of each experiment

SPECIAL TEST EQUIPMENT
1. AM, IM, RM, CM & IM&SS interface simulators
2. Internal work platforms for the MDA

FACILITIES
1. Area to contain the MDA and support equipment for ambient functional
2. Temporary external ladders and access platforms

Table XI. (Cont.)

TEST TITLE	TEST NUMBER
MDA Vibration	14.4

TEST OBJECTIVE

Demonstrate that the MDA can survive vibrations encountered during launch.

TEST CONFIGURATION

1. Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION
The MDA will be mounted on an electrodynamic shaker utilizing a structure simulator of the SLA and AM. The structure simulator will provide the MDA/AM attach points, simulate the structure and provide attachment to the shaker table. Prior to the test all systems shall be verified operational. Mass simulators of all experiments installed for launch shall be installed for this test.

OPERATION
The MDA will be subjected to all three axis of vibration to the criteria specified in the MDA CEI Specification. The MDA systems will be in the same configuration as at launch. After the vibration test is complete, a functional test will be performed on the MDA to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

The MDA shall sustain no damage during the vibration test, and all systems shall operate properly.

SUPPORT REQUIREMENTS

GSE
1. Equipment to functionally check MDA systems (portable)
2. MDA transport and handling GSE

SPECIAL TEST EQUIPMENT
1. Fixture to simulate SLA/AM structure and provide attachment of MDA to shaker table
2. Instrumentation to monitor MDA vibration levels at selected locations
3. Experiment mass simulators

FACILITIES
1. Shaker system to vibrate the MDA in three axis (individually)
2. Vibration test area

Table XI. (Cont.)

TEST TITLE	TEST NUMBER
MDA Shock (Transportation and Handling) - Part 1	14.5.1

TEST OBJECTIVE

Demonstrate that the MDA can survive the shocks encountered during transport and handling.

TEST CONFIGURATION

1. Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION
The MDA will be installed on a shock table with a fixture that will simulate the transportor and attach points. The MDA will be positioned in the normal transport position. Prior to the test, all systems shall be verified operational.

OPERATION
The MDA will be subjected to a transport and handling shock to the levels and axis specified in the MDA CEI Specification. During the test, all systems shall be in the stored condition. After the shock test, a functional test will be performed to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

The MDA shall sustain no damage during the shock test, and all systems shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. MDA transport and handling GSE
2. Equipment to functionally check MDA systems (portable)

SPECIAL TEST EQUIPMENT
1. Fixture to attach the MDA to the shock table and simulate handling structure
2. Instrumentation to monitor MDA shock levels at selected locations

FACILITIES
1. A facility to perform the shock tests

Table XI. (Cont.)

TEST TITLE	TEST NUMBER
MDA Shock (Launch) - Part 2	14.5.2

TEST OBJECTIVE

Demonstrate that the MDA can survive the shock encountered during launch.

TEST CONFIGURATION

1. Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION
The MDA will be installed on a shock table with a fixture that will simulate the AM/SLA structure and provide the MDA/AM attach points for the MDA. The MDA will be positioned in the launch position. Prior to the test, all systems shall be verified operational. Mass simulators of all experiments installed for launch shall be installed for this test.

OPERATION
The MDA will be subjected to a launch shock to the levels and axis specified in the MDA CEI specification. During the launch shock test, all systems will be in the launch configuration. After the test, a functional test will be performed to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

The MDA shall sustain no damage during the test and all systems shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. MDA transport and handling GSE
2. Equipment to functionally check MDA systems (portable)

SPECIAL TEST EQUIPMENT
1. Fixture to attach MDA to shock table in launch position and simulate AM/SLA structure
2. Instrumentation to monitor shock levels at selected points

FACILITIES
1. Facility to perform shock test

Table XI. (Cont.)

TEST TITLE	TEST NUMBER
MDA Shock (Docking) - Part 3	14.5.3

TEST OBJECTIVE

Demonstrate that the MDA can survive the shocks encountered during the docking of various modules.

TEST CONFIGURATION

1. Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION
The MDA will be rigidly mounted on a fixture simulating the AM attachment point, in the vertical position. Prior to the test, all systems shall be verified to be operational.

OPERATION
The test will be performed under the following modes: (1) End port docking shock loads, (2) side port docking shock loads, (3) end port reaction shock loads caused by a docked module during a second module docking maneuver, (4) side port reaction shock load.
An interface docking simulator will be attached to either the end port or one of the side ports. The shock ordnance will be installed behind this simulator to induce a shock through the docking collar to represent either docking or reaction shock to the levels specified in the MDA **CEI specification.** After each shock test, a functional test will be performed to verify that no damage has resulted from the induced shocks.

CRITERIA FOR SUCCESS

The MDA shall sustain no damage during the shock test, and all systems shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. MDA transport and handling GSE
2. Equipment to functionally check MDA systems (portable)

SPECIAL TEST EQUIPMENT
1. Fixture to rigidly mount the MDA in vertical position
2. Instrumentation to monitor MDA shock levels at selected locations

FACILITIES
1. A facility to perform shock test

Table XI. (Cont.)

TEST TITLE	TEST NUMBER
MDA Acoustic	14.6

TEST OBJECTIVE

Demonstrate that the MDA can survive the acoustic vibrations encountered during launch.

TEST CONFIGURATION

Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION
The MDA will be placed in a combination AM structure/SLA panel simulator. Mass simulators for all experiments mounted in the MDA during launch will be installed. Prior to the acoustic test, all systems will be verified to be operational.

OPERATION
The acoustic sound pressure shall be induced thru the SLA panels to the MDA and will be to the levels specified in the MDA CEI Specification. The test may be performed in more than one port, if required. The MDA systems shall be in the launch configuration.

After the acoustic test, a functional test shall be performed to verify that no damage has resulted from the acoustic vibration.

CRITERIA FOR SUCCESS

The MDA shall sustain no damage during the acoustic test, and all systems shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. MDA transport and handling GSE
2. Equipment to functionally check the MDA systems (portable)

SPECIAL TEST EQUIPMENT
1. AM/SLA simulator to provide structure for mounting and SLA panels
2. Instrumentation to monitor vibration levels at specified locations
3. Experiment mass simulators

FACILITIES
1. Facility to perform MDA/AM/SLA acoustic test

Table XI. (Cont.)

TEST TITLE	TEST NUMBER
MDA Mass Properties	14.7

TEST OBJECTIVE

To demonstrate that the mass properties of the MDA meet design specifications.

TEST CONFIGURATION

Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION
The load cells, slings and MDA attach rigging will be calibrated and checked out prior to the mass properties test.

OPERATION
The MDA mass properties will be performed in two configurations; 1) launch with experiment mass simulators installed, and 2) orbit with simulators removed. Mass properties will include weight, CG (three-axis) and mass moment of inertia (two-axis).

CRITERIA FOR SUCCESS

The mass properties of the MDA shall agree with the engineering analysis.

SUPPORT REQUIREMENTS

GSE
1. MDA handling and transport GSE

SPECIAL TEST EQUIPMENT
1. Mass properties equipment
2. Experiment Mass Simulators

FACILITIES
Area to perform mass properties test (MDA both horizontal and vertical).

Table XI. (Cont.)

TEST TITLE	TEST NUMBER
MDA Pressure Test	14.8

TEST OBJECTIVE

To demonstrate that the MDA is capable of being pressurized to operational and proof pressures with no adverse effects.

TEST CONFIGURATION

Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION

The MDA will be placed in an area acceptable for pressurization. An AM simulator will be utilized to provide a structural cover for the AM/MDA interface. Docking collar simulators will be utilized to verify seal between MDA and various docked carriers. The mass spectrometer will be calibrated prior to leak test. Prior to this test, a structural proof pressure test will have been performed (during manufacturing).

OPERATION

The test will be performed in two operations:

1. The MDA will be pressurized to $1\frac{1}{4}$ times operating pressure utilizing a helium/nitrogen mixture. Verification will be made that no major leaks are detected. The pressure will then be reduced to operational pressure where a mass spectrometer test will be performed.
2. At the completion of the above test, a docking collar simulator will be installed on each of the docking ports to verify proper seal between port and collar.

CRITERIA FOR SUCCESS

There shall be no adverse effects from the test pressures and leak rates from mass spectrometer shall fall within design specifications.

SUPPORT REQUIREMENETS

GSE

1. MDA handling and transport GSE

Table XI. (Cont.)

MDA Pressure Test (continued)

SPECIAL TEST EQUIPMENT

1. Mass spectrometer for leak test
2. Equipment to monitor MDA pressure
3. Pressurization panel capable of supplying a helium/nitrogen mixture of gas
4. Test fixture to support MDA

FACILITIES

1. Area to perform MDA proof and leak test

Table XI. (Cont.)

TEST TITLE

MDA Equipment Storage for Launch

TEST NUMBER

14.9

TEST OBJECTIVE

1. Demonstrate location for all experiments and support subsystems installed for launch

TEST CONFIGURATION

Prototype launch configured MDA

TEST DESCRIPTION

PREPARATION
The MDA will be in the vertical position. All storage containers for experiments and subsystems will be installed. Nonfunctional mockups of the experiments and subsystems will be utilized for this test.

OPERATION
Load all experiments and subsystems mockups into the storage containers located in MDA. Demonstrate that no interference exists and all equipment can be loaded.

CRITERIA FOR SUCCESS

MDA storage area will be sufficient for all equipment scheduled for the flight

SUPPORT REQUIREMENTS

GSE
None

SPECIAL TEST EQUIPMENT
1. Fixture to hold MDA in vertical position
2. Internal work platforms for access to various containers
3. Experiment and subsystem mockups

FACILITIES
1. Area to contain MDA in vertical position
2. Temporary external work platforms

3.2.4 Resupply Module (RM) - The RM is a new carrier required for the AAP program and will undergo a complete qualification program. This qualification program will be performed on a prototype RM capable of performance in the specified environments called for in the qualification requirement matrix.

The details of the RM qualification program are described in the following test flow diagram (figure 15) and accompanying test descriptions (Table XII).

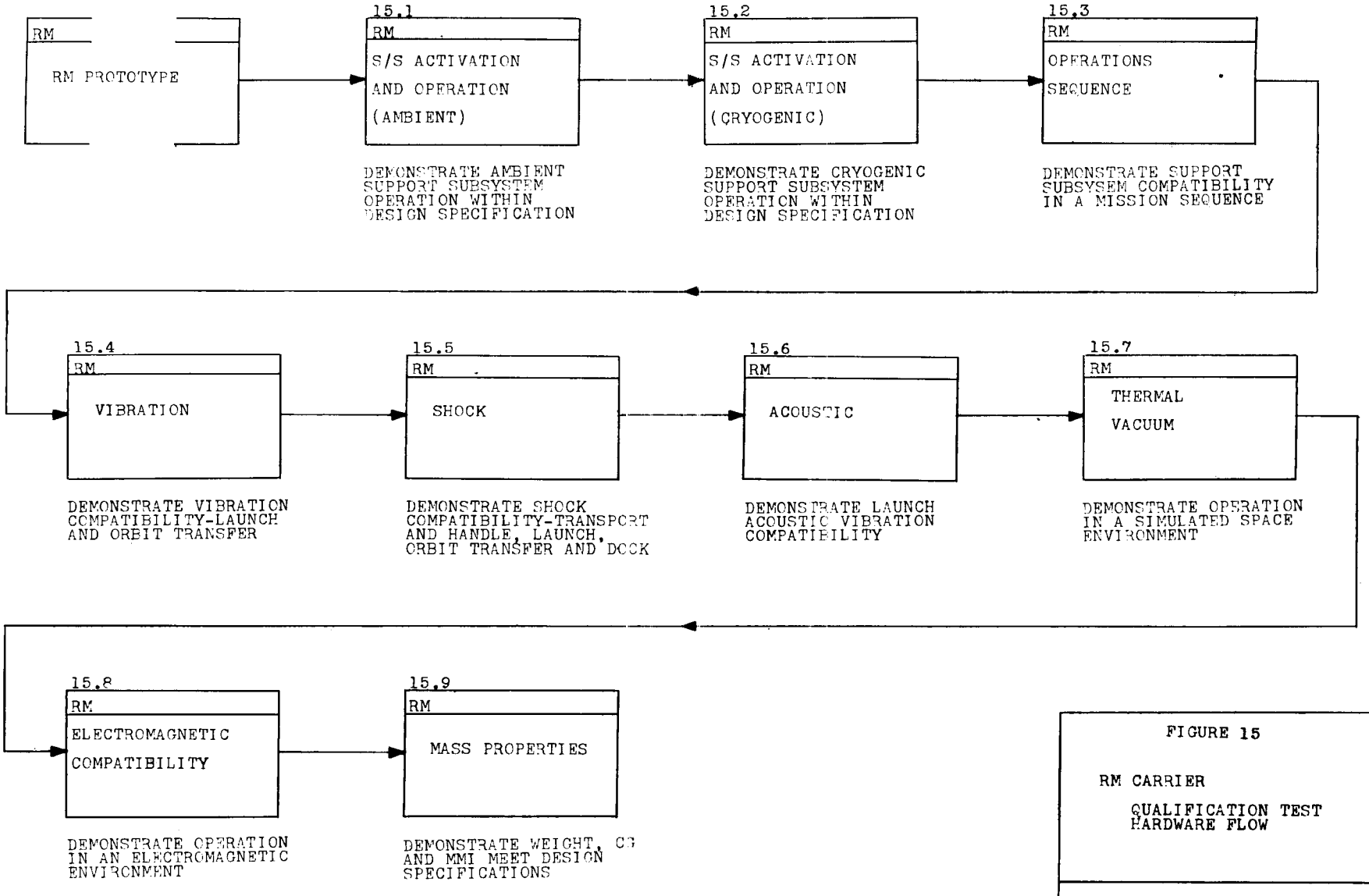


Figure 15. RM Carrier Qualification Test Hardware Flow

Table XII. Test Descriptions for Figure 15

TEST TITLE	TEST NUMBER
RM Support Subsystem Activation and Operation (Ambient)	15.1

TEST OBJECTIVE

Demonstrate that all subsystems operate within design specifications.

TEST CONFIGURATION

Prototype Flight Configured RM

TEST DESCRIPTION

PREPARATION
The RM will be in the horizontal position. No propellants will be simulated or loaded, however, the systems will be pressurized. (Electrical functional only) GSE will be checked out and connected. All RM pretests shall be performed such as single point ground, resistance measurements, etc. Electrical loads will be simulated.

OPERATION
Each subsystem will be tested individually as indicated below:

Support Subsystems \ Test	Continuity	Resistance	Leak Check	Flow Rate	VSWR & Insertion loss	Functional
Electrical Power	X	X				X
Display and Control	X	X				X
Communication	X	X			X	X
Sensors						X
Prototype Molecular Siere ECS	X	X	X	X		X
Gaseous Storage			X	X		X
Water Storage			X			

During this test, compatibility will be demonstrated with any GSE utilized to support this program.

Table XII. (Cont.)

RM Support Subsystem Activation and Operation (Ambient) (continued)

Interface simulators will be utilized to provide and monitor interface signals. Electrical interfaces will be demonstrated within specification by use of these simulators during subsystem operation.

CRITERIA FOR SUCCESS

All subsystems shall operate within design specifications

SUPPORT REQUIREMENTS

GSE 1. RM electrical GSE to allow an ambient functional to be performed

SPECIAL TEST EQUIPMENT

1. AM and MDA Interface Simulator
2. CM Interface Simulator
3. Instrumentation to perform ambient functional

FACILITIES

1. Area to contain RM and support equipment for an ambient functional, and allow subsystem pressurization.

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM Support Subsystem Activation and Operation (Cryogenic)	15.2

TEST OBJECTIVE

Demonstrate that the RM pressure and cryogenic systems operate within design specifications.

TEST CONFIGURATION

Prototype flight configured RM.

TEST DESCRIPTION

PREPARATION

The RM will be in a vertical position mounted on a propellant/pressurization test stand. All subsystems will have been electrically demonstrated prior to the propellant transfer test. Individual components will have been subjected to proof pressures.

OPERATION

The cryogenic transfer test program will be performed as follows:

1. Pressurize and leak check all fluid and pressure systems.
2. Proof pressure all fluid and pressure systems.
3. Load all fluids (O_2, N_2 and H_2); demonstrate GSE compatibility.
4. Perform transfer of these fluids in an abbreviated mission sequence; demonstrate:
   a. Flow rate
   b. Response time
5. Unload and clean systems

CRITERIA FOR SUCCESS

1. All fluid and pressure systems shall operate within design specifications
2. All prelaunch GSE servicing equipment shall be demonstrated compatible with the flight hardware

SUPPORT REQUIREMENTS

GSE

1. Propellant and servicing GSE
2. Transport and handling GSE

Table XII. (Cont.)

RM Support Subsystem Activation and Operation (Cryogenic) (continued)

SPECIAL TEST EQUIPMENT

1. AM/MDA mechanical and electrical control interface simulator
2. Mounting fixture for RM on test stand
3. Mass spectrometer (leak check)

FACILITIES

1. Test stand to mount RM, provide the necessary commodities and allow system pressurization and cryogenic transfer

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM - Operations Sequence	15.3

TEST OBJECTIVE

Demonstrate that all RM subsystems are compatible during operation of a mission sequence.

TEST CONFIGURATION

Prototype flight configured RM.

TEST DESCRIPTION

PREPARATION
The RM will be in the horizontal position. Propellants will not be simulated or loaded. (Electrical functional only.) The individual subsystems will have been verified prior to this operations sequence test.

OPERATION
The subsystems on the RM will be operated in a mission sequence in abbreviated time. The operation will start with liftoff, proceed through dock and orbit transfer with the CM (simulator) then dock with the MDA (simulator) and performance of all operations when combined with the cluster.

Interface simulators will be utilized to provide loads, and provide and monitor interface signals. Electrical interfaces will be demonstrated within specification by use of these simulators during subsystem operation.

CRITERIA FOR SUCCESS

Demonstrate compatibility of all subsystems during their operation in a mission sequence

SUPPORT REQUIREMENTS

GSE
1. GSE to functionally check the RM (portable)
2. RM transport and handling GSE

Table XII. (Cont.)

RM - Operations Sequence (continued)

SPECIAL TEST EQUIPMENT
1. AM and MDA interface simulator
2. CM interface simulator

FACILITIES
1. Area to contain the RM and support equipment for an ambient functional
2. Temporary external ladders and access platforms

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM Vibration (Launch) - Part 1	15.4.1

TEST OBJECTIVE

Demonstrate that the RM can survive vibrations encountered during launch.

TEST CONFIGURATION

Prototype flight configured RM.

TEST DESCRIPTION

PREPARATION
The RM will be installed on a vibration shaker utilizing an SLA structure simulator. The SLA structure simulator will provide the SLA attach points, simulate the structure and provide attachment to the shaker table. Prior to the test, all systems shall be verified operational. Liquids will be simulated.

OPERATION
The RM will be subjected to all three axis of vibration to the criteria specified in the RM CEI specification. The RM systems will be in the same configuration as launch. After the vibration test is complete, a functional test will be performed on the RM to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

The RM shall sustain no damage during the vibration test and all systems shall operate properly.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE
2. GSE to functionally check RM (portable)

Table XII. (Cont.)

RM Vibration (Launch) - Part 1 (continued)

SPECIAL
1. Fixture to attach to shaker table and simulate SLA structure and attach points to RM
2. Instrumentation to monitor RM vibration levels at selected locations

FACILITIES
1. Shaker system to vibrate the RM in three axis individually
2. Vibration test area

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM Vibration (Orbit Transfer)-Part 2	15.4.2

TEST OBJECTIVE

Demonstrate that the RM can survive the vibrations encountered during orbit transfer.

TEST CONFIGURATION

1. Prototype flight, configured RM

TEST DESCRIPTION

PREPARATION
The RM will be suspended from several selected attach points. A CSM interface simulator will be attached to the docking collar, and the RM will be subjected to orbit transfer vibrations through this docking collar. Prior to the test, all systems shall be verified functional. Liquids shall be simulated.

OPERATION
The RM shall be subjected to all three axis of vibration to the criteria specified in the RM CEI specification. After the vibration test is complete, a functional test will be performed on the RM to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

The RM shall sustain no damage during the vibration tests, and all systems shall operate properly after the vibration test.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE
2. GSE to functionally check the RM (portable)

SPECIAL TEST EQUIPMENT
1. Fixture to suspend the RM
2. Simulate CM docking collar to induce vibration
3. Instrumentation to monitor RM vibration levels

Table XII. (Cont.)

RM Vibration (Orbit Transfer) - Part 2 (continued)

FACILITIES

1. Area to suspend the RM and a shaker system to induce the vibration

2. Vibration test area.

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM Shock (Transportation and Handling) - Part 1	15.5.1

TEST OBJECTIVE

Demonstrate that the RM can survive the shocks encountered during transport and handling

TEST CONFIGURATION

Prototype flight configured RM

TEST DESCRIPTION

PREPARATION
The RM will be installed on a shock table with a fixture that will simulate the transportor and attach points. The RM will be positioned in the horizontal position. Prior to the test, all systems shall be verified operational

OPERATION
The RM will be subjected to a transport and handling shock to the levels and axis specified in the RM CEI specification. During the test, all systems shall be in the stored condition. After the shock test, a functional test will be performed to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

The RM shall sustain no damage during the shock test, and all systems shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE
2. GSE to functionally check the RM (portable)

SPECIAL TEST EQUIPMENT
1. Fixture to attach the RM to the shock table in the horizontal position and simulate handling structure.
2. Instrumentation to monitor shock levels at selected points.

FACILITIES
1. A facility to perform the shock tests with the shock table capable of holding the RM in the horizontal position.

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM Shock (Launch) - Part 2	15.5.2

TEST OBJECTIVE

Demonstrate that the RM can survive the shock encountered during launch

TEST CONFIGURATION

Prototype flight configured RM.

TEST DESCRIPTION

PREPARATION
The RM will be installed on a shock table with a fixture that will simulate the SLA structure and provide the SLA attach points for the RM. The RM shall be positioned in the launch position. Prior to the test, all systems shall be verified operational. Liquids shall be simulated.

OPERATION
The RM will be subjected to a launch shock to the levels and axis specified in the RM CEI specification. During the launch shock test, all RM systems will be in the launch configuration. After the shock test, a functional test will be performed to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

The RM shall sustain no damage during the shock test and all systems shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE
2. GSE to functionally check the RM (portable)

SPECIAL TEST EQUIPMENT
1. Fixture to attach RM to shock table in launch position and simulate SLA structure.
2. Instrumentation to monitor shock levels at selected points.

FACILITIES
1. A facility to perform the shock test with a shock table capable of holding the RM in a launch position.

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM Shock (Orbit) - Part 3	15.5.3

TEST OBJECTIVE

Demonstrate that the RM can survive the shocks encountered during orbit transfer and docking.

TEST CONFIGURATION

Prototype flight configured RM

TEST DESCRIPTION

PREPARATION
The RM will be suspended in the horizontal position with slings around the barrel section of the RM. A CM docking interface simulator will be positioned at one end and an MDA docking interface simulator on the other end. Prior to the test, all systems shall be verified operational. Liquids shall be simulated.

OPERATION The test will be performed in two parts:

1. The first part will verify orbit transfer. The CM interface simulator will be attached to the suspended RM. Ordnance for shock will be placed behind this simulator to induce a shock through the docking collar to simulate orbit transfer shock to the levels specified in the RM CEI Specification.
2. The second part will verify docking to the MDA. A CM interface docking simulator will be attached to one end of the RM and a MDA simulator will be attached to the other end. The shock ordnance will be installed on the MDA end and the shock induced will simulate maximum docking shock as specified in the RM CEI Specification.

After each shock test, a functional test will be performed to verify that no damage has resulted from the induced shocks.

CRITERIA FOR SUCCESS

The RM shall sustain no damage during the shock test, and all systems shall operate properly after the test.

Table XII. (Cont.)

RM Shock (Orbit) - Part 3 (continued)

SUPPORT REQUIREMENTS

GSE

1. RM handling and transport GSE
2. GSE to functionally check the RM (portable)

SPECIAL TEST EQUIPMENT

1. CSM docking interface simulator
2. MDA docking interface simulator
3. Instrumentation to monitor shock levels at selected points

FACILITIES

1. A facility to perform the shock tests, with the RM suspended and the shock induced through the CM and MDA docking interface simulators

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM Acoustic	15.6

TEST OBJECTIVE

Demonstrate that the RM can survive the acoustic test

TEST CONFIGURATION

Prototype flight configured RM

TEST DESCRIPTION

PREPARATION
The RM will be placed in a simulated SLA. The SLA-RM combination will be placed in the acoustical test area. Prior to the acoustic test, all systems will be verified operational. Liquids will be simulated.

OPERATION
The RM-SLA will be subjected to the launch acoustic vibrations as specified in criteria the RM CEI Specifications. This test may be performed in more than one part if required. The acoustic sound pressure shall be induced through the SLA panels to the RM. The RM systems shall be in the launch configuration. After the acoustic test, a functional test shall be performed to verify that no damage has resulted from the acoustic vibrations.

CRITERIA FOR SUCCESS

The RM shall sustain no damage during the acoustic test, and all systems shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE
2. GSE to functionally check the RM (portable)

SPECIAL TEST EQUIPMENT
1. SLA to house RM during acoustic test
2. Instrumentation to monitor vibration levels at specified points.

FACILITIES
1. A facility to perform acoustic tests on the RM/SLA combination.

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM Thermal Vacuum	15.7

TEST OBJECTIVE

Demonstrate that the RM can survive and operate in a simulated space environment.

TEST CONFIGURATION

Prototype flight configured RM

TEST DESCRIPTION

PREPARATION
The RM will be installed in a thermal vacuum chamber on a fixture that is capable of positioning the RM to simulate the various sun angles as observed in orbit. Simulated propellants will be loaded. An IR cage will be utilized to simulate reflected solar energy. The RM will undergo a simulated mission to verify all systems operational under ambient conditions prior to the start of the thermal vacuum test.

OPERATION
The RM will be subjected to a simulated orbit (sun angles and shadowing) and a mission operations sequence performed. Each operation will be performed long enough to allow temperature stabilization. The basic phases are:

1. Simulated liftoff to demonstrate altitude changes.
2. Orbit operations
   a. Maximum heat loading
   b. Minimum heat loading
   c. Nominal heat loading
3. Special

The basic test program will be from 3 to 4 weeks

CRITERIA FOR SUCCESS

All systems will operate properly during the simulated mission performed under a thermal vacuum.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE

Table XII. (Cont.)

RM Thermal Vacuum (continued)

2. GSE to functionally operate the RM, including simulated propellant transfer.

SPECIAL TEST EQUIPMENT

1. Support and rotation fixture inside the T.V. chamber
2. Instrumentation to monitor temperatures on the RM

FACILITIES

1. Facility that contains a thermal vacuum chamber large enough to allow rotation of the RM inside the chamber.
2. External work platforms
3. IR cage and associated sequencing system.

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM - Electromagnetic Compatibility	15.8

TEST OBJECTIVE

Demonstrate that the RM will operate properly in the specified electromagnetic environment.

TEST CONFIGURATION

Prototype flight configured RM

TEST DESCRIPTION

PREPARATION
The RM will be placed in a screen room. Test equipment will be set up to induce certain levels of electromagnetic interference

Electromagnetic monitoring systems will be installed on the RM. An ambient functional will be performed to check the EMC monitoring equipment and obtain a baseline.

OPERATION
The RM will be operated in a simulated orbit electromagnetic environment. The EMC monitoring equipment will evaluate all systems to verify at least the margin of safety specified in the RM CEI Specification

CRITERIA FOR SUCCESS

The simulated electromagnetic environment will produce no more than the level of interference on any RM subsystem specified.

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE
2. GSE to functionally operate the RM

SPECIAL TEST EQUIPMENT
1. EMI monitors and equipment to induce EMI
2. Holding fixture (Inert to Radio Frequency Energy)

FACILITIES
1. Screen room to contain RM
2. External work platforms

Table XII. (Cont.)

TEST TITLE	TEST NUMBER
RM - Mass Properties	15.9

TEST OBJECTIVE

To demonstrate that the mass properties of the RM meet design specifications.

TEST CONFIGURATION

Prototype flight configured RM

TEST DESCRIPTION

PREPARATION
The load cells, slings and RM attach rigging will be calibrated/checked out prior to the mass properties test.

OPERATION

THe RM mass properties will be performed in two configurations, fully loaded and unloaded. Mass properties will include weight CG (three-axis)and mass moment of inertia (two-axis).

CRITERIA FOR SUCCESS

The mass properties of the RM shall agree with the engineering analysis

SUPPORT REQUIREMENTS

GSE
1. RM handling and transport GSE

SPECIAL TEST EQUIPMENT
1. Mass properties equipment
2. Holding fixture for RM

FACILITIES
1. Area to perform mass properties test (RM both vertical and hortizontal).

3.2.5 ATM/Rack Carrier - The ATM Rack will be subjected to a full qualification test program. This test program will be divided into two parts; the ATM package qualification and the ATM/Rack combination qualification test program.

3.2.5.1 ATM Package Qualification - The ATM package has been considered a separate Contract End Item (CEI) and as such will have a separate qualification program. This qualification program will be performed on a prototype ATM package, including all experiments capable of performance in the environments called for in the qualification requirements matrix.

The details of the ATM qualification program are described in the following test flow diagram (figure 16) and accompanying test descriptions (Table XIII).

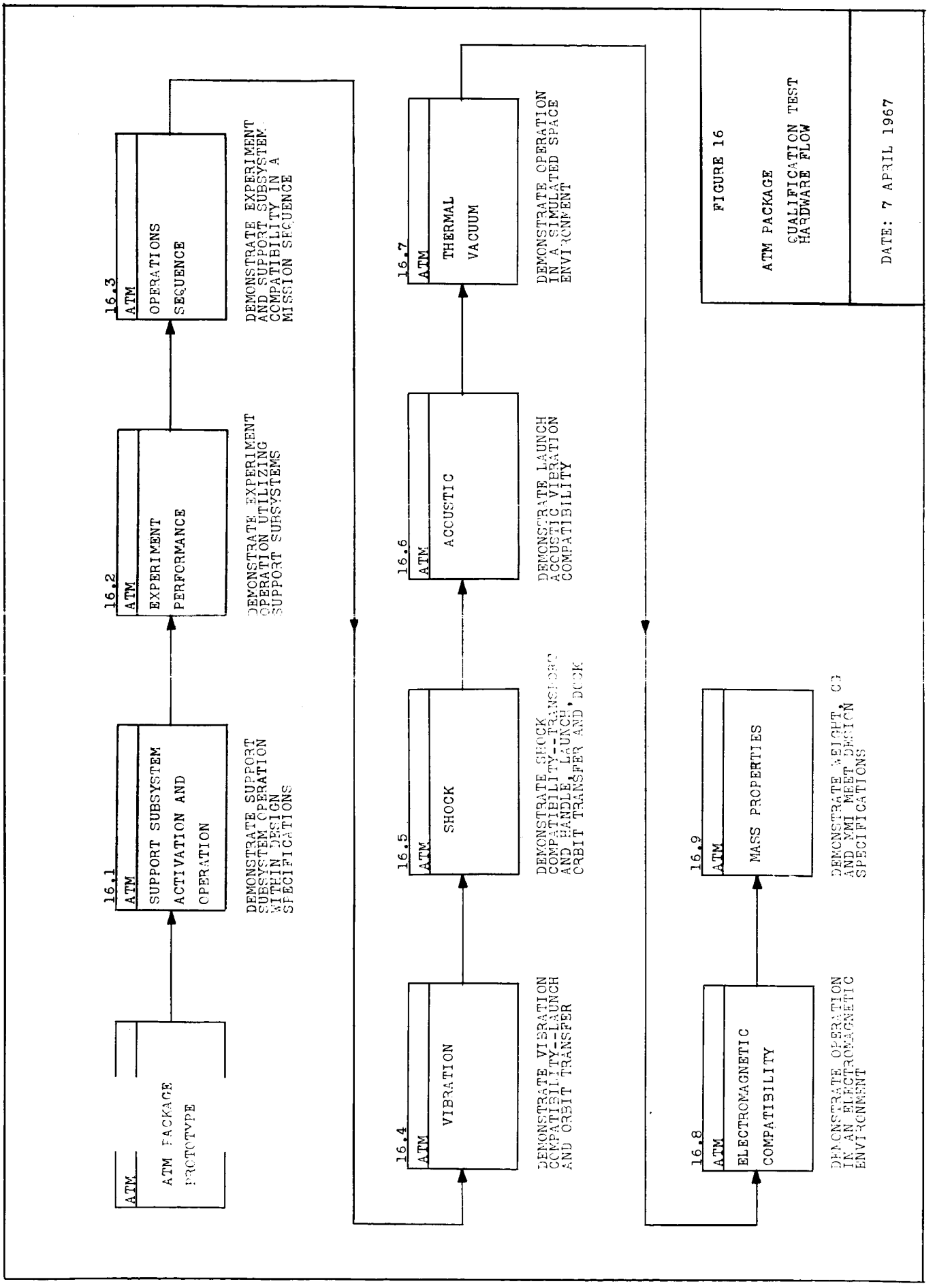


Figure 16. ATM Package Qualification Test Hareware Flow

Table XIII. Test Descriptions for Figure 16

TEST TITLE — TEST NUMBER

ATM Package Subsystem Activation & Operation — 16.1

TEST OBJECTIVE

Demonstrate that all subsystems operate within design specifications.

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION
The ATM Package will be in the vertical position. GSE will be checked out and connected. All ATM pretests shall be performed such as single point, ground resistance measurements, etc. Electrical loads will be simulated. An ATM/Rack simulator will be utilized to provide interfaces between Rack and ATM package.

OPERATION
Each subsystem will be tested individually:

Test / Support Subsystems	Continuity	Resistance	Functional	
Electrical Power Cabling	X	X		
Display and Control Cabling	X	X		
Data Management Cabling	X	X		
Fine Pointing Control	X	X	X	

During the test, compatibility will be demonstrated with any GSE utilized to support this program.

Interface simulators will be utilized to provide loads, and provide and monitor interface signals. Electrical interfaces will be demonstrated within specification by use of these simulators during subsystem operation.

ATM Package Subsystem Activation and Operation (continued)

CRITERIA FOR SUCCESS

All systems shall operate within design specifications.

SUPPORT REQUIREMENTS

GSE
1. ATM handling GSE
2. Equipment to functionally check the ATM systems (portable)

SPECIAL TEST EQUIPMENT
1. ATM/Rack interface simulator

FACILITIES
Area to contain ATM and support equipment for an ambient functional.

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Experiment Performance	16.2

TEST OBJECTIVE

Demonstrate that ATM package experiments will operate within design specifications

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION
The ATM will be in the vertical position. GSE will be checked out and connected. All ATM pretests shall be performed such as alignment, single point ground, resistance measurements, etc. Electrical loads will be simulated. An ATM/Rack interface simulator will be utilized to supply the display and control, power, and data management interfaces.

OPERATION
The following experiments will be operated individually in conjunction with the support subsystems. Refer to section 5 for experiment integration test requirements of these experiments:

- S020 - UV X-ray Solar Photography
- S052 - White Light Coronagraphy
- S053A - UV Coronal Spectrography
- S053B - UV Spectrograph
- S054 - X-ray Spectrographic Telescope
- S055A - UV Spectrometer
- S055B - UV Spectrometer (Ultra-Violet Spectroheiliometer)
- S055C - UV Spectrometer - H_α Telescope
- S056 - X-ray Telescope

CRITERIA FOR SUCCESS

The experiments will operate within specification when operated in conjunction with the support subsystems.

SUPPORT REQUIREMENTS

GSE
1 ATM handling GSE
2. Equipment to support the operation of the ATM experiments
3. Equipment to operate each subsystem

Table XIII. (Cont.)

ATM Package Experiment Performance (continued)

SUPPORT REQUIREMENTS

SPECIAL TEST EQUIPMENT

1. Rack interface simulator for power data management, and display and control

FACILITIES

Area to contain ATM and support equipment for ambient functional.

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Operations Sequence	16.3

TEST OBJECTIVE

Demonstrate that all ATM subsystems and experiment are compatible when operated in a mission sequence.

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION
The ATM will be in the vertical position. GSE will be checked out and connected. The individual subsystems and experiments will have been verified prior to this operations sequence test. ATM/Rack interface simulator will be utilized to simulate display and control, power and data management interfaces.

OPERATION
The subsystems and experiments on the ATM will be operated in a mission sequence in compressed time. The operation will start with liftoff, proceed through docking with cluster, then performance of all operations required for the mission.

CRITERIA FOR SUCCESS

Demonstrate compatibility of all subsystems and experiments during their operation in a mission sequence.

SUPPORT REQUIREMENTS

GSE
1. ATM handling GSE
2. Equipment to functionally check the ATM systems (portable)
3. Equipment to support the operation of the ATM experiments

SPECIAL TEST EQUIPMENT
ATM/Rack interface simulator

FACILITIES
Area to contain ATM and support equipment for an ambient functional

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Vibration (Launch) - Part 1	16.4.1

TEST OBJECTIVE

Demonstrate that the ATM package can survive vibrations encountered during launch.

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION

The ATM will be installed on a vibration shaker utilizing a rack structure simulator. The simulator will provide the ATM/rack attach points, simulate the structure and provide attachment to the shaker table. An ATM/rack electrical interface simulator will be installed to provide rack electrical interfaces. All experiments will be installed. Prior to the test, all systems and experiments shall be verified operational.

OPERATION

The ATM will be subjected to vibration in three axis to the criteria specified in the ATM CEI Specification. The ATM systems and experiments will be in the same configuration as launch. Vibration levels will be monitored. After the vibration test is complete, a functional test will be performed on the ATM to verify no damage has resulted from the vibration.

CRITERIA FOR SUCCESS

The ATM package shall sustain no damage during the vibration test and all systems and experiments shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE

1. ATM handling and transport GSE
2. Equipment to functionally check the ATM systems (portable)
3. Equipment to support the operation of the ATM experiments

SPECIAL TEST EQUIPMENT

1. Fixture to simulate rack structure and attach points and provide attachment to shaker table
2. Instrumentation to monitor ATM vibration levels at selected locations
3. ATM/Rack electrical interface simulator

Table XIII. (Cont.)

ATM Package Vibration (Launch) - Part 1 (continued)

FACILITIES

1. Shaker system to vibrate the ATM in three axes.

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Vibration (Orbit Transfer) - Part 2	16.4.2

TEST OBJECTIVE

Demonstrate that the ATM package can survive vibrations encountered during orbit transfer.

TEST CONFIGURATION

Prototype flight configured ATM package.

TEST DESCRIPTION

PREPARATION
The ATM package will be installed in a rack simulator which will provide attach points for ATM. The ATM/Rack simulator will then be suspended from several selected attach points. An ATM/Rack electrical interface simulator will be installed to provide Rack electrical interfaces. The ATM will be subjected to orbit transfer vibrations through the rack attach points. The vibration input to the rack will simulate the vibration imparted to the ATM through the Rack. Prior to the test, all systems and experiments shall be verified functional.

OPERATION
The ATM will be subjected to vibrations in three axis to the criteria specified in the ATM CEI Specification. After the completion of the vibration test, a functional test will be performed on the ATM to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

The ATM shall sustain no damage during the vibration test, and all systems and experiments shall operate properly, after the test.

SUPPORT REQUIREMENTS

GSE
1. ATM handling and transport GSE
2. Equipment to functionally check the ATM systems (portable)
3. Equipment to support the operation of each experiment

SPECIAL TEST EQUIPMENT
1. Fixture to simulate rack structure and attach points and provide point for vibration input
2. Instrumentation to monitor ATM vibration levels at selected locations.
3. ATM/Rack electrical interface simulator

Table XIII. (Cont.)

ATM Package Vibration (Orbit Transfer) - Part 2 (continued)

FACILITIES

1. Area to suspend the ATM/Rack simulator
2. Shaker system to induce the vibration

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Shock (Transportation and Handling) - Part 1	16.5.1

TEST OBJECTIVE

Demonstrate that the ATM package can survive the shock encountered during transport and handling.

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION
The ATM package will be installed on a shock table with a fixture that will simulate the transporter and attach points. The ATM will be positioned in the horizontal position. Prior to the test, all systems and experiments shall be verified operational.

OPERATION
The ATM will be subjected to a transport and handling shock to the levels and axis criteria specified in the ATM CEI Specification. During the test, all systems and experiments will be in the stored mode. Shock levels will be monitored. After the shock test, a functional test will be performed to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

The ATM shall sustain no damage during the shock test, and all subsystems and experiments shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. ATM handling and transport GSE
2. Equipment to functionally check the ATM systems
3. Equipment to support the operation of the ATM experiments

SPECIAL TEST EQUIPMENT
1. Fixture to attach the ATM to the shock table in the horizontal position and simulate transporter structure
2. Instrumentation to monitor shock levels at specified locations
3. ATM/Rack electrical interface simulator

Table XIII. (Cont.)

ATM Package Shock (Transportation and Handling) - Part 1 (continued)

FACILITIES

1. Facility to perform shock test
2. Shock table capable of holding the ATM in horizontal position.

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Shock (Launch) - Part 2	16.5.2

TEST OBJECTIVE

Demonstrate that the ATM package can survive the shock encountered during launch.

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION
The ATM will be installed on a shock table with a fixture that will simulate the rack structure and provide the rack attach points for the ATM. An ATM/Rack electrical interface simulator will be installed to provide the Rack electrical interfaces. The ATM shall be positioned in the launch position. Prior to the test, all systems and experiments shall be verified operational.

OPERATION
The ATM will be subjected to a launch shock to the levels and axis criteria specified in the ATM CEI Specification. During the shock test, all systems and experiments will be in the launch configuration. Shock levels will be monitored. After the shock test, a functional test will be performed to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

The ATM shall sustain no damage during the shock test and all systems and experiments shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. ATM handling and transport GSE
2. Equipment to functionally check the ATM systems
3. Equipment to support the operation of the ATM experiments

SPECIAL TEST EQUIPMENT
1. Fixture to attach the ATM to the shock table in the vertical position and simulate the rack structure
2. Instrumentation to monitor shock levels at specified locations
3. ATM/Rack electrical interface simulator

Table XIII. (Cont.)

ATM Package Shock (Launch) - Part 2 (continued)

FACILITIES

1. Facility to perform shock test.
2. Shock table capable of holding the ATM in vertical position.

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Shock (Orbit) - Part 3	16.5.3

TEST OBJECTIVE

Demonstrate that the ATM package can survive the shocks encountered during the orbit transfer and docking.

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION
The ATM will be mounted in a fixture that will simulate the rack structure and provide the rack attach points for the ATM. An ATM/Rack electrical interface simulator will be installed to provide the Rack electrical interface. The ATM/Rack simulator will then be suspended in the horizontal position with slings attached to selected points on the rack simulator. Prior to the test, all systems and experiments shall be verified operational.

OPERATION
The test will be performed in two parts:

1. The first part will verify orbit transfer. Ordnance will be placed on the rack simulator at a point that will simulate the shock load induced by the CSM propulsion system start. The shock level will be as specified in the ATM CEI Specification.
2. The second part will verify docking to MDA. Ordnance will be placed on the rack simulator at a point that will simulate the shock load induced by the maximum docking impact as specified by criteria in the ATM CEI Specification. Shock levels will be monitored during the test. At the completion of each shock test, a functional test will be performed to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

The ATM shall sustain no damage during the shock test and all systems and experiments shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. ATM handling and transport GSE

Table XIII. (Cont.)

ATM Package Shock (Orbit) - Part 3 (continued)

GSE

2. Equipment to functionally check the ATM systems
3. Equipment to support the operation of the ATM experiments

SPECIAL TEST EQUIPMENT

1. Fixture to simulate the Rack structure and ATM attach points and ordnance installation provisions to simulate orbit transfer and docking shocks
2. Instrumentation to monitor the shock levels at specified locations
3. ATM/Rack electrical interface simulator

FACILITIES

1. Facility to perform shock test with the ATM/Rack simulator suspended in the horizontal position

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Acoustic	16.6

TEST OBJECTIVE

Demonstrate that the ATM package can survive the acoustic vibrations encountered during launch.

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION
The ATM will be mounted in a fixture that will simulate the rack structure and provide the rack attach points for the ATM. An ATM/Rack electrical interface simulator will be installed to provide the Rack electrical interface.

OPERATION
The ATM/Rack/SLA will be subjected to the launch acoustic vibrations as specified in the ATM CEI Specifications. This test may be performed in more than one part if required. The acoustic sound pressure shall be induced thru the SLA panels to the ATM. All systems and experiments will be in the launch mode. After the acoustic test, a functional test shall be performed to verify that no damage has resulted from the acoustic vibrations.

CRITERIA FOR SUCCESS

The ATM shall sustain no damage during the acoustic test, and all systems and experiments shall operate properly after the test.

SUPPORT REQUIREMENTS

GSE
1. ATM handling and transport GSE
2. Equipment to functionally check the ATM systems
3. Equipment to support the operation of the ATM experiments

SPECIAL TEST EQUIPMENT
1. Fixture to simulate the Rack structure and provide ATM attach points
2. SLA simulator
3. Instrumentation to monitor acoustic vibration levels at specified points
4. ATM/Rack electrical interface simulator

FACILITIES
1. Facility to perform ATM/Rack/SLA acoustic test

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Thermal Vacuum	16.7

TEST OBJECTIVE

Demonstrate that the ATM package can survive and operate in a simulated space environment.

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION

The ATM will be installed in a thermal vacuum chamber on a fixture that allows the ATM to be rotated to two positions;- pointed directly at the solar source and rotated 90°. Shadowing will be provided to simulate the deployed solar panels. An IR cage will be installed to simulate reflected solar energy. A Rack interface simulator will be utilized to provide electrical and mechanical interfaces. The ATM will undergo a simulated mission to verify all systems and experiments are operational under ambient conditions prior to start of the thermal vacuum test.

OPERATION

The ATM will be subjected to the following conditions as specified in the ATM

1. With the ATM pointed directly toward the solar source and solar panel shadowing simulated, the ATM will go through a simulated mission operations sequence. Each system and experiment will be monitored to verify no adverse effects from the solar simulation.
2. The ATM will be rotated so that the side of the ATM package will be subjected to the solar source with proper shadowing. A mission sequence will not be performed. The ATM passive thermal control system will be monitored to verify that it is capable of maintaining desired temperatures within the ATM package with systems and experiments secure.

CRITERIA FOR SUCCESS

All systems and experiments will operate within the specified temperature range during the simulated mission performed under a thermal vacuum environment.

Table XIII. (Cont.)

ATM Package Thermal Vacuum (continued)

SUPPORT REQUIREMENTS

GSE
1. ATM handling and transport GSE
2. Equipment to functionally operate the ATM systems
3. Equipment to support the operation of the ATM experiments

SPECIAL TEST EQUIPMENT
1. Support and rotation fixture for the ATM in the TV chamber
2. Rack interface simulator; shadowing provisions
3. Instrumentation to monitor systems and experiments on ATM

FACILITIES
1. Facility that contains a thermal vacuum chamber large enough to allow 90° rotation of the ATM inside the chamber

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Electromagnetic Compatibility	16.8

TEST OBJECTIVE

Demonstrate that the ATM package will operate properly in the specified electromagnetic environment.

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION
The ATM will be placed in a screen room on a fixture that will simulate the rack structure and provide the rack attach points and electrical interface for the ATM. Test equipment will be set up to induce certain levels of electromagnetic interference. Electromagnetic monitoring systems will be installed on the ATM. Prior to the EMC tests all systems and experiments shall be verified operational and the EMC monitoring systems will be calibrated.

OPERATION
The ATM will be operated in a simulated orbit electromagnetic environment. Systems and experiments will be monitored to verify operation is not altered from the ambient functional performed prior to test. The EMC monitoring equipment will evaluate all systems to verify at least the margin of safety specified in the ATM CEI specification.

CRITERIA FOR SUCCESS

The simulated electromagnetic environment will produce no more than a specified level of interference on any ATM subsystem/ experiment

SUPPORT REQUIREMENTS.

GSE
1. ATM handling and transport GSE
2. Equipment to functionally check the ATM systems
3. Equipment to support the operation of the ATM experiments

Table XIII. (Cont.)

ATM Package Electromagnetic Compatibility (continued)

SPECIAL TEST EQUIPMENT

1. Equipment to induce EMI
2. Instrumentation to monitor systems and experiments for EMI
3. EMI monitors
4. RF trasnparent support fixture for the ATM package

FACILITIES

1. Screen room to contain ATM
2. External work platforms

Table XIII. (Cont.)

TEST TITLE	TEST NUMBER
ATM Package Mass Properties	16.9

TEST OBJECTIVE

Demonstrate that the mass properties of the ATM package meet design specifications

TEST CONFIGURATION

Prototype flight configured ATM package

TEST DESCRIPTION

PREPARATION
The load cells, slings and ATM attach rigging will be calibrated/checked out prior to the mass properties test.

OPERATION
The ATM mass properties will include weight, center of gravity (three-axis) and mass moment of inertia (two-axis).

CRITERIA FOR SUCCESS

The mass properties of the ATM package shall agree with the engineering analysis

SUPPORT REQUIREMENTS

GSE
1. ATM handling and transport GSE

SPECIAL TEST EQUIPMENT

Mass properties equipment

FACILITIES

Area to perform mass properties test (ATM both vertical and horizontal)

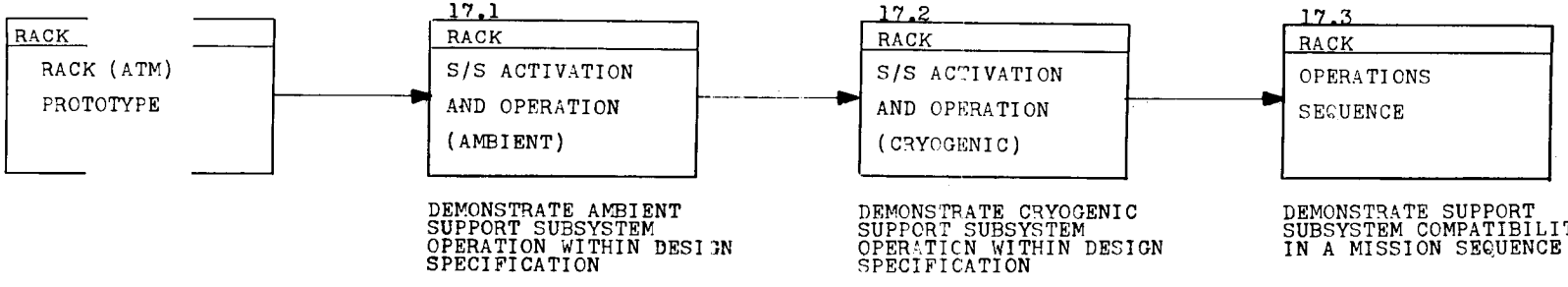
3.2.5.2 ATM Rack Qualification - The ATM/Rack qualification program will be performed on a prototype Rack, associated subsystems, and the ATM package from the ATM qualification program. The ATM/Rack prototype will be capable of performance in the environments called for in the qualification requirements matrix.

The test program is divided into two basic parts; the tests with the ATM package simulated, and the tests with the prototype ATM package.

The tests with the ATM package simulated demonstrate that the rack subsystems are operating properly and are ready to be tested with the prototype ATM package. The details of the Rack and subsystem test program are described in the test flow diagram illustrated in figure 17 and the accompanying test descriptions (Table XIV).

The test program with the prototype rack and ATM package combined will demonstrate compatibility of the ATM/Rack combination.

The details of the ATM/Rack qualification program are described in the test flow diagram illustrated in figure 18 and the accompanying test descriptions (Table XV).



NOTE: PARTIAL BLOCKS ARE FOR REFERENCE ONLY

FIGURE 17

RACK (ATM)
QUALIFICATION TEST
HARDWARE FLOW

DATE: 7 APRIL 1967

Figure 17. RACK (ATM) Qualification Test Hardware Flow

Table XIV. Test Descriptions for Figure 17

TEST TITLE

TEST NUMBER

Rack (ATM) Support Subsystem Activation & Operation (Ambient)

17.1

TEST OBJECTIVE

Demonstrate the compatibility and operation of the support subsystems installed in the rack.

TEST CONFIGURATION

Prototype rack with all subsystems installed.

TEST DESCRIPTION

PREPARATION
The Rack will be in the vertical position with all subsystems installed. The LM and ATM interface will be simulated to provide normal interface requirements. Solar panels will be simulated.

OPERATION
Each subsystem will be tested individually (except cryogenics)

Test / Support Subsystem	Continuity	Resistance	Leak Check	Flow Rate	USWR and Inertial Loss	Functional
Solar Array Cabling	x	x				
Electrical Power	x	x				x
Communication	x	x			x	x
Data Management	x	x				x
Pointing Control	x	x				x
Water Storage			x	x		

Table XIV. (Cont.)

Rack (ATM) Support Subsystem Activation & Operation (Ambient) (continued)

During this test, compatibility will be demonstrated with any GSE utilized to support this program.

Interface simulators will be utilized to provide loads, and provide and monitor interface signals. Electrical interfaces will be demonstrated within specification by use of these simulators during subsystem operation.

CRITERIA FOR SUCCESS

All subsystems shall operate within CEI specification

SUPPORT REQUIREMENTS

GSE

1. Equipment to support the Rack subsystem operations

SPECIAL TEST EQUIPMENT

1. ATM & MDA interface simulators
2. Necessary instrumentation for support systems testing
3. Solar panel simulator

FACILITIES

1. Test position to hold the Rack in a vertical position
2. External work platforms

Table XIV. (Cont.)

TEST TITLE	TEST NUMBER
Rack (ATM) Support Subsystem Activation and Operation (Cryogenics)	17.2

TEST OBJECTIVE

Demonstrate the operation of the cryogenic storage subsystem.

TEST CONFIGURATION

Prototype Rack with subsystems installed.

TEST DESCRIPTION

PREPARATION
The Rack will be installed in the horizontal position. The LM interface will be simulated to provide normal LM interface requirements.

OPERATION
Perform a leak check of the cryogenic system then demonstrate filling of cryogenic storage container. Operate the subsystem under simulated mission load. Check flow rate and GSE compatibility.

CRITERIA FOR SUCCESS

The subsystem will operate within CEI specification

SUPPORT REQUIREMENTS

GSE
1. Equipment to support the Rack cryogenic storage system operation

SPECIAL TEST EQUIPMENT
1. Cryogenic transfer equipment
2. Necessary instrumentation to support test
3. LM interface simulator

FACILITIES
1. Cryogenic area
2. Rack support fixture

Table XIV. (Cont.)

TEST TITLE	TEST NUMBER
Rack (ATM) Operations Sequence	17.3

TEST OBJECTIVE

To demonstrate compatibility between the subsystems when operated in a mission sequence.

TEST CONFIGURATION

Rack prototype with support subsystems installed.

TEST DESCRIPTION

PREPARATION
The Rack will be in the vertical position. GSE will be checked out and connected. A simulator will be utilized to provide required interfaces between the Rack and the ATM Package and LM. Solar panels will be simulated. Individual subsystems will have been verified prior to this test. Cryogenics will not be used.

OPERATION
The subsystems (and ATM & LM simulators) will be operated in a mission sequence in compressed time. The operation will start with liftoff, proceed through CSM docking and orbit transfer, docking with cluster, then performance of all operations (except cryogenics) required for the mission.

CRITERIA FOR SUCCESS

All subsystems will perform with CEI specifications when operated to the mission sequence.

SUPPORT REQUIREMENTS

GSE
1. Equipment to operate each subsystem

SPECIAL TEST EQUIPMENT
1. LM interface simulator
2. ATM interface simulator
3. Support fixture for the Rack
4. Solar panel simulators

FACILITIES
1. Area for Rack test performance

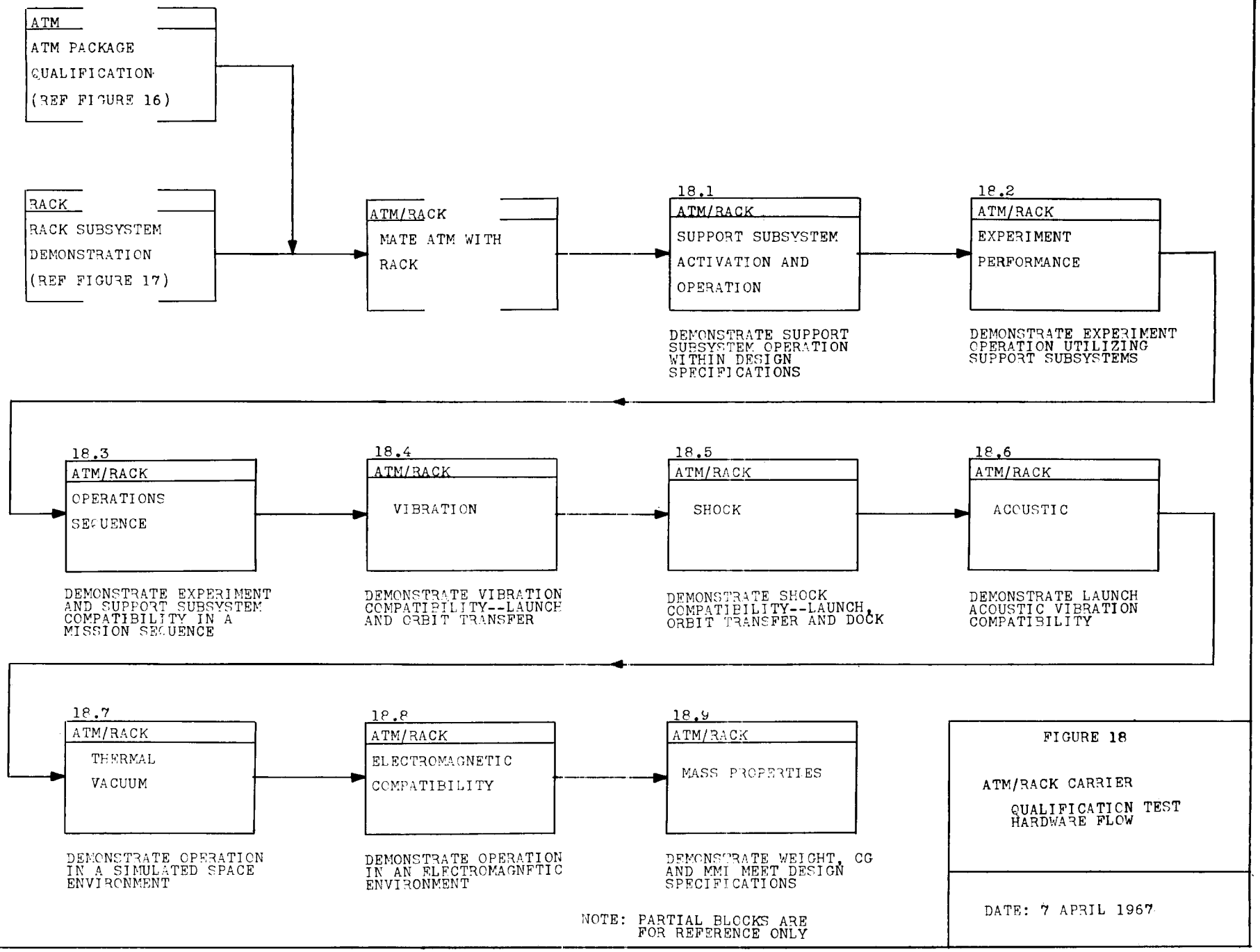


Figure 18. ATM/Rack Carrier Qualification Test Hardware Flow

Table XV. Test Descriptions for Figure 18

TEST TITLE — TEST NUMBER

ATM/Rack Support Subsystem Activation and Operation 18.1

TEST OBJECTIVE

Demonstrate that the ATM/Rack subsystems will operate within design specifications.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be in the vertical position (launch position). GSE will be checked out and connected. A LM simulator will be utilized to provide interfaces between LM and ATM/Rack. All ATM/Rack pretests shall be performed, such as single point ground, resistance measurements, etc. Electrical loads will be simulated. The solar panels will be simulated.

OPERATION
Each subsystem will be tested individually (except cryogenic transfer).

Test / Support Subsystem	Continuity	Resistance	Leak Check	Flow Rate	VSWR and Insertion Loss	Functional
Solar Array Cabling	x	x				
Electrical Power	x	x				x
Communication	x	x			x	x
Data Management	x	x				x
Pointing Control	x	x				x
Fine Pointing Control	x	x				x
Water Storage			x	x		x

ATM/Rack Support Subsystem Activation and Operation (continued)

During this test, compatibility will be demonstrated with any GSE utilized to support this program.

Interface simulators will be utilized to provide loads, and provide and monitor interface signals. Electrical interfaces will be demonstrated within specification by use of these simulators during subsystem operation.

CRITERIA FOR SUCCESS

All subsystems shall operate to CEI specifications

SUPPORT REQUIREMENTS

GSE

1. ATM/Rack handling and transport GSE
2. Equipment to functionally check the ATM/Rack support systems (portable)

SPECIAL TEST EQUIPMENT

1. LM interface simulator
2. Solar array simulator

FACILITIES

Area to contain ATM/Rack and support equipment for an ambient functional.

Table XV. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Experiment Performance	18.2

TEST OBJECTIVE

Demonstrate that ATM/Rack experiment will operate within design specifications.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be in the vertical position. GSE will be checked out and connected. A LM simulator will be utilized to provide interfaces between LM and ATM/Rack. All ATM/Rack pre-tests shall be performed such as alignment single point ground, resistance measurements, etc. Electrical loads will be simulated. The solar array will be simulated.

OPERATION
The following experiments will be operated individually in conjunction with the various support subsystems. Refer to section 5 for integration test requirements for these experiments:

S020 - UV X-ray Solar Photography
S052 - White Light Coronography
S053A - UV Coronal Spectrograph
S053B - UV Spectrograph
S054 - X-ray Spectrographic Telescope
S055A - UV Spectrometer
S055B - UV Spectrometer (UV Spectroheliometer)
S055C - UV Spectrometer - Hα Telescope
S056 - X-ray Telescope

MSFC57 - Gravity Simulation Workbench

CRITERIA FOR SUCCESS

The experiment will operate within CEI Specifications when operated in conjunction with the support subsystems.

Table XV. (Cont.)

ATM/Rack Experiment Performance (continued)

SUPPORT REQUIREMENTS

GSE

1. ATM/Rack handling and transport GSE
2. Equipment to support the operation of the ATM experiments
3. Equipment to operate each subsystem

SPECIAL TEST EQUIPMENT

1. LM interface simulator
2. Solar Array simulator

FACILITIES

1. Area to contain ATM/Rack and support equipment for ambient functional.

Table XV. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Operations Sequence	18.3

TEST OBJECTIVE

Demonstrate that all ATM/Rack subsystems and experiments are compatible when operated in a mission sequence.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be in the vertical position. GSE will be checked out and connected. A LM simulator will be utilized to provide interfaces between LM and ATM/Rack. The individual subsystems and experiments will have been verified prior to this operations sequence test. The solar array power supply will be simulated.

OPERATION
The subsystems and experiments on the ATM/Rack will be operated in a mission sequence in compressed time. The operation will start with liftoff, proceed through docking with cluster, then performance of all operations required for the mission.

CRITERIA FOR SUCCESS

Demonstrate compatibility of all subsystems and experiments during their operation in a mission sequence.

SUPPORT REQUIREMENTS

GSE
1. Equipment to functionally check the ATM/Rack subsystems
2. Equipment to support the operation of the ATM experiments

SPECIAL TEST EQUIPMENT
1. LM interface simulator
2. Solar array simulator
3. Instrumentation necessary to support the test program.

Table XV. (Cont.)

ATM/Rack Operations Sequence (continued)
FACILITIES 1. Area to contain ATM/Rack and support equipment for an ambient functional.

Table XV. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Vibration (Launch) - Part 1	18.4.1

TEST OBJECTIVE

Demonstrate that the ATM/Rack can survive vibrations encountered during launch.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be installed on a vibration shaker utilizing a SLA structure simulator. The SLA simulator will provide the SLA attach points, simulate the structure and provide attachment to the shaker table. An LM mass simulator will be installed on top of the ATM/Rack. An LM electrical simulator will be utilized to provide interfaces between the LM and ATM/Rack. Prior to the test all systems and experiments shall be verified operational. Liquids will be simulated.

OPERATION
The ATM/Rack will be subjected to vibration in three axis to the criteria specified in the ATM/Rack CEI Specification. The ATM/Rack subsystems and experiments will be in the same configuration as at launch. Vibration levels will be monitored. After the test is complete a functional test will be performed on the ATM/Rack to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

The ATM/Rack shall sustain no damage during the vibration test and all subsystems and experiments shall operate within specification after the test.

SUPPORT REQUIREMENTS

GSE
1. ATM handling and transport GSE
2. Equipment to functionally check the ATM systems
3. Equipment to support the operation of the ATM experiments

Table XV. (Cont.)

ATM/Rack Vibration (Launch) - Part 1 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shaker table and simulate SLA structure and attach points for ATM/Rack.
2. Instrumentation to monitor ATM/Rack vibration of selected locations.
3. LM interface simulator
4. LM mass simulator

FACILITIES

1. Shaker system to vibrate the ATM/Rack in three axes (one at a time)

Table XV. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Vibration (Orbit Transfer) - Part 2	18.4.2

TEST OBJECTIVE

Demonstrate that the ATM/Rack can survive vibrations encountered during orbit transfer.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be suspended from several selected attach points. A LM structural interface simulator will be attached to the LM/ATM interface to provide the point for vibration input. A LM electrical simulator will provide the electrical interface between the LM and ATM/Rack. The vibration input to the ATM/Rack will simulate the vibration imparted to the ATM through the LM. Prior to the test, all systems and experiments shall be verified operational. Liquids will be simulated.

OPERATION
The ATM/Rack will be subjected to vibrations in three axis to the criteria specified in the ATM/Rack CEI specification. The ATM/Rack subsystems will be in the same configuration as during orbit transfer. Vibration levels will be monitored. After the test is complete a functional test will be performed on the ATM/Rack to verify no damage has resulted from the induced vibration.

CRITERIA FOR SUCCESS

The ATM/Rack shall sustain no damage during the vibration test and all sybsystems and experiments shall operate within specification.

SUPPORT REQUIREMENTS

GSE
1. ATM/Rack handling and transport GSE
2. Equipment to functionally check the ATM/Rack systems
3. Equipment to support the operation of the ATM experiments

Table XV. (Cont.)

ATM/Rack Vibration (Orbit Transfer) - Part 2 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to suspend the ATM/Rack
2. LM structural interface simulator
3. LM electrical interface simulator
4. Instrumentation to monitor the ATM/Rack vibration at selected locations

FACILITIES

1. Area to suspend the ATM/Rack
2. Shaker system to induce the vibration

Table XV. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Shock (Launch) - Part 1	18.5.1

TEST OBJECTIVE

Demonstrate that the ATM/Rack can survive the shock encountered during launch.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be installed on a shock table with a fixture that will simulate the SLA structure and provide the SLA attach points for the ATM/Rack. The ATM/Rack will be positioned in the launch position. A LM mass simulator will be installed on top of the ATM/Rack. A LM electrical simulator will provide the electrical interface between the LM and ATM/Rack. Prior to the test, all subsystems and experiments shall be verified operational. Liquids will be simulated.

OPERATION
The ATM/Rack will be subjected to a launch shock to the levels and axis specified in the ATM/Rack CEI Specification. During the test all systems and experiments will be in the launch configuration. Shock levels will be monitored. After the shock test, a functional test will be performed to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

The ATM/Rack shall sustain no damage during the shock test, and all subsystems and experiments shall operate within specification after the test.

SUPPORT REQUIREMENTS

GSE
1. ATM/Rack handling and transport GSE
2. Equipment to functionally check the ATM/Rack subsystems
3. Equipment to support the operation of the ATM experiments

Table XV. (Cont.)

ATM/Rack Shock (Launch) - Part 1 (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to attach to shock table and simulate the SLA structure and attach points
2. Instrumentation to monitor shock levels at selected locations
3. LM Mass Simulator
4. LM electrical interface simulator

FACILITIES

1. Facility to perform shock test
2. Shock table capable of holding the ATM/Rack SLA simulator in launch position

Table XV. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Shock (Orbit) - Part 2	18.5.2

TEST OBJECTIVE

Demonstrate that ATM/Rack can survive the shock encountered during orbit transfer and docking.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION

The ATM/Rack will be suspended in the horizontal position with the slings attached to several selected positions. A LM mass simulator will be attached to the ATM/Rack. A LM electrical simulator will provide the electrical interface between the LM and ATM/Rack. Prior to the test, all subsystems and experiments shall be verified operational. Liquids will be simulated.

OPERATION

The test will be performed in two parts:

1. The first part will verify orbit transfer. Ordnance will be placed at a point that will simulate the shock load induced by the CSM propulsion system start. The shock level will be to the criteria specified in the ATM/Rack CEI Specification.
2. The second part will verify docking to the MDA. Ordnance will be placed at a point that will simulate the shock load induced by the maximum docking impact as specified in the ATM/Rack CEI specification.

Shock levels will be monitored during the test. At the completion of each shock test a functional test will be performed to verify that no damage has resulted from the induced shock.

CRITERIA FOR SUCCESS

The ATM/Rack shall sustain no damage during the shock test and all subsystems and experiments shall operate with specification after the test.

SUPPORT REQUIREMENTS

GSE

1. ATM handling and transport GSE

Table XV. (Cont.)

ATM/Rack Shock (Orbit) - Part 2 (continued)

2. Equipment to functionally check the ATM/Rack subsystems
3. Equipment to support the operation of the ATM experiments

SPECIAL TEST EQUIPMENT

1. Fixture to suspend the ATM/Rack combination
2. Instrumentation to monitor the shock levels at specified locations
3. LM mass simulator
4. LM electrical interface simulator

FACILITIES

1. Facility to perform shock test with ATM/Rack suspended in horizontal position

Table XV. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Acoustic	18.6

TEST OBJECTIVE

Demonstrate that the ATM/Rack can survive the acoustic vibrations encountered during launch.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be installed in an acoustic test area utilizing a SLA simulator. The SLA simulator will consist of mounting provisions for the ATM/Rack, simulate the SLA structure and panels. A LM mass simulator will be installed on top of the ATM/Rack. A LM electrical simulator will provide the electrical interface between the LM and ATM/Rack. Prior to the acoustic test all systems and experiments shall be verified operational.

OPERATION
The ATM/Rack/SLA shall be subjected to the launch acoustic vibrations as specified in the ATM/Rack CEI Specification. This test may be performed in more than one part if required. The acoustic sound pressure shall be induced through the SLA panels to the ATM. All systems and experiments will be in the launch mode. After the acoustic test, a functional test shall be performed to verify that no damage has resulted from the acoustic vibration.

CRITERIA FOR SUCCESS

The ATM/Rack shall sustain no damage during the acoustic test and all systems and experiments shall operate with specification after the test.

SUPPORT REQUIREMENTS

GSE
1. ATM/Rack handling and transport GSE
2. Equipment to functionally check the ATM/Rack systems
3. Equipment to support the operation of the ATM experiments

Table XV. (Cont.)

ATM/Rack Acoustic (continued)

SPECIAL TEST EQUIPMENT

1. Fixture to simulate the SLA panels, ATM/Rack attach points and structure
2. Instrumentation to monitor acoustic vibration levels at specified locations
3. LM mass simulator
4. LM electrical interface simulator

FACILITIES

1. Facility to perform ATM/Rack/SLA acoustic test

Table XV. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Thermal Vacuum	18.7

TEST OBJECTIVE

Demonstrate that the ATM/Rack can survive and operate in a simulated space environment.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

The ATM/Rack will be installed in a thermal vacuum chamber on a fixture that allows the ATM to be rotated to two positions; pointed directly at the solar source and rotated 90°. This fixture will thermally simulate the LM. An IR cage will simulate reflected solar energy. Shadowing will be provided to simulate the deployed solar panels. Cryogenics will be simulated. A LM electrical simulator will be provided outside the chamber with electrical cabling between the LM simulator and the ATM/Rack. The ATM/Rack will undergo a simulated mission to verify all systems and experiments are operational under ambient conditions prior to start of the thermal vacuum test. The solar array power supply will be simulated.

OPERATION

The ATM/Rack will be subjected to the following conditions:

1. With the ATM pointed directly toward the solar source and solar panel shadowing and power supply simulated, the ATM/Rack will go through a simulated mission operations sequence. Each system and experiment will be monitored to verify no adverse effects from the solar simulation.
2. The ATM/Rack will be rotated so that the side of the ATM package will be subjected to the solar source. A mission sequence will not be performed. The thermal control system will be monitored to verify that it is capable of maintaining desired temperatures within the ATM package, with systems and experiments secured.

CRITERIA FOR SUCCESS

All systems and experiments will operate within specification during the simulated mission performed under a thermal vacuum environment.

Table XV. (Cont.)

ATM/Rack Thermal Vacuum (continued)

SUPPORT REQUIREMENTS

GSE

1. ATM handling and transport GSE
2. Equipment to functionally operate the ATM/Rack systems
3. Equipment to support the operation of the ATM experiments

SPECIAL TEST EQUIPMENT

1. Support and rotation fixture for the ATM/Rack (also LM Thermal Simulator)
2. Solar array power supply simulator.
3. Solar panel shadowing simulator
4. Instrumentation to monitor the systems and experiments on the ATM/Rack LM electrical simulator.

FACILITIES

1. Facility that contains a thermal vacuum chamber large enough to allow 90° rotation of the ATM/Rack inside the chamber. Chamber has full solar and IR capability
2. IR cage to simulate reflected solar energy

Table XV. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Electromagnetic Compatibility (EMC)	18.8

TEST OBJECTIVE

Demonstrate that the ATM/Rack will operate properly in a specified electromagnetic environment.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION
The ATM/Rack will be placed in a screen room. A LM electrical simulator will be utilized to provide the interface between the LM and ATM/Rack. Test equipment will be set up to induce certain levels of electromagnetic interference. Electromagnetic monitoring systems will be installed in the ATM/Rack subsystems. Prior to the EMC tests, all systems and experiments shall be verified operational and the EMC monitoring systems will be calibrated.

OPERATION
The ATM/Rack will be operated in a simulated orbit electromagnetic environment. Systems and experiments will be monitored to verify operation is not altered from the ambient functional performed prior to test. The EMC monitoring equipment will evaluate all systems to verify at least the margin of safety specified in the ATM/Rack CEI Specifications.

CRITERIA FOR SUCCESS

The simulated electromagnetic environment shall produce no more than a specified level of interference on any ATM Rack subsystem or experiment.

SUPPORT REQUIREMENTS

GSE
1. ATM/Rack handling and transport GSE
2. Equipment to functionally check the ATM/Rack systems
3. Equipment to support the operation of the ATM experiments

Table XV. (Cont.)

ATM/Rack Electromagnetic Compatibility (EMC) (continued)

SPECIAL TEST EQUIPMENT

1. Equipment to induce EMI
2. Instrumentation to monitor systems and experiments for EMI
3. LM electrical interface simulator
4. EMI monitors
5. RF transparent support fixture for the ATM/Rack

FACILITIES

1. Screen room to contain ATM/Rack
2. External work platforms

Table XV. (Cont.)

TEST TITLE	TEST NUMBER
ATM/Rack Mass Properties	18.9

TEST OBJECTIVE

Demonstrate that the mass properties of the ATM/Rack meet design specifications.

TEST CONFIGURATION

Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION
The load cells, slings and ATM/Rack attach rigging will be calibrated/checked out prior to the mass properties test.

OPERATION
The ATM/Rack mass properties will include weight, center of gravity (three-axis) and mass moment of inertia (two-axis).

CRITERIA FOR SUCCESS

The mass properties of the ATM/Rack shall agree with the engineering analysis.

SUPPORT REQUIREMENTS

GSE
1. ATM/Rack handling and transport GSE

SPECIAL TEST EUIPMENT
1. Mass properties equipment

FACILITIES
1. Area to perform mass properties test (ATM/Rack both vertical and horizontal).

4. INTERCARRIER VERIFICATION TEST PROGRAM

4.1 General - The intercarrier verification test program is designed to verify the systems compatibility of the various integrated experiment modules in the launch and orbit configurations. This test program is based on the assumption that all components, experiments, subsystems and integrated experiment modules used in this test program have been qualified or at least undergone individual design verification testing including EMC tests.

The test program will be divided into three basic parts:

a. Launch compatibility tests
b. Flights AAP 1 and 2 orbit configuration compatibility tests
c. Flights AAP 1, 2, 3 and 4 orbit configuration compatibility tests

Launch configuration tests on Flights AAP 1, 2, 3 and 4 hardware combinations will verify the mechanical and electrical interfaces between carriers and between carriers and GSE.

The launch EMC test will be performed at KSC during the launch pad RF open loop test.

The Flight AAP 1 and 2 orbit configuration tests will be performed utilizing a combination of the S-IVB, IU, SLA (lower), AM, MDA, LM&SS and the CSM. The orbit operations demonstrated utilizing this configuration will be those included in the following: OWS passivation and activation, OWS experiment operation and OWS securing (undock Flight AAP 1 CSM).

The Flight AAP 1, 2, 3 and 4 orbit configuration test will be performed utilizing a combination of the S-IVB, IU, SLA (lower), AM, MDA, LM&SS, RM, LM, ATM/Rack and the CSM. The orbit operations demonstrated utilizing this configuration will be those included in the following: re-activation of the OWS and continuing through OWS experiment operation, ATM/Rack experiment operation and de-activation of the cluster (undock of Flight AAP 3 CSM).

The cluster systems compatibility test sequence proposed for each orbit configuration will start with support subsystem tests, the individual experiment tests and finally a simulated mission test. After this basic test sequence is completed, an

open loop (antenna system) EMC test will be conducted. The final test segment to be completed on each orbit configuration will be the contingency tests to verify critical system malfunctions and emergency procedures.

4.1.1 Test Objectives - The basic test objectives of the intercarrier verification test program is to verify the compatibility of the integrated experiment module interfaces (reference figure 19 for single line interfaces) and to verify systems level operation of the various launch and orbital experiment module configurations. The mission sequences to be verified and the experiment module configurations to be utilized for these sequences are indicated in figure 20.

The integrated experiment module intercarrier test program will be performed under ambient environmental conditions. No environmental tests will be imposed on the orbital configurations. The specific objectives of the intercarrier verification test program are:

a. Experiment Integration

(1) Verify that all flights AAP 1,2,3 and 4 experiments can be properly stored during the launch-boost portion of their respective flights.

(2) Verify that all flights AAP 1,2,3 and 4 experiments can be properly removed from storage, handled, installed and activated.

(3) Verify on orbit mission configurations 1/2 and 3/4, that experiment performance is within design tolerances when operated in a normal mission sequence and integrated into the spacecraft.

b. Support Subsystem Operation

(1) Verify on orbital mission configurations 1/2 and 3/4, that support subsystem performance is within design tolerance when operated in a normal mission sequence.

c. Man-Machine Compatibility

(1) Verify that the astronauts capability to operate and maintain spacecraft equipment is not compromised by spacecraft design.

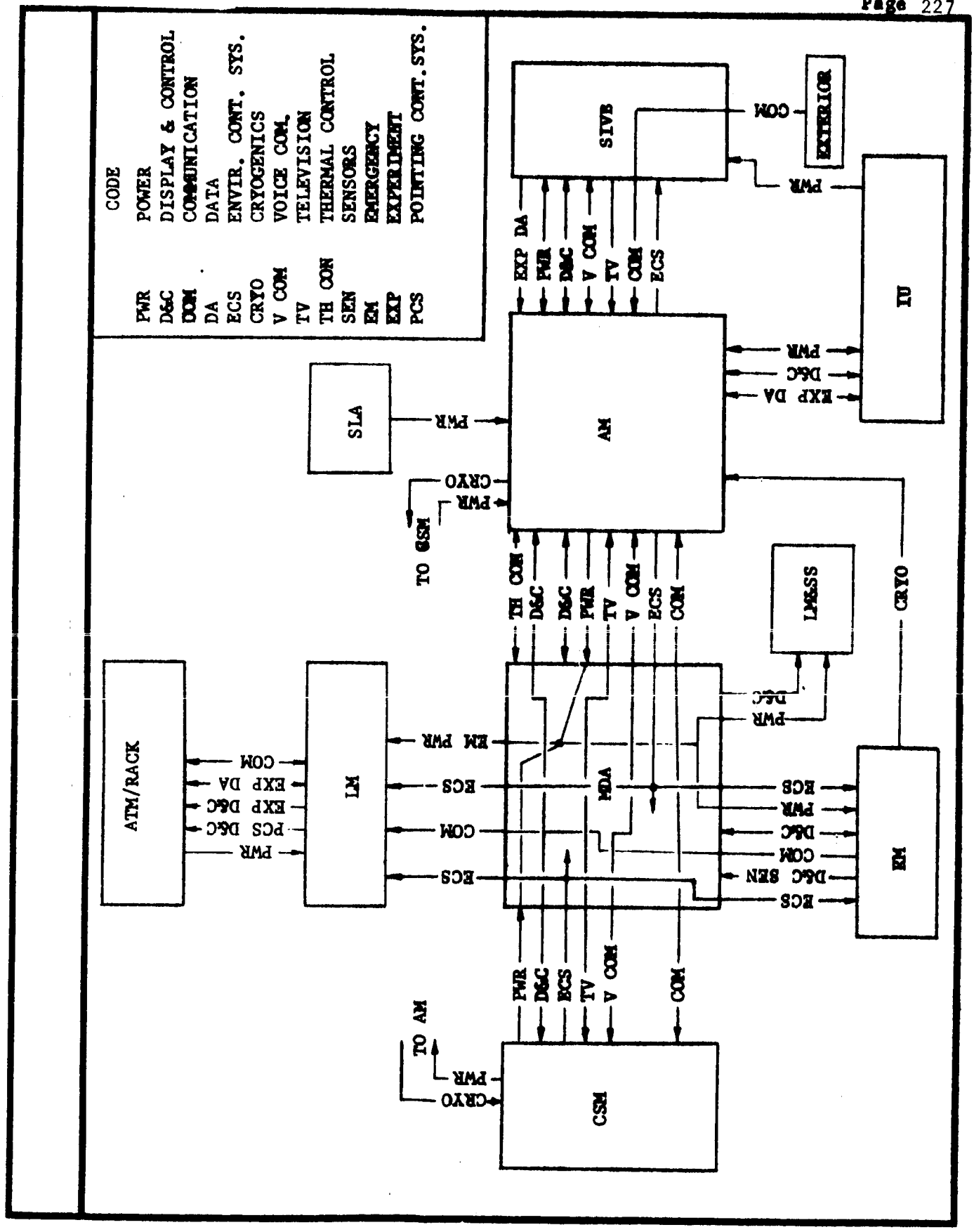


Figure 19. Carrier Interfaces, Cluster Configuration

Mission Number and Carriers	Flight 1		Flight 2					Flight 3		Flight 4	
Mission Operations	CSM	LM&SS	S-IVB	IU	AM	MDA	SLA	RM	CSM	LM	ATM Rack
1. Launch Flight	x	x									
2. Mission Operations	x	x									
3. Launch Flight 2			x	x	x	x	x				
4. Rendezvous & Docking	x	x	x	x	x	x	x				
5. S-IVB Passivation											
a. Vent & Dump	x	x	x	x	x	x	x				
b. Safing Operations	x	x	x	x	x	x	x				
6. OWS Activation											
a. Tank Entry and Sealing	x	x	x	x	x	x	x				
b. Pressurization	x	x	x	x	x	x	x				
c. Equipment Installation & Activate	x	x	x	x	x	x	x				
7. Mission Operations											
a. Experiment Performance	x	x	x	x	x	x	x				
b. Subsystem Performance	x	x	x	x	x	x	x				
8. Securing											
a. Store Data	x	x	x	x	x	x	x				
b. Secure Support Subsystems & Experiments	x	x	x	x	x	x	x				
c. Establish Spacecraft Attitude	x	x	x	x	x	x	x				
d. Undock and Re-entry	x	x	x	x	x	x	x				
9. OWS Reactivation Check		x	x	x	x	x	x				

Figure 20. Mission Operations VS Flight Articles

(Sheet 1 of 2)

Mission Number and Carriers	Flight 1		Flight 2					Flight 3		Flight 4	
Mission Operations	CSM	LM&SS	S-IVB	IU	AM	MDA	SLA	RM	CSM	LM	ATM Rack
10. Launch Flight AAP 3								x	x		
11. Rendezvous & Dock		x	x	x	x	x	x	x	x		
12. Mission Operations											
a. Equipment Transfer		x	x	x	x	x	x	x	x		
b. Mechanical Connection		x	x	x	x	x	x	x	x		
c. Functional Verification		x	x	x	x	x	x	x	x		
d. OWS Activation		x	x	x	x	x	x	x	x		
13. Launch Flight AAP 4										x	x
14. Rendezvous & Dock									x	x	x
15. Mission Operations											
a. Establish & Maintain Attitude		x	x	x	x	x	x	x	x	x	x
b. Support S/S Operations		x	x	x	x	x	x	x	x	x	x
c. Experiment Performance		x	x	x	x	x	x	x	x	x	x
16. Securing											
a. Store Data		x	x	x	x	x	x	x	x	x	x
b. Securing S/S & Experiments		x	x	x	x	x	x	x	x	x	x
c. Establish Spacecraft Attitude		x	x	x	x	x	x	x	x	x	x
d. Undock & Re-entry		x	x	x	x	x	x	x	x	x	x

Figure 20. Mission Operations VS Flight Articles
(Sheet 2 of 2)

d. Spacecraft Module Interface

(1) Verify the design adequacy of carrier to carrier structural, mechanical and electrical interfaces.

e. Ground Station Compatibility

(1) Verify the capability of the ground station to support each of the AAP 1/2 and 3/4 missions.

f. Thermal Balance

(1) By analysis of experiment module thermal vacuum tests, the cluster configuration scale model tests and OWS full scale thermal vacuum test, verify that the environmental control system(s) employed during the orbital missions 1/2 and 3/4 are capable of maintaining man and equipment thermal environments within prescribed tolerances.

g. Electromagnetic Compatibility

(1) Verify that the launch configured spacecraft of Flights AAP 1, 2, 3 and 4 are not adversely affected by the launch site electromagnetic environment.

(2) Verify that the launch configured spacecraft of Flights AAP 1, 2, 3 and 4 do not adversely affect other AAP systems.

(3) Verify electromagnetic compatibility of the orbit configured spacecraft of Flights AAP 1 and 2, and 3 and 4.

h. GSE Compatibility

(1) Verify that the launch configured spacecraft of Flights AAP 1, 2, 3 and 4 can be controlled, monitored and serviced by the applicable AAP ground support equipment.

i. Contingencies

(1) Verify equipment performance and procedural methods developed for the following situations:

(a) Failure of one or more flights
(b) Malfunctioning of critical equipment
(c) Alternate grouping of experiments
(d) Emergencies

4.1.2 Test Configuration

4.1.2.1 Test Articles - The various test article configurations that were envisioned as candidates for the cluster test program were evaluated in a trade study performed on 23 February 1967 (reference ED-2002-69, "Configuration Trade Study, Cluster Verification Test"). An excerpt from this trade study, figure 21, graphically shows the percentage of total cluster test objectives that can be accomplished by each candidate configuration.

The candidate configurations are shown in figure 22. The description of test articles utilized in this trade study is included in figure 23.

The conclusion of this trade study indicates the following preference of cluster candidate configurations: 1,3,2,7. Candidate configurations 4, 5 and 6 would have to be evaluated further to determine their value in a cluster test program.

Candidate 1 is the basis for the intercarrier verification test program proposed in this plan. Alternates to Candidate 1, the use of all prototype hardware except the LM&SS, will depend on integrated experiment module availability, cost and schedule and the degree of risk that can be tolerated. Determination of the alternates is beyond the scope of this test plan and will be the subject of a separate study performed during phase D.

4.1.2.2 Cluster Configuration Orientation - The cluster configuration will be assembled, starting with the placement of the S-IVB/IU combination, and followed by placement of the lower SLA, AM, MDA and CSM along a common centerline. The orientation of the MDA will be with the LM&SS docking port in the up position (an LM&SS electrical simulator may be utilized for all tests except the EMC test, when the LM&SS semifunctional mockup is required). When the Flights AAP 1, 2, 3 and 4 orbit configuration is assembled, the LM/ATM rack combination will be added to one

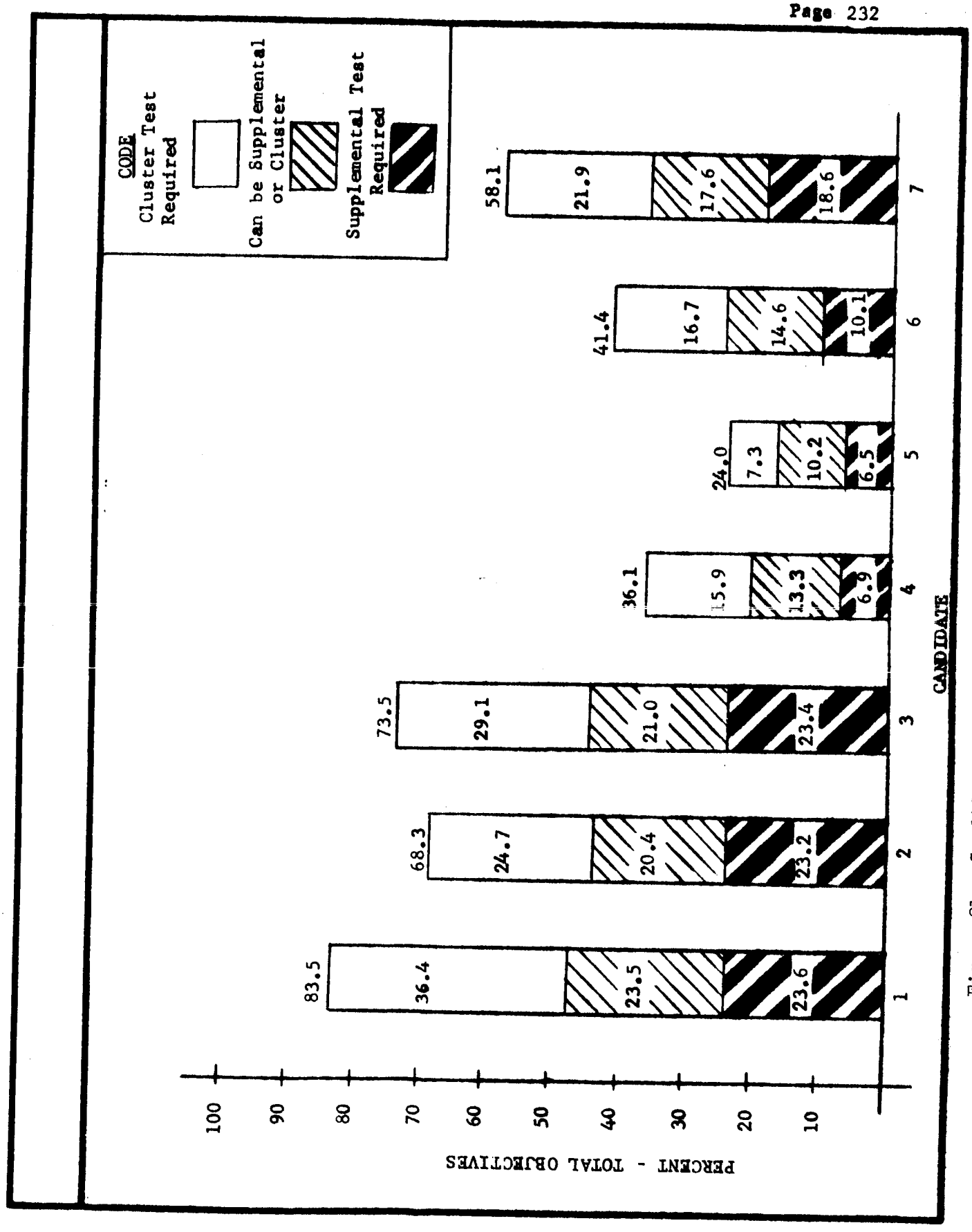


Figure 21. Candidate Configuration VS Percent - Total Objectives

CANDIDATE	SIVB	IU	SLA	AM	MDA	RM	LM	ATM/RACK	CSM	LM&SS
#1	P	P	P	P	P	P	P	P	P	(S) + SFM
#2	S	P	P	P	P	P	P	P	P	(S) + SFM
#3	SFM	P	P	P	P	P	P	P	P	(S) + SFM
#4	P	P	P	P	P	P	S	P	S	S
#5	S	P	P	P	P	P	S	P	S	S
#6	SFM	P	P	P	P	P	P	P	S	SFM
#7	SFM	P	P	P	P	P	S	P	P	SFM

S - Simulator

P - Prototype

SFM - Semi-Functional Mockup

Figure 22. Candidate Configurations

ARTICLE	MECHANICAL DESCRIPTION	ELECTRICAL/ELECTRONIC
S-IVB Prototype	Complete launch configured less engine assembly. Sufficient engine assembly (values, etc.) to perform activation, pressurization and operations on the propellant feed lines. Floors for OWS operation in the S-IVB will be reinforced for manned operation under one "G" environment with S-IVB in vertical position. Attach points for ladders, one "G" mobility aids and platforms will be installed in the S-IVB tank for access during test operations.	Completely flight configured less engine assembly. Electrical required for pressure, activation and passivation.
IU Prototype	Complete structure.	Electronics required for passivation (power, programming, interconnections, up data link). Booster electronics simulated. Simulators will be same size and shape as flight components and provide same EMC reflectivity.
AM Prototype	Complete flight configured.	Completely flight configured.
MDA Prototype	Completely flight configured including stored experiments.	Completely flight configured.
SLA Prototype	Completely flight configured except for solar panels which will be structurally simulated for EMC test.	Completely flight configured. Solar power simulated by ground power source.

Figure 23. Test Article Description
(Sheet 1 of 4)

ARTICLE	MECHANICAL DESCRIPTION	ELECTRICAL/ELECTRONIC
ATM/Rack Prototype	Completely flight configured except for solar panels. (Simulated for EMC)	Completely flight configured. Solar power simulated by ground power source.
CM Prototype	Completely flight configured.	Completely flight configured.
SM Prototype	Complete SM structure.	Only the electronics required to support cluster test will be required.
RM Prototype	Completely flight configured.	Completely flight configured.
S-IVB Simulator	1. Portion of the tank dome and hatch to mate with AM & IU attach points. 2. Simulator to mate with 5 PSI GO_2 supply from AM.	1. Passivation modification simulation. 2. Whip antenna system.
LM Simulator	None (only that required to provide electrical connection with MDA and ATM/rack)	1. Complete display and control simulation (ATM interface) 2. Complete data management system (ATM/rack interface) 3. Complete communication system (ATM/rack interface) 4. Power switching, sequencing and loads (ATM rack interface) 5. Antenna system link (interface with MDA) 6. MDA to LM emergency power system. Simulation including switching and loads.

Figure 23. Test Article Description
(Sheet 2 of 4)

ARTICLE	MECHANICAL DESCRIPTION	ELECTRICAL/ELECTRONIC
SM Simulator (Probably combined with CM)	Fuel cell resupply cryogenic system will be simulated to the extent necessary to allow transfer from the AM.	Simulated fuel cell power with some basic characteristics as the SM fuel cell.
LM&SS Simulator	None (only enough to allow electrical connection with MDA)	1. Power switching, sequencing and load simulation. 2. Provide simulated housekeeping data to the MDA interface.
CM Simulator (Probably combined with SM Simulator)	None (only enough mechanical simulation to provide for electrical connection with MDA)	1. Complete display and control capability. 2. Sufficient simulation to accurately simulate CM data outputs and accept data inputs across the MDA interface. 3. Communication simulation to accept inputs and provide outputs across the MDA interface. 4. Simulator will provide voice communications to allow test engineers to communicate through the MDA interface. 5. Simulated CM power will provide same basic response and characteristics as CM. (SM fuel cell)

Figure 23. Test Article Description
(Sheet 3 of 4)

ARTICLE	MECHANICAL DESCRIPTION	ELECTRICAL/ELECTRONIC
S-IVB Semi-Functional Mockup (SFM)	Same outside profile, dimensions and RF reflectivity characteristics as flight S-IVB (forward portion only). Internal provisions provided to allow all subsystems and experiments to be installed and operated.	1. Whip antenna system. 2. OWS passivation modification circuitry. 3. Ordnance (destruct) system will be simulated, with installation in the flight position.
LM&SS Semi-Functional Mockup (SFM)	Same outside profile, dimensions and RF reflectivity characteristics as the Flight LM&SS.	Simulation of power consumption. Simulation of display and control.

Figure 23. Test Article Description
(Sheet 4 of 4)

side MDA port and the RM will be added to the other port (the bottom port is not utilized).

The ATM/Rack and SLA solar arrays are electrically simulated for all testing except the EMC test program. During EMC testing the two solar array systems are both electrically and mechanically simulated.

The centerline of the cluster will be approximately 23 to 25 inches above the floor level to allow the solar arrays to be installed on the top and bottom of the S-IVB and to allow the full solar array to be installed on the ATM/Rack during EMC testing. (Ref. figure 24.)

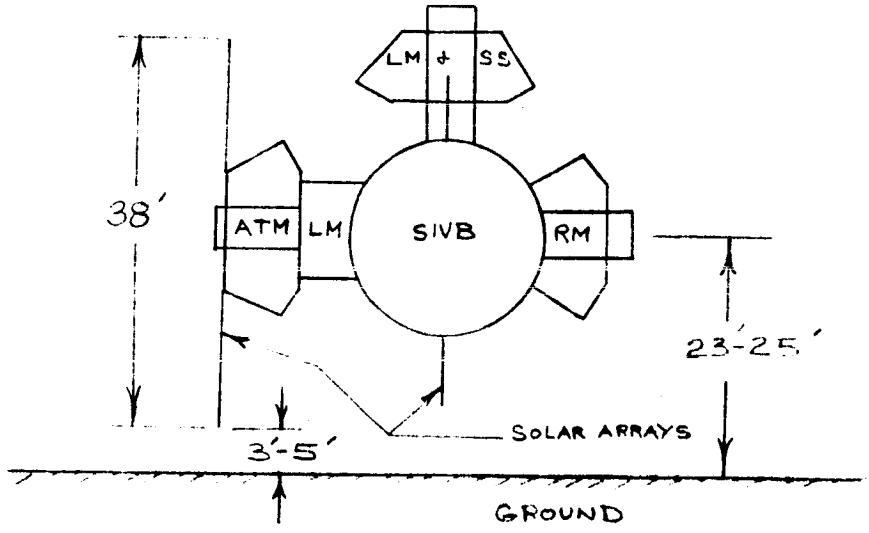


Figure 24. End View, Cluster Configuration With Solar Arrays

4.1.2.3 Support Fixtures - The support fixtures for the cluster will support each integrated experiment module in a specific position to allow cluster assembly and test. These fixtures will be interlocking to provide a firm base for the cluster. The fixtures will be made of wood or other RF transparent material to allow antenna system to be operated open loop with a minimum of reflected interference. The following is a basic description of each fixture.

a. Test Fixture for the S-IVB/IU - The S-IVB/IU will be supported on a fixture in the horizontal position. This fixture will be set in place by an overhead crane. The S-IVB/IU will be supported in this fixture by cradles. This fixture will raise the S-IVB at least 13 feet off the floor to allow the EMC test to be performed and to allow access to all areas of the S-IVB during test.

b. Test Fixture for the SLA/AM- This fixture will support the SLA and AM (mated) in the horizontal position and will be set in place by an overhead crane and locked to the S-IVB support fixture. The SLA/AM will be attached to this fixture at the IU attach points and the SLA/AM attach points. (The fixture will be built in such a way as to allow the IU and SLA to be mated.) The fixture will support the SLA/AM high enough off the floor to mate with the S-IVB (approximately 23-25' floor to centerline of the SLA/AM). The fixture will have vernier adjustments in the vertical, to the left and right of the centerline, and along the centerline.

c. Test Fixtures for the MDA, CM, SM & LM - Each fixture will support the module in the horizontal position on cradles and will be set in place by an overhead crane and locked to the other support fixtures for the cluster. Other features of this fixture are the same as item b - SLA/AM.

d. Test Fixtures for the RM & ATM/Rack - Each fixture will support the module in the horizontal position with attachment to the rack structure. Other features of this fixture are the same as item b - SLA/AM.

e. Test Fixtures for the LM&SS - This fixture will support the LM&SS in the vertical position with the docking collar that mates with the MDA in the down position. The fixture will be set in place by an overhead crane, with the four support legs attached to the fixture supporting the MDA. The LM&SS will be supported at the SLA attach points. (The four SLA attach point legs on the rack may be removed and the support fixture tied to the rack structure.) Other features of the fixture are the same as item b - SLA/AM.

4.1.2.4 Internal Platforms and Ladders for Cluster Operation - Cluster test operations will be performed in a one "g" environment in an orientation described in section paragraph 4.1.2.2. In this environment, access and movement inside each cluster integrated experiment module will require platforms and ladders. Illustrations of these requirements are shown in figures 25 through 29.

4.1.3 Major Test Description - The basic objective of the cluster system compatibility test program is to verify the compatibility of the integrated experiment modules in the two basic orbit configurations of Flights AAP 1 and 2 experiment modules and Flights AAP 1, 2, 3 and 4 experiment modules.

The cluster systems compatibility test program will verify all orbital operations possible, within the constraint of the ground checkout environment, that are accomplished during these flights, and in addition, verification of critical malfunction corrective actions and emergency procedures and performance of special tests (i.e., parametric voltage, contingency tests, etc.).

The cluster test program for the orbit 1 and 2, and 1, 2, 3 and 4 configurations are basically performed in the same sequence. This sequence is depicted in the following paragraphs.

4.1.3.1 Subsystem/Experiment Compatibility Tests

a. Test Objectives - The basic objectives to be demonstrated during this test program are: Experiment Integration, Support Subsystem Operations, Man-Machine Compatibility, Spacecraft Module, Interface Ground Station Compatibility, and Limited EMC (antennas operated closed loop).

b. Prerequisites - Prior to starting the subsystem/experiment compatibility test program, EMC monitoring systems will be installed at selected locations to detect any EMC problems that may occur outside the open loop EMC test program and to provide information to determine a baseline for systems operation during the EMC test program.

c. Test Sequence - The subsystem/experiment compatibility test program will start with support subsystem tests, the individual experiment test and finally a simulated mission test.

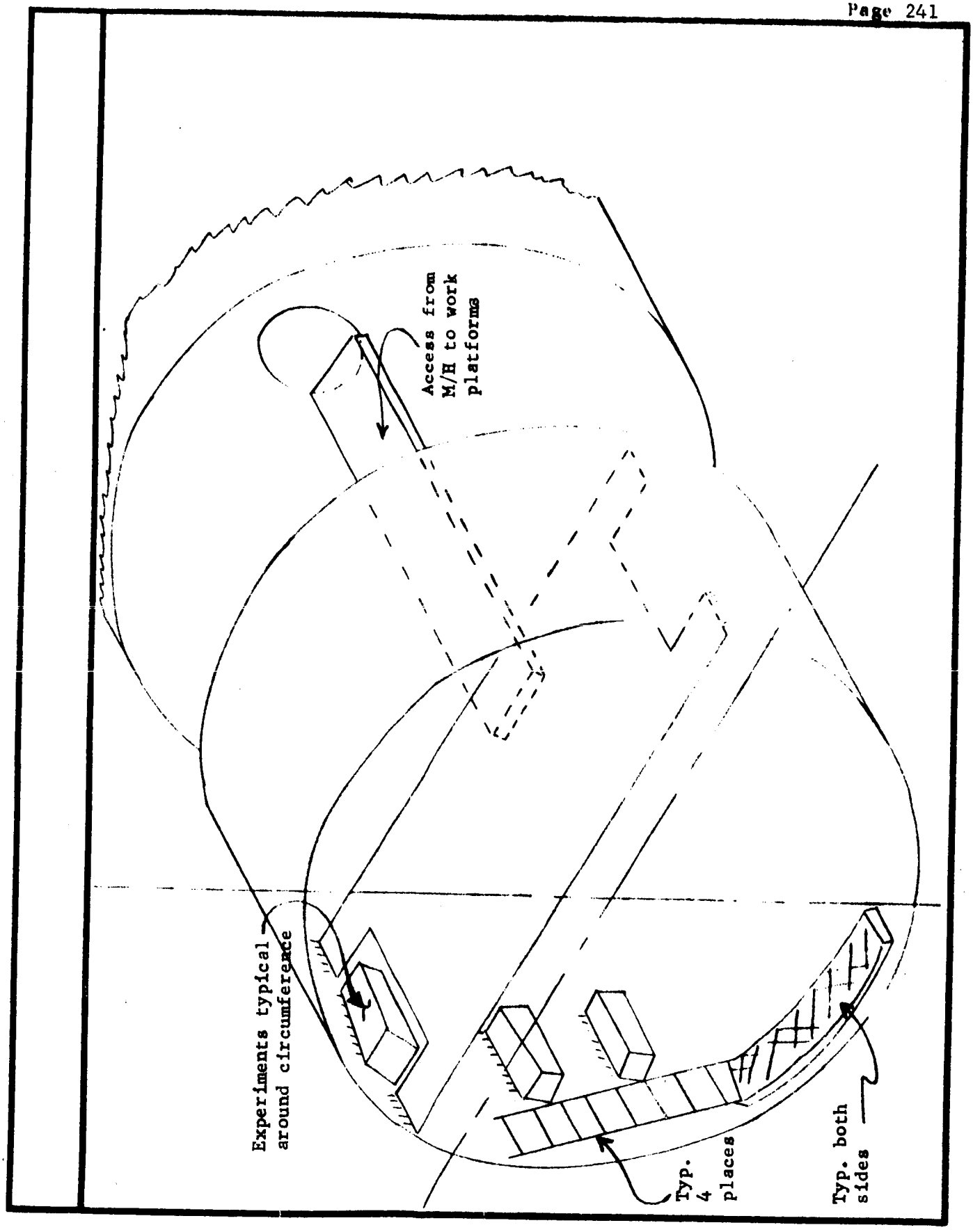


Figure 25. S-IVB Interior Work Platforms

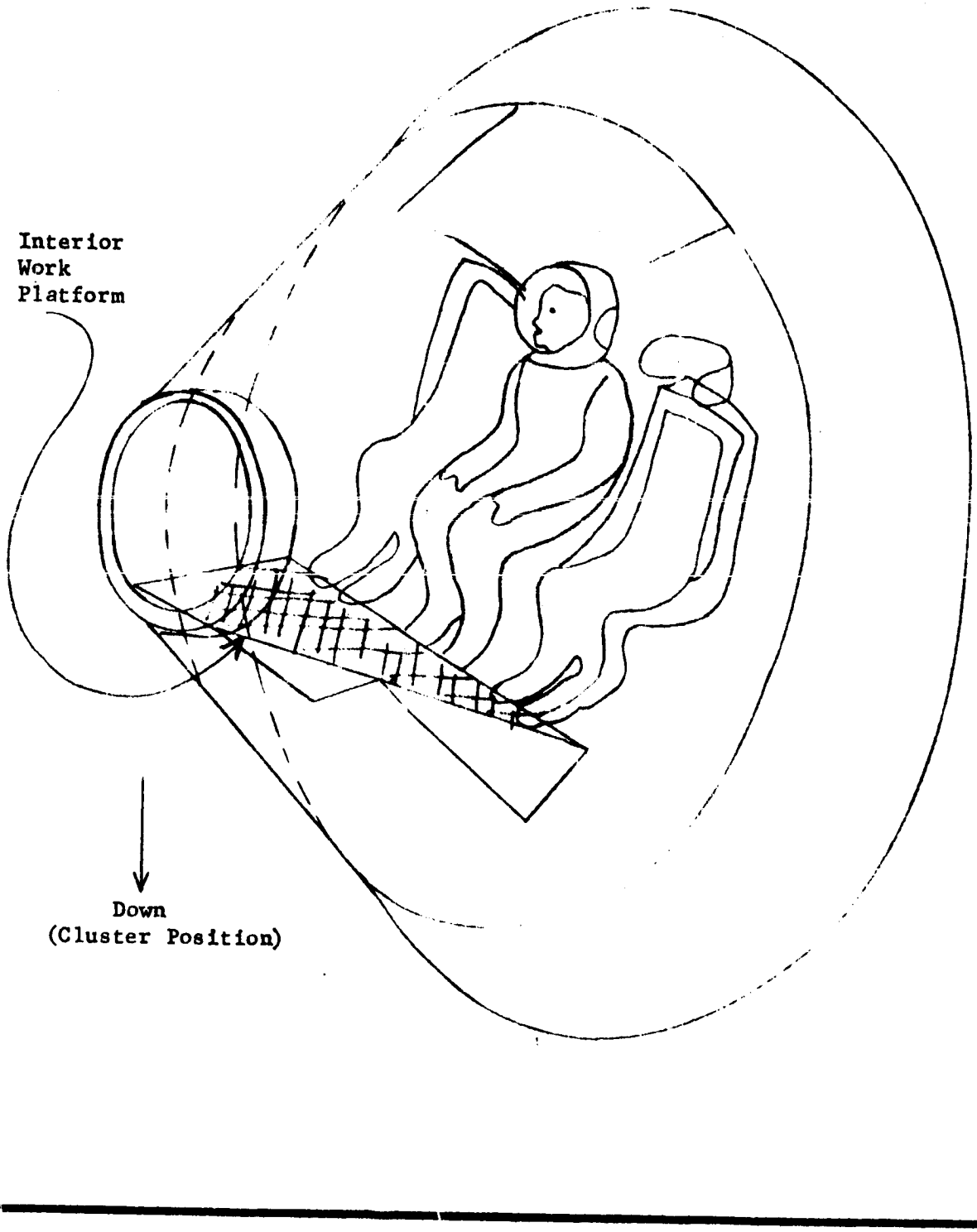


Figure 26. CM Interior Work Platforms

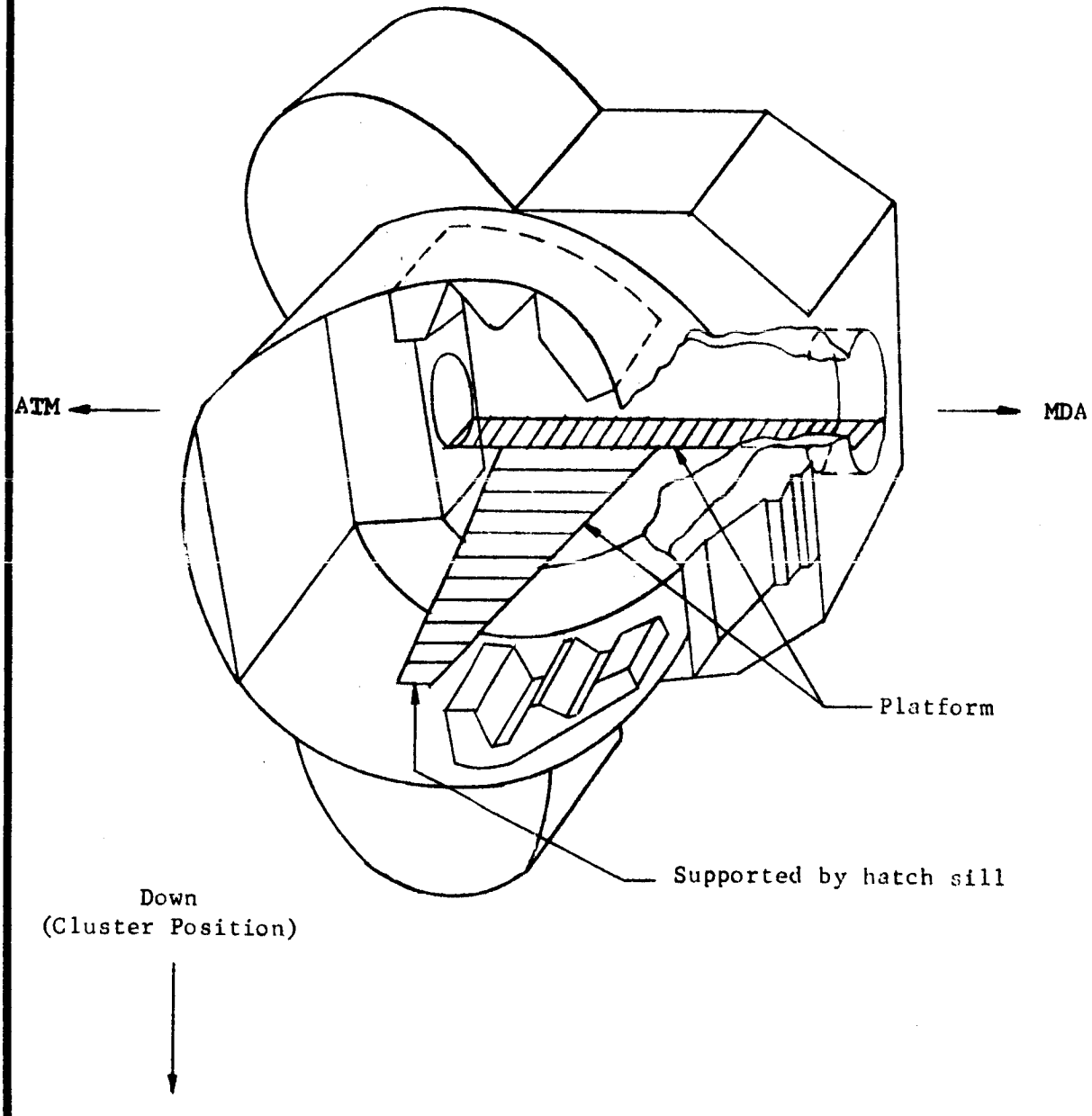


Figure 27. LM Internal Work Platforms

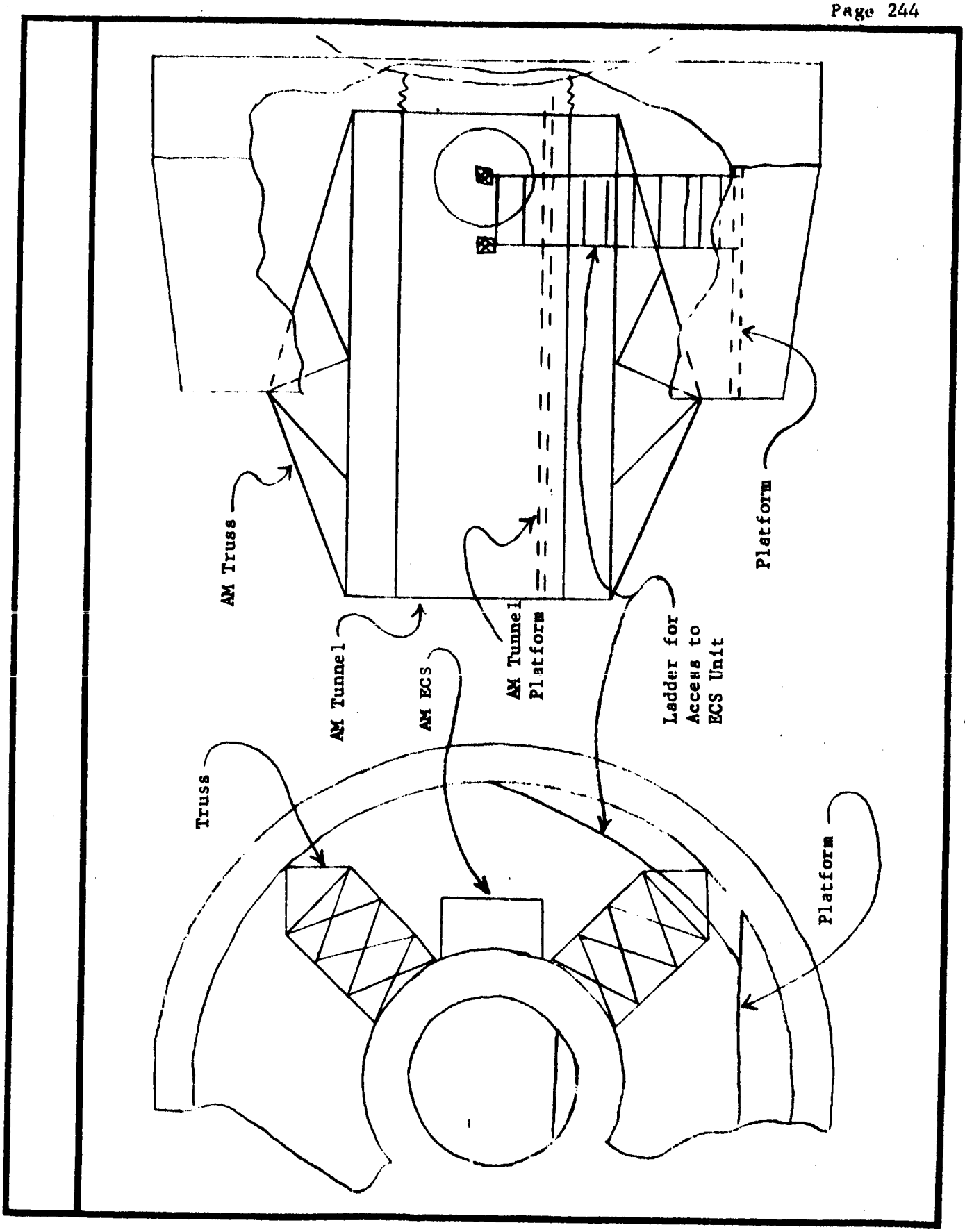


Figure 28. AM, SLA, IU Work Platforms

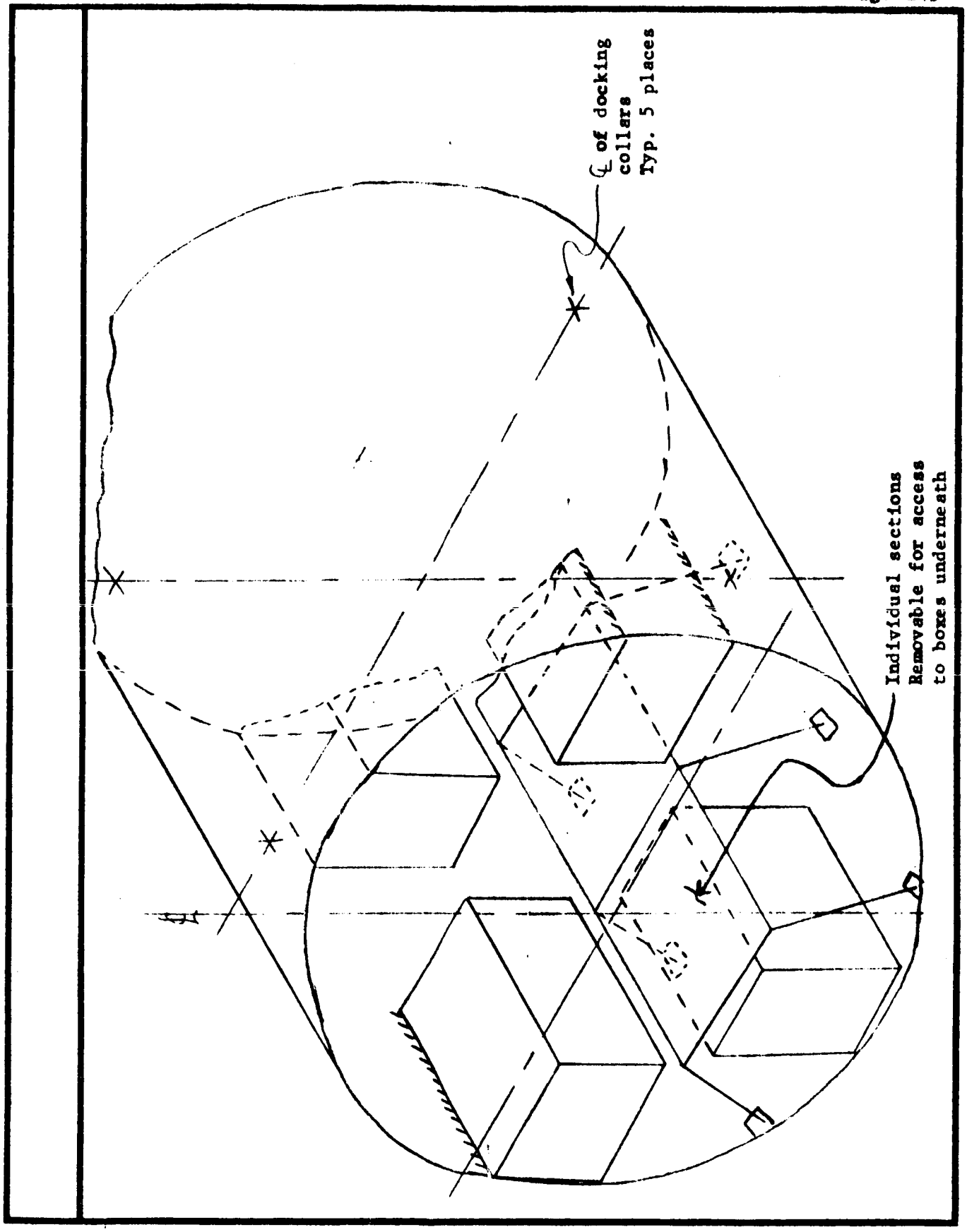


Figure 29. MDA Interior Work Platforms

All support subsystems will be tested prior to any experiment tests. These subsystem will be turned on in a mission sequence. Support subsystem parametric testing will be performed during this test phase.

After the support subsystem testing is complete, each experiment will be turned on one at a time in a mission sequence. This test phase basically verified the individual experiment and the cluster support subsystem compatibility.

Completion of the individual experiment checkout will be followed by a mission simulation test. This test will be performed with the subsystems and experiments operated in a mission sequence. Simultaneous operation of experiments will be determined by the experiment operation timelines, however, the operating times will be abbreviated.

4.1.3.2 EMC Test (Open Loop Antenna Operation)

a. Test Objective - The basic objective of the EMC test program is to verify the electromagnetic compatibility of the integrated experiment modules, support subsystems and experiments when operated in a mission sequence.

b. Prerequisites

(1) Configuration - The cluster configuration for this test will be the same as the previous test except the S-IVB and ATM/Rack solar array simulators will be installed and the LM&SS semifunctional mockup will be installed. In addition, the remaining EMC test monitors will be installed and connected to portable recorders or landline instrumentation.

(2) Prerequisite Tests - A mission sequence will be performed with the antennas operated closed loop and all EMC monitoring equipment operating to determine a baseline prior to the start of the open loop EMC test. After this test is complete, all landline connections possible will be removed, the airborne power system transferred to batteries, and the antenna systems set up for open loop operation.

c. Test Sequence - The EMC test program will start with the operation of each antenna system individually and culminate with a mission sequence. Each antenna system will be operated one at a time with the experiments not operating. Subsystem elements will be monitored to detect detrimental effects.

At the completion of this test phase, a mission simulation test will be performed with the subsystems and experiments operated in a mission sequence. Experiments and subsystems will be operated to a predicted mission timeline sequence, but to abbreviated time.

4.1.3.3 Contingency Tests

a. Test Objective - Contingency tests are performed on the two orbit configuration to verify the following:

(1) Demonstrate corrective actions required due to critical subsystem malfunction which affect astronaut safety.

(2) Verify that the malfunction analysis of critical failures is correct.

b. Prerequisites - Prior to starting the contingency test program, the subsystem/experiment compatibility and EMC test programs must have been completed to establish a firm baseline.

c. Test Sequence - The test sequences will be established after a complete malfunction analysis has been completed.

4.1.4 Ground Support Equipment - The cluster test program will be performed with each cluster control station manned to simulate orbit operations. Most of the test will be performed by either automatic signals sent by cluster sequencing equipment or by the test personnel at the various cluster control station locations. The ground station will be simulated to provide simulation of the up links and down links between the cluster and the ground stations. Some landlines will be required for such items as airborne power simulation (for solar arrays), ECS heat sinks, additional instrumentation, etc.

The actual integrated experiment module GSE, or equipment simulating this GSE, will be required to checkout the module prior to its operation in the cluster and in the event that support subsystem problems occur during the cluster test program. This GSE would not be required during the cluster operation with the exception of the GSE required to allow experiment module operations to be performed because of the ground checkout environment (i.e., ground heat sinks, solar array power simulators, etc.). In addition to the test and checkout GSE, transport and handling GSE will be required for each carrier.

The major pieces of GSE required for each module to check out the module prior to the cluster test program and those required during the cluster test program are identified in figure 30. The DDAS, DEE and Gemini ground station are the main pieces of GSE utilized during the cluster test program to provide the RF link with the cluster. Additional monitors may be required during cluster EMC testing to better evaluate the reactions of the various subsystems when exposed to the EMI environment likely to occur on orbit. Critical parameters (ordnance circuits, etc.) will be monitored continuously probably by carry-on recorders with data reduction to permit continuous monitoring.

The following paragraphs describe the major pieces of ground support equipment.

4.1.4.1 Carrier Checkout GSE Requirements

a. CSM & LM - The RCA-110A system at MSFC in conjunction with ACE type carry-on equipment will be utilized for the carrier tests. An interface adapter will be utilized between the RCA-110A and ACE carry-on equipment to perform the following:

(1) Adapt the parallel computer information from the RCA-110A to serial bi-phase information for input to the carry-on ACE.

(2) Adapt the serial bi-phase information from the ACE carry-on equipment to parallel computer information for input to the RCA-110A.

These carriers are to be used principally for cluster type testing and therefore need not be completely checked. Areas that likely will not need checking include the following:

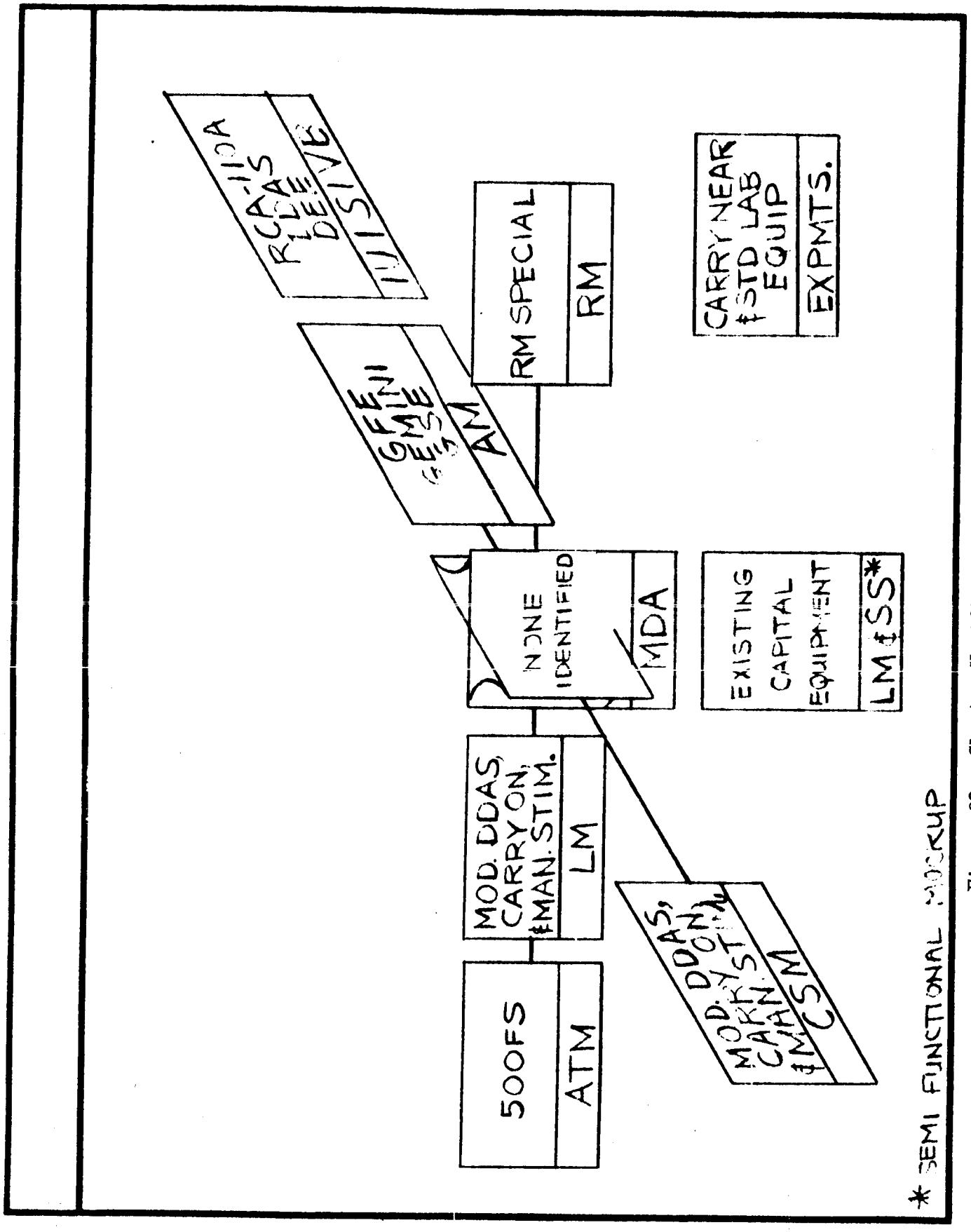


Figure 30. Cluster Verification Test, Electrical GSE

(1) Guidance and Navigation
(2) Propulsion System Operation
(3) Cryogenic Systems Operation

Fluid servicing equipment will be required during carrier precluster checkout and cluster test operations. These tests will generally require pressure/leak GSE, ground heat sinks and coolant servicing GSE. CSM and LM fluid servicing GSE will be supplied by the carrier contractor.

b. ATM/Rack - The ATM/Rack GSE identified by MSFC will be required to verify that a satisfactory checkout of the carrier has been performed prior to any cluster operation. When problems are encountered on the ATM during cluster tests, the ATM GSE will be used to verify fixes and/or to isolate the problem encountered.

There are no modifications anticipated for the ATM/Rack GSE hardware. The software required will be investigated and minimized to expedite the required test programs.

Special stimuli such as a simulated solar source will be provided by MSFC. Critical parameters will be constantly monitored by carry-on recording equipment with data reduction to permit continuous monitoring.

Fluid servicing of H_2O and LN_2 during cluster tests will be provided by existing GSE.

c. RM - The RM GSE has not been identified at this time. An assumption has been made that the carrier contractor will supply the necessary GSE. No hardware modifications are anticipated for MSFC testing. Software requirements will be analyzed and minimized to expedite the carrier verification as it relates to cluster usage. It is anticipated that a significant reduction can be made in this area since little or no resupply will be actually implemented (no cryogenics, high pressure gases, etc.) during the cluster test program. RM contractor supplied GSE will be employed.

d. AM - The GSE required to support the AM will be that identified by McDonnell and will be needed in its entirety. Checkout will be performed prior to cluster testing and, when AM malfunctions are encountered, to verify fixes and/or isolate problems during cluster testing.

McDonnell presently plans to provide two sets of GSE - one to be shipped to the MSOB at KSC and later to the launch complex, the other destined for MSC for training. The latter set would have to be diverted to MSFC for cluster support.

Cluster operation will depend on AM ground power except when performing the RFI portion of the test. The McDonnell TM ground station will be needed to monitor and record pertinent data from the carrier. Critical parameters will require carry-on recorders with data reduction to permit continuous monitoring.

Fluid servicing GSE will be required for coolant servicing and to supply a ground heat sink during cluster testing. All GSE will be contractor furnished.

e. MDA - The MDA GSE has not been identified at this writing. The required GSE will be nominal unless the present MDA tasks are expanded considerably. Ground handling, fluid servicing (leak testing) and electrical GSE will not be modified in any form. The same general concepts employed with the checkout of other carriers will be followed.

f. LM&SS - The LM&SS semifunctional mockup utilized in the cluster and associated tests at MSFC will provide interface and physical simulation of the actual carrier. Verification at MSFC prior to use in the cluster will probably consist of an electrical test of the interface. It is assumed that this can be performed with existing capital equipment for the most part with possibly some discrete type control capability also required.

Cluster operation will be handled by TM monitors and manually implemented stimuli. If critical parameters exist they will be handled in the same manner as proposed for the LM, CSM, etc.

g. S-IVB/IU - Cluster and associated tests will include verification of the passivation circuitry installed in the S-IVB/IU. This circuitry will be verified by an RCA-110A system including existing DDAS and DEE-3 capabilities. The command link portion will be verified utilizing the existing command and TM capability.

4.1.4.2 General GSE Requirements for Cluster Test Operations - The following GSE, in addition to providing checkout capability for the individual carriers of the cluster, will be required for cluster operations. The major items in this category are as follows:

a. DEE-3 - This piece of GSE will be utilized to monitor critical EMC and mission sequence parameters not normally monitored or that require relatively fast response capabilities for transient recording. This system will not be used during EMI testing.

b. DDAS - Four channel DDAS capability is anticipated to handle the ATM, LM, CSM and carry-on PCM systems. The LM & CSM channels will require modifications to permit the DDAS (72 KBPS capability) to be compatible with the 51.2 KBPS PCM train available from these carriers. The complete system will probably not include all line drivers, line receivers, etc. associated with a standard KSC installation. Software changes will be incorporated as required. Complete pre-detection recording and some post detection recording and display will be implemented.

c. Carry-On PCM System - This system will consist of one each Mod. 3.1 PCM unit, Mod. 410 multiplexer, Mod. 270 multiplexer and CT-19B RF assembly. The latter will be needed only during RFI tests when the cluster should be connected to the ground through RF links only.

d. Instrumentation Ground Station - This system will be used in conjunction with the DDAS to receive, demodulate, demultiplex, decode and record TM data. Additional capability exists for accommodating FM and SSB carriers if the requirement develops.

e. Ground Power Supplies - Two additional 28V ground power supplies (one for the ATM and one for the AM) will be required during cluster tests. These will not be used, however, during EMI tests since they would not permit isolation of the cluster as desired.

f. Gemini Ground Station - A portion of the Gemini ground station will be utilized during the cluster test program to provide the RF link between the AM and ground.

The ground station will also process the RF information.

4.1.4.3 Special Test Equipment - The special test equipment required to supplement the GSE identified in the previous paragraph in support of the cluster test program includes:

Platforms and Access Equipment

a. Inside Work Platforms - S-IVB - Portable work platforms and ladders will be required inside the S-IVB to reach all areas during experiment and subsystem installation and operation.

b. Outside Work Platforms - Work platforms outside the test articles will be required for access on all cluster configurations. The platforms for access to the cluster will be movable (wheels) and have one adjustable level. Platforms will support 500 pounds and have an area 3 feet by 5 feet. Platform will extend from ground level to 35 feet high and will have a 10-foot horizontal travel.

c. Platforms Inside all Modules to Crawl/Walk - Platforms to crawl or walk will be required inside the following modules: AM, RM, MDA, LM, & CSM. The platforms will be in sections to allow access to equipment, consoles, etc. under the platforms. The platforms will be light weight (fiberglass). These platforms will have a variable 3-foot to 6-foot length, approximately 2 feet wide. Platform support frames will be required shaped like a π (cross member with two legs) to lock into the platforms. Support frames are 2' wide with two adjustable legs (1½ to 3 feet) with padding on the legs.

Electrical Tools

a. Landline Instrumentation Harness - An instrumentation harness connecting all added instrumentation points on the cluster will be required. This harness will connect approximately 1000 instrumentation points to a central data system on the cluster. Average run 50 feet.

In addition, a landline instrumentation cable between the cluster and the instrumentation ground station will be required. This cable will be approximately 200 feet long.

b. Temporary Lighting Inside Cluster - Temporary lighting will be required inside the cluster in all working areas to allow operations to be performed when the normal module systems are not operating or during emergency conditions. Areas where lighting is required are S-IVB, AM, MDA, LM, RM and CM.

c. Communications System Between Test Locations - A headset communications system will be required between all stations in the cluster, the outside GSE test positions, the instrumentation ground station, and a central test conductors area. Approximately 35 positions are required with at least the selection capability of 8 channels.

d. Central Timing Distribution System - Central timing will be distributed to all GSE, ground station, and special test equipment which contain recording devices. This will allow synchronization of all recordings. In addition, certain discretes will be recorded over the same system.

e. Fire Alarm and Safety System Inside Cluster - A fire or emergency alarm system will be installed in the cluster during testing. This system will include a PA system and a bell alarm system. In addition, standard fire fighting equipment will be installed, i.e., portable extinguishers, etc.

Mechanical Tools

a. Fixture to Support Erectable Equipment Which Cannot Withstand a One "G" Environment - The solar panels will require support when extended in a one "G" environment. In addition, certain booms which will be extended during testing will also require additional support. These supports will be a tripod system, with a small cradle to support the deployed device and extendable from 5 to 10 feet, 10 to 20 feet, and 20 to 40 feet.

b. ATM/Rack Solar Panel Simulators - The ATM/Rack solar panels are required to provide RF reflection during the cluster EMC test program. These panels will be fabricated from the same outside material as the actual panels (parts toward cluster). Four panels will be required. These panels will be of the same size and shape as the actual ATM/Rack panels, but strong enough to support their own weight.

c. OWS Solar Panel Simulators - The OWS solar panels are required to provide RF reflections during the cluster EMC test program. These panels will be fabricated from the same outside material as the actual panels. Two panels are required. These panels will be of the same size and shape as the actual panels, but strong enough to support their own weight (with support at two places along the panel).

4.1.4.4 Experiment GSE - Experiments will be verified prior to carrier installation in the experiment accommodations area at MSFC.

Experiment peculiar GSE will be provided by the experiment contractor and will be provisioned in the experiment accommodations area.

Fluid servicing will be provided during cluster operation as follows:

a. Experiment M489, Heat Exchanger Service
H_2O and vacuum pump to permit operation longer than a few seconds.

b. Experiment M493, Electron Beam Welding
Vacuum Pump needed to permit operation.

4.1.5 Facilities

4.1.5.1 Basic Requirements - The building to perform the cluster test program needs to be large enough to allow complete assembly of the Flights AAP 3 and 4 cluster in the horizontal position as described in paragraph 4.1.2.2, "Cluster Configuration Orientation." In addition, a clearance of 6 to 14 feet from all antennas should be provided from all building reflective surfaces to obtain the best results during the open loop EMC test sequence. The building to accommodate these size requirements has to have an area approximately 135 feet long, 80 feet wide and 70 feet high to allow installation of the presently defined configuration shown in figure 16.

This building should also include the following items:

a. Pressurization Area - During the cluster test program, certain subsystem components in the cluster will be pressurized (3000 psia. N_2 in a 3 cubic-foot volume or the entire cluster pressurized to 7 psig). This building must be capable of accommodating these test requirements.

b. Overhead Crane - An overhead crane is needed for the movement of the integrated experiment modules.

c. Support Equipment Area - In addition to the test article, space is required for the cluster support equipment, i.e., ground station, power supplies and GSE for the integrated experiment modules and experiments.

Two buildings have been considered for the cluster test program, building 4708 and building 4755.

4.1.5.2 Building 4708 - Building 4708 has the following specifications: a floor space area of 177 feet by 80 feet with an overhead hook height of approximately 33 feet, and a ceiling height of 43 feet. This area is surrounded by a blast screen for pressurization testing. The ground station is positioned on the side of the blast screen. (Reference figure 31)

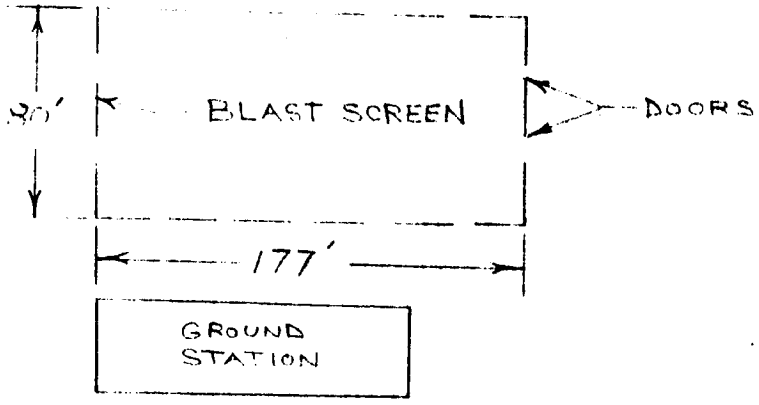
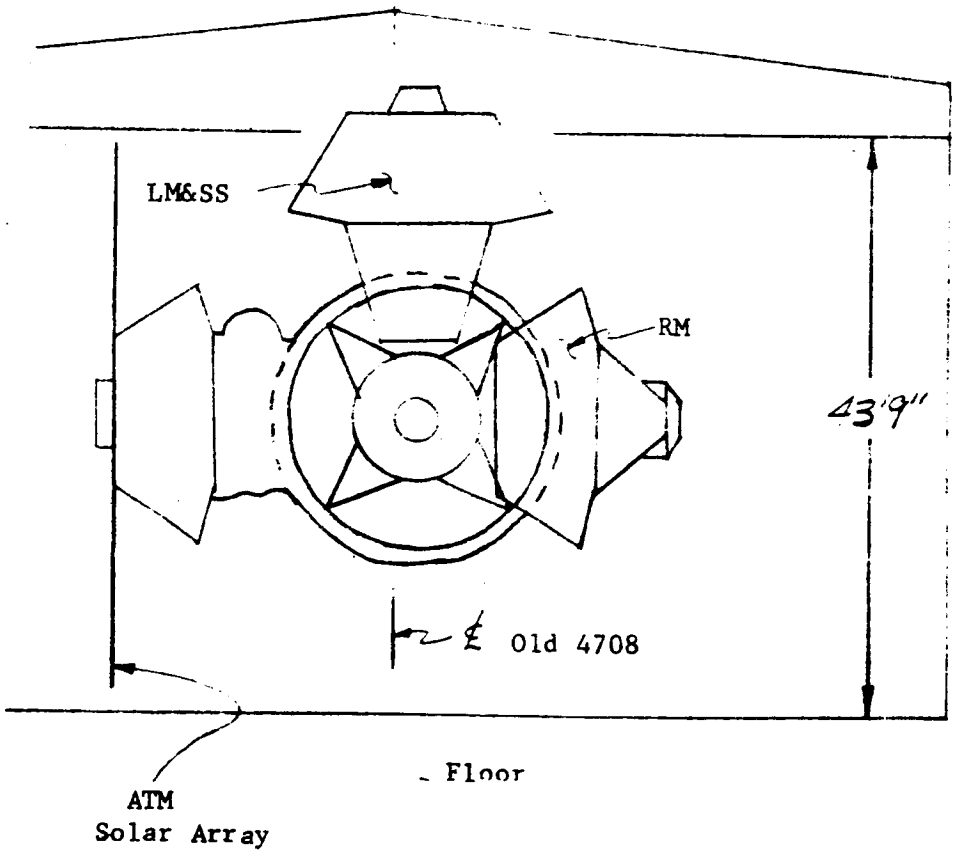


Figure 31. Building 4708 Floor Plan, Pressurization Area

This building has the overhead crane, a pressurization area, and a support equipment area (including a ground instrumentation system); however, the height of the ceiling does not meet the size requirements. Figure 32 shows that the cluster configuration can be accommodated. However, use of this building will have a degrading effect on the open loop EMC test (i.e., basic structure should be no closer than 2 λ from the antennas or 6 to 14 feet.

4.1.5.3 Building 4755 - Building 4755 has the following specifications: A floor space area of 153 feet by 232 feet with an overhead hook height of approximately 76 feet and a ceiling height of 86 feet.

This building has an overhead crane, a support equipment area, and adequate size to contain the cluster configuration. A blast screen would have to be provided. The basic problem with using this building is the present ground station location which is in building 4708. At this location, a ground station landline system will have to be provided between building 4708 ground station and building 4755 (approximately 3000 feet). An RF link could be substituted for some of the landline system.



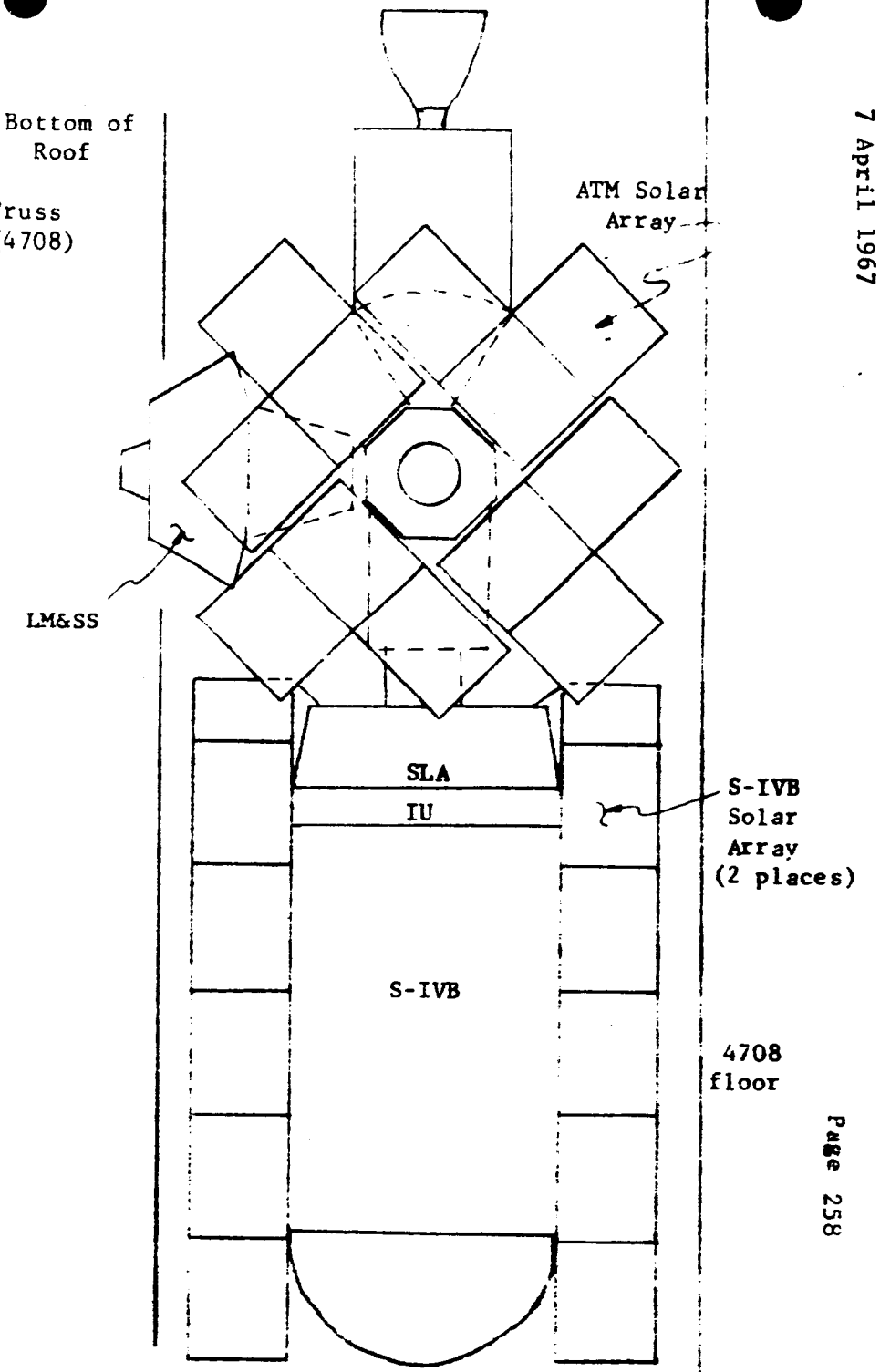


Figure 32. Flights AAP 1 thru 4 Cluster Configuration installed in Bldg. 4708 for EMC

4.1.6 Cluster Test Problem Areas - During the formulation of the cluster test program, several problem areas were identified. Each problem was investigated to the extent that a solution could be identified. The problems that were significant are identified in the following Problem Summary (figure 33) along with the basic solution. A detailed discussion on each problem area is contained in the "Cluster Verification Test Justification and Feasibility" technical study and analysis report, ED-2002-68, dated 17 March 1967.

PROBLEM	SOLUTION
EMC Compatibility	
Determine the EMC test location that is the most cost effective, and will give good test results.	Both an outside open area and an enclosed area were considered. The enclosed area was chosen as the most cost effective, with good test results. Building 4708 and 4755 were chosen as the two enclosed areas.
Ground Isolation during the EMC test.	Operate the cluster open loop, on internal power supplies, manned, and data gathered by TM (open loop) tape recorders and go-no-go circuits.
One "G" Environment	
Mobility and access within the cluster.	Select cluster orientation to achieve best access within LM & CM and provide crawl/access platforms within modules.
Experiments and subsystems that will not operate due to cluster orientation.	If the experiment or subsystem operation is required: 1. Use a functional simulator. 2. Remove the component/experiment and orient in a new position
Cluster orientation of modules causes degradation of man-machine compatibility tests (i.e., the use of crawl/access platforms hampers evaluation of operation timelines.)	Cluster testing will have to be supplemented by cluster segment testing to verify man-machine compatibility (i.e., during the ATM/Rack LM test program, it will be oriented so that the LM floor is in the down position, or during the S-IVB qualification program, it will be oriented so the workshop floor is in the down position.

Figure 33. Problem Summary
(Sheet 1 of 3)

PROBLEM	SOLUTION
Support fixture interference with subsystem or experiment mechanical interference checks during cluster test operations.	Design the support fixture to have interference and supplement these mechanical interference checks by tests on the non-functional mockup.
Schedule Perform the cluster test program within the AAP program guideline schedule.	Split the test program in two parts; perform all flight 1/2 cluster test prior to flight #1, and perform all flight 3/4 cluster test prior to flight #3. If incompatibilities are found between 1/2 and 3/4 modules after flight 2, rework flight 3/4 modules.
Cryogenics Transfer, handling and use of cryogenics during cluster operations poses hazardous conditions to the cluster modules, ground support equipment and personnel in the proposed cluster test locations (Bldg. 4708 or Bldg. 4755).	Remove the modules involved with cryogenics from the cluster test area to a cryogenic test area and perform the operations involving cryogenics. Simulate their operation during the cluster test program.
Environmental Control System Operations Environmental control system compatibility cannot be demonstrated between the AM, LM and CSM because of 14 psia ambient pressure invalidates tests concerning heat transfer, gas mixing and pressurization.	Perform thermal vacuum tests on modules to evaluate the individual AM, LM & CSM ECS operation and use analysis to evaluate cluster systems operation. In addition, operate the ECS system during cluster testing to the extent possible at 14 psia to allow evaluation of its interfaces with other experiments/subsystems.

Figure 33. Problem Summary
(Sheet 2 of 3)

PROBLEM	SOLUTION
Solar Array Power Solar array operation during the cluster test would require a large collimated light source plus a solar array air conditioning system.	Actual operation of the solar arrays is not feasible due to the expense of test setup and questionable operation during test. Solar array simulators will be utilized that simulate the input characteristics of the solar array and analysis used to supplement the simulator to demonstrate solar array system compatibility.
Contingencies 1. Malfunction of systems which are not operated at the cluster level. 2. Malfunction of components that could cause damage to other system elements.	These malfunctions will have to be demonstrated at a sub cluster level or by analysis. After a determination that the test is required, those components suspected of being damaged by the test would be spared for replacement after test.
Experiment Availability It is anticipated that some of the experiments will not be available at the start of the test program.	Functional simulators will be utilized until the experiment prototype is available.

Figure 33. Problem Summary
(Sheet 3 of 3)

4.2 Prerequisites - The test programs to support the intercarrier verification test program should be complete prior to the start of the intercarrier tests.

Included in these prerequisites are the following:

a. Completion of the full-scale mockup program to determine compatibility of all mechanical interfaces.

b. Completion of the scale model antenna test program to determine optimum placement on all antennas for the various orbit configurations.

c. Completion of the thermal analysis of the orbital configurations and/or completion of thermal model tests.

The details of the above test programs are found in the development test section of this report.

4.3 Launch Configuration Compatibility Tests

4.3.1 Flight AAP 1 - The LM&SS is a new integrated experiment module and verification of the LM&SS access and servicing during prelaunch will be performed. The launch configuration will be assembled utilizing prototype test articles.

The Flight AAP 1 launch configuration EMC test will be required. Launch EMC will be performed as part of the flight hardware prelaunch tests at KSC.

The detail of the Flight AAP 1 launch verification test program is described in the following flow diagram (figure 34) and accompanying test descriptions (Table XVI).

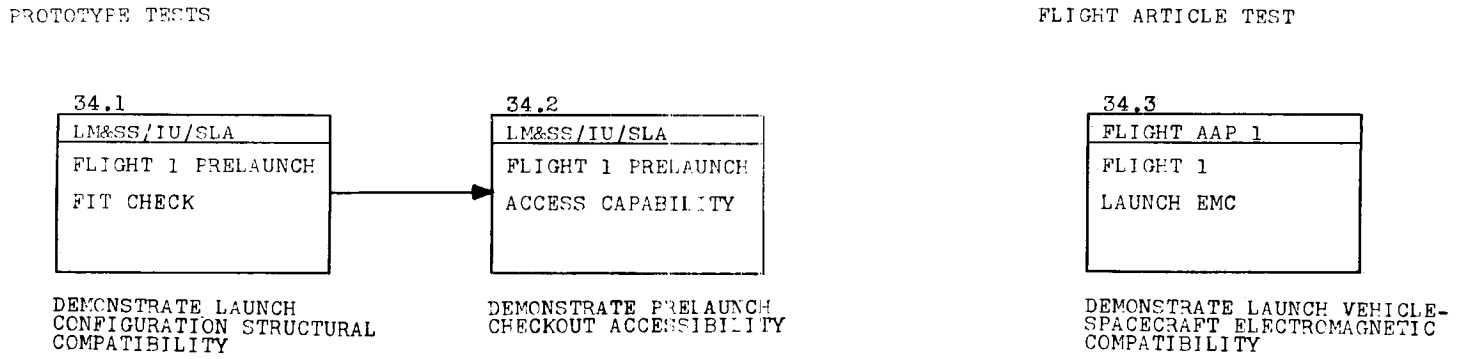


FIGURE 34

FLIGHT AAP 1
LAUNCH COMPATIBILITY TESTS

DATE: 7 APRIL 1967

Figure 34. Flight AAP 1 Launch Compatibility Tests

Table XVI. Test Descriptions for Figure 34

TEST TITLE	TEST NUMBER
Flight AAP 1 Prelaunch Fit Check	34.1

TEST OBJECTIVE

Demonstrate that for Flight AAP 1 there are no structural interface problems for prelaunch checkout.

TEST CONFIGURATION

1. Prototype flight configured LM&SS
2. Prototype flight configured SLA
3. Prototype flight configured IU

TEST DESCRIPTION

PREPARATION

The IU/Lower SLA combination will be set up in the vertical position as follows:

The IU support fixture will be positioned on the floor and the IU and Lower SLA positioned on this fixture. Access platforms will be positioned at the same height as the launch platform levels.

OPERATION

The LM&SS prototype will be lowered on the lower SLA attachment area. The Upper SLA will be positioned over the LM&SS Rack and attached to the Lower SLA. Verification will be made that no incompatibilities exist at the structural interface and that no interference exists between the LM&SS and SLA/IU.

CRITERIA FOR SUCCESS

No structural interference problems shall exist between the LM&SS and SLA/IU combination.

SUPPORT REQUIREMENTS

GSE

1. LM&SS transport and handling equipment
2. SLA transport and handling equipment.
3. IU transport and handling equipment.

Table XVI. (Cont.)

Flight AAP 1 Prelaunch Fit Check (continued)

SPECIAL TEST EQUIPMENT

1. IU support fixture between floor and IU.
2. Internal work platforms.

FACILITIES

1. Area to perform physical fit to LM&SS/SLA/IU in vertical position.
2. Overhead crane
3. Platforms for work access (same levels as launch).

Table XVI. (Cont.)

TEST TITLE	TEST NUMBER
Flight AAP 1 Prelaunch Access Capability	34.2

TEST OBJECTIVE

Demonstrate Flight AAP 1 prelaunch checkout accessibility to LM&SS

TEST CONFIGURATION

1. Prototype flight configured LM&SS
2. Prototype flight configured SLA
3. Prototype flight configured IU

TEST DESCRIPTION

PREPARATION
The Flight AAP 1 prelaunch fit check shall have been performed and the LM&SS, SLA and IU will be in the vertical position. Access platforms will be positioned at the same height as the launch platform levels. Prelaunch servicing GSE will be installed on the applicable levels.

OPERATION
Flight servicing GSE will be connected and verification will be made that all prelaunch ground servicing can be accomplished in prescribed sequence. GSE compatibility will be demonstrated. Man-machine relationship will be verified. No fluids will be transferred.

(After test, the LM&SS, SLA and IU will be placed on transporters.)

CRITERIA FOR SUCCESS

1. Man-machine relationship will be verified.
2. Prelaunch servicing GSE shall be demonstrated compatible with flight hardware.

SUPPORT REQUIREMENTS

GSE
1. Flight LM&SS servicing GSE
2. LM&SS, SLA&IU transport & handling GSE

SPECIAL TEST EQUIPMENT
1. Internal work platforms

Table XVI. (Cont.)

Flight AAP 1 Prelaunch Access Capability (continued)

FACILITIES

1. Area to perform LM&SS/SLA/IU access check.
2. Platforms for work access (same levels as launch).

Table XVI. (Cont.)

TEST TITLE	TEST NUMBER
Flight AAP 1 Launch EMC	34.3

TEST OBJECTIVE

Demonstrate that launch EMI environment has no adverse effects on carrier systems.

TEST CONFIGURATION

The flight CSM and LM&SS will be installed on the launch vehicle

TEST DESCRIPTION

PREPARATION
EMC monitoring equipment will be installed on the specified carrier subsystems and experiments.

OPERATION
The effects of launch EMI on the carriers will be monitored during the launch vehicle/spacecraft simulate boost phase test sequence. This test will be an open loop RF test. (Normal Apollo test.)

CRITERIA FOR SUCCESS

The launch environment shall have no adverse effects on the carrier subsystems and experiments.

SUPPORT REQUIREMENTS

GSE
1. GSE to support simulated launch program

SPECIAL TEST EQUIPMENT
1. EMC monitoring equipment

FACILITIES
1. Launch vehicle test area (normal Apollo test presently performed).

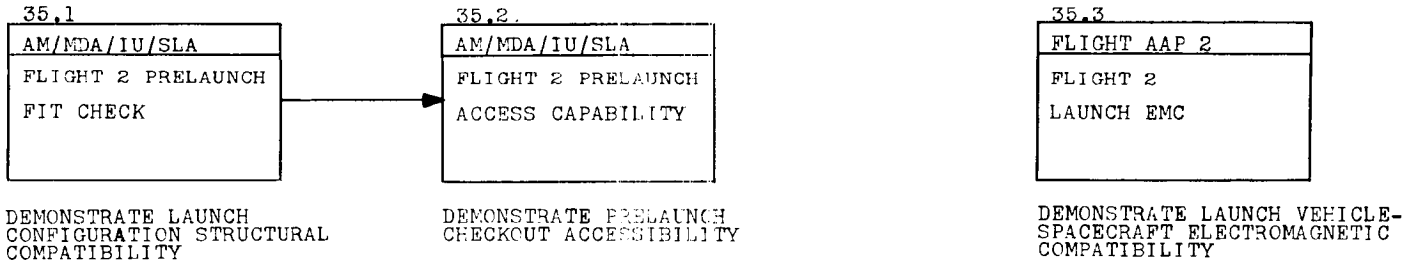
4.3.2 Flight AAP 2 - The integrated experiment modules involved in Flight AAP 2 are all new or modified and will require verification of experiment module access and servicing during prelaunch.

The verification of flight article EMC will be performed on the flight articles at KSC.

The details of the Flight AAP 2 launch verification test program are described in the following test flow diagram (figure 35) and accompanying test descriptions (Table XVII).

PROTOTYPE TESTS

FLIGHT ARTICLE TEST



DEMONSTRATE LAUNCH CONFIGURATION STRUCTURAL COMPATIBILITY

DEMONSTRATE PRELAUNCH CHECKOUT ACCESSIBILITY

DEMONSTRATE LAUNCH VEHICLE-SPACECRAFT ELECTROMAGNETIC COMPATIBILITY

FIGURE 35

FLIGHT AAP 2
LAUNCH COMPATIBILITY TESTS

DATE: 7 APRIL 1967

Figure 35. Flight AAP 2 Launch Compatibility Tests

Table XVII. Test Descriptions for Figure 35

TEST TITLE	TEST NUMBER
Flight AAP 2 Prelaunch Fit Check	35.1

TEST OBJECTIVE

Demonstrate that for Flight AAP 2 there are no structural interface problems for prelaunch checkout.

TEST CONFIGURATION

1. Prototype flight configured AM
2. Prototype flight configured MDA
3. Prototype flight configured SLA
4. Prototype flight configured IU

TEST DESCRIPTION

PREPARATION
The IU/Lower SLA combination will be set up in the vertical position as follows:

The IU support fixture will be positioned on the floor and the IU and Lower SLA positioned on the fixture. Access platforms will be positioned at the same height as the launch platform levels.

OPERATION
The AM prototype will be lowered on the Lower SLA attachment area. The MDA will be lowered and attached to the AM, then the Upper SLA will be positioned over the AM/MDA and attached to the Lower SLA. Verification will be made that no incompatibilities exist at the structural interfaces and that no interference exists between the AM/MDA and SLA/IU.

CRITERIA FOR SUCCESS

No structural interference problems shall exist between the AM/MDA and SLA/IU combination.

SUPPORT REQUIREMENTS

GSE
1. AM transport and handling GSE.
2. MDA transport and handling GSE

Table XVII. (Cont.)

Flight AAP 2 Prelaunch Fit Check (continued)

3. SLA transport and handling GSE
4. IU transport and handling GSE

SPECIAL TEST EQUIPMENT

1. IU support fixture between floor and IU
2. Internal work platforms

FACILITIES

1. Area to perform physical fit of AM/MDA/SLA/IU in vertical position
2. Overhead crane
3. Platforms for work access (same levels as launch).

Table XVII. (Cont.)

TEST TITLE	TEST NUMBER
Flight AAP 2 Prelaunch Access Capability	35.2

TEST OBJECTIVE

Demonstrate Flight AAP 2 prelaunch checkout accessibility to AM/MDA.

TEST CONFIGURATION

1. Prototype flight configured AM
2. Prototype flight configured MDA
3. Prototype flight configured SLA
4. Prototype flight configured IU

TEST DESCRIPTION

PREPARATION
The Flight AAP 2 prelaunch fit check shall have been performed and the AM, MDA, SLA and IU will be in the vertical position. Access platforms will be positioned at the same height as the launch platform levels. Prelaunch servicing GSE will be installed on the applicable levels.

OPERATION
Flight servicing GSE will be connected and verification will be made that all prelaunch ground servicing can be accomplished in prescribed sequence. GSE compatibility will be demonstrated. Man-machine relationship will be verified. No fluids will be transferred.

(After test, the AM, MDA, SLA and IU will be placed on transportors)

CRITERIA FOR SUCCESS

1. Man-machine relationship will be verified.
2. Prelaunch servicing GSE shall be demonstrated compatible with flight hardware.

SUPPORT REQUIREMENTS

GSE
1. Flight AM/MDA servicing GSE.
2. AM, MDA, SLA, and IU transport and handling GSE.

Table XVII. (Cont.)

Flight AAP 2 Prelaunch Access Capability (continued)

SPECIAL TEST EQUIPMENT
1. Internal work platforms

FACILITIES
1. Area to perform AM/MDA/SLA/IU access check
2. Platforms for work access (same levels as launch)

Table XVII. (Cont.)

TEST TITLE	TEST NUMBER
Flight AAP 2 Launch EMC	35.3

TEST OBJECTIVE

Demonstrate that launch EMI environment has no adverse effects on carrier systems.

TEST CONFIGURATION

The flight S-IVB, AM, MDA, IU, SLA and Nose Cone will have been installed on the launch vehicle.

TEST DESCRIPTION

PREPARATION
EMC monitoring equipment will be installed on the specified carrier subsystems and experiments.

OPERATION
The effects of launch EMI on the carriers will be monitored during the launch vehicle/spacecraft simulate boost phase test sequence. This test will be an open loop RF test (normal Apollo test).

CRITERIA FOR SUCCESS

The launch environment shall have no adverse effects on the carrier subsystems and experiments.

SUPPORT REQUIREMENTS

GSE
1. GSE to support simulated launch program

SPECIAL TEST EQUIPMENT
1. EMC monitoring equipment

FACILITIES
1. Launch vehicle test area (normal Apollo test presently performed).

4.3.3 Flight AAP 3 - The RM is a new integrated carrier and verification of the RM access and servicing during prelaunch needs to be performed in the launch configuration. This verification will be performed utilizing prototype test articles.

The verification of flight article EMC will be performed on the flight articles at KSC.

The details of the Flight AAP 3 launch verification test program are described in the following flow diagrams (figure 36) and accompanying test descriptions (Table XVIII).

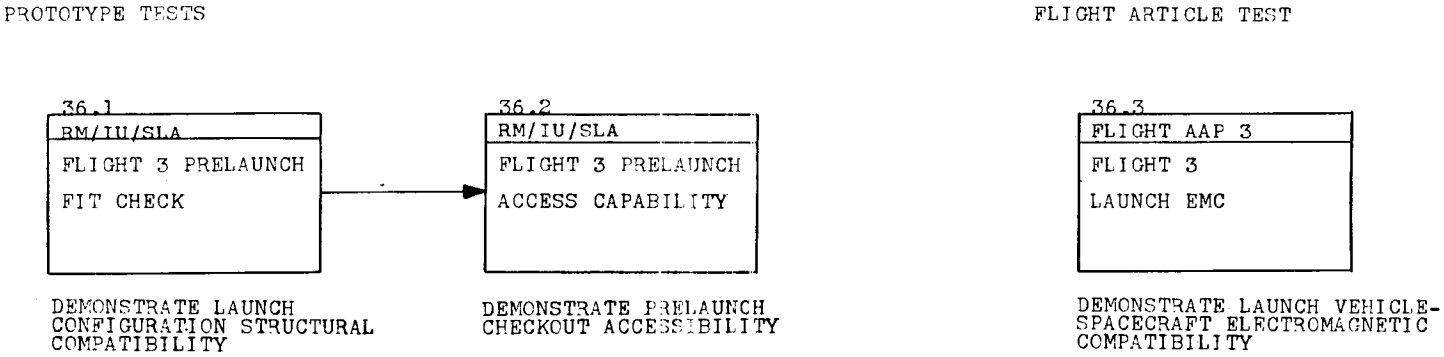


FIGURE 36

FLIGHT AAP 3
LAUNCH COMPATIBILITY TESTS

DATE: 7 APRIL 1967

Figure 36. Flight AAP 3 Launch Compatibility Tests

Table XVIII. Test Descriptions for Figure 36

TEST TITLE	TEST NUMBER
Flight AAP 3 Prelaunch Fit Check	36.1

TEST OBJECTIVE

Demonstrate that for Flight AAP 3 there are no structural interface problems for prelaunch checkout.

TEST CONFIGURATION

1. Prototype flight configured RM
2. Prototype flight configured SLA.
3. Prototype flight configured IU.

TEST DESCRIPTION

PREPARATION
The IU/Lower SLA combination will be set up in the vertical position as follows:

The IU support fixture will be positioned on the floor and the IU and Lower SLA positioned on this fixture. Access platforms will be positioned at the same height as the launch platform levels.

OPERATION
The RM prototype will be lowered on the Lower SLA attachment area. The Upper SLA will be positioned over the RM and attached to the Lower SLA. Verification will be made that no incompatibilities exist at the structural interface and that no interference exists between the RM and SLA/IU.

CRITERIA FOR SUCCESS

No structural interference problems shall exist between the RM and SLA/IU combination.

SUPPORT REQUIREMENTS

GSE
1. RM transport and handling equipment.
2. SLA transport and handling equipment.
3. IU transport and handling equipment.

Table XVIII. (Cont.)

Flight AAP 3 Prelaunch Fit Check (continued)

SPECIAL TEST EQUIPMENT

1. IU support fixture between floor and IU.
2. Internal work platforms

FACILITIES

1. Area to perform physical fit of RM/SLA/IU in vertical position
2. Overhead crane.
3. Platforms for work access (same levels as launch).

Table XVIII. (Cont.)

TEST TITLE	TEST NUMBER
Flight AAP 3 Prelaunch Access Capability	36.2

TEST OBJECTIVE

Demonstrate Flight AAP 3 prelaunch checkout accessibility to RM.

TEST CONFIGURATION

1. Prototype flight configured RM
2. Prototype flight configured SLA
3. Prototype flight configured IU

TEST DESCRIPTION

PREPARATION
The Flight AAP 3 prelaunch fit check shall have been performed and the RM, SLA and IU will be in the vertical position. Access platforms willbe positioned at the same height as the launch platform levels. Prelaunch servicing GSE will be installed on the applicable levels.

OPERATIONS
Flight servicing GSE will be connected and verification will be made that all prelaunch ground servicing can be accomplished in prescribed sequence. GSE compatibility will be demonstrated. Man-machine relationship will be verified. No fluids will be transferred.

(After test, the RM, SLA & IU will be placed on transportors.)

CRITERIA FOR SUCCESS

1. Man-machine relationship will be verified.
2. Prelaunch servicing GSE shall be demonstrated compatible with flight hardware.

SUPPORT REQUIREMENTS

GSE
1. Flight RM servicing GSE.
2. RM, SLA & IU transport and handling GSE.

SPECIAL TEST EQUIPMENT
1. Internal work platofrms.

Table XVIII. (Cont.)

Flight AAP 3 Prelaunch Access Capability (continued)

FACILITIES

1. Area to perform RM/SLA/IU access check
2. Platforms for work access (same levels as launch).

Table XVIII. (Cont.)

TEST TITLE	TEST NUMBER
Flight AAP 3 Launch EMC	36.3

TEST OBJECTIVE

Demonstrate that launch EMI environment has no adverse effects on carrier systems.

TEST CONFIGURATION

The flight RM and CSM will be installed on the launch vehicle.

TEST DESCRIPTION

PREPARATION
EMC monitoring equipment will be installed on the specified carrier subsystems and experiments.

OPERATION
The effects of launch EMI on the carriers will be monitored during the launch vehicle/spacecraft simulate boost phase test sequence. This test will be an open loop RF test (normal Apollo test).

CRITERIA FOR SUCCESS

The launch environment shall have no adverse effects on the carrier subsystems and experiments.

SUPPORT REQUIREMENTS

GSE
1. GSE to support simulated launch program.

SPECIAL TEST EQUIPMENT
1. EMC monitoring equipment

FACILITIES
1. Launch vehicle test area (normal Apollo test presently performed).

4.3.4 Flight AAP 4 - The integrated experiment modules involved in Flight AAP 4 are all new or modified and will require verification of experiment module access and servicing during prelaunch. This verification will be performed utilizing prototype test articles.

The verification of flight article EMC will be demonstrated as a normal function of KSC prelaunch activities.

The details of the Flight AAP 4 launch verification test program are described in the following test flow diagram (figure 37) and accompanying test descriptions (Table XIX).

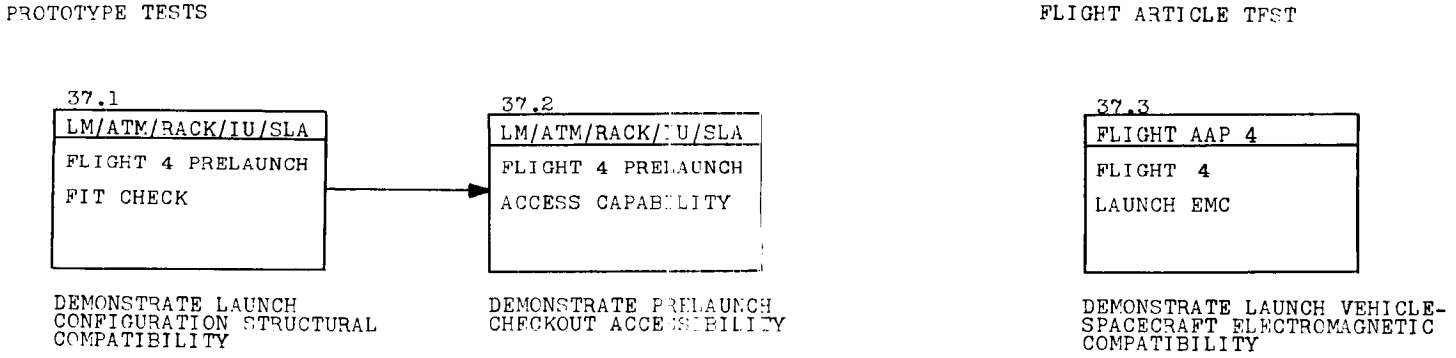


FIGURE 37

FLIGHT AAP 4
LAUNCH COMPATIBILITY TESTS

DATE: 7 APRIL 1967

Figure 37. Flight AAP 4 Launch Compatibility Tests

Table XIX. Test Descriptions for Figure 37

TEST TITLE	TEST NUMBER
Flight AAP 4 Prelaunch Fit Check	37.1

TEST OBJECTIVE

Demonstrate that for Flight AAP 4 there are no structural interface problems for prelaunch checkout.

TEST CONFIGURATION

1. Prototype flight configured LM
2. Prototype flight configured ATM/Rack
3. Prototype flight configured SLA
4. Prototype flight configured IU

TEST DESCRIPTION

PREPARATION

The IU/Lower SLA combination will be set up in the vertical position as follows:

The IU support fixture will be positioned on the floor and the IU and Lower SLA positioned on this fixture. Access platforms will be positioned at the same height as the launch platform levels.

OPERATION

The ATM/Rack prototype will be lowered on the Lower SLA attachment area. The LM will be lowered and attached to the ATM/Rack, then the Upper SLA will be positioned over the LM/ATM/Rack and attached to the Lower SLA. Verification will be made that no incompatibilities exist at the structural interfaces and that no interference exists between the LM/ATM/Rack and SLA/IU.

CRITERIA FOR SUCCESS

No structural interference problems shall exist between the LM/ATM/Rack and SLA/IU combination.

SUPPORT REQUIREMENTS

GSE

1. LM transport and handling GSE
2. ATM/Rack transport and handling GSE

Table XIX. (Cont.)

Flight AAP 4 Prelaunch Fit Check (continued)

3. SLA transport and handling GSE
4. IU transport and handling GSE

SPECIAL TEST EQUIPMENT

1. IU support fixture between floor and IU.
2. Internal work platforms.

FACILITIES

1. Area to perform physical fit of LM/ATM/Rack/SLA/IU in vertical position.
2. Overhead crane.
3. Platforms for work access (same levels as launch).

Table XIX. (Cont.)

TEST TITLE	TEST NUMBER
Flight AAP 4 Prelaunch Access Capability	37.2

TEST OBJECTIVE

Demonstrate Flight AAP 4 prelaunch checkout accessibility to LM/ATM/Rack

TEST CONFIGURATION

1. Prototype flight configured LM
2. Prototype flight configured ATM/Rack.
3. Prototype flight configured SLA
4. Prototype flight configured IU.

TEST DESCRIPTION

PREPARATION
The Flight AAP 4 prelaunch fit check shall have been performed and the LM/ATM/Rack, SLA and IU will be in the vertical position. Access platforms will be positioned at the same height as the launch platform levels. Prelaunch servicing GSE will be installed on the applicable levels.

OPERATION
Flight servicing GSE will be connected and verification will be made that all prelaunch ground servicing can be accomplished in prescribed sequence. GSE compatibility will be demonstrated. Man-machine relationship will be verified. No fluids will be transferred.

(After test, the LM, ATM/Rack, SLA & IU will be placed on transportors).

CRITERIA FOR SUCCESS

1. Man-machine relationship will be verified.
2. Prelaunch servicing GSE shall be demonstrated compatible with flight hardware.

SUPPORT EQUIPMENT

GSE
1. Flight LM/ATM Rack servicing GSE.
2. LM, ATM/RAck, SLA & IU transport & handling GSE.

Table XIX. (Cont.)

Flight AAP 4 Prelaunch Access Capability (continued)

SPECIAL TEST EQUIPMENT

1. Internal work platforms

FACILITIES

1. Area to perform LM/ATM/Rack/SLA/IU access check.
2. Platforms for work access (same levels as launch).

Table XIX. (Cont.)

TEST TITLE	TEST NUMBER
Flight AAP 4 Launch EMC	37.3

TEST OBJECTIVE

Demonstrate that launch EMI environment has no adverse effects on carrier systems.

TEST CONFIGURATION

The flight LM, ATM/Rack and Nose Cone will be installed on the launch vehicle.

TEST DESCRIPTION

PREPARATION
EMC monitoring equipment will be installed on the specified carrier subsystems and experiments.

OPERATION
The effects of launch EMI on the carriers will be monitored during the launch vehicle/spacecraft simulate boost phase test sequence. This test will be an open loop RF test (normal Apollo test).

CRITERIA FOR SUCCESS

The launch environment shall have no adverse effects on the carrier subsystems and experiments.

SUPPORT REQUIREMENTS

GSE
1. GSE to support simulated launch program.

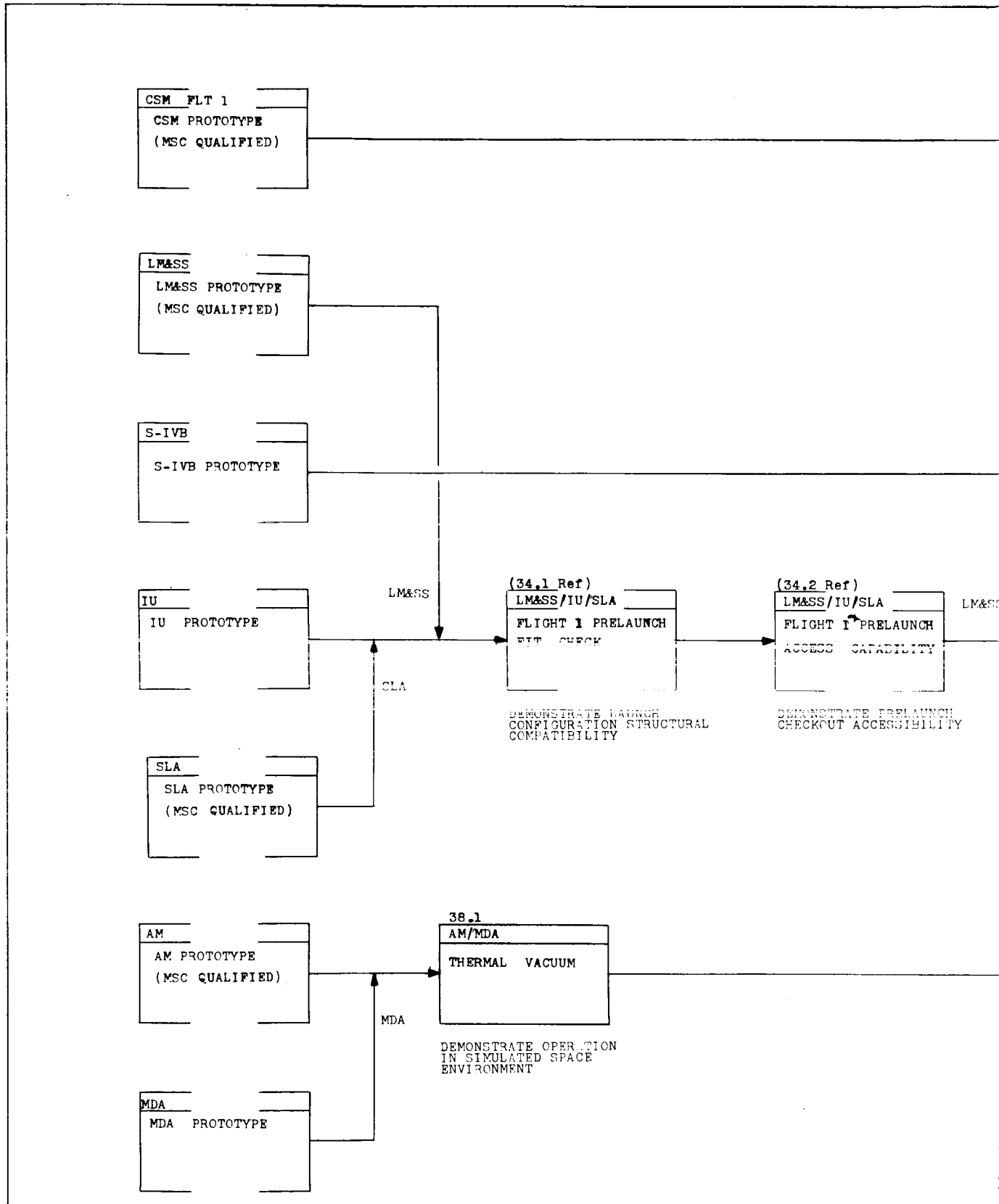
SPECIAL TEST EQUIPMENT
1. EMC monitoring equipment.

FACILITIES
1. Launch vehicle test area (normal Apollo test presently performed).

4.4 Orbit Configurations

4.4.1 Flights AAP 1 and 2 Prototype Intercarrier Tests - Flights AAP 1 and 2 intercarrier verification test program will cover all operations performed in space starting with Flight AAP 1 modules rendezvous and dock with Flight AAP 2 and continuing through the deactivation of the OWS. The flight CSM/LM&SS orbit verification test prior to rendezvous and dock to Flight AAP 2 OWS will be performed at MSC and is not included in this plan.

The details of the Flights AAP 1 and 2 orbit verification test program are described in the following test flow diagram (figure 38) and accompanying test descriptions (Table XX).



FOLDOUT FRAME 1

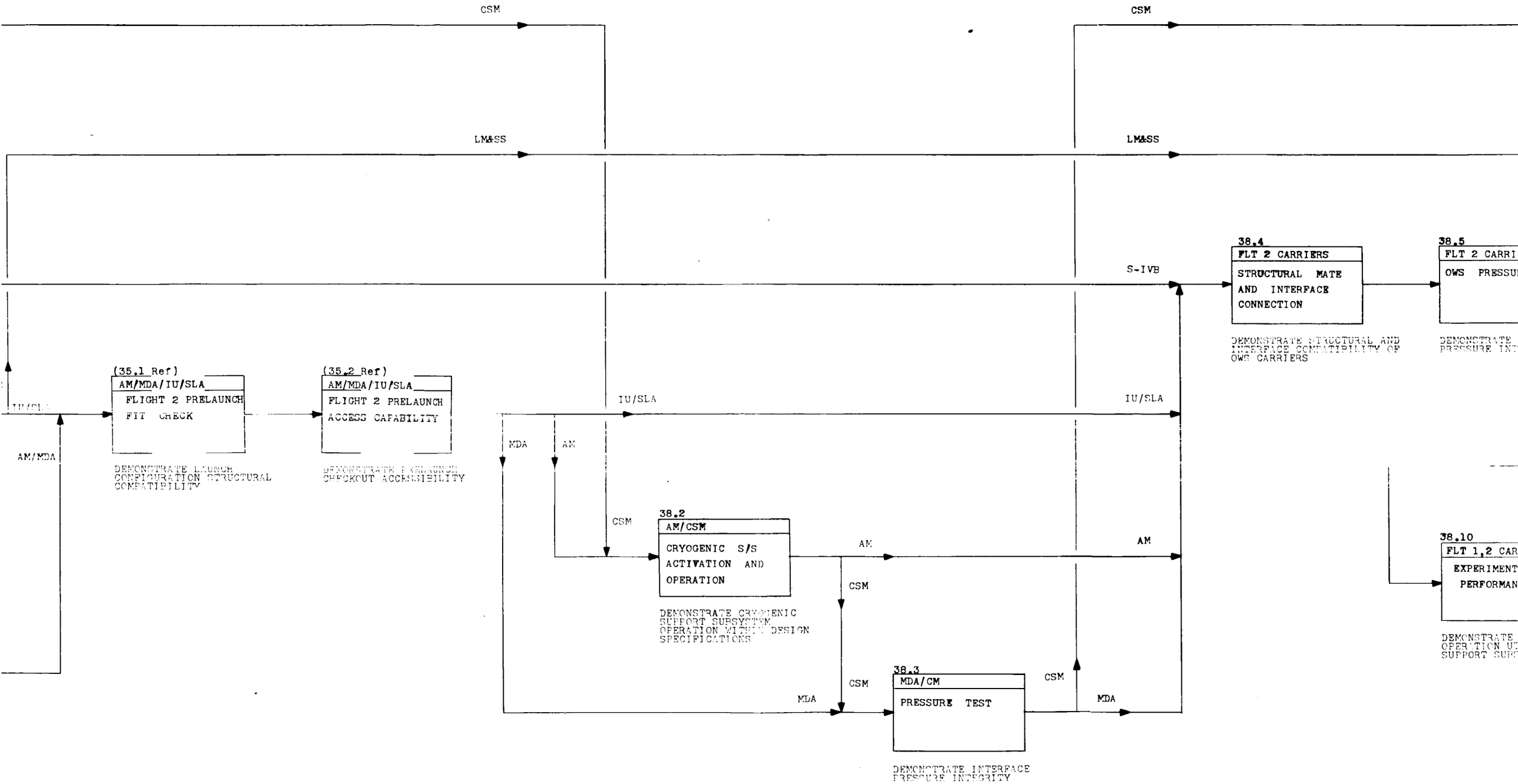


Figure 38. Intercarrier - Flight AAP 1/2 Design Verification Tes

FOLDOUT FRAME 2

FOLDOUT FRAME 3

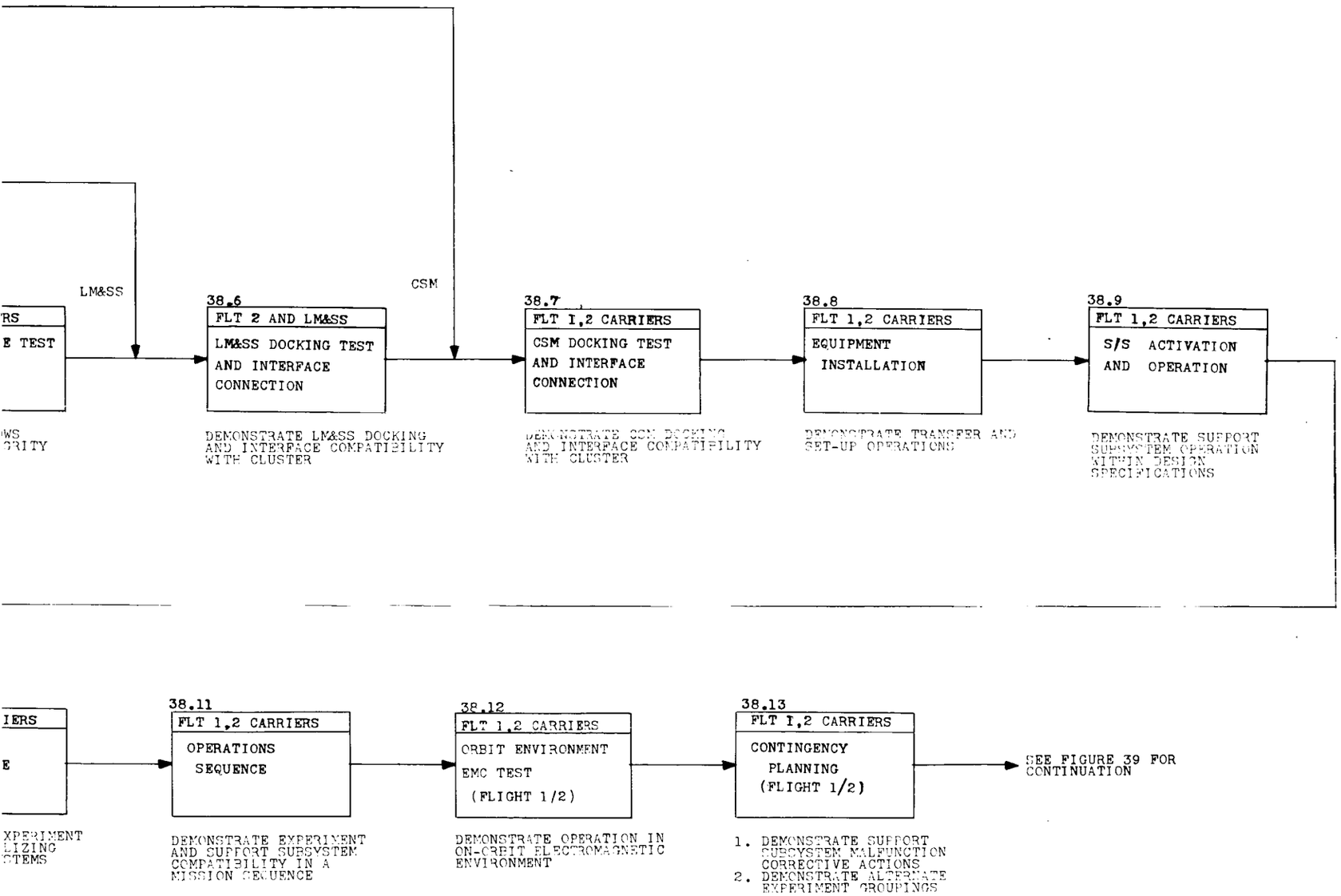


Figure 38

INTERCARRIER - FLIGHT AAP 1/2
DESIGN VERIFICATION TEST
HARDWARE FLOW

DATE: 7 APRIL 1967

FOLDOUT FRAME 4

FOLDOUT FRAME 5

Table XX. Test Descriptions for Figure 38

TEST TITLE	TEST NUMBER
AM/MDA Thermal Vacuum	38.1

TEST OBJECTIVE

Demonstrate that the AM/MDA can survive and operate in a simulated space environment.

TEST CONFIGURATION

1. Prototype flight configured MDA
2. Prototype flight configured AM

TEST DESCRIPTION

PREPARATION

AM will be installed in a thermal vacuum chamber on a rigid fixture which consists of an S-IVB dome, IU and lower SLA to simulate the thermal interface. The S-IVB dome will consist of simulation of air return to AM (heat exchanger, CO_2, contamination, etc.). Thermal, mechanical and electrical by use of the docking collars.

MDA will undergo a simulated mission to verify that all systems are operational under ambient conditions prior to the start of the thermal vacuum test. Shadowing will be simulated.

OPERATION

This test will be performed in their separate test setups:

1. Maximum AM/MDA temperature will be simulated with the test articles in the Mission AAP 1/2 orbit configuration. The CSM and LM&SS simulators will be installed with minimum shadowing on the AM/MDA.
2. Minimum AM/MDA temperature will be simulated with the test articles in the Flights AAP 1/2/3/4 orbit configuration. The CSM, LM&SS, RM, LM and ATM simulators will be installed with maximum shadowing on the AM/MDA (ATM solar array deployed in line with the solar radiation).
3. Nominal AM/MDA temperature will be simulated with the test articles in the Flights AAP 1/2/3/4 orbit configuration. All of the above simulators will be in line with the solar radiation.

During each test a mission operations sequence will be performed to verify proper operation. Each operation will be performed

Table XX. (Cont.)

AM/MDA Thermal Vacuum (continued)

long enough to allow temperature stabilization.

CRITERIA FOR SUCCESS

All systems will operate properly during the simulated mission performed under a thermal vacuum.

SUPPORT REQUIREMENTS

GSE

1. MDA handling and transport GSE
2. AM handling and transport GSE
3. Equipment to functionally operate the AM/MDA systems

SPECIAL TEST EQUIPMENT

1. Support fixture to mount AM/MDA to T.V. chamber
2. Instrumentation to monitor temperatures and pressures on AM/MDA.
3. Mockups to simulate shadowing on AM/MDA
4. Thermal, mechanical and electrical simulators of RM, LM, ATM, LM&SS and CSM.

FACILITIES

1. Facility that contains a T.V. chamber large enough to receive an AM/MDA with fixture and simulators.

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
AM/CSM Cryogenic Subsystem Activation and Operation.	38.2

TEST OBJECTIVE

Demonstrate that the AM/CSM cryogenic transfer system operates within design specifications.

TEST CONFIGURATION

1. Prototype flight configured AM
2. Prototype flight configured CSM

TEST DESCRIPTION

PREPARATION

The AM and CSM will be side by side in the vertical position in a cryogenic test area. AM and CSM shall have completed carrier level qualification tests. Individual components will have been subjected to proof pressures. GSE will be connected and an ambient functional performed prior to the cryogenic transfer test.

OPERATION

The cryogenic transfer test program will be performed as follows:

1. Connect AM/CSM cryogenic transfer lines
2. Pressurize and leak check all cryogenic systems
3. Proof pressure all cryogenic systems
4. Load cryogenics (LO_2, LH_2). Demonstrate GSE compatibility.
5. Perform transfer of these fluids in an abbreviated mission sequence. Demonstrate: (a) Flow rate
   (b) Response time
6. Unload and clean systems

CRITERIA FOR SUCCESS

1. All cryogenic systems shall operate within design specifications.
2. All prelaunch GSE servicing equipment shall be demonstrated compatible with the flight hardware.

SUPPORT REQUIREMENTS

Table XX. (Cont.)

AM/CSM Cryogenic Subsystem Activation and Operation (continued)

GSE

1. AM & CSM propellant and servicing GSE
2. AM & CSM transport & handling GSE
3. Am & CSM electrical GSE

SPECIAL TEST EQUIPMENT

1. Mass spectrometer for leak check
2. Mounting fixtures for AM and CSM on test stand
3. Pressurization equipment to perform subsystem leak check

FACILITIES

1. Cryogenic test area to mount AM and CSM, provide the necessary commodities and allow system pressurization and cryogenic transfer

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
MDA/CM Pressure Test	38.3

TEST OBJECTIVE

To demonstrate that the MDA/CM combination is capable of being pressurized to operational pressure with interface leakage within design specifications.

TEST CONFIGURATION

1. Prototype flight configures MDA
2. Prototype flight configured CM

TEST DESCRIPTION

PREPARATION
The MDA and CM will be mated (horizontal) in an area acceptable for pressurization. The MDA and CM will be on support fixtures that will have vernier adjustments to allow mating. An AM simulator will be utilized to provide a structural cover for the AM/MDA interface.

OPERATION
The MDA and CM will be pressurized to proof pressure utilizing a helium/nitrogen mixture. Verification will be made that no structural damage or major leaks have occurred. The pressure will then be reduced to operational pressure where a mass spectrometer test will be performed on the CM/MDA interface.

CRITERIA FOR SUCCESS

1. There shall be no adverse effects for the proof pressure.
2. Leak rates of the CM/MDA interface shall be within design specifications.

SUPPORT REQUIREMENTS

GSE
1. CM handling and transport GSE
2. MDA handling and transport GSE
3. Pressurization panel capable of supplying and monitoring a helium/nitrogen mixture of gas

Table XX. (Cont.)

MDA/CM Pressure Test (continued)

SPECIAL TEST EQUIPMENT

1. Mass spectrometer for leak test.
2. Pressurization panel capable of supplying and monitoring a helium/nitrogen mixture of gas.
3. CM and MDA support fixtures.
4. AM interface simulator

FACILITIES

Area to perform CM/MDA proof pressure and leak test.

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
Flight AAP 2 Carrier Structural Mate And Interface Connection	38.4

TEST OBJECTIVE

Demonstrate mating and interface connection of Flight AAP 2 carriers.

TEST CONFIGURATION

Prototype flight configured carriers S-IVB, IU, AM, MDA, lower SLA

TEST DESCRIPTION

PREPARATION
The Flight AAP 2 carriers will be installed on handling fixtures that have capability of vernier adjustment so physical mate may be accomplished. The area utilized will be acceptable for pressurization. The S-IVB and IU will be together on one fixture, the lower SLA and AM together on a second fixture and the MDA on a third.

OPERATION
The carriers shall be structurally mated and the carrier pressure interfaces (S-IVB/AM and AM/MDA) connected. Visual inspection shall be performed to verify proper mate. The following interfaces will then be connected and the listed checks performed:

Carriers	Interface	Tests				
		Physical Fit	Continuity	Resistence	Leak Check	
S-IVB/AM	Solar Array Power	x	x	x		
	Electrical Distribution	x	x	x		
	Display and Control	x				
	Communication	x				
	Data Management	x				
	Voice Data	x				
	Life Support	x			x	

Table XX. (Cont.)

Flight 2 Carrier Structural Mate and Interface Connection (continued)

Carriers	Interface	Tests			
		Physical Fit	Continuity	Resistance	Leak Check
S-IVB/IU	Passivation System	x			
AM/IU	Passivation System	x			
	Data Management	x			
	Voice Data	x			
	Life Support	x			x
AM/MDA	Electrical Power	x	x	x	
	Display and Control	x			
	Communication	x			
	Data Management	x			
	Passivation System	x			
	Life Support	x			x
	Thermal Control	x			x

CRITERIA FOR SUCCESS

Structural mate shall be accomplished and interface connections shall be made with no incompatibilities between carriers.

SUPPORT REQUIREMENTS

GSE

1. S-IVB, IU, AM, MDA, SLA Transportation and handling GSE

SPECIAL TEST EQUIPMENT

1. Support fixtures to hold the S-IVB/IU, lower SLA/AM and MDA in horizontal position.
2. Internal work platforms for access to interfaces connections
3. Pressurization equipment to perform subsystem leak check.

FACILITIES

1. Area large enough to assemble Flight AAP 2 carriers into OWS configuration.
2. External work platforms.

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
OWS Pressure Test	38.5

TEST OBJECTIVE

Demonstrate OWS pressure integrity between Flight AAP 2 carriers.

TEST CONFIGURATION

Prototype flight configured carriers:
S-IVB, IU, AM, MDA, Lower SLA

TEST DESCRIPTION

PREPARATION
The Flight AAP 2 carriers shall have had the pressure interface fit check accomplished.

OPERATION
The OWS will be pressurized with nitrogen/helium mixture to on orbit proof pressure in a mission sequence and verification will be made that no structual damage or major leaks exist at pressure interfaces. The pressure will then be adjusted to on orbit operating pressure and a mass spectrometer leak check will be performed.

CRITERIA FOR SUCCESS

1. The OWS pressure interfaces shall show no adverse effects from the proof pressure test.
2. Leakage shall be within design specifications..

SUPPORT REQUIREMENTS

GSE
None

SPECIAL TEST EQUIPMENT
1. Mass spectrometer for leak test.
2. Fixtures to hold S-IVB/IU, lower SLA/AM and MDA in the horizontal position.
3. Pressurization panel capable of supplying and monitoring a helium/nitrogen mixture.

FACILITIES
1. Area large enough to perform OWS pressure test.
2. External work platforms.

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
LM&SS Docking Test and Interface Connection	38.6

TEST OBJECTIVE

Demonstrate the capability of docking LM&SS with cluster and making all interface connection.

TEST CONFIGURATION

Prototype flight configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS

TEST DESCRIPTION

PREPARATION
The Flight AAP 2 carriers will be mounted in horizontal position on fixtures to hold them in on orbit configuration with MDA docking collar for LM&SS in top position. A fixture will be put in place to hold LM&SS rigid once docking has been performed.

OPERATION
The LM&SS will be lowered by use of an overhead crane until the LM&SS is in the docked position with the MDA. Visual inspection will be made to verify that proper fit exists between the two modules. Connect electrical power interface, verify proper fit and perform a resistance and continuity check. Connect display and control interface and verify proper fit of connectors.

CRITERIA FOR SUCCESS

Docking shall be accomplished per design requirements. Interfaces shall be connected and no incompatibilities shall exist.

SUPPORT REQUIREMENTS

GSE
1. LM&SS transportation and handling GSE.

SPECIAL TEST EQUIPMENT
1. Continuity and resistance test equipment.
2. Fixtures to hold Flight AAP 2 carriers in on orbit configuration.
3. Fixture to hold LM&SS rigid after docking has been performed.

Table XX. (Cont.)

LM&SS Docking Test and Interface Connection (continued)

FACILITIES

1. Area to contain OWS configuration in horizontal position.
2. Overhead crane with sufficient clearance to dock LM&SS on top MDA port.
3. External work platforms.

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
CSM Docking Test and Interface Connection	38.7

TEST OBJECTIVE

Demonstrate the capability of docking CSM with cluster and making all interface connections.

TEST CONFIGURATION

Prototype flight configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM

TEST DESCRIPTION

PREPARATION
The Flight AAP 2 carriers will be mounted in horizontal position on fixtures to hold them in on orbit configuration with MDA docking collar for LM&SS in top position. Docking of LM&SS shall have been performed. The CSM will be mounted on a fixture with vernier adjustment that will allow the CSM to be docked with cluster.

OPERATION
The CSM will be moved in and docked with the end port of the MDA. Visual inspection will be made to verify that proper fit exists between the two modules. The following interfaces will then be connected and the listed checks performed:

CSM/MDA

1. Electrical power
   a. Physical fit
   b. Continuity
   c. Resistance

2. Display and Control, Communication and Data Management
   a. Physical fit.

3. Life Support
   a. Physical fit
   b. Leak check

Table XX. (Cont.)

CSM Docking Test and Interface Connection (continued)

CSM/MDA

1. Electrical Power
   a. Physical Fit
   b. Continuity
   c. Resistance

2. Cryogenics (O_2, H_2)
   a. Physical Fit
   b. Leak Check

CRITERIA FOR SUCCESS

Docking shall be accomplished per design requirements. Interfaces shall be connected and no incompatibilities shall exist.

SUPPORT REQUIREMENTS

GSE

1. CSM transportation and handling GSE

SPECIAL TEST EQUIPMENT

1. Continuity and resistance test equipment
2. Fixtures to hold Flight AAP 2 carriers in on orbit configuration.
3. Fixture to hold LM&SS rigid after docking has been performed.
4. Fixture to hold CSM for docking process.
5. Pressurization equipment to perform subsystem leak check.
6. Internal work platforms for access to interface connections.

FACILITIES

1. Area to contain OWS configuration in horizontal position.
2. External work platforms.

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
Equipment Installation - Mission AAP 1/2	38.8

TEST OBJECTIVE

Demonstrate that the support subsystems and experiments can be set up in the Prototype OWS.

TEST CONFIGURATION

Prototype flight configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, CSM, LM&SS

TEST DESCRIPTION

PREPARATION
The OWS will be in the horizontal position on fixtures to hold carriers in on-orbit configuration. The inside of the S-IVB shall have temporary work platforms to allow installation of subsystems and experiments. Ground air conditioning will be supplied to the interior of the OWS. Temporary lighting will be installed until lighting subsystem is activated.

OPERATION
The support subsystems and experiments will be removed from launch location, moved to orbit location and installed in a mission sequence. Interferences and fit checks will be made during this installation.

CRITERIA FOR SUCCESS

The experiments and support subsystems shall be installed in the mission sequence without interference from previously installed equipment or S-IVB structure.

SUPPORT REQUIREMENTS

GSE None

SPECIAL TEST EQUIPMENT
1. Prototype experiments and support subsystems.
2. Air conditioning for OWS interior.
3. Temporary lighting.
4. Test fixtures to hold the OWS in a horizontal position.
5. Internal work platform.
6. Equipment mobility aids.

Table XX. (Cont.)

Equipment Installation - Mission AAP 1/2

FACILITIES

1. Area to contain OWS in horizontal position.
2. External work platforms.

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
Support Subsystem Activation and Operation - Mission AAP 1/2	38.9

TEST OBJECTIVE

Demonstrate the compatibility and operation of the support subsystems installed in the OWS.

TEST CONFIGURATION

Prototype orbit configured carriers: S-IVB, IU, AM, MDA, Lower SLA, CSM, LM&SS

TEST DESCRIPTION

PREPARATION

The OWS will be in the horizontal position on fixtures to hold carriers in on-orbit configuration. All subsystems will be installed. Any subsystems that will not operate in horizontal position will be simulated. Cryogenics will not be used. Solar arrays will be simulated. Ground air conditioning will be supplied for OWS interior. GSE will be checked out and connected. Antenna system will be closed loop; i.e., antenna hats, coax and amplifiers between antennas and Ground Station.

OPERATION

Each support subsystem will be functioned individually and monitored to verify proper operation. GSE and ground station compatibility will be verified. Intercarrier compatibility will be demonstrated. Power characteristics will be demonstrated. Parametric tests will be performed on each subsystem to verify operation at design limits.

Following is a list of Mission AAP 1/2 OWS support subsystems, their applicable carriers and tests required for activation.

Table XX. (Cont.)

Support Subsystem Activation and Operation - Mission AAP 1/2 (con't)

SUPPORT SUBSYSTEM	CARRIER					TEST					
	CSM	SIVB	IU	AM	MDA	Continuity	Resistance	VSWR & Insertion Loss	Leak Check	Flow Rate	Functional
Electrical Power	X	X	X	X		X	X				X
Display and Control	X	X		X	X	X	X				X
Communication	X	X		X		X	X	X			X
Data Management	X	X		X		X	X				X
Passivation System		X	X		X	X	X				X
TV Monitor		X				X	X				X
Lighting		X				X	X				X
Camera Units		X				X	X				X
Thermal Control		X		X	X	X	X		X	X	X
Water		X							X		
Vacuum		X							X		X
Compressed Air		X							X	X	X
Oxygen Supply		X							X	X	X
Waste Management		X							X	X	X
Life Support				X		X	X		X	X	X
Sensors					X						X
Solar Array		X				Simulated					
Cryogenics				X		Simulated					
ECS	X					Simulated					

CRITERIA FOR SUCCESS

All support subsystems will operate within design specifications.

SUPPORT REQUIREMENTS

GSE:

1. Equipment to support and monitor the OWS subsystem operations.
2. Ground station.
3. Land line ground station.
4. Simulated loads for subsystems.
5. S-IVB Solar Array Simulator.

Table XX. (Cont.)

Support Subsystem Activation and Operation - Mission
AAP 1/2 (continued)

SPECIAL TEST EQUIPMENT:

1. Simulators for subsystems not operable in horizontal position.
2. Ground air conditioning.
3. Test fixtures to hold OWS in horizontal position.
4. Internal work platforms.

FACILITIES:

1. Area to contain OWS in horizontal position.
2. External work platforms.

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
Experiment Performance - Mission AAP 1/2	38.10

TEST OBJECTIVE

Demonstrate OWS experiments one at a time, utilizing the support subsystems.

TEST CONFIGURATION

Prototype orbit configured carriers: S-IVB, IU, AM, MDA, Lower SLA, CSM, LM&SS.

TEST DESCRIPTION

PREPARATION

The cluster will be in the activated OWS configuration. Support subsystems will have been functioned individually. Solar arrays will be simulated. GSE will be checked out and connected. Ground air conditioning will be supplied for OWS interior.

OPERATION

The experiment will be operated individually in conjunction with the support subsystems. Verification will be made that there are no incompatibilities between experiments and subsystems. Refer to section 5 for experiment integration test requirements of these experiments:

D012 - Astronaut Maneuvering Unit
D017 - Solid Electrolyte Carbon Dioxide Reduction
D018 - Integrated Maintenance
D019 - Suit Donning and Sleep Station Evaluation
D020 - Evaluation of Alternate Restraints for Mobility and Maint.
D021 - Expandable Airlock
D022 - Expandable Structures for Recovery

M018 - Vectorcardiogram
M050 - Metabolic Cost of Inflight Tasks
M051 - Inflight Assessment of Cardiovascular Function
M052 - Bone and Muscle Changes
M053 - Human Vestibular Function
M054 - Neurological Study
M055 - Time and Motion Study

Table XX. (Cont.)

Experiment Performance - Mission AAP 1/2 (continued)

M439 - Star-Horizon Automatic Tracking
M464 - Onboard Checkout Equipment
M466 - Spacesuit and Lunar Surface Experiment Hardware
M469 - ST-124 Removal
M479 - Zero-G Flammability
M486 - EVA Equipment and Hardware Evaluation
M487 - Crew Quarters
M488 - High Pressure Air Expulsion
M489 - Heat Exchanger Service
M492 - Joining Tubular Assemblies in Space Environment
M493 - Electron Beam Welding

S005 - Synoptic Terrain Photography
S006 - Synoptic Weather Photography
S009 - Primary Cosmic Radiation
S018 - Micrometeorite Collection
S065 - Multi-Band Terrain Photography

T002 - Manual Navigation Sightings
T003 - Nephelometer Experiment
T017 - Meteoroid Impact and Erosion
T020 - Jet Shoes
T021 - Meteoroid Velocity and Impact into Aluminum
T023 - Collection of Surface Absorbed Materials

CRITERIA FOR SUCCESS

Each experiment will operate within specification when operated in conjunction with the support subsystem.

SUPPORT REQUIREMENTS

Same as 38.9 plus the following:
GSE:
1. Equipment to support and monitor the operation of each experiment.

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
Operation Sequence - Mission AAP 1/2	38.11

TEST OBJECTIVE

Demonstrate that the experiments and support subsystems are compatible when operated in a mission sequence.

TEST CONFIGURATION

Prototype orbit configured carriers: S-IVB, IU, AM, MDA, Lower SLA, CSM, LM&SS

TEST DESCRIPTION

PREPARATION

The cluster will be in an OWS configuration after the equipment (subsystem and experiments) has been installed and activated. GSE will be checked out and connected. Solar arrays will be simulated. Ground air conditioning will be supplied to OWS interior. The subsystem operation and each experiment operation shall have been demonstrated prior to this test. Any subsystem that will not operate in horizontal position will be simulated.

OPERATION

The test will be performed in the following sequence:

1. The vent and dump of propellant tanks will be simulated by performing a mission sequence (with dry tanks) and verifying all reactions of airborne systems. Manual override of vent process by ground station commands shall be demonstrated.
2. S-IVB safing will be performed in a mission sequence to specified timelines (modified by minimum container pressures).
   a. The disarming of the destruct system shall be initiated by ground command. System will be monitored to verify current signal is received.
   b. Verification will be made that all containers to be vented manually are accessible.
3. Each subsystem and experiment will be operated in the sequence that they would be operated during the mission. Established mission timelines will be compressed. Astronaut stations will be manned for this test. Support subsystem and experiment simulation will be held to a minimum.

Table XX. (Cont.)

Operation Sequence - Mission AAP 1/2 (continued)

CRITERIA FOR SUCCESS

The support subsystems and experiments will perform within specification when operated to the mission sequence and timelines.

SUPPORT REQUIREMENTS

Same as 38.9 plus the following:

GSE
Equipment to support and monitor the operation of each experiment

SPECIAL TEST EQUIPMENT

None

FACILITIES

None

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
Orbit EMC Environment Test - Mission AAP 1/2	38.12

TEST OBJECTIVE

1. Demonstrate that orbit EMI environment has no adverse effect on carrier systems.
2. Verify antenna field strength.

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM

TEST DESCRIPTION

PREPARATION
Prototypes will be assembled horizontally in the on-orbit configuration. The LM&SS carrier will be in the top port of the MDA and the cluster will be at least 20 feet off the ground. RF absorbing material will be positioned at specified locations under the cluster and around support members. GSE will be checked out and connected. EMC monitoring equipment will be installed at specified locations. Carrier level EMC tests will have been performed prior to this test.

OPERATION
A simulated mission sequence will be performed with all antenna systems operated open loop. Subsystems and experiments with power requirements will be operated and EMC will be monitored for detrimental effects. Antenna field strength will be measured.

CRITERIA FOR SUCCESS

1. Subsystems and experiments will operate with no adverse effects due to EMI.
2. Antenna field strength shall be within design specification.

SUPPORT REQUIREMENTS Same as 38.9 plus the following:

GSE
1. Equipment to support and monitor the operation of each experiment

Table XX. (Cont.)

Orbit EMC Environment Test - Mission AAP 1/2 (continued)

GSE

2. EMC monitoring equipment.
3. Transport and handling GSE for all listed carriers.

SPECIAL TEST EQUIPMENT

1. Antenna strength measuring equipment.
2. Fixtures made of RF transparent material to hold center line of cluster approximately 25 feet off the ground.

FACILITIES

1. Area to contain the OWS M horizontal position for EMC testing.

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
Contingency Planning - Mission AAP 1/2 (Critical Subsystem Malfunction Verification)	38.13.1

TEST OBJECTIVE

Demonstrate corrective actions required due to critical subsystem malfunctions which may affect astronaut safety.

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM

TEST DESCRIPTION

PREPARATION
OWS Operation Sequence - Mission AAP 1/2 (38.11) shall have been performed prior to this test.

OPERATION
Possible malfunctions derived by system analysis will be simulated and emergency procedures verified.

CRITERIA FOR SUCCESS

Emergency procedures against critical subsystem malfunctions shall be verified to be adequate for astronaut safety.

SUPPORT REQUIREMENTS Same as 38.9

Table XX. (Cont.)

TEST TITLE	TEST NUMBER
Contingency Planning - Mission AAP 1/2 (Alternate Experiment Grouping)	38.13.2

TEST OBJECTIVE

Demonstrate identified alternate experiment groupings to be used in case of experiment delivery problems or changes in mission objectives.

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM

TEST DESCRIPTION

PREPARATION
OWS Experiment Performance - Mission AAP 1/2 (38.10) and OWS Operation Sequence - Mission AAP 1/2 (38.11) shall have been performed prior to this test.

OPERATION
1. Experiments added for this contingency test will be operated individually in conjunction with the support subsystems. Verification will be made that there are no incompatibilities between experiments and support subsystems.
2. Each subsystem and experiment in the alternate group will be operated in the sequence that they would be operated during the mission. Established mission timelines will be compressed and utilized. Astronaut stations will be manned for this test.

CRITERIA FOR SUCCESS

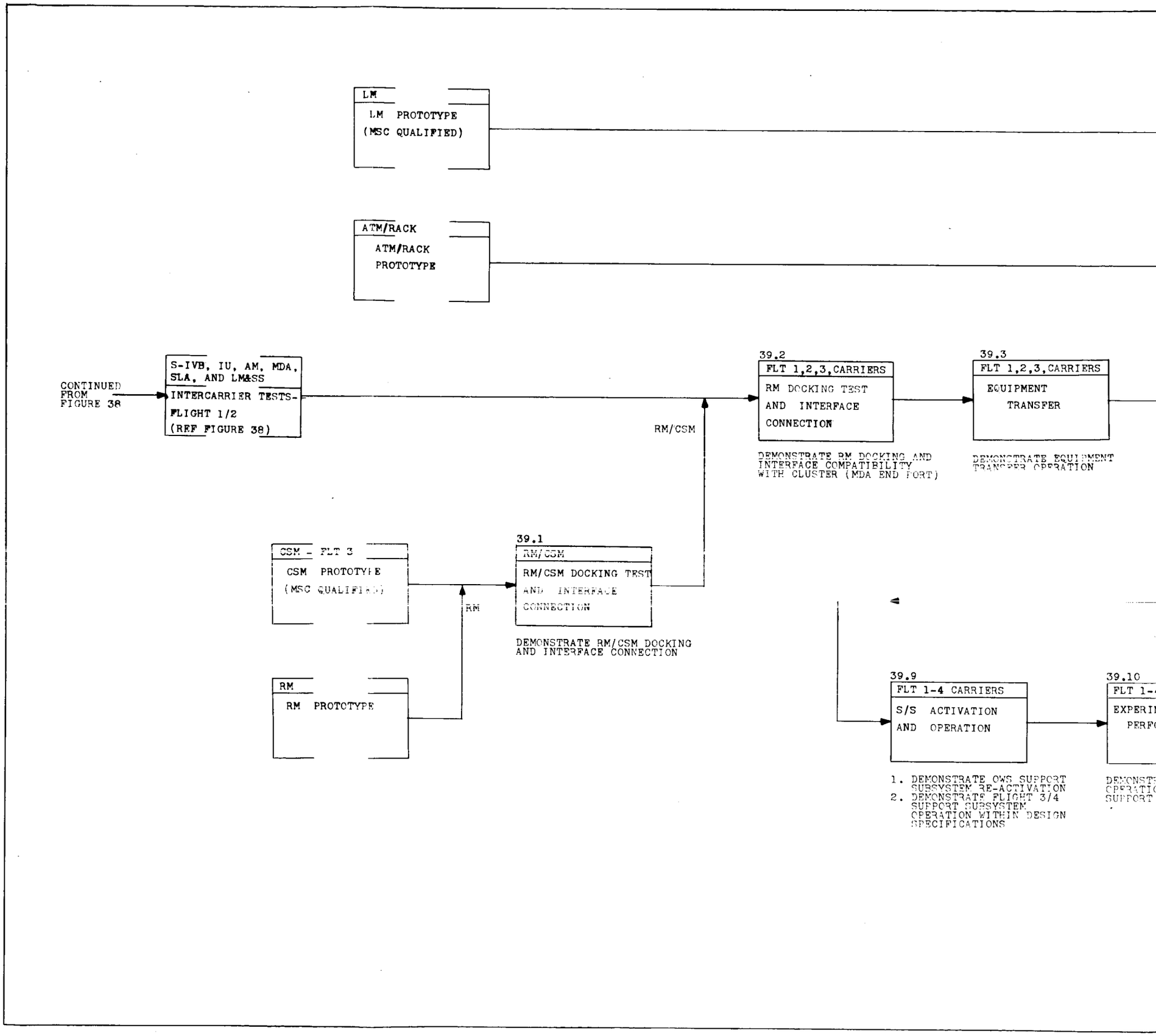
1. Alternate experiments will perform within design specifications when operated with support subsystems.
2. The experiments and subsystems will perform within specifications when operated to the mission sequence and timelines.

SUPPORT REQUIREMENTS Same as 38.9 plus the following:

GSE
1. Equipment to support and monitor the operation of each experiment.

4.4.2 Flights AAP 3 and 4 Prototype Intercarrier Tests - The Flights AAP 3 and 4 intercarrier verification test program will cover all operations performed in space starting with the reactivation of the OWS and continuing through the deactivation of the OWS/ATM system.

The details of the Flights AAP 3 and 4 orbit verification test program are described in the following test flow diagram, figure 39, and accompanying test descriptions (Table XXI).



FOLDOUT FRAME 1

FOLDOUT FRAME

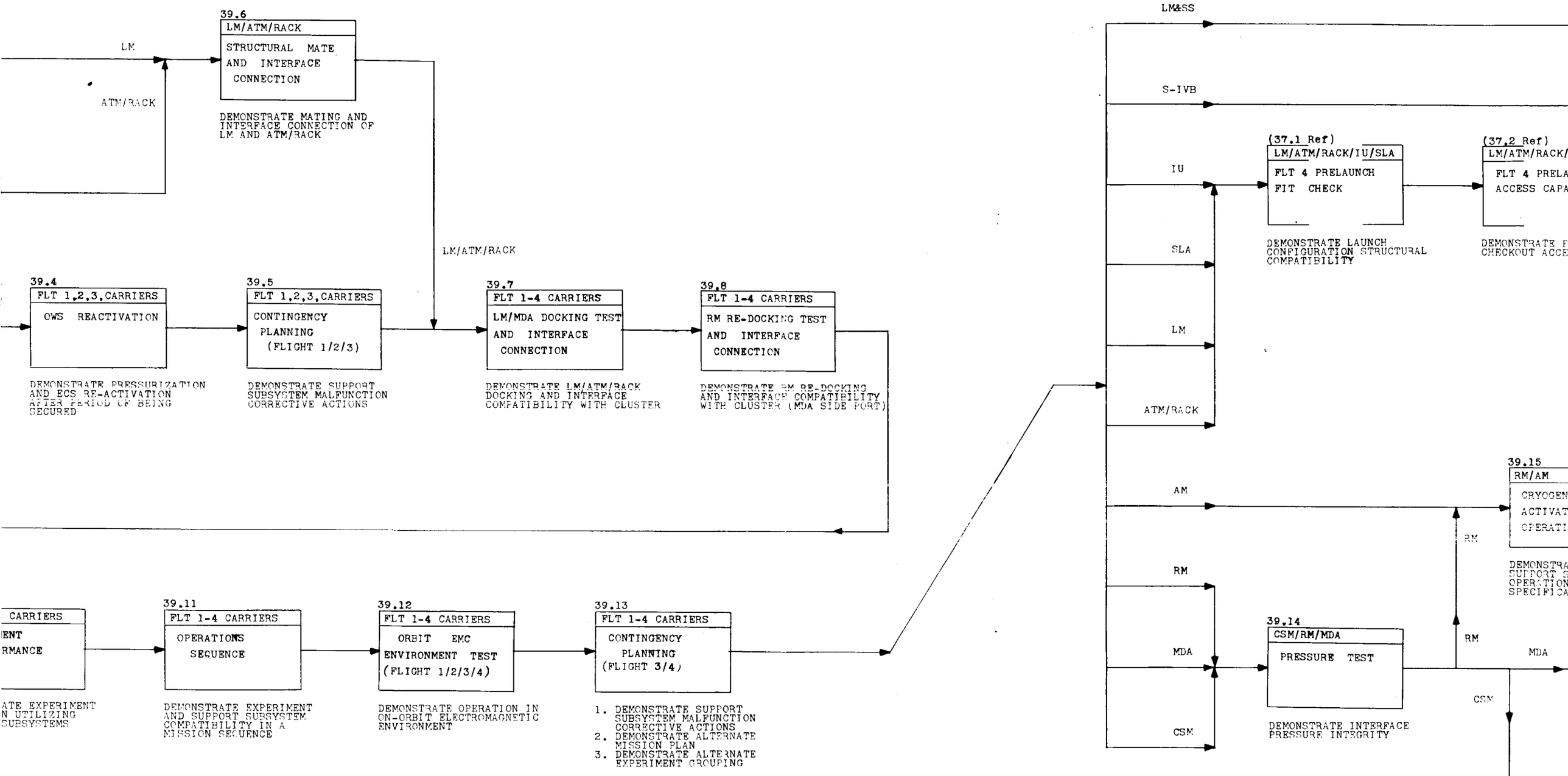
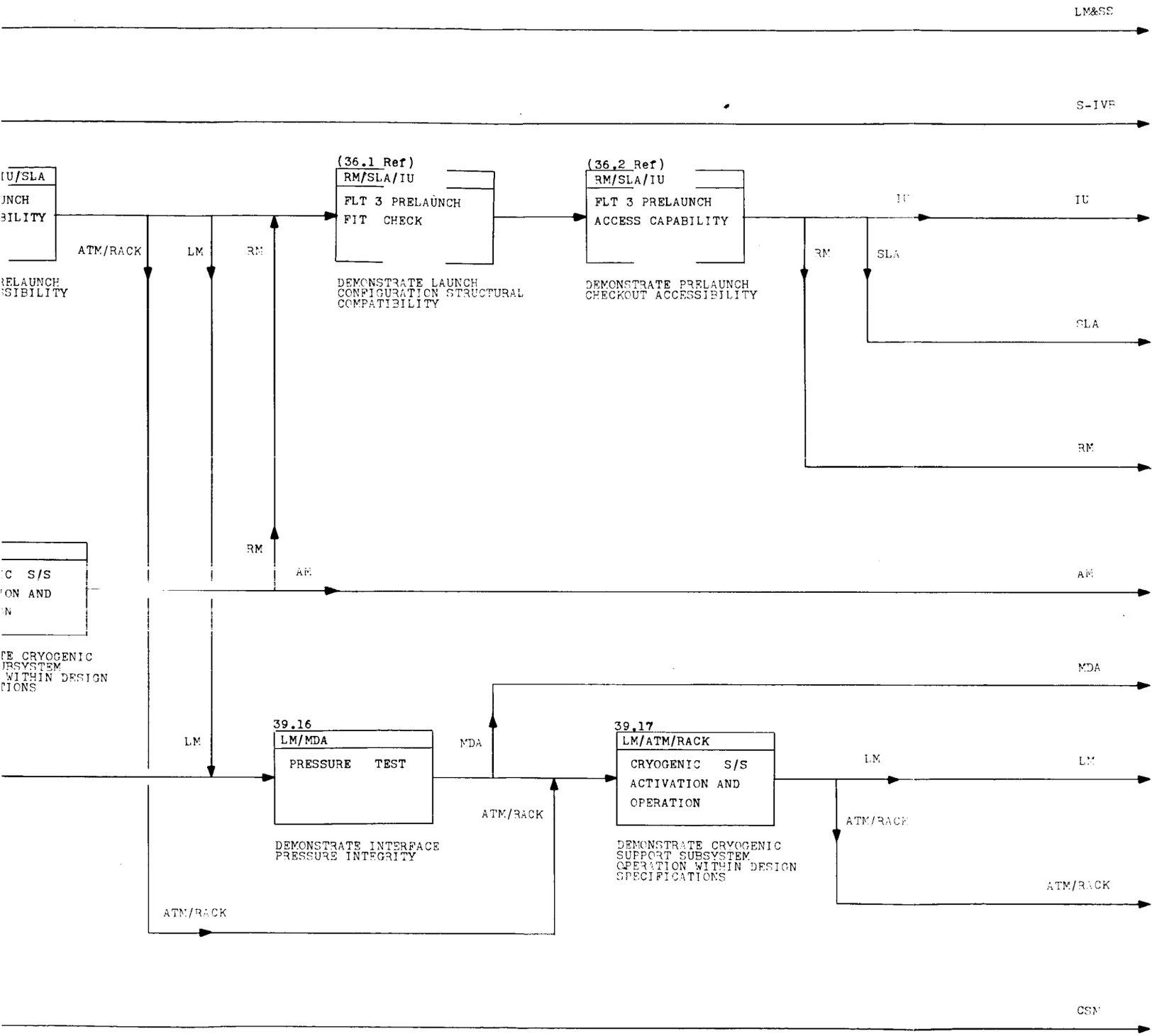


Figure 39. Intercarrier - Flight AAP 1/2/3/4 Design Verification Test Hardware Flow

FOLDOUT FRAME 2

FOLDOUT FRAME 3



NOTE: MODULE DISPOSITION MAY CONSIST OF THE FOLLOWING:

1. CLUSTER CONFIGURATION MAINTAINED FOR REAL TIME MISSION SUPPORT
2. INDIVIDUAL CARRIERS SHIPPED TO KSC FOR PRELAUNCH CHECKOUT SUPPORT
3. INDIVIDUAL CARRIERS UPDATED FOR LATER MISSION TEST ACTIVITIES

Figure 39

INTERCARRIER - FLIGHT AAP 1/2/3/4
DESIGN VERIFICATION TEST
HARDWARE FLOW

DATE: 7 APRIL 1967

FOLDOUT FRAME 4

FOLDOUT FRAME 5

Table XXI. Test Descriptions for Figure 39

TEST TITLE	TEST NUMBER
RM/CSM Docking Test and Interface Connection	39.1

TEST OBJECTIVE

Demonstrate docking between RM and CSM

TEST CONFIGURATION

Prototype flight configured carriers:
RM, CSM

TEST DESCRIPTION

PREPARATION
The RM and CSM will be mounted horizontally on fixtures with vernier adjustment to facilitate mating.

OPERATION
The RM and CSM will be docked and verification made that no interference exists between the two modules.

CRITERIA FOR SUCCESS

Docking shall be accomplished per design requirements with no incompatibilities between carriers.

SUPPORT REQUIREMENTS

GSE
None

SPECIAL TEST EQUIPMENT
Fixtures to dock RM and CSM in horizontal position

FACILITIES
Area to perform docking of RM and CSM in horizontal position

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
RM Docking Test and Interface Connection	39.2

TEST OBJECTIVE

Demonstrate the capability of docking RM with cluster and making interface connection

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, IM&SS, CSM, RM

TEST DESCRIPTION

PREPARATION
The Flights AAP 1 and 2 carriers will be mounted in horizontal position on fixtures to hold them in on-orbit configuration with MDA docking collar for IM&SS in top position. RM/CSM docking shall have been accomplished. The RM/CSM will be mounted on a fixture with vernier adjustment that will allow the RM/CSM to be docked with the cluster.

OPERATION
The RM/CSM will be moved in and the RM docked with the end port of the MDA. Visual inspection will be made to verify that proper fit exists between the RM and MDA.

CRITERIA FOR SUCCESS

Docking shall be accomplished per design requirements with no incompatibilities between carriers.

SUPPORT REQUIREMENTS

GSE
None

SPECIAL TEST EQUIPMENT
1. Fixtures to hold Flights AAP 1 and 2 carriers in on orbit configuration
2. Fixture to hold RM/CSM for docking with cluster

FACILITIES
1. Area to contain OWS configuration in horizontal position
2. External work platforms

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
OWS Equipment Transfer - Flight AAP 3	39.3

TEST OBJECTIVE

Demonstrate that equipment transfer from Flight AAP 3 carriers to the OWS can be accomplished

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM, RM

TEST DESCRIPTION

PREPARATION
The OWS will be in the horizontal position. Platforms will be installed inside to provide access to various areas where equipment will be stowed. Ground air conditioning will be supplied to the OWS interior. Temporary lighting will be installed until lighting subsystem is activated.

OPERATION
The equipment will be removed from the launch location and transported to proper areas in the OWS. Mission sequence and timelines shall be utilized and verified.

CRITERIA FOR SUCCESS

The equipment provided by Flight AAP 3 shall be installed in the OWS per specified mission sequence and timelines.

SUPPORT REQUIREMENTS

GSE
None

SPECIAL TEST EQUIPMENT
1. Ground air conditioning
2. Temporary lighting in OWS
3. Test fixtures to hold OWS in horizontal position
4. Interior work platforms
5. Equipment mobility aids

FACILITIES
1. Area to contain OWS in horizontal position
2. External work platforms

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
OWS Reactivation	39.4

TEST OBJECTIVE

Demonstrate capability of reactivating the OWS pressurization and ECS systems after a period of being secured

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM, RM

TEST DESCRIPTION

PREPARATION
Equipment Transfer - Flight AAP 3 (39.3) will have been performed. GSE for pressurization and ECS will be checked out and installed.

OPERATION
OWS repressurization to orbit pressure will be simulated. ECS will be reactivated and verification made that system operates properly after having been secured on Mission AAP 1/2.

CRITERIA FOR SUCCESS

1. Repressurization shall be achieved per design specification.
2. ECS will be reactivated with no discrepancies.

SUPPORT REQUIREMENTS

GSE
GSE for functional check of OWS pressurization system and ECS

SPECIAL TEST EQUIPMENT
1. Ground air conditioning
2. Temporary lighting
3. Test fixtures to hold OWS in horizontal position
4. Work platform for OWS interior

FACILITIES
1. Area to contain OWS in horizontal position
2. External work platforms

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
Contingency Planning - Flights AAP 1/2/3 (Critical Subsystem Malfunction Verification)	39.5

TEST OBJECTIVE

Demonstrate corrective actions required due to critical subsystem malfunctions which may affect astronaut safety

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM, RM

TEST DESCRIPTION

PREPARATION
OWS Reactivation (39.4) shall have been performed prior to this test.

OPERATION
Possible malfunctions derived by system analysis will be simulated and emergency procedures verified.

CRITERIA FOR SUCCESS

Emergency procedures against critical subsystem malfunctions will be verified to be adequate for astronaut safety.

SUPPORT REQUIREMENTS

Same as 39.4

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
LM/ATM/RACK Structural Mate and Interface Connection	39.6

TEST OBJECTIVE

Demonstrate mating and interface connection of LM and ATM/Rack

TEST CONFIGURATION

Prototype orbit configured carriers:
LM, ATM/Rack

TEST DESCRIPTION

PREPARATION
The LM and ATM/Rack will be mounted horizontally on fixtures with vernier adjustment to facilitate mating.

OPERATION
The LM and ATM/Rack will be structually mated and verification made that no interference exists between the two modules. The following interfaces will be connected and the listed checks performed:

1. Electrical Power
   a. Physical Fit
   b. Continuity
   c. Resistance
2. Communication, Display and Control
   a. Physical Fit
3. Water, Cryogenics (O_2)
   a. Physical Fit
   b. Leak Check

CRITERIA FOR SUCCESS

Structural mate shall be accomplished and interface connections shall be made with no incompatibilities between carriers.

SUPPORT REQUIREMENTS

GSE
LM and ATM/Rack transportation and handling GSE

Table XXI. (Cont.)

LM/ATM/Rack Structural Mate and Interface Connection (continued)

SPECIAL TEST EQUIPMENT

1. Continuity and resistance test equipment
2. Fixtures to mount LM and ATM/Rack in horizontal position
3. Pressurization equipment to perform subsystem leak check
4. Internal work platforms

FACILITIES

Area to perform mating of LM and ATM/Rack in horizontal position

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
LM/ATM/Rack Docking Test and Interface Connection	39.7

TEST OBJECTIVE

Demonstrate the capability of docking LM/ATM/Rack with cluster and making all interface connections

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM, RM, LM/ATM/Rack

TEST DESCRIPTION

PREPARATION
The Flights AAP 1, 2 and 3 carriers will be mounted in horizontal position on fixtures to hold them in on orbit configuration with MDA docking collar for LM&SS in top position. The LM/ATM/Rack will be mounted on a fixture with vernier adjustment that will allow the LM/ATM/Rack to be docked with the cluster.

OPERATION
The LM/ATM/Rack will be moved in and docked with a side port of the MDA. Visual inspection will be made to verify that proper fit exists between the two modules. The following interfaces will be connected and the listed checks performed:

1. Emergency Power
   a. Physical Fit
   b. Continuity
   c. Resistance
2. Communication, Display and Control
   a. Physical Fit
3. Life Support
   a. Physical Fit
   b. Leak Check

CRITERIA FOR SUCCESS

Docking shall be accomplished per design requirements. Interfaces shall be connected and no incompatibilities shall exist between carriers.

Table XXI. (Cont.)

LM/ATM/Rack Docking Test and Interface Connection (continued)

SUPPORT REQUIREMENTS

GSE
None

SPECIAL TEST EQUIPMENT
1. Continuity and resistance test equipment
2. Fixtures to hold Flights AAP 1, 2 and 3 carriers in on-orbit configuration
3. Fixture to hold LM/ATM/Rack for docking with cluster
4. Pressurization equipment to perform subsystem leak check
5. Internal work platforms

FACLITIES
1. Area to contain OWS configuration in horizontal position
2. External work platforms

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
RM Redocking Test and Interface Connection	39.8

TEST OBJECTIVE

Demonstrate the capability of redocking RM with cluster and making all interface connections.

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, LM/ATM/Rack, CSM, RM

TEST DESCRIPTION

PREPARATION
The Flights AAP 1, 2 and 4 carriers will be mounted in horizontal position on fixtures to hold them in on-orbit configuration with MDA docking collar for LM&SS in top position. The RM will be mounted on a fixture with vernier adjustment that will allow the RM to be docked with the cluster.

OPERATION
The RM will be moved in and docked with the side port opposite where the LM/ATM/Rack is docked. Visual inspection will be made to verify that proper fit exists between the two modules. The following interfaces will be connected and the listed checks performed:

RM/MDA
1. Electrical Power
   a. Physical Fit
   b. Continuity
   c. Resistance
2. Communication, Data Management, Display and Control
   a. Physical Fit
3. Life Support
   a. Physical Fit
   b. Leak Check

RM/AM
1. Gaseous O_2, N_2
   a. Physical Fit
   b. Leak Check

Table XXI. (Cont.)

RM Redocking Test and Interface Connection (continued)

2. Cryogenics (O_2, N_2, H_2)
   a. Physical Fit
   b. Leak Check

At the completion of the RM docking process, the CSM will be redocked to the end port of the MDA per figure 38, Test No. 38.7.

CRITERIA FOR SUCCESS

Docking shall be accomplished per design requirements. Interfaces shall be connected and no incompatibilities shall exist between carriers.

SUPPORT REQUIREMENTS

GSE
None

SPECIAL TEST EQUIPMENT
1. Continuity and resistance test equipment
2. Fixtures to hold Flights AAP 1, 2 and 4 carriers in on-orbit configuration
3. Fixture to hold RM for docking with cluster
4. Pressurization equipment to perform subsystem leak check
5. Internal work platforms

FACILITIES
1. Area to contain OWS configuration in horizontal position
2. External work platforms

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
Support Subsystem Activation and Operation Mission AAP 3/4	39.9

TEST OBJECTIVE

1. Demonstrate OWS support subsystem reactivation after period of being secured.
2. Demonstrate compatibility and operation of support subsystems installed for Mission AAP 3/4.

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM, RM, LM, ATM/Rack

TEST DESCRIPTION

PREPARATION

OWS Support Subsystem Activation and Operation - Mission AAP 1/2 (38.9) will have been performed prior to this test. Preparation for additional Flights AAP 3 and 4 subsystems will be similar to that in Flights 1 and 2.

OPERATION

1. Replenishment supplies provided by Flight AAP 3 carriers will be utilized to reactivate subsystems remaining on orbit from Mission AAP 1/2. Verification will be made that sufficient consumables are available for the remainder of Mission AAP 3/4.
2. Subsystems unique to Mission AAP 3/4 will be functioned individually and monitored to verify proper operation. Intercarrier, GSE and Ground Station compatibility will be demonstrated. Power characteristics will be monitored. Parametric tests will be performed on each subsystem to verify operation at design limits. ATM solar panel deployment will be simulated.

   Following is a list of Mission AAP 3/4 OWS support subsystems, their applicable carriers and test requirements.

Table XXI. (Cont.)

Support Subsystem Activation and Operation Mission AAP 3/4 (continued)

Support Subsystem	Carrier								Test					
	CSM	LM&SS	S-IVB*	AM*	MDA*	RM	LM	ATM/Rack	Continuity	Resistance	VSWR & Insertion Loss	Leak Check	Flow Rate	Functional
Electrical Power	X	X	X	X		X	X	X	X	X				X
Display and Control	X		X	X	X	X	X		X	X				X
Communication	X		X	X		X	X	X	X	X	X			X
Data Management	X	X	X	X			X	X	X	X				X
TV Monitor			X						X	X				X
Lighting			X						X	X				X
Camera Units			X						X	X				X
Thermal Control			X	X	X		X		X	X		X	X	X
Water			X			X	X	X				X		
Vacuum			X									X		X
Compressed Air			X									X	X	X
Oxygen Supply			X									X	X	X
Waste Management			X									X	X	X
Life Support				X			X		X	X		X	X	X
Sensors					X	X								X
Reactivation Nitrogen				X					X	X		X		X
Molecular Sieve ECS						X			X	X		X	X	X
Gaseous Storage						X						X	X	X
Solar Array			X					X	Simulated					
Cryogenics				X		X	X	X	Simulated					
ECS	X								Simulated					
Pointing Control								X	Tested as S/S					

* Indicates carriers with support subsystems to be reactivated.

Table XXI. (Cont.)

Support Subsystem Activation and Operation Mission AAP 3/4 (continued)

CRITERIA FOR SUCCESS

1. All OWS support subsystems capable of being reactivated.
2. Mission AAP 3/4 unique subsystems shall operate within design specifications.

SUPPORT REQUIREMENTS - Same as 38.9 plus the following:

GSE

1. Equipment to support and monitor the Mission AAP 3/4 subsystem operations.
2. ATM solar array simulator.

SPECIAL TEST EQUIPMENT

Test fixtures to hold all Flights AAP 1/2/3/4 in horizontal

FACILITIES

None

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
Experiment Performance - Mission AAP 3/4	39.10

TEST OBJECTIVE

Demonstrate experiments one at a time in conjunction with the support subsystems

TEST CONFIGURATION

Prototype orbit configured articles:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM, RM, LM, ATM/Rack

TEST DESCRIPTION

PREPARATION

Experiment Performance - Mission AAP 1/2 (38.10) will have been performed prior to this test as well as support subsystems activation and operation. Solar arrays will be simulated. GSE will be checked out and connected. Ground air conditioning will be supplied to the cluster.

OPERATION

1. Replenishment supplies provided by Flight AAP 3 carriers will be utilized to reactivate experiments remaining on orbit from Mission AAP 1/2. Verification will be made that sufficient consumables are available for the remainder of Mission AAP 3/4. Refer to section 5 for experiment integration test requirements of the following Mission AAP 1/2 reactivated experiments:

   D012 - Astronaut Maneuvering Unit
   D018 - Integrated Maintenance
   D019 - Suit Donning and Sleep Station Evaluation
   D020 - Evaluation of Alternate Restraints for Mobility and Maint.
   M018 - Vectorcardiogram
   M050 - Metabolic Cost of Inflight Tasks
   M051 - Inflight Assessment of Cardiovascular Function
   M052 - Bone and Muscle Changes
   M053 - Human Vestibular Function
   M054 - Neurological Study
   M055 - Time and Motion Study
   M464 - Onboard Checkout Equipment
   M469 - ST-124 Removal
   M493 - Electron Beam Welding
   S063 - UV Airglow Horizon Photography

Table XXI. (Cont.)

Experiment Performance - Mission AAP 3/4 (continued)

S065 - Multi-Band Terrain Photography
T013 - Crew Activity Vehicle Disturbances
MSFC 57 - Gravity Simulation Workbench

2. Experiments unique to Mission AAP 3/4 will be operated individually in conjunction with support subsystems. Verification will be made that there are no incompatibilities between experiments and subsystems. Refer to section 5 for experiment integration test requirements of the following Mission AAP 3/4 experiments:

S017 - X-Ray Astronomy
S019 - UV Stellar Astronomy
S020 - UV X-Ray Solar Photography
S052 - White Light Coronography
S053A- UV Coronal Spectrograph
S053B- UV Spectrographic
S054 - X-Ray Spectrographic Telescope
S055A- UV Spectrometer
S055B- UV Spectrometer (UV Spectroheliometer)
S055C- UV Spectrometer - Hα Telescope
S056 - X-Ray Telescope
S061 - Potato Respiration
T004 - Frog Otolith Function

CRITERIA FOR SUCCESS

1. Sufficient consumables will be supplied by Flight AAP 3 carriers for reactivation of experiments for Mission AAP 3/4.
2. Mission AAP 3/4 unique experiments will operate within specification when operated in conjunction with the support subsystem.

SUPPORT REQUIREMENTS - Same as 39.9 plus the following

GSE
Equipment to support and monitor the operation of Mission AAP 3/4 experiments

SPECIAL TEST EQUIPMENT
None

FACILITIES
None

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
Operation Sequence - Mission AAP 3/4	39.11

TEST OBJECTIVE

Demonstrate that the experiments and support subsystems are compatible when operated in a mission sequence

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, IM&SS, CSM, RM, IM, ATM/Rack

TEST DESCRIPTION

PREPARATION
The cluster will be in an OWS configuration after the equipment (subsystem and experiments) has been installed and activated. GSE will be checked out and connected. Solar array will be simulated. Ground air conditioning will be supplied. The subsystem operation and each experiment operation shall have been demonstrated prior to this test. Any subsystem that will not operate in horizontal position will be simulated.

OPERATION
Each subsystem and experiment will be operated in the sequence that they would be operated during the mission. Established mission timelines will be compressed. Astronaut stations will be manned for this test. Support subsystem and experiment simulation will be held to a minimum.

CRITERIA FOR SUCCESS

The experiments and subsystems will perform within specification when operated to the mission sequence and timelines.

SUPPORT REQUIREMENTS - Same as 39.10

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
Orbit EMC Environment Test - Mission AAP 3/4	39.12

TEST OBJECTIVE

1. Demonstrate that orbit EMI environment has no adverse effect on carrier systems.
2. Verify antenna field strength.

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM, RM, LM, ATM/Rack

TEST DESCRIPTION

PREPARATION
Prototypes will be assembled horizontally in the on-orbit configuration. The LM&SS carrier will be in the top port of the MDA and the cluster will be at least 20 feet off the ground. RF absorbing material will be positioned at specified locations under the cluster and around support members. GSE will be checked out and connected. EMC monitoring equipment will be installed at specified locations. Carrier level EMC tests will have been performed prior to this test.

OPERATION
A simulated mission sequence will be performed with all antenna systems operated open loop. Subsystems and experiments with power requirements will be operated and EMC will be monitored for detrimental effects. Antenna field strength will be measured.

CRITERIA FOR SUCCESS

1. Subsystems and experiments will operate with no adverse effects due to EMI.
2. Antenna field strength shall be within design specification.

SUPPORT REQUIREMENTS - Same as 39.10 plus the following

GSE
1. Transport and handling GSE for all listed carriers.
2. EMC monitoring equipment

SPECIAL TEST EQUIPMENT
1. Antenna strength measuring equipment.

Table XXI. (Cont.)

Orbit EMC Environment Test - Mission AAP 3/4 2. Fixtures made of RF transparent material to hold centerline of cluster approximately 25 feet off the ground. FACILITIES Area to contain the OWS in horizontal position for EMC testing.

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
Contingency Planning - Mission AAP 3/4 (Critical Subsystem Malfunction Verification)	39.13.1

TEST OBJECTIVE

Demonstrate corrective actions required due to critical subsystem malfunctions which may affect astronaut safety

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM, RM, LM, ATM/Rack

TEST DESCRIPTION

PREPARATION
Operation Sequence - Mission AAP 3/4 (39.11) shall have been performed prior to this test.

OPERATION
Possible malfunctions derived by system analysis will be simulated and emergency procedures verified.

CRITERIA FOR SUCCESS

Emergency procedures against critical subsystem malfunctions shall be verified to be adequate for astronaut safety.

SUPPORT REQUIREMENTS - Same as 39.9

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
Contingency Planning - Mission AAP 3/4 (Alternate Experiment Grouping)	39.13.2

TEST OBJECTIVE

Demonstrate identified alternate experiment groupings to be used in case of experiment delivery problems or changes in mission objectives

TEST CONFIGURATION

Prototype orbit configured carriers:
S-IVB, IU, AM, MDA, Lower SLA, LM&SS, CSM, RM, LM, ATM/Rack

TEST DESCRIPTION

PREPARATION

OWS Experiment Performance - Mission AAP 3/4 (39.10) and OWS Operation Sequence - Mission AAP 3/4 (39.11) shall have been performed prior to this test.

OPERATION

1. Experiments added for this contingency test will be operated individually in conjunction with the support subsystems. Verification will be made that there are no incompatibilities between experiments and support subsystems.
2. Each subsystem and experiment in the alternate group will be operated in the sequence that they would be operated during the mission. Established mission timelines will be compressed and utilized. Astronaut stations will be manned for this test.

CRITERIA FOR SUCCESS

1. Alternate experiments will perform within design specifications when operated with support subsystems.
2. The experiments and subsystems will perform within specifications when operated to the mission sequence and timelines.

SUPPORT REQUIREMENTS - Same as 39.10

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
CM/RM/MDA Pressure Test	39.14

TEST OBJECTIVE

To demonstrate that the CM/RM/MDA combination is capable of being pressurized to operational pressure with interface leakage within design specifications

TEST CONFIGURATION

1. Prototype flight configured CM
2. Prototype flight configured RM
3. Prototype flight configured MDA

TEST DESCRIPTION

PREPARATION
The CM/RM/MDA will be mated (horizontal) in an area acceptable for pressurization. The CM, RM and MDA will be on support fixtures with vernier adjustments to allow mating. An AM simulator will be utilized to provide a structural cover for the AM/MDA interface.

OPERATION
The CM/RM/MDA will be pressurized to proof pressure utilizing a helium/nitrogen mixture. Verification will be made that no structural damage or major leaks have occured. The pressure will then be reduced to operational pressure where a mass spectrometer test will be performed on the CM/RM/MDA interfaces.

CRITERIA FOR SUCCESS

1. There shall be no adverse effects from the proof pressure.
2. Leak rates of the CM/RM/MDA interfaces shall be within design specifications.

SUPPORT REQUIREMENTS

GSE
1. CM handling and transport GSE
2. RM handling and transport GSE
3. MDA handling and transport GSE

Table XXI. (Cont.)

CM/RM/MDA Pressure Test (continued)

SPECIAL TEST EQUIPMENT

1. Mass spectrometer for leak test
2. Pressurization panel capable of supplying and monitoring a helium/nitrogen mixture of gas.
3. Support fixtures for CM, RM and MDA
4. AM interface simulator

FACILITIES

Area to perform CM/RM/MDA proof and leak test

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
RM/AM Cryogenic Subsystem Operation	39.15

TEST OBJECTIVE

Demonstrate that the RM/AM cryogenic transfer system operates within design specifications.

TEST CONFIGURATION

1. Prototype flight configured RM
2. Prototype flight configured AM

TEST DESCRIPTION

PREPARATION

The RM and AM will be side by side in the vertical position in a cryogenic test area. RM and AM shall have completed carrier level qualification tests. Individual components will have been subjected to proof pressures. GSE will be connected and an ambient functional performed prior to the cryogenic transfer test.

OPERATION

The cryogenic transfer test program will be performed as follows:

1. Connect RM/AM cryogenic transfer lines.
2. Pressurize and leak check all cryogenic systems.
3. Proof pressure all cryogenic systems.
4. Load cryogenics (LO_2, LH_2, LN_2). Demonstrate GSE compatibility.
5. Perform transfer of these fluids in an abbreviated mission sequence. Demonstrate: (a) flow rate
   (b) response time
6. Unload and clean systems.

CRITERIA FOR SUCCESS

1. All cryogenic systems shall operate within design specifications.
2. All prelaunch GSE servicing equipment shall be demonstrated compatible with the flight hardware.

SUPPORT REQUIREMENTS

GSE

1. AM and RM propellant and servicing GSE
2. AM and RM transport and handling GSE

Table XXI. (Cont.)

RM/AM Cryogenic Subsystem Operation (continued)

3. AM and RM electrical GSE

SPECIAL TEST EQUIPMENT

1. Mass spectrometer for leak check
2. Mounting fixtures for RM and AM on test stand
3. Pressurization equipment to perform subsystem leak check

FACILITIES

Cryogenic test area to mount RM and AM, provide the necessary commodities and allow system pressurization and cryogenic transfer

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
MDA/LM Pressure Test	39.16

TEST OBJECTIVE

To demonstrate that the MDA/LM combination is capable of being pressurized to operational pressure with interface leakage within design specifications

TEST CONFIGURATION

1. Prototype flight configured MDA
2. Prototype flight configured LM

TEST DESCRIPTION

PREPARATION
The MDA/LM will be mated (horizontal) in an area acceptable for pressurization. The LM and MDA will be on support fixtures with vernier adjustment to allow mating. An AM simulator will be utilized to provide a structural cover for the AM/MDA interface.

OPERATION
The MDA/LM will be pressurized to proof pressure utilizing a helium/nitrogen mixture. Verification will be made that no structural damage or major leaks have occurred. The pressure will then be reduced to operational pressure where a mass spectrometer test will be performed on the MDA/RM interface.

CRITERIA FOR SUCCESS

1. There shall be no adverse effects from the proof pressure.
2. Leak rates of the MDA/LM interface shall be within design specifications.

SUPPORT REQUIREMENTS

GSE
1. LM handling and transport GSE
2. MDA handling and transport GSE

SPECIAL TEST EQUIPMENT
1. Mass spectrometer for leak test
2. Pressurization panel capable of supplying and monitoring a helium/nitrogen mixture of gas
3. Support fixtures for LM and MDA

Table XXI. (Cont.)

MDA/LM Pressure Test (continued) 4. AM interface simulator FACILITIES Area to perform LM/MDA proof and leak test

Table XXI. (Cont.)

TEST TITLE	TEST NUMBER
LM/ATM/Rack Cryogenic Subsystem Operation	39.17

TEST OBJECTIVE

Demonstrate that the LM/ATM/Rack cryogenic transfer system operates within design specifications

TEST CONFIGURATION

1. Prototype flight configured LM
2. Prototype flight configured ATM/Rack

TEST DESCRIPTION

PREPARATION

The LM and ATM/Rack will be mated in the horizontal position in a cryogenic test area. LM and ATM/Rack shall have completed carrier level qualification tests. Individual components will have been subjected to proof pressures. GSE will be connected and an ambient functional performed prior to the cryogenic transfer test.

OPERATION

The cryogenic transfer test program will be performed as follows:

1. Connect LM/ATM cryogenic transfer lines.
2. Pressurize and leak check all cryogenic systems.
3. Proof pressure all cryogenic systems.
4. Load cryogenics (LO_2). Demonstrate GSE compatibility.
5. Perform transfer of these fluids in an abbreviated mission sequence. Demonstrate: (a) flow rate
   (b) response time
6. Unload and clean systems.

CRITERIA FOR SUCCESS

1. The cryogenic systems shall operate within design specifications.
2. All prelaunch GSE servicing equipment shall be demonstrated compatible with the flight hardware.

SUPPORT REQUIREMENTS

GSE

1. ATM/Rack propellant and servicing GSE

Table XXI. (Cont.)

LM/ATM/Rack Cryogenic Subsystem Operation (continued)

2. IM and ATM/Rack transport and handling GSE
3. LM and ATM/Rack electrical GSE

SPECIAL TEST EQUIPMENT

1. Mass spectrometer for leak check
2. Mounting fixtures for AM and CSM on test stand
3. Pressurization equipment to perform subsystem leak check

FACILITIES

Cryogenic test area to hold mated LM/ATM/Rack, provide the necessary commodities and allow system pressurization and cryogenic transfer

5. EXPERIMENT INTEGRATION TEST REQUIREMENTS

5.1 General - The following pages delineate the assigned experiments for Flights AAP 1, 2, 3, and 4; the carriers/clusters on which the experiment is performed (figure 40); and the integration test requirements (Table XXII). The experiment integration tests will verify and demonstrate that:

a. The experiments are compatible with the carriers and support subsystems.

b. The required subsystems are adequate to support the experiment operation.

EXPERIMENT		CARRIER/CLUSTER REQUIREMENT						
NUMBER	TITLE	S-IVB	IU	MDA	AEM PACKAGE	ATM/ RACK	CLUSTER 1/2	CLUSTER 3/4
D012	Astronaut Maneuvering Unit						X	X
D017	Solid Electrolyte Carbon Dioxide Reduction						X	
D018	Integrated Maintenance	X					X	X
D019	Suit Donning and Sleep Station Evaluation	X					X	X
D020	Evaluation of Alternate Restraints for Mobility and Maintenance	X					X	X
D021	Expandable Airlock			X			X	
D022	Expandable Structures for Recovery	X					X	
M018	Vectorcardiogram	X					X	X
M050	Metabolic Cost of Inflight Tasks	X					X	X
M051	Inflight Assessment of Cardiovascular Function	X					X	X
M052	Bone and Muscle Changes	X					X	X
M053	Human Vestibular Function	X					X	X
M054	Neurological Study	X					X	X
M055	Time and Motion Study	X					X	X
M423	Hydrostatic Gas Bearing Evaluation		X					
M425	Tracking and Navigation		X					
M439	Star-Horizon Automatic Tracking						X	
M464	Onboard Checkout Equipment	X					X	X
M466	Spacesuit and Lunar Surface Experiment Hardware	X					X	
M469	ST-124 Removal	X	X				X	X
M479	Zero-G Flammability	X					X	
M486	EVA Equipment and Hardware Evaluation	X					X	
M487	Crew Quarters	X					X	
M488	High Pressure Air Expulsion	X					X	
M489	Heat Exchanger Service	X					X	
M492	Joining Tubular Assemblies in Space Environment	X					X	
M493	Electron Beam Welding	X					X	X
S005	Synoptic Terrain Photography						X	
S006	Synoptic Weather Photography						X	
S009	Primary Cosmic Radiation						X	
S017	X-Ray Astronomy							X
S018	Micrometeorite Collection						X	
S019	UV Stellar Astronomy							X
S020	UV X-Ray Solar Photography				X	X		X
S027	X-Ray Astronomy		X					
S052	White Light Coronography				X	X		X
S053A	UV Coronal Spectrograph				X	X		X
S053B	UV Spectrograph				X	X		X
S054	X-Ray Spectrographic Telescope				X	X		X
S055A	UV Spectrometer				X	X		X
S055B	UV Spectrometer (UV Spectroheliometer)				X	X		X
S055C	UV Spectrometer - H Telescope				X	X		X
S056	X-Ray Telescope				X	X		X
S061	Potato Respiration							X
S063	UV Airglow Horizon Photography			X				X
S065	Multi-Band Terrain Photography						X	X
T002	Manual Navigation Sightings						X	
T003	Nephelometer Experiment	X					X	
T004	Frog Otolith Function							X
T013	Crew Activity Vehicle Disturbances	X						X
T017	Meteoroid Impact and Erosion			X			X	
T018	Precision Optical Tracking		X					
T020	Jet Shoes	X					X	
T021	Meteoroid Velocity and Impact into Aluminum			X			X	
T022	Heat Pipe Demonstration		X					
T023	Collection of Surface Absorbed Materials	X					X	
MSFC 57	Gravity Simulation Workbench	X				X		

Figure 40. Experiment Performance Area

Table XXII. Integration Test Requirements

EXPERIMENT TITLE

Astronaut Maneuvering Unit

EXPERIMENT NUMBER

D012

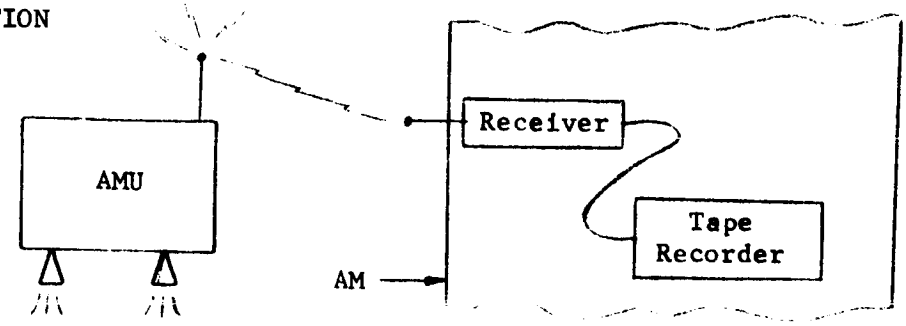
LAUNCH LOCATION

AM - Flight AAP 2
LM - Flight AAP 4

PERFORMANCE LOCATION

AM/External Flight AAP 2
LM/AM/External Flight AAP 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Display and controls
2. Crew systems
3. Data management

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit
2. Telemetry Check - Activate AMU and check spacecraft reception.

Table XXII. (Cont.)

EXPERIMENT TITLE — EXPERIMENT NUMBER

Solid Electrolyte Carbon Dioxide Reduction D017

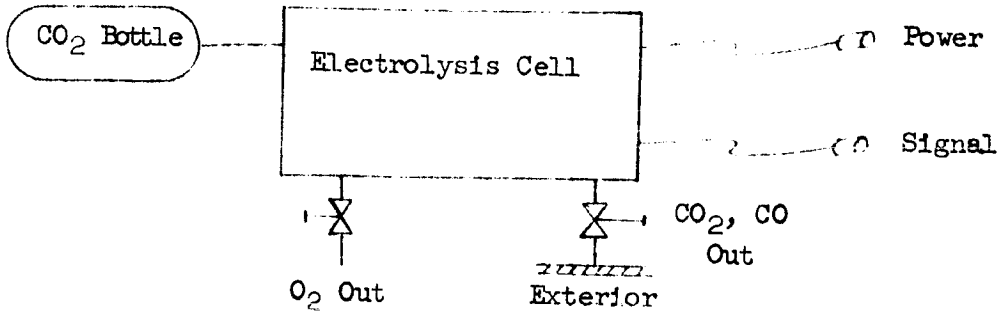
LAUNCH LOCATION

CSM Flight AAP 1

PERFORMANCE LOCATION

CSM Mission AAP 1/2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Display and Control
2. Power
3. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

35 min. @ 200 watts, peak to 320 watts, then gradual decrease to 210 watts. Total time - 4 hours

INTEGRATION TESTS

1. Phsycial Fit
   a. Storage fit check - basic unit
   b. Power cable connection
   c. Data cable connection
   d. CO_2, CO exhaust interface connection
2. Vacuum Connection Leak Check
3. Electrical Power Consumption
4. Operational Check-operate unit-verify output signals on data channels.

Table XXII. (Cont.)

EXPERIMENT TITLE

Integrated Maintenance

EXPERIMENT NUMBER

D018

LAUNCH LOCATION

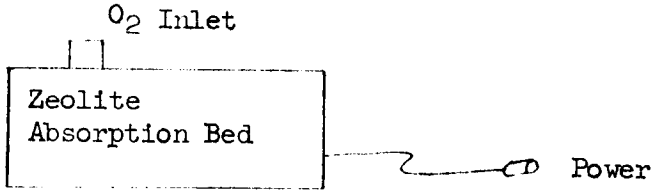
MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

OWS Flights AAP 2 and 4

CONFIGURATION

Astronaut performs maintenance tasks monitored by camera and recorder; also performs the following experiment:



SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Power
3. Camera units
4. Display and controls
5. On board checkout (M464)

EXPERIMENT ACTIVATION AND POWER REQUIRED

Two 9-hour intervals @ 200 watts
24 hours @ 30 watts

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check-zeolite bed, maintenance tools, astronaut restraining devices.
   b. Operational fit check of all hardware
   c. Zeolite bed power connection
   d. Camera and tape recorder placement
2. Electrical power consumption

Table XXII. (Cont.)

EXPERIMENT TITLE

Suit Donning and Sleep Station Evaluation

EXPERIMENT NUMBER

D019

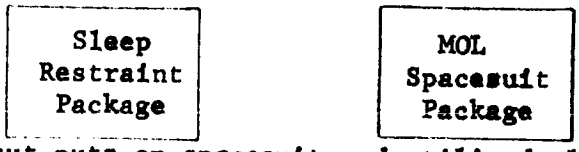
LAUNCH LOCATION

MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

OWS Flights AAP 2 and 4

CONFIGURATION



Astronaut puts on spacesuit and utilized sleep restraints - actions are monitored by camera and tape recorder.

SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Camera units
3. On board checkout (M464)

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check- basic units and accessories
   b. Operational location fit check
   c. Camera and tape recorder placement

Table XXII. (Cont.)

EXPERIMENT TITLE	EXPERIMENT NUMBER
Evaluation of Alt. Restraints for Mobility and Maintenance	D020

LAUNCH LOCATION

MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

OWS Flight AAP 2 and 4

CONFIGURATION

Astronaut performs mobile exercises and maintenance tasks - actions are monitored by camera and recorder

SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Camera units
3. On board checkout (M464)

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - all equipment
   b. Camera and recorder placement

Table XXII. (Cont.)

EXPERIMENT TITLE

Expandable Airlock

EXPERIMENT NUMBER

D021

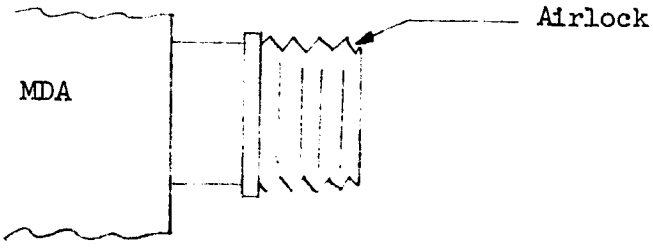
LAUNCH LOCATION

MDA

PERFORMANCE LOCATION

MDA Flight AAP 2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Voice data
3. Data management
4. Display and control

EXPERIMENT ACTIVATION AND POWER REQUIRED

5 sec. deployment @280 watts
50 min. @ 40 watts

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit and accessories
   b. Operational location fit check
   c. Sensor interface connection-temp. and pressure probes
   d. O_2 supply interface connection
   e. Power interface connection - deployment and lighting
   f. Camera location
2. Verify pressurization
3. Leak check
4. Verify sensor operation
5. Electrical Power Consumption

Table XXII. (Cont.)

EXPERIMENT TITLE	EXPERIMENT NUMBER
Expandable Structures for Recovery	D022

LAUNCH LOCATION

MDA/AM

PERFORMANCE LOCATION

OWS/AM External Flight AAP 2

CONFIGURATION

1. Astronaut demonstrates ability to deploy and lock an expandable re-entry capsule structure and install a payload in it.
2. Demonstration of an in space expansion and rigidization of a chemically rigidized fluted core glass cloth panel.

Actions are monitored by camera and tape recorder

SUPPORT SUBSYSTEMS REQUIRED

1. AM
   a. Voice data
   b. Data management
   c. Power
2. OWS
   a. Voice data
   b. Camera units

EXPERIMENT ACTIVATION AND POWER REQUIRED

5 amps @ 28 VDC for 5 sec for initiation

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic units
   b. Operational location fit check - collapsed and deployed
   c. Return storage fit check
   d. Camera and tape recorder placement
   e. Power cable connection

Table XXII. (Cont.)

EXPERIMENT TITLE

Vectorcardiogram

EXPERIMENT NUMBER

M018

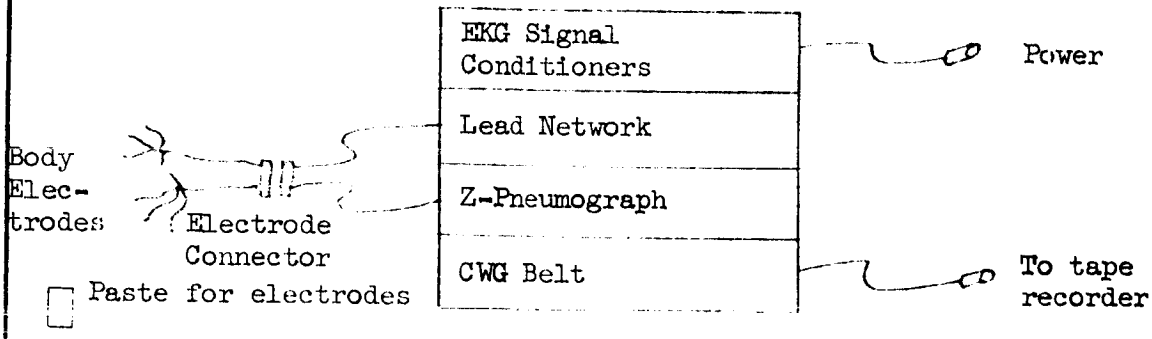
LAUNCH LOCATION

MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

OWS Flights AAP 2 and 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data management
2. Power
3. Display and controls

EXPERIMENT ACTIVATION AND POWER REQUIRED

1 watt per 40 min. duration

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit and accessories
   b. Operational location fit check
   c. Cable connection to tape recorder
   d. Power cable connection
   e. Subject cable harness connection to electrode connector
2. Electrical Power Consumption
3. Calibration Check - Simulate known input to electrodes - record on tape - compare tape results to input.

Table XXII. (Cont.)

EXPERIMENT TITLE

Metabolic Cost of In Flight Tasks

EXPERIMENT NUMBER

M050

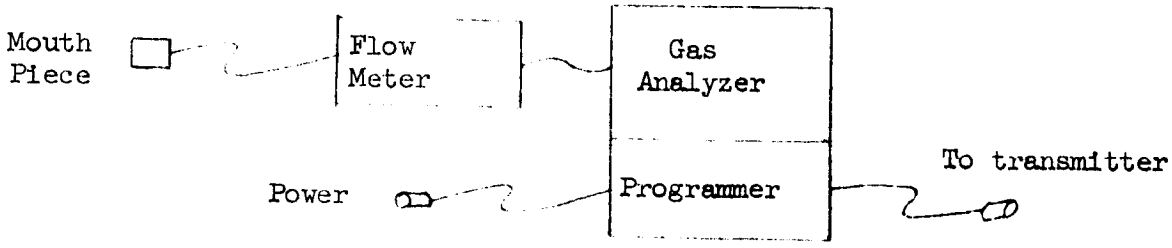
LAUNCH LOCATION

MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

OWS Flights AAP 2 and 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data management
2. Power

EXPERIMENT ACTIVATION AND POWER REQUIRED

40 min. per day @ 6 watts 6 days

INTEGRATION TESTS

1. Physical Fit
   a. Storage Fit check - basic unit and accessories
   b. Operational location fit check
   c. Cable connection to telemetry equipment
   d. Power cable connection
2. Electrical Power Consumption
3. Calibration Check - Introduce a known volume ratio of O_2 & CO_2 gas through the mouthpiece - compare gas analyzer readout and telemetry data with input.

Table XXII. (Cont.)

EXPERIMENT TITLE	EXPERIMENT NUMBER
Inflight Assessment of Cardiovascular Function	M051

LAUNCH LOCATION

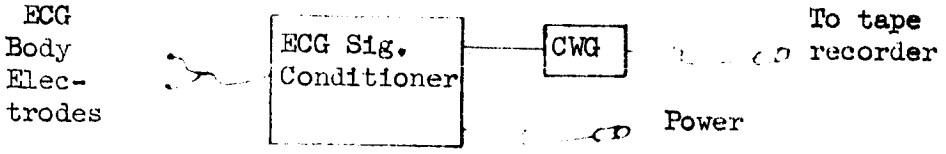
MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

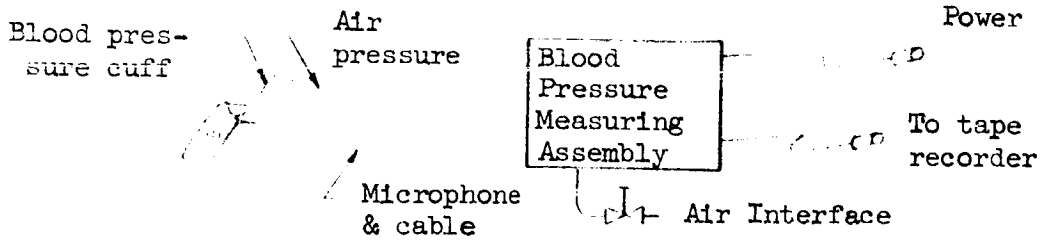
OWS Flights AAP 2 and 4

CONFIGURATION

Electrocardiogram



Blood Measuring Assembly



Lower Body Negative Pressure

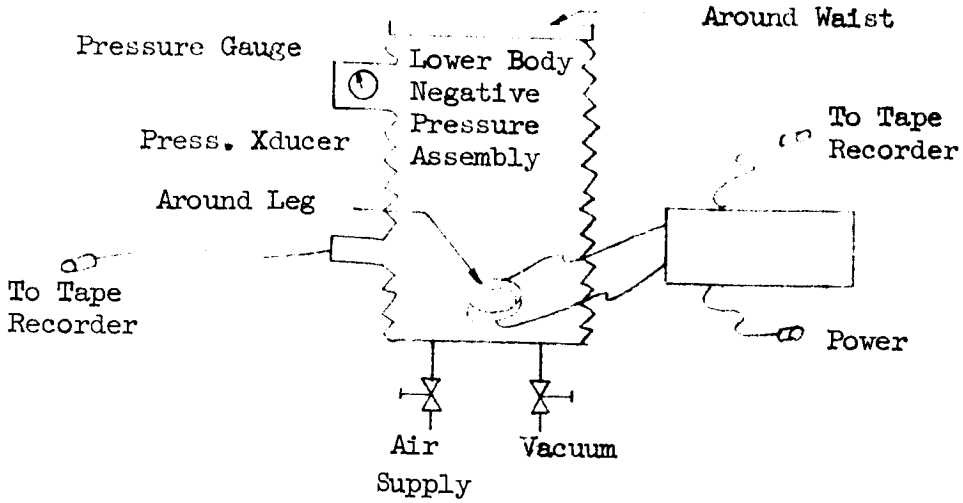


Table XXII. (Cont.)

SUPPORT SUBSYSTEMS REQUIRED

EXPERIMENT NUMBER

M051 (cont'd)

1. Data Management
2. Power
3. Camera units
4. Compressed air
5. Vacuum

EXPERIMENT ACTIVATION AND POWER REQUIRED

Three 45 minute sessions - one per day
10 min. @ 25 watts
35 min. @ 1.7 watts

INTEGRATION TESTS

1. Physical Fit
   a. Storage Fit Check - basic units and accessories
   b. Operational Location Fit Check
   c. Power Cable Connections
   d. Tape Recorder Cable Connections
   e. Air Interface Connections
   f. Vacuum Interface Connections
   g. Body Electrode Cable Connection
2. Air Connection Leak Check and Pressure Check
3. Vacuum Connection Leak Check and Vacuum Check
4. Electrical Power Consumption
5. Operational Check

Stimulate input with known quantities or data
and compare with output tape

Table XXII. (Cont.)

EXPERIMENT TITLE

Bone and Muscle Changes

EXPERIMENT NUMBER

M052

LAUNCH LOCATION

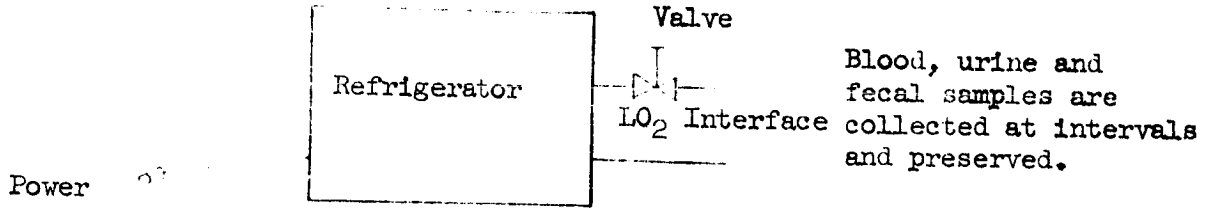
MDA Flight AAP 2 CSM Flights AAP 1 and 3

PERFORMANCE LOCATION

OWS/CSM Flights AAP 2 and 4

CONFIGURATION

INSTALLED BEFORE LAUNCH



SUPPORT SUBSYSTEMS REQUIRED

1. OWS
   a. Power
   b. Waste management
2. CSM
   a. Power
   b. Thermal control
   c. Crew systems

EXPERIMENT ACTIVATION AND POWER REQUIRED

Refrigerator on at all times

INTEGRATION TESTS

1. LO_2, interface leak check
2. LO_2 flow rate

Table XXII. (Cont.)

EXPERIMENT TITLE

Human Vestibular Function

EXPERIMENT NUMBER

M053

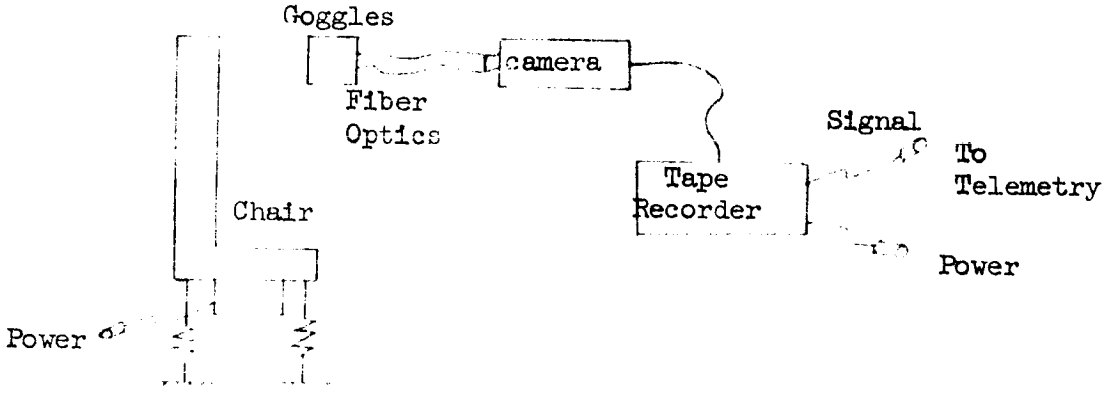
LAUNCH LOCATION

MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

OWS Flights AAP 2 and 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Voice Data
2. Data management
3. Power
4. Camera units

EXPERIMENT ACTIVATION AND POWER REQUIRED

Each test ½ hr. @ 500 watts

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit and accessories
   b. Operational location fit check
   c. Power cable connection
   d. Signal cable connection
2. Electrical power consumption

Table XXII. (Cont.)

EXPERIMENT TITLE

Neurological Study

EXPERIMENT NUMBER

M054

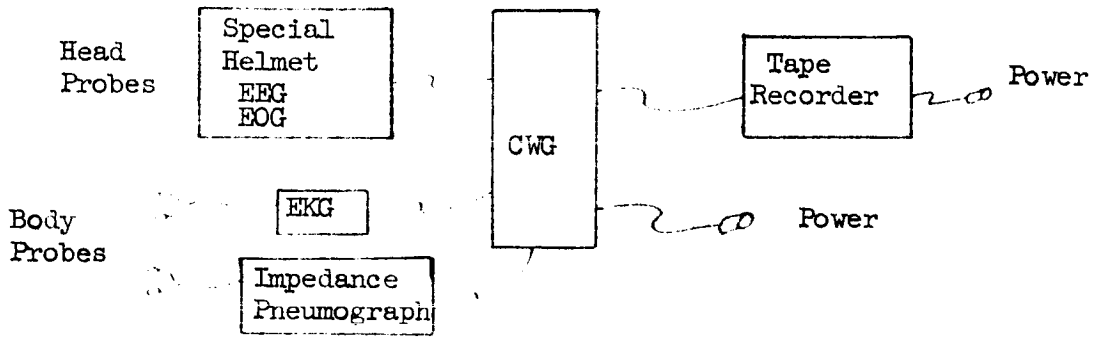
LAUNCH LOCATION

MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

OWS Flights AAP 2 and 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data management (biomed recorder)
2. Power
3. Onboard checkout (M464)

EXPERIMENT ACTIVATION AND POWER REQUIRED

Periods of 4 hours and 8 hours @ 1.7 watts

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic assemblies and accessories
   b. Operational location fit check
   c. Power cable connection
2. Electrical power consumption
3. Calibration check - simulate known input to probes - compare tape results to input.

Table XXII. (Cont.)

EXPERIMENT TITLE

Time and Motion Study

EXPERIMENT NUMBER

M055

LAUNCH LOCATION

MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

OWS Flights AAP 2 and 4

CONFIGURATION

Astronaut performs various physical tasks - actions are monitored by camera and tape recorder

SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Camera units

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - equipment for time study tasks
   b. Operational location fit check
   c. Camera and recorder location

Table XXII. (Cont.)

EXPERIMENT TITLE

Hydrostatic Gas Bearing Evaluation

EXPERIMENT NUMBER

M423

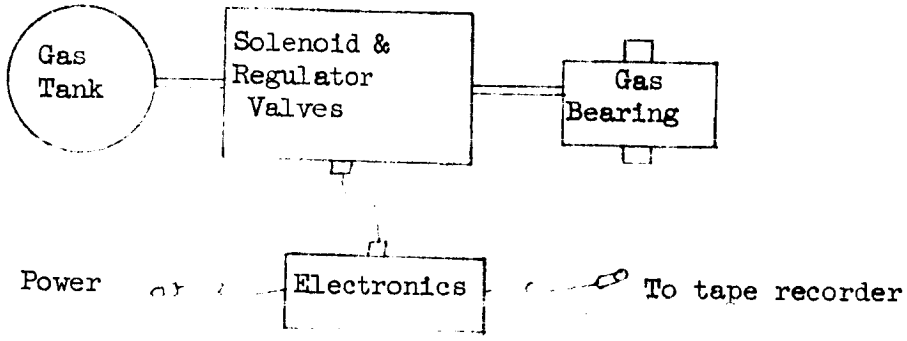
LAUNCH LOCATION

IU Flight AAP 4

PERFORMANCE LOCATION

IU Flight AAP 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data management

EXPERIMENT ACTIVATION AND POWER REQUIRED

4½ hours @ 84 watts

INTEGRATION TESTS

1. Physical fit
   a. Tape recorder cable connection
2. Electrical Power Consumption

Table XXII. (Cont.)

EXPERIMENT TITLE

Tracking and Navigation

EXPERIMENT NUMBER

M425

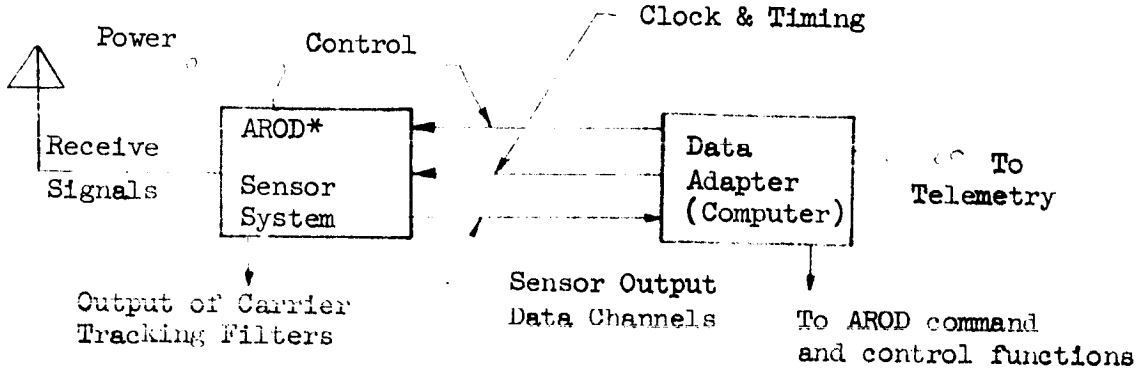
LAUNCH LOCATION

IU Flight AAP 4

PERFORMANCE LOCATION

IU Flight AAP 4

CONFIGURATION



*Airborne Range Orbit Determination

SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

150 watts for 15 min.

INTEGRATION TESTS

1. Physical Fit
   a. Storage/operational location fit check
   b. Data cable connections
   c. Power cable connections
2. Electrical power consumption

Table XXII. (Cont.)

EXPERIMENT TITLE

Star-Horizon Automatic Tracking

EXPERIMENT NUMBER

M439

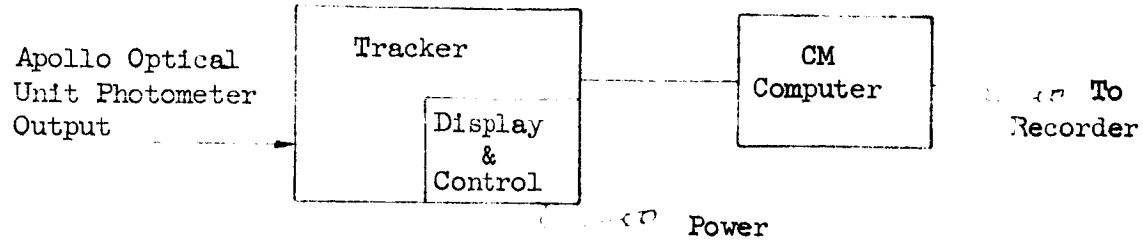
LAUNCH LOCATION

CSM Flight AAP 1

PERFORMANCE LOCATION

CSM Mission AAP 1/2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Display and Control
2. Power
3. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

Unknown

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit
   b. Operational location fit check
   c. Power cable connection
   d. Interface connection with CM computer and photometer

Table XXII. (Cont.)

EXPERIMENT TITLE

Onboard checkout Equipment

EXPERIMENT NUMBER

M464

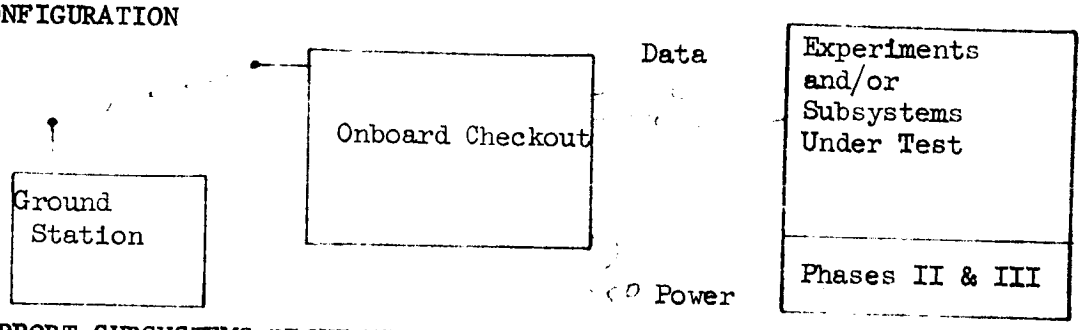
LAUNCH LOCATION

MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

OWS Flights AAP 2 and 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data Management
2. Power

EXPERIMENT ACTIVATION AND POWER REQUIRED

Checkout Power
- Phase I - 15 min/day @ 475 watts
- Phase II - 30 min/day @ 475 watts
- Phase III - 1 hr. 45 min/day @ 665 watts

Monitor Power
- 1.2 sec. @ 300-380 watts

Standby Power
- 5 watts

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit
   b. Operational location fit check
   c. Power cable connection
   d. Interface connections with selected experiments or subsystems
2. Electrical Power Consumption
3. Operational check - simulate experiment/subsystem input with known data and compare with output
4. Verify OWS can be operated from ground systems

Table XXII. (Cont.)

EXPERIMENT TITLE	EXPERIMENT NUMBER
Spacesuit and Lunar Surface Experiment Hardware	M466

LAUNCH LOCATION

MDA

PERFORMANCE LOCATION

OWS Flight AAP 2

CONFIGURATION

Astronaut performs various tasks utilizing lunar spacesuit, special tools and hardware under a 1/6 "g" environment - actions are monitored by TV and movie cameras.

SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Data management
3. Camera units

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit

    a. Storage fit check - all equipment and accessories
    b. Camera placement

Table XXII. (Cont.)

EXPERIMENT TITLE	EXPERIMENT NUMBER
ST-124 Removal	M469

LAUNCH LOCATION

IU/MDA Flight AAP 2 CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

IU/OWS Flight AAP 2 OWS Flight AAP 4

CONFIGURATION

Astronaut removes ST-124 system from IU with special tools, and moves to OWS. The ST-124 will be disassembled and certain selected components removed. Actions are monitored by TV and movie camera.

SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Data management
3. Power
4. Camera units
5. Display and controls

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - TV camera, movie camera, tool kit, ST-124 stowage after removal
   b. Tether attachment and length
   c. Operational camera set-up

Table XXII. (Cont.)

EXPERIMENT TITLE

Zero-G Flammability

EXPERIMENT NUMBER

M479

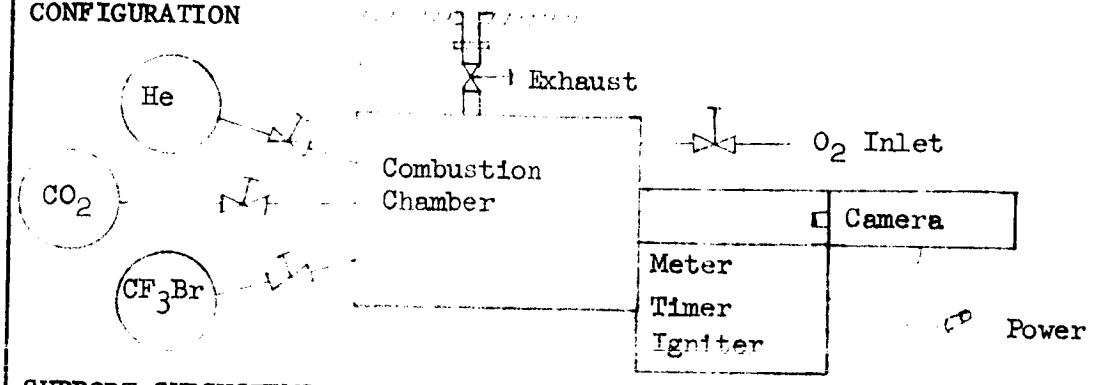
LAUNCH LOCATION

MDA

PERFORMANCE LOCATION

OWS Flight AAP 2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Data management
3. Power
4. Camera units
5. Oxygen supply
6. Vacuum
7. Onboard checkout (M464)

EXPERIMENT ACTIVATION AND POWER REQUIRED

87 sec. each test
igniter - 2 sec @ 560 watts
controls - 25 sec @ 56 watts
camera - 60 sec. @ 140 watts
} Common Start

Total of 5.4 hours testing time

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit and accessories
   b. Operational location fit check
   c. Power cable connection
   d. Exhaust interface connection
2. Electrical Power Consumption
3. Verify Exhaust Operation

Table XXII. (Cont.)

EXPERIMENT TITLE

EVA Equipment and Hardware Evaluation

EXPERIMENT NUMBER

M486

LAUNCH LOCATION

MDA

PERFORMANCE LOCATION

OWS Flight AAP 2

CONFIGURATION

Mobility aids and EVA equipment are evaluated by monitoring actions on TV and movie cameras.

SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Data management
3. Power
4. Camera units
5. Onboard checkout (M464)

EXPERIMENT ACTIVATION AND POWER REQUIRED

3 hour session
2 sessions per day for 6 days

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - mobility aids, hardware and accessories
   b. Operational location fit check
   c. Camera placement

Table XXII. (Cont.)

EXPERIMENT TITLE	EXPERIMENT NUMBER
Crew Quarters	M487

LAUNCH LOCATION

MDA

PERFORMANCE LOCATION

AM/OWS Flight AAP 2

CONFIGURATION

Astronauts erect various structures for living quarters in S-IVB. Actions are monitored on TV and movie cameras.

SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Data management
3. Power
4. Camera units
5. Onboard checkout (M464)

EXPERIMENT ACTIVATION AND POWER REQUIRED

48 hours setup time

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - all structures, assemblies and accessories
   b. Operational location fit check
   c. Camera placement

Table XXII. (Cont.)

EXPERIMENT TITLE

High Pressure Air Explusion

EXPERIMENT NUMBER

M488

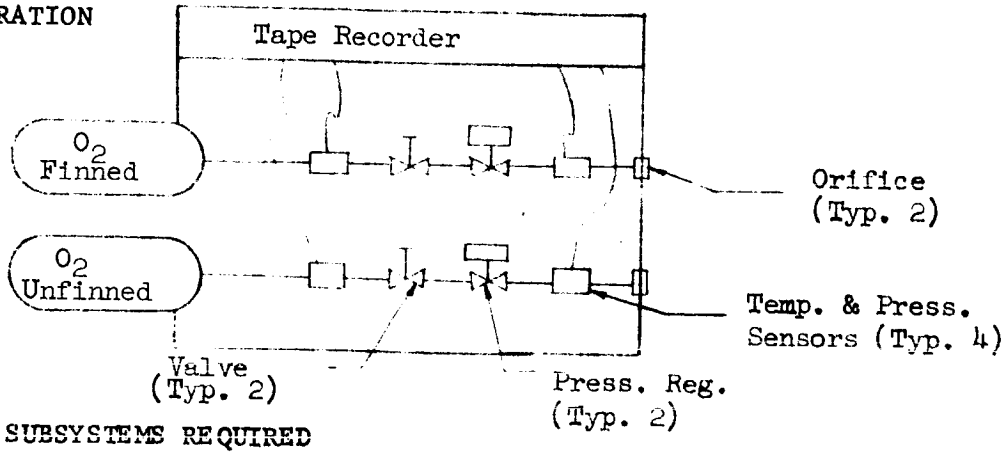
LAUNCH LOCATION

MDA

PERFORMANCE LOCATION

OWS Flight AAP 2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data management

EXPERIMENT ACTIVATION AND POWER REQUIRED

20 min. @ 18 watts

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit and tanks
   b. Operational location fit check
   c. Power cable connection
2. Electrical power consumption
3. Sensor Calibration - Introduce a gas whose thermodynamic expulsion characteristics under 1 "g" are known - compare tape data with known data.

Table XXII. (Cont.)

EXPERIMENT TITLE

Heat Exchanger Service

EXPERIMENT NUMBER

M489

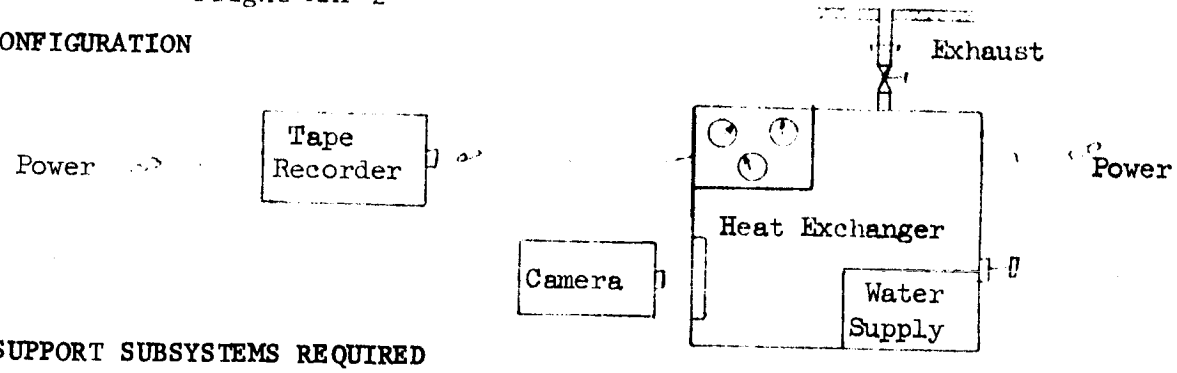
LAUNCH LOCATION

MDA

PERFORMANCE LOCATION

OWS Flight AAP 2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Data management
3. Power
4. Camera units
5. Vacuum

EXPERIMENT ACTIVATION AND POWER REQUIRED

16 hours
5 to 630 watts intermittently 350 watts average

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit and accessories
   b. Operational location fit check
   c. Power cable connections
   d. Tape recorder connection
   e. Exhaust interface connection
   f. Camera location
2. Electrical power consumption
3. Calibration check
   Operate under 1 "g" condition - check known or expected result with tape data.
4. Verify Exhaust Operation

Table XXII. (Cont.)

EXPERIMENT TITLE

Joining Tubular Assemblies in Space Environment

EXPERIMENT NUMBER

M492

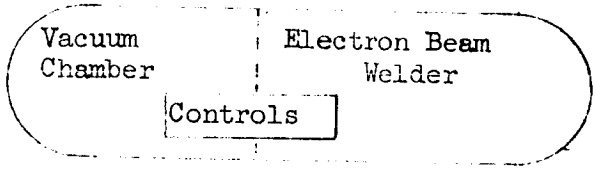
LAUNCH LOCATION

MDA

PERFORMANCE LOCATION

OWS Flight AAP 2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Camera units
3. On board checkout (M464)

EXPERIMENT ACTIVATION AND POWER REQUIRED

No power data.
This experiment is performed simultaneously with M493
1½ hours total time for both

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit
   b. Operational location fit check
   c. Power cable connection

2. Electrical Power Consumption

Table XXII. (Cont.)

EXPERIMENT TITLE

Electron Beam Welding

EXPERIMENT NUMBER

M493

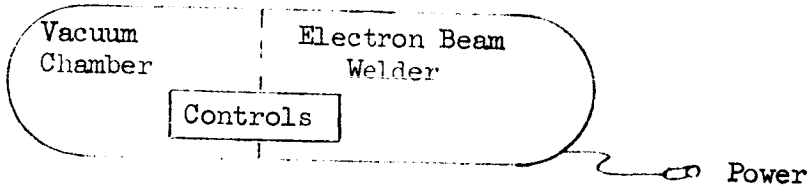
LAUNCH LOCATION

MDA CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

OWS Flights 2 and 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Camera units
3. Onboard checkout (M464)

EXPERIMENT ACTIVATION AND POWER REQUIRED

No power data.
This experiment is performed simultaneously with M492 on Flight AAP 2.
1½ hours total time for both

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit
   b. Operational fit check
   c. Power cable connection
2. Electrical Power Consumption

Table XXII. (Cont.)

EXPERIMENT TITLE

Synoptic Terrain Photography

EXPERIMENT NUMBER

S005

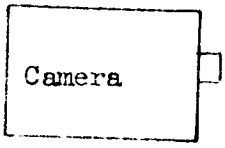
LAUNCH LOCATION

CSM Flight AAP 1

PERFORMANCE LOCATION

CSM Mission AAP 1/2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Voice data

EXPERIMENT ACTIVATION AND POWER REQUIRED

Performed in conjunction with S006

INTEGRATION TESTS

1. Physical Fit

   a. Storage fit check camera and accessories
   b. Operational location fit check

Table XXII. (Cont.)

EXPERIMENT TITLE

Synoptic Weather Photography

EXPERIMENT NUMBER

S006

LAUNCH LOCATION

CSM Flight AAP 1

PERFORMANCE LOCATION

CSM Mission AAP 1/2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Voice data

EXPERIMENT ACTIVATION AND POWER REQUIRED

Performed in conjunction with S005

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - camera and accessories
   b. Operational location fit check

Table XXII. (Cont.)

EXPERIMENT TITLE

Primary Cosmic Radiation

EXPERIMENT NUMBER

S009

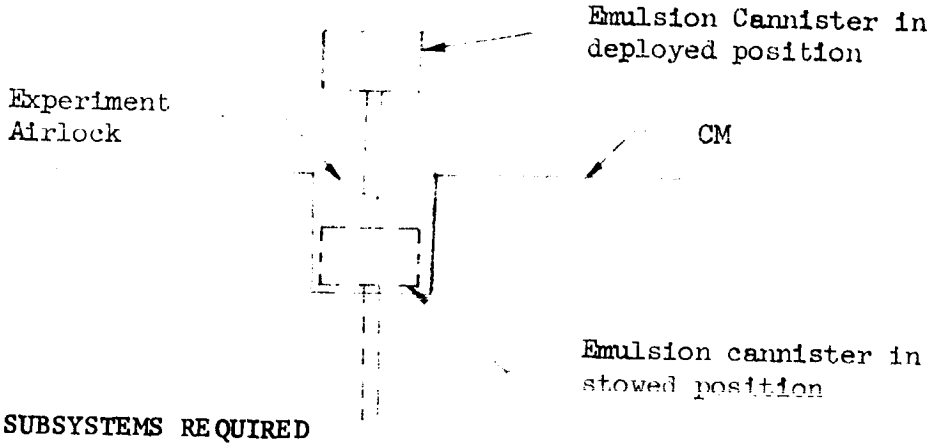
LAUNCH LOCATION

CSM Flight AAP 1

PERFORMANCE LOCATION

CSM Mission AAP 1/2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Thermal Control
3. Display and control

EXPERIMENT ACTIVATION AND POWER REQUIRED

Total of 300 hours @ 2 watts

INTEGRATION TESTS

1. Physcial Fit
   a. Storage fit check - basic unit
   b. Operational location fit check
   c. Heater power cable connection
2. Electrical power consumption

Table XXII. (Cont.)

EXPERIMENT TITLE

X-Ray Astronomy

EXPERIMENT NUMBER

S017

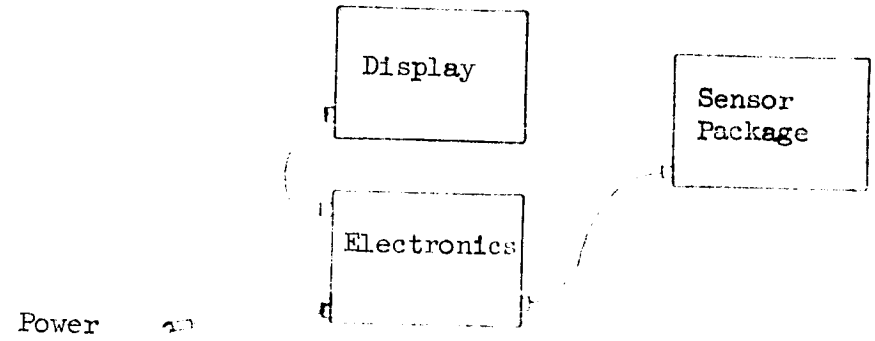
LAUNCH LOCATION

LM&SS Rack

PERFORMANCE LOCATION

RACK - Scheduled on Flight AAP 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Data management
3. Display and control

EXPERIMENT ACTIVATION AND POWER REQUIRED

30 min. intervals @ 7 watts
10 hour duration

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit
   b. Operational location fit check
   c. Power cable connection
2. Sensor alignment with respect to spacecraft
3. Electrical Power Consumption

Table XXII. (Cont.)

EXPERIMENT TITLE

Micrometeorite Collection

EXPERIMENT NUMBER

S018

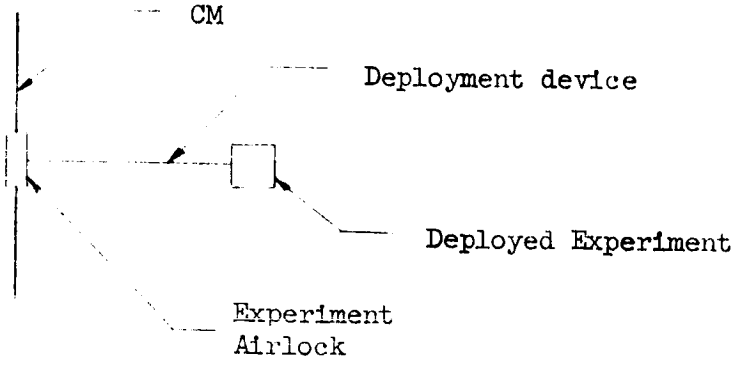
LAUNCH LOCATION

CSM Flight AAP 1

PERFORMANCE LOCATION

CSM Mission AAP 1/2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Voice data - deployment and retrieval

EXPERIMENT ACTIVATION AND POWER REQUIRED

No power requirements

INTEGRATION TESTS

1. Physical Fit

   a. Storage fit check - basic unit and accessories
   b. Operational location fit check

Table XXII. (Cont.)

EXPERIMENT TITLE

UV Stellar Astronomy

EXPERIMENT NUMBER

S019

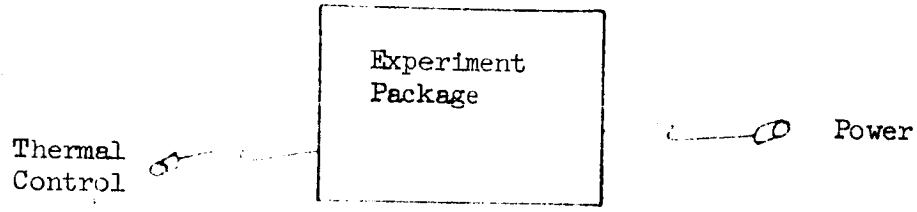
LAUNCH LOCATION

CSM Flight AAP 3

PERFORMANCE LOCATION

CSM Mission AAP 3/4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Thermal Control
3. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

6-2/3 hours @ 2 watts

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit
   b. Operational location fit check
   c. Thermal Control Interface
   d. Power Cable Connection
2. Verify Thermal Control Operation
3. Electrical Power Consumption

Table XXII. (Cont.)

EXPERIMENT TITLE

UV X-Ray Solar Photography

EXPERIMENT NUMBER

S020

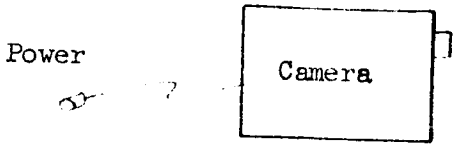
LAUNCH LOCATION

ATM/Rack

PERFORMANCE LOCATION

ATM/Rack Flight AAP 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Power

EXPERIMENT ACTIVATION AND POWER REQUIRED

6 hours @ 1 watt

INTEGRATION TESTS

1. Physical Fit

   a. Storage fit check - camera and film

Table XXII. (cont.)

EXPERIMENT TITLE

X-Ray Astronomy

EXPERIMENT NUMBER

8027

LAUNCH LOCATION

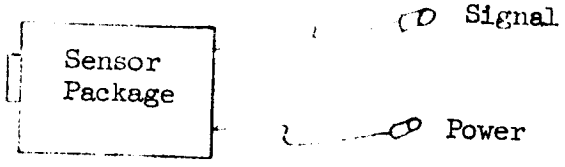
IU Flight AAP 3

PERFORMANCE LOCATION

IU Flight AAP 3

CONFIGURATION

Installed before launch



SUPPORT SUBSYSTEMS REQUIRED

1. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

4.5 to 7.0 hours @ 21 watts

INTEGRATION TESTS

1. Sensor Package - spacecraft alignment
2. Power Consumption
3. Operational Check

Table XXII. (Cont.)

EXPERIMENT TITLE

White Light Coronagraphy

EXPERIMENT NUMBER

S052

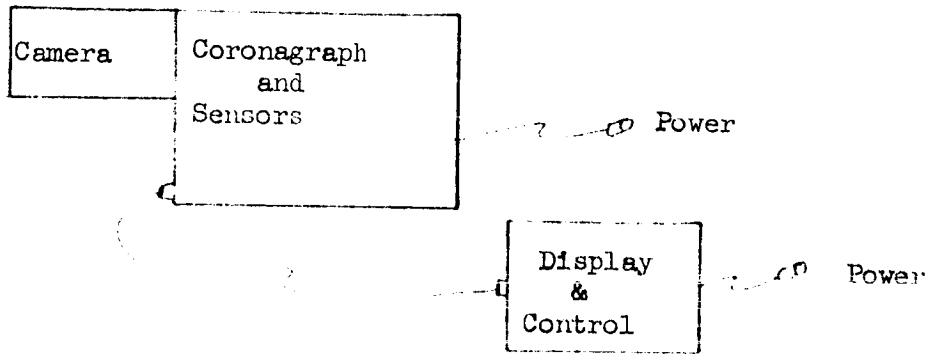
LAUNCH LOCATION

ATM/Rack

PERFORMANCE LOCATION

ATM/Rack Flight AAP 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Display and control

EXPERIMENT ACTIVATION AND POWER REQUIRED

2 weeks @ 3 watts with 8 watt peaks

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit and accessories
   b. Operational location fit check
   c. Power cable connections
2. Electrical Power Consumption
3. Operational check
   a. Stimulate sensors and monitor display panel

Table XXII. (Cont.)

EXPERIMENT TITLE

UV Coronal Spectrograph

EXPERIMENT NUMBER

S053A

LAUNCH LOCATION

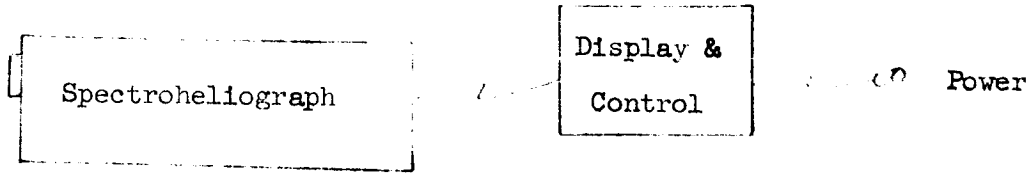
ATM/Rack

PERFORMANCE LOCATION

ATM/Rack Flight AAP 4

CONFIGURATION

Installed before launch



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Display and control

EXPERIMENT ACTIVATION AND POWER REQUIRED

10 sec @ 30 watts
200 times intermittently

INTEGRATION TESTS

1. Spectroheliograph - spacecraft alignment
2. Electrical Power Consumption
3. Operational Check

Table XXII. (Cont.)

EXPERIMENT TITLE

UV Spectrograph

EXPERIMENT NUMBER

S053B

LAUNCH LOCATION

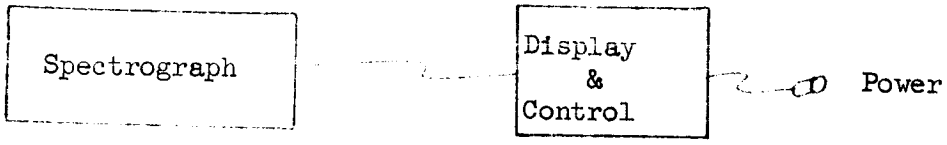
ATM/Rack

PERFORMANCE LOCATION

ATM/Rack Flight AAP 4

CONFIGURATION

Installed before launch



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Display and Control

EXPERIMENT ACTIVATION AND POWER REQUIRED

20 hours @ 5 watts with intermittent peaks to 20 watts

INTEGRATION TESTS

1. Spectrograph - spacecraft alignment
2. Electrical power consumption
3. Operational check

Table XXII. (Cont.)

EXPERIMENT TITLE

X-Ray Spectrographic Telescope

EXPERIMENT NUMBER

3054

LAUNCH LOCATION

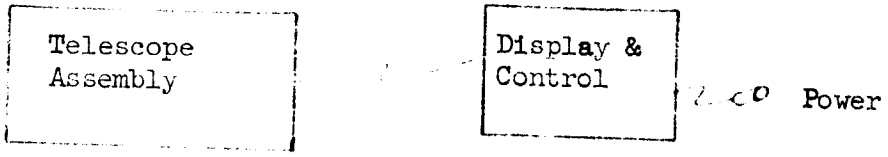
ATM/Rack

PERFORMANCE LOCATION

ATM/Rack Flight AAP 4

CONFIGURATION

Installed before launch



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Display and Control
3. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

10 to 48 watts with spikes to 63 watts

INTEGRATION TESTS

1. Telescope - spacecraft alignment
2. Electrical power consumption
3. Operational check

Table XXII. (Cont.)

EXPERIMENT TITLE

UV Spectrometer

EXPERIMENT NUMBER

S055A

LAUNCH LOCATION

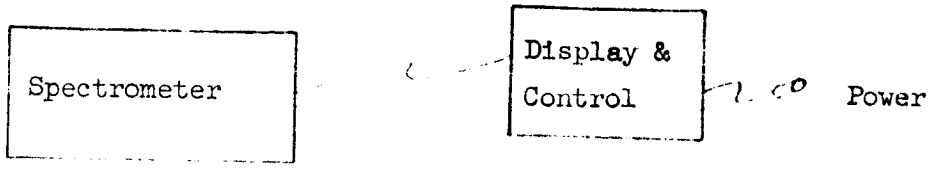
ATM/Rack

PERFORMANCE LOCATION

ATM/Rack Flight AAP 4

CONFIGURATION

Installed before launch



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Display and Control
3. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

12 min. @ 7 watts for each observation

INTEGRATION TESTS

1. Spectrometer - spacecraft alignment
2. Electrical Power Consumption
3. Operations Check

Table XXII. (Cont.)

EXPERIMENT TITLE — EXPERIMENT NUMBER

UV Spectrometer (Ultra-violet Spectroheliometer) S055B

LAUNCH LOCATION

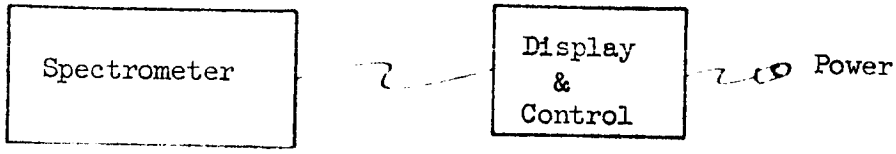
ATM/Rack

PERFORMANCE LOCATION

ATM/Rack Flight AAP 4

CONFIGURATION

Installed before launch



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Display and Control
3. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

5 min. @ 20 watts for each observation
2.3 watts standby

INTEGRATION TESTS

1. Spectrometer - spacecraft alignment
2. Electrical Power Consumption
3. Operations Check

Table XXII. (Cont.)

EXPERIMENT TITLE

UV Spectrometer - H_{α} Telescope

EXPERIMENT NUMBER

S055C

LAUNCH LOCATION

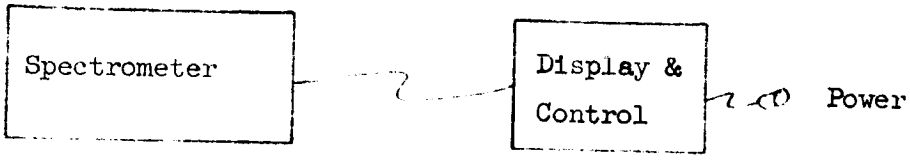
ATM/Rack

PERFORMANCE LOCATION

ATM/Rack Flight AAP 4

CONFIGURATION

Installed before launch



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Display and Control
3. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

90 min. @ 1.5 watts avg.

INTEGRATION TESTS

1. Spectrometer - Spacecraft Alignment
2. Electrical Power Consumption
3. Operations Check

Table XXII. (Cont.)

EXPERIMENT TITLE

X-Ray Telescope

EXPERIMENT NUMBER

S056

LAUNCH LOCATION

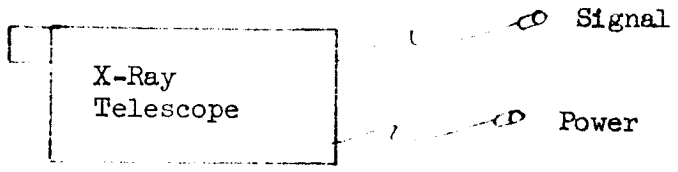
ATM/Rack

PERFORMANCE LOCATION

ATM/Rack Flight AAP 4

CONFIGURATION

Installed before launch



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Display

EXPERIMENT ACTIVATION AND POWER REQUIRED

45 hours @ 15 watts with peaks of unknown magnitude

INTEGRATION TESTS

1. Telescope - Spacecraft Alignment
2. Electrical Power Consumption
3. Operational Check

Table XXII. (Cont.)

EXPERIMENT TITLE

Potato Resporation

EXPERIMENT NUMBER

S061

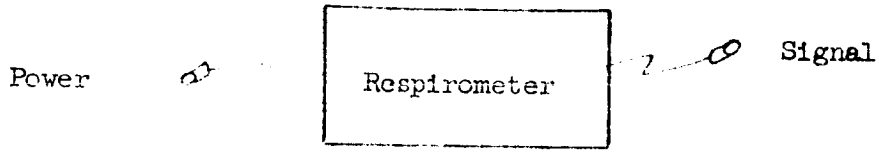
LAUNCH LOCATION

CSM Flight AAP 3

PERFORMANCE LOCATION

CSM Mission AAP 3/4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

0.7 watts/unit for duration of experiment

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit
   b. Operational location fit check
   c. Power cable connection
   d. Data cable connection

Table XXII. (Cont.)

EXPERIMENT TITLE

UV Airglow Horizon Photography

EXPERIMENT NUMBER

S063

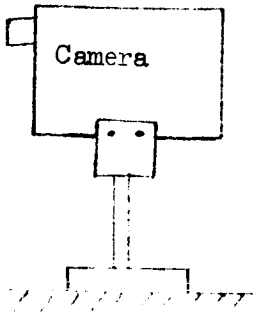
LAUNCH LOCATION

CM Flight AAP 3

PERFORMANCE LOCATION

MDA Flight AAP 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data management
2. Displays and controls

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage Fit Check - camera, bracket and accessories
   b. Operational location fit check

Table XXII. (Cont.)

EXPERIMENT TITLE

Multi-Band Terrain Photography

EXPERIMENT NUMBER

S065

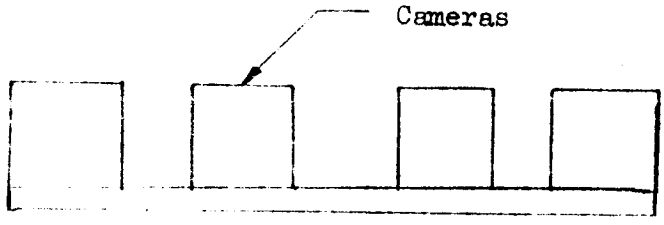
LAUNCH LOCATION

CSM Flight AAP 1
CSM Flight AAP 3 (Resupply)

PERFORMANCE LOCATION

CSM Mission AAP 1/2
CSM Mission AAP 3/4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data management

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - cameras and accessories
   b. Operational location fit check

Table XXII. (Cont.)

EXPERIMENT TITLE

Manual Navigation Sightings

EXPERIMENT NUMBER

T002

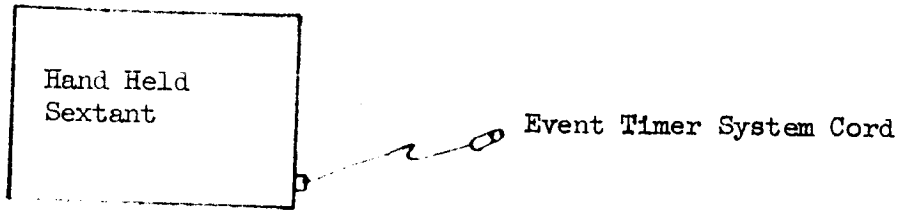
LAUNCH LOCATION

CSM Flight AAP 1

PERFORMANCE LOCATION

CSM Mission AAP 1/2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit
   b. Operational location fit check
   c. Data cord connection

Table XXII. (Cont.)

EXPERIMENT TITLE

Nephelometer Experiment

EXPERIMENT NUMBER

T003

LAUNCH LOCATION

CSM Flight AAP 1

PERFORMANCE LOCATION

CSM/OWS Flight AAP 2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. CSM
   a. Power
2. OWS
   a. Power

EXPERIMENT ACTIVATION AND POWER REQUIRED

1 watt for 12 min. per day

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit
   b. Operational location fit check
   c. Power cable connection
2. Electrical Power Consumption

Table XXII. (Cont.)

EXPERIMENT TITLE

Frog Otolith Function

EXPERIMENT NUMBER

T004

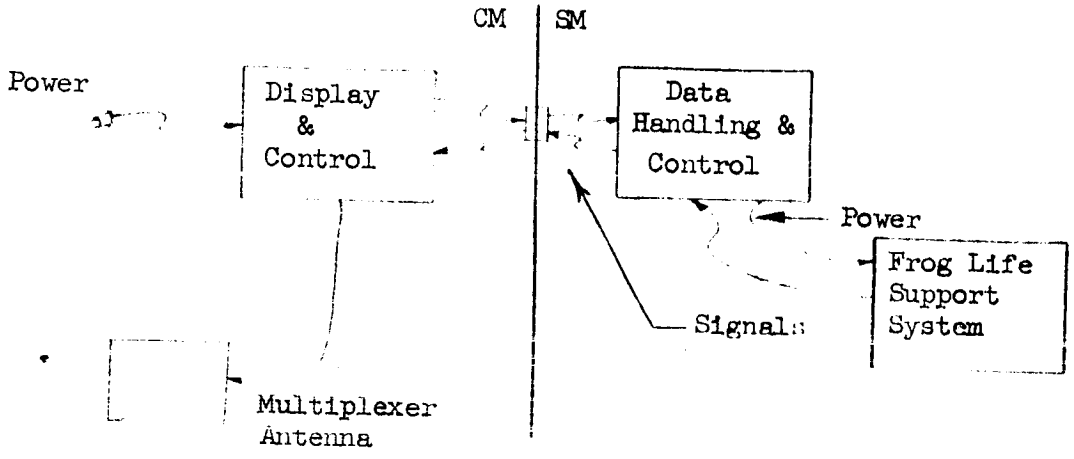
LAUNCH LOCATION

CSM Flight AAP 3

PERFORMANCE LOCATION

CSM Mission AAP 3/4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data Management
2. Thermal Control
3. Display and Control

EXPERIMENT ACTIVATION AND POWER REQUIRED

5.3 watts continuous
3 watts, 27.5 VDC for 8 min/session
15 watts, 115 VDC for 22 sec/session
Total of 44 sessions in 72 hours

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit and accessories
   b. Operational location fit check
   c. Power cable interfaces
   d. Signal cable interfaces
   e. Antenna cable interface
2. Electrical Power Consumption
3. Operational Check - simulate input with known quantities or data and compare with output

Table XXII. (Cont.)

EXPERIMENT TITLE

Crew Activity Vehicle Disturbances

EXPERIMENT NUMBER

T013

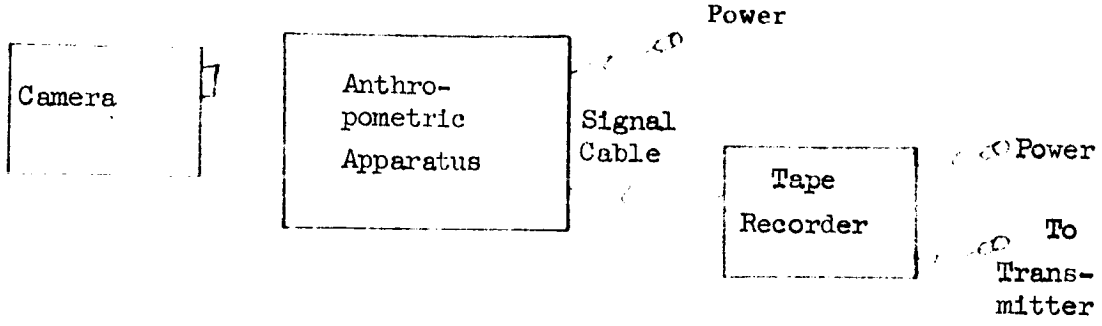
LAUNCH LOCATION

MDA

PERFORMANCE LOCATION

OWS Flight AAP 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Camera Units
3. Data Management

EXPERIMENT ACTIVATION AND POWER REQUIRED

1 hour @ 50 watts

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - basic unit and accessories
   b. Operational location of tape recorder and camera
   c. Cable connection to telemetry equipment
   d. Signal cable connection to tape recorder
   e. Power cable connections for recorder and anthropometric apparatus
2. Electrical Power Consumption
3. Calibration Check
   Induce known displacements in the anthropometric apparatus - compare tape results to input

Table XXII. (Cont.)

EXPERIMENT TITLE	EXPERIMENT NUMBER
Meteoroid Impact and Erosion	T017

LAUNCH LOCATION

MDA External

PERFORMANCE LOCATION

AM/MDA External Flights AAP 2 and 4

CONFIGURATION

Polished vycor glass panels mounted before launch

SUPPORT SUBSYSTEMS REQUIRED

1. Display and control

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - folded panels
   b. Deployed location fit check

2. Operational Check
   a. Deployment control

Table XXII. (Cont.)

EXPERIMENT TITLE

Precision Optical Tracking

EXPERIMENT NUMBER

T018

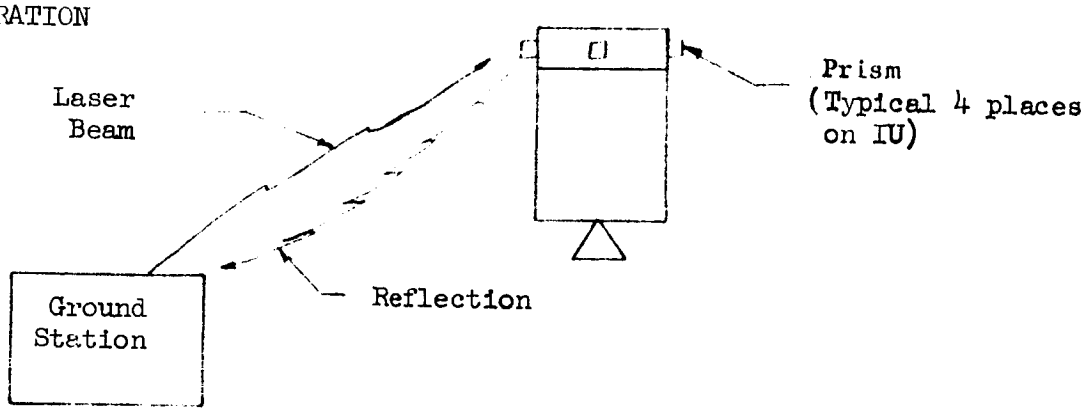
LAUNCH LOCATION

IU Flight AAP 4

PERFORMANCE LOCATION

IU Flight AAP 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

None

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage/operational location fit check

Table XXII. (Cont.)

EXPERIMENT TITLE	EXPERIMENT NUMBER
Jet Shoes	T020

LAUNCH LOCATION

MDA

PERFORMANCE LOCATION

OWS Flight AAP 2

CONFIGURATION

Astronaut maneuvers in S-IVB and actions are monitored by camera and recorder.

SUPPORT SUBSYSTEMS REQUIRED

1. Voice data
2. Camera units
3. Onboard checkout (M464)

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Stowage fit check - basic unit and accessories
   b. Camera and recorder location

Table XXII. (Cont.)

EXPERIMENT TITLE

Meteoroid Velocity and Impact Into Aluminum

EXPERIMENT NO.

T021

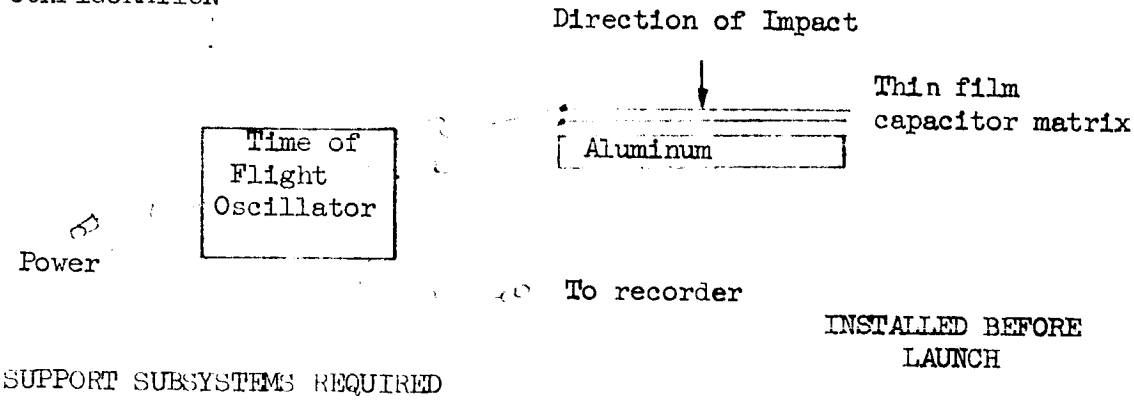
LAUNCH LOCATION

MDA External

PERFORMANCE LOCATION

CM/MDA External Flights AAP 2 and 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Power
2. Voice data
3. Data management
4. Display and Control

EXPERIMENT ACTIVATION AND POWER REQUIRED

13 days @ 10 watts
90 watt surges @ impacts

INTEGRATION TESTS

1. Physical fit
   a. Tape recorder cable connection
   b. Return storage fit check
2. Electrical Power Consumption
3. Control operational check - verify protective covers can be removed and experiment can be turned on

Table XXII. (Cont.)

EXPERIMENT TITLE

Heat Pipe Demonstration

EXPERIMENT NUMBER

T022

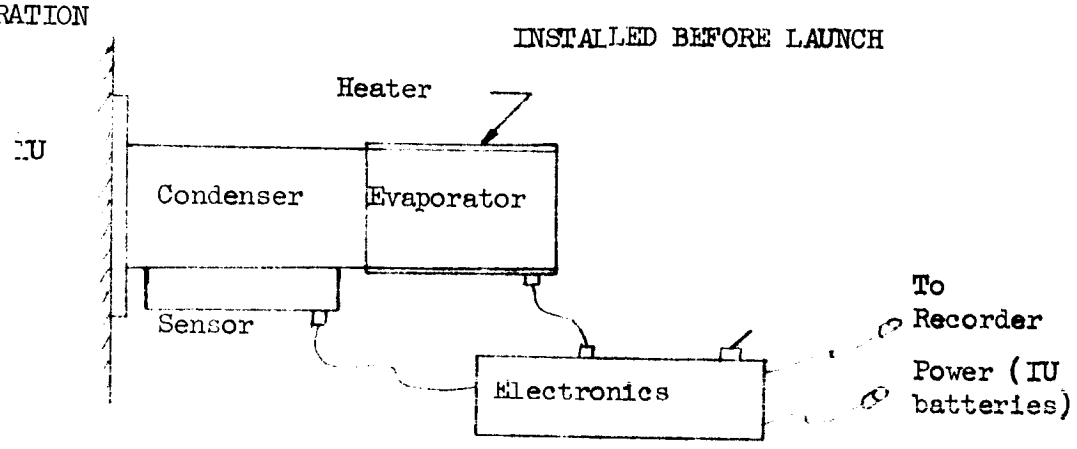
LAUNCH LOCATION

IU Flight AAP 4 AAP 2

PERFORMANCE LOCATION

IU Flight AAP 4 AAP 2

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Data management

EXPERIMENT ACTIVATION AND POWER REQUIRED

2 hours @ 120 watts

INTEGRATION TESTS

1. Physical Fit
   a. Tape recorder cable connection
2. Electrical Power Consumption

Table XXII. (Cont.)

EXPERIMENT TITLE	EXPERIMENT NUMBER
Collection of Surface Absorbed Materials	T023

LAUNCH LOCATION

S-IVB Exterior Flight AAP 2

PERFORMANCE LOCATION

S-IVB Exterior Flight AAP 2

CONFIGURATION

Specimen collection slides placed at several strategic locations on S-IVB, secured by aluminum brackets. Slides collected after orbit is achieved and placed in collection box for return.

SUPPORT SUBSYSTEMS REQUIRED

1. Thermal Control

EXPERIMENT ACTIVATION AND POWER REQUIRED

None

INTEGRATION TESTS

1. Physical Fit
   a. Storage fit check - collection box
   b. Thermal control interface

Table XXII. (Cont.)

EXPERIMENT TITLE

Gravity Substitute Workbench

EXPERIMENT NUMBER

MSFC 57

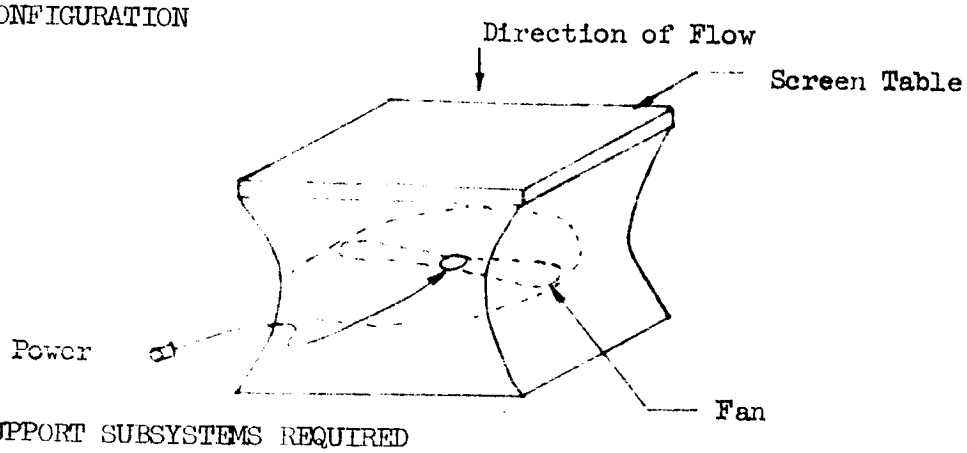
LAUNCH LOCATION

ATM Rack

PERFORMANCE LOCATION

OWS Flight AAP 4

CONFIGURATION



SUPPORT SUBSYSTEMS REQUIRED

1. Power

EXPERIMENT ACTIVATION AND POWER REQUIRED

Unknown

INTEGRATION TESTS

1. Physical Fit
   a. Storage Fit Check
   b. Operational location fit check
   c. Power cable connection
2. Electrical Power Consumption