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APPENDIX TO SPENT STAGE EXPERIMENT SUPPORT MODULE PROPOSAL

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SECTION 1.0 INTRODUCTION

This Appendix contains supplementary material on selected subjects which complements the MSFC Spent Stage Experiment Support Module (SSESM) Proposal. Presented are the design ground rules upon which the SSESM design is based, mission and mission task sequences, structural testing criteria, electrical system schematics, instrumentation equipment list and measurements, maintenance concepts, handling procedures, and crew familiarization requirements.

SECTION 2.0 DESIGN GROUND RULES

2.1 MISSION DESIGN GROUND RULES

2.1.1 General

The Saturn IB Design Ground Rules, revision 2, R-P&VE-VAD-65-101, will apply except where specifically stated otherwise.

a. Mission. - Mission objective of the S-IVB Spent Stage Experiment is to activate the AS-209 S-IVB LH_2 tank into a large pressurized workshop in which astronauts can operate in a shirt-sleeve environment for 4 hours per 16-hour period for 20 days. Minimum change to the Saturn IB launch vehicle and Block II Command Service Module (CSM) and maximum use of developed and qualified subsystems, operational procedures and techniques should be employed whenever possible. A design objective is to retain a readiness and capability on the S-IVB stage and CSM for use on a standard Apollo mission.

(1) Orbit Conditions. - It will be determined if CSM propulsion must be used for orbit circularization to meet the minimum mission duration.

(2) Experiment Definition. - The primary experiment is the passivation and activation of the S-IVB spent stage into a workshop capable of supporting manned activity and the activation of the Spent Stage Experiment Support Module (SSESM) and associated support systems. A limited number of corollary experiments will be incorporated in the S-IVB Spent Stage Experiment. Experiment equipment will be stowed or installed inside and/or outside the SSESM during launch into orbit.

(3) Orbital Operation

(a) The transposition and docking maneuver will be accomplished after orbital confirmation and systems checkout.

(b) The planned Apollo docking procedure will be followed which includes fold-out of the spacecraft Lunar Excursion Module (LEM) adapter panels to their normal 45-degree deployment position. It will be determined what the subsequent deployment will be.

(c) The S-IVB stage will stabilize and control its own attitude during the CSM transposing and docking maneuver.

(d) The CSM will provide all stabilization and control required for the spacecraft after the transposing and docking maneuver is completed.

(e) Attitude control of the spacecraft will be provided when required for experiment operation and thermal control of the workshop. It will be determined if operational requirements other than those stated dictate attitude control for the spacecraft for specified periods of operation.

(f) Propulsion capabilities for the CSM for orbital abort will be maintained throughout the entire mission.

(g) After transposing and docking, the CSM will provide all orbital guidance and earth communication.

(h) Service Module (SM) propellant loading will be in accordance with mission requirements.

(i) Preparation for activation of the workshop will be made after the transposing and docking maneuver and normal inflight checkout have been accomplished.

(j) All equipment required for S-IVB LH_2 tank habitation and experiment utilization will be carried external to the S-IVB LH_2 tank at launch and assembled manually in orbit.

(k) LH_2 tank will be vented prior to astronaut egress from the air lock.

(l) The S-IVB LH_2 tank will be made ready for occupancy by astronaut removal and storage of the LH_2 tank dome hatch, followed by attachment of a stowed flexible pressure sealing boot between the aft end of the air lock and the LH_2 tank dome hatch mounting surface.

(m) LH_2 tank passivation functions will be telemetered via the Instrument Unit (IU) for ground monitoring.

(n) The LH_2 interior tank wall will have a protective coating to inhibit burning of insulation if the tank wall is penetrated by a micrometeoroid.

(o) Titanium spheres located within the LH_2 tank will either be removed or protective covers will be installed.

b. Configuration. - The Saturn IB spent stage experiment launch vehicle will consist of an operational Saturn IB launch vehicle and air lock unit. The Saturn IB launch vehicle is composed of the S-IB stage, S-IVB stage, and IU. The first Saturn IB launch vehicle utilized will be AS-209. Modifications to the Saturn and Apollo hardware will be held to a minimum. Modification to AS-209 which could prevent the accomplishment of its primary mission as an Apollo backup will not be permitted. Existing or off-the-shelf hardware will be used to minimize cost, schedule, and development problems.

S-IVB/IU subsystems which represent a potential hazard to the astronaut will be modified to provide a method(s) of passivation.

Add-on type S-IVB subsystem passivation modifications will be installed at Kennedy Space Center (KSC).

Subsystems to be investigated for passivation should include, but not be restricted to, the following: Electrical System, Hydraulic System, Stored Gases, Ordnance System, and Propellant.

c. Interface Requirements. - MSFC will control the following interfaces in addition to the Saturn IB launch vehicle interfaces: Air lock to CSM, Air lock to S-IVB Stage, Air lock to IU, Air lock to SLA, Air lock to the Launch Complex, and Air lock to the Government Furnished Support Equipment.

All interfaces will be controlled in accordance with the Interface Control Documents (ICD's) in the Apollo Intercenter Interface Control Document Log (1A01) and the Saturn Interface Control Document Log (1S01).

2.1.2 Experiments

a. Experiment Integration. - MSFC will integrate experiments and develop interface specifications.

b. Weight. - The maximum weight of corollary experiments and associated equipment will not exceed 1,000 pounds.

2.1.3 Launch Facilities

The Saturn IB Spent Stage Experiment launch vehicle will be capable of being launched from Launch Complexes (LC) 34 and 37B.

2.2 S-IB STAGE DESIGN GROUND RULES

Configuration of the S-IB stage for the Saturn IB Orbital Workshop launch vehicle will be identical to the S-IB stage for the operational Saturn IB launch vehicle.

2.3 S-IVB STAGE DESIGN GROUND RULES

2.3.1 General

a. Configuration. - The S-IVB Orbital Workshop is an operational S-IVB/IB stage, with minor modifications to support the spent stage experiment.

b. Interface Requirements

(1) Interface Tooling. - The air lock flexible bellows adapter interface tooling (master mating gauge) will be manufactured by the S-IVB stage contractor.

2.3.2 Structure (Propellant Containers)

a. The LH_2 tank forward dome access opening will be enlarged to a 43-inch diameter.

b. Provisions will be made for the storage of the LH_2 tank forward access dome hatch.

c. A hand valve will be provided in the LH_2 tank forward dome hatch, or in the near vicinity, for manually venting hydrogen gas which is liberated from the LH_2 tank insulation.

d. The LH_2 tank forward dome will have provisions to mate and make a pressure tight connection with the flexible bellows adapter.

e. One hundred holes will be drilled and tapped at the intersections of the waffle pattern grids in the LH_2 tank for the purpose of mounting equipment and experiments. Work will be accomplished in accordance with MSFC SK10-8270.

f. An atmosphere circulation blower system will be required within the LH_2 tank.

2.3.3 Propulsion System (Propellant Evacuation)

a. Venting of the LH_2 tank will be accomplished by the nonpropulsive vent system.

b. Method (s) to be employed to evacuate residual and flight performance reserve LOX will be determined.

c. Existing controls will be modified to accomplish evacuating and/or venting of propellants.

2.3.4 Environmental Control System

The environmental control system which is located on the air lock support structure will provide atmosphere supply to the workshop.

2.4 SSESM DESIGN GROUND RULES

2.4.1 General

The SSESM is defined as an independent air lock unit which interconnects the CSM and the S-IVB LH_2 tank and is mounted at the

LEM attach points in the LEM adapter. The SSESM will include docking capability with the CSM and will provide environmental control system, electrical power, and life support to the S-IVB spent stage for the entire mission.

The air lock and docking structure will not be connected to or transmit loads to the S-IVB stage hydrogen tank forward dome during powered flight of the launch vehicle.

a. Configuration. - The SSESM will include an air lock, docking structure, environmental control system, electrical power system, and support equipment, as defined below. It will also include the support structure for these systems, expendables, and experiment stowage. The air lock will have the capability for independent and integrated operation with the CSM and S-IVB Workshop.

b. Interface Requirements

(1) Interface Tooling. - Manned Spacecraft Center (MSC) and/or the spacecraft contractor will provide the air lock/ spacecraft interface tooling. The S-IVB stage contractor will provide the air lock/S-IVB adapter interface tooling.

(2) Field Splice Connecting Hardware. - MSFC will supply the connecting hardware for all air lock unit field splices. The interface hardware will be specified and documented in vehicle assembly documentation by the S-IB stage contractor. The hardware will be delivered to Cape Kennedy in compliance with the vehicle assembly schedule for AS-209.

c. Alignment. - Air lock unit to S-IVB forward bulkhead alignment is not critical as the design of the flexible adapter will allow for minor misalignment. Internal alignment of the air lock unit components will be controlled by an MSFC drawing "to be released." This drawing will govern pertinent design documentation but will not be used for manufacturing, procurement of hardware, inspection of manufactured items or assembly.

d. Reliability. - The reliability goal for the SSESM has not been established.

e. Weights. - The maximum weight of the SSESM and corollary experiments is 10,996 pounds. The control weight is presently established as 9,000 pounds without the carry-on experiments. These weights are preliminary and will be revised.

2.4.2 Test Requirements

The complete SSESM test item and subsystem will be functionally tested to verify the capability to meet the structural loads, natural and induced environments expected during mission lifetime. Human factor task tests will be performed to assure man/machine compatibility. Electrical power requirements during ground test operations will be provided from an external source.

2.4.3 Flight Mechanics

a. Natural Environments. - Design of the SSESM will be based on applicable natural (space) environmental conditions, as given in NASA reports TMX-53273 and NASA TMX-53023.

b. Induced Environments. - Design of the SSESM will be based on applicable induced environmental conditions, as given in MSFC Report IN-P&VE-S-63-1.

2.4.4 Structure

a. General. - The operational air lock will provide minimum environment perturbation on the CSM, micrometeorite protection as great as CSM, even lighting distribution, local voice communications, and operational sensing equipment to all systems required for the operations of the workshop. The docking structure will make maximum use of existing CSM/LEM design and components. The air lock will be capable of accommodating two suited astronauts, and a locking through cycle will normally be done for two astronauts. The air lock will allow for astronaut suit donning and doffing.

b. Emergency Facilities. - The air lock will provide for emergency occupancy by two astronauts independent of the CSM.

c. Factors of Safety. - The following factors of safety are the minimum values to be applied. They are to be used in addition to consideration of vibration magnification and shock given to surge phenomena, coupling between stages and propulsion system vibrations. Analytical investigations and test results will be used to validate the actual factors of safety of hydraulic and pneumatic systems. Safety factors different from those specified in the guide will require approval by the procuring agency.

(1) General Structure

Manned Vehicle

Yield factor of safety	= 1.10
Ultimate factor of safety	= 1.40

(2) Hydraulic or Pneumatic Systems

Flexible hose, tubing, ducts, and fittings less than 1 1/2 inches in diameter.

Proof pressure	= 2.00 × limit pressure
Burst pressure	= 4.00 × limit pressure

Flexible hose, tubing, ducts, and fittings 1 1/2 inches in diameter and greater.

Proof pressure	= 1.50 × limit pressure
Burst pressure	= 2.50 × limit pressure

Actuating cylinders, valves, filters, switches.

Proof pressure	= 1.50 × limit pressure
Burst pressure	= 2.50 × limit pressure

Reservoirs

Proof pressure	= 1.50 × limit pressure
Yield pressure	= 1.10 × limit pressure
Burst pressure	= 2.00 × limit pressure

d. Dimensions. - The cylindrical air lock will be nominally 65 inches in diameter and a minimum of 110 inches long (gross length). The length may be greater than 110 inches if necessary.

e. <u>Access</u>. - The air lock will contain three hatches:

Top hatch (Apollo command module exit) identical to LEM docking hatch.

Side hatch (exit to LEM adapter area).

Bottom hatch (entrance to S-IVB stage hydrogen tank) will be 48 inches in diameter. All equipment for the workshop will pass through the air lock.

f. <u>Docking Structure</u>. - The top of the air lock and support structure will include a docking structure compatible with the Block II Apollo spacecraft and similar to the LEM docking adapter. The docking structure will be capable of carrying all loads induced by the SM propulsion system as a result of orbit change maneuvers in addition to docking loads.

g. <u>Adapter (air lock/S-IVB)</u>. - Provisions will be made for a pressure-tight connection to the S-IVB LH_2 forward dome mounting surface after removal of the dome cover which provides a pressure environment for passage from the air lock to the hydrogen tank.

h. <u>Equipment Support and Storage</u>. - The air lock support structure will be capable of supporting all experiment and support equipment as well as the air lock. Equipment to be used inside the S-IVB hydrogen tank during operation in orbit will be stowed on the air lock unit during launch.

i. <u>Umbilicals</u>. - Two pressure suit loop umbilicals will be provided in the air lock. Umbilical length will be sufficient to allow the astronaut to move to the S-IVB common bulkhead.

j. <u>Lightning Protection</u>. - The air lock unit will have the capability to receive and discharge lightning without damage to the vehicle. For additional information see Kennedy Space Center policy memorandum dated November 30, 1964.

k. <u>Electrostatic Compatibility</u>. - It will be determined if a positive shorting system is required to make the air lock/docking mechanism and CSM compatible during docking maneuver.

2.4.5 Propulsion System

There is no propulsion system associated with the air lock unit.

2.4.6 Astrionic Systems

a. Electrical System

(1) Battery power will provide a maximum of electrical power with an average of 750 watts for 4 hours/16-hour cycle for Environmental Control System (ECS), housekeeping, scientific purposes, and lighting requirements.

(2) Provisions will be made for electrical and instrumentation support for activities inside the S-IVB LH_2 tank.

(3) General lighting requirements will be determined and provided for the air lock and the S-IVB LH_2 tank.

(4) Necessary electrical controls and displays of critical S-IVB spent stage parameters will be centralized on panels to be located within the air lock.

b. Instrumentation System

(1) Basic instrumentation will allow monitoring of air lock environmental control system and housekeeping during pad checkout, ascent, and orbit. Basic system does not include visual coverage or data storage.

(2) Telemetry will utilize existing IU antenna system.

(3) System checkout and procedures will be compatible with present system.

(4) Vehicle-to-ground voice communication will be by CSM. Local voice communication will be by spacecraft system.

(5) Lighting requirements for television or film cameras will be defined if the requirement exists.

(6) It will be determined if monitoring of experiments is required.

2.4.7 Environmental Control System (ECS)

Flight qualified Gemini, Saturn, or Apollo hardware components will be used whenever expedient. Refurbished flight components are acceptable.

a. Function. - The environmental control system will provide atmosphere supply to the S-IVB LH_2 tank and the air lock.

b. Display. - ECS displays will be located in the air lock and LH_2 tank.

c. Controls. -

(1) ECS controls for the air lock and LH_2 tank will be located in the air lock.

(2) The pressure in the air lock may be reduced to vacuum from the air lock or LH_2 tank with the aft hatch closed.

(3) Dump valves will be provided at the fore, aft, and side hatches of the air lock.

(4) The air lock and LH_2 tank pressures will have the capability of being equalized from the LH_2 tank.

(5) The air lock will have the capability of being pressurized or unpressurized manually.

d. Atmosphere Requirements. - The ECS will be composed of four 20-cubic-foot spheres of metabolic oxygen for pressurization of the LH_2 tank and air lock and one 3.5-cubic-foot LEM sphere for resupply of the Portable Life Support System (PLSS). The ECS will permit:

(1) Two men to work in the LEM adapter, air lock, and S-IVB hydrogen tank areas for an average of 4 hours per 16-hour period for 20 days.

(2) 1.25 charges of the stage hydrogen tank (approximately 10,000 cubic feet) and for 30 pressurizations of the air lock.

(3) Leakage rate will be approximately 30 pounds per day.

(4) Fifteen hours of extravehicular activity by two men, or a total of 30 manhours.

(5) Temperature: 65 $\pm$ 25°F with minimal temperature oscillation.

(6) Pressure: 3.5 to 5.5 psia.

(7) Relative humidity: 30-70 percent.

(8) Carbon dioxide: 0.1 psia.

2.4.8 Human Engineering

The human engineering design principles presented in MSFC-STD-267A will be used. Criteria in this document will be used as guidelines.

2.4.9 GSE

a. MSFC will provide all necessary electrical GSE.

b. Maximum use will be made of existing Saturn IB launch complex facilities and equipment.

c. Checkout will be conducted in accordance with MSFC document SR-QUAL-64-13, Space Vehicle Stage Analysis and Checkout Guidelines, dated May 1, 1964.

d. System checkout equipment and procedures will be compatible with present systems. Systems must also conform to safety regulations of KSC operations.

e. No new umbilical plates or swing arms will be permitted.

f. Necessary controls and displays for critical parameters will be provided in the launch complex.

2.4.10 Weight and Balance

Prior to shipment to KSC, measurements will be made to determine weight and 3-axis center of gravity.

2.4.11 Crew Training Requirements

Flight crew training will be provided for the activation of the SSESM, passivation/activation of the S-IVB LH_2 tank and installation, and operation of the corollary experiments.

2.5 INSTRUMENT UNIT DESIGN GROUND RULES

2.5.1 Configuration

Modification of the IU to support the spent stage experiments will be held to an absolute minimum.

2.6 CREW SYSTEM GROUND RULES

The following crew systems criteria reflect astronaut requirements and limitations which have impact on hardware design and mission planning:

a. The normal location of the crew when not engaged in S-IVB Workshop, extravehicular, or experimental tasks will be in the CM.

b. The crew will be periodically rotated in their tasks during the mission.

c. Two crewmen at a time will perform activities outside the CM.

d. Pressure suits will be worn by the astronauts when entering a pressurized area for the first time.

e. The pressure suit umbilical will not be disconnected in a vacuum on the AS-209 mission.

f. Voice communications shall be maintained at all times between the task performers and the CM.

g. One crew member shall remain within the CM.at all times except in an emergency.

h. The astronauts will not require a maneuvering unit for activities within the Spacecraft LEM Adapter (SLA). A Portable Life Support System (PLSS) and tethers will be utilized for SLA activities.

i. The crew will maintain two separate compartments at all times as a safety precaution.

j. A 10-minute portable oxygen supply is provided each space-suited astronaut.

k. The normal eating, sleeping, personal hygiene, and other station-keeping tasks will be performed in the CM.

l. After the initial entry to a pressurized compartment, and the compartment is verified operational, subsequent entries to the pressurized compartment may be conducted in shirt sleeves.

m. The Block II Apollo full pressure suit will be utilized.

n. The water-cooled undergarment will be used for astronaut thermal control when the PLSS is required. Three of these will be stored in the air lock.

o. The suit pressure will nominally be 3.5 psi above ambient when the suit is pressurized.

p. The nominal suit inlet temperature will be 50°F.

q. The nominal suit atmosphere will be 100 percent O_2.

r. A thermal outergarment is required for all activities in vacuum.

s. The optimum size access opening for astronaut transfer while wearing the PLSS and thermal outergarment is 38.5 inches.

t. The two PLSS units normally carried in the LEM will be stored in the air lock. A third PLSS is stowed in the CM. The PLSS will be used for emergency operations or as an alternate mode to the suit umbilical.

u. Due to sizing, hygiene, and drying requirements, and to provide the astronaut with immediate access to a space pressure suit, three additional pressure suits will be provided. Two of the suits will be stored in the air lock.

v. Tethers will be available for all activities outside the air lock.

w. Two pressure suit umbilicals, in addition to those provided in the CM, are located in the air lock. The air lock suit umbilicals will reach all parts of the interior LH_2 tank.

x. A habitable environment is provided in the pressurized air lock with the following nominal atmospheric conditions:

(1) 100 percent O_2

(2) 5 psia

(3) 70° F

(4) 30-50 percent relative humidity

y. The air lock has sufficient volume to accommodate two men, pressure suited and pressurized, and the storage of their equipment. Each man can don and doff the pressure suit, thermal garment, and PLSS in the air lock.

z. The air lock pressure will nominally be 5 psia O_2 upon reaching orbit.

aa. The air lock will be secured to the LH_2 tank bulkhead opening during orbit by the astronauts.

bb. The air lock and LH_2 tank atmospheric pressures may be equalized at any time from the air lock.

cc. The air lock will provide access to the LH_2 tank as well as the SLA.

dd. The manhole cover bolts will be removed by reactionless tools. Conventional tools will be available as backup.

ee. The LH_2 tank is vented prior to crew egress from the CM.

ff. The LH_2 tank will not be pressurized until attachment to air lock.

gg. The LH_2 tank and air lock are at vacuum when the manhole cover is removed.

hh. The LH_2 tank and air lock atmosphere must be monitored whenever astronauts are present. Capability must be provided to monitor atmosphere both from the CM and locally to provide direct readout and redline alarm. The following must be measured constantly for shirt-sleeve operations:

(1) CO_2 Partial Pressure

(2) Total Pressure

(3) Temperature

(4) Humidity

ii. Vehicle attitude control may be required for thermal control inside the LH_2 tank.

SECTION 3.0 MISSION SEQUENCE

3.1 GENERAL

This section presents a general and detailed sequence for each event currently defined in the design reference mission. In addition, a typical crew time line summary is presented for the first few mission days.

3.2 GENERAL MISSION SEQUENCE

Presented in Figures 3.2-1 through -6 are the initial releases of the S-IVB spent stage experiment design reference mission general sequence for use in analysis and planning. While this sequence is based upon the latest available conceptual design information, it is expected that subsequent design effort will dictate numerous changes to the sequence and provide more data for expanding the sequence to a more detailed level. These changes and additions will be reflected in subsequent releases as necessary to keep the sequence accurate and current during the course of this program.

This design reference mission sequence covers the period from the initiation of launch vehicle countdown through the completion of the 20-day S-IVB spent stage experiment. Data presented herein are limited primarily to gross level vehicle/experiment peculiar sequence with such information as the launch vehicle normal countdown and flight sequences being referenced.

3.3 DETAILED MISSION SEQUENCE

Each event scheduled for days 1, 2, and 20 is sequenced in detail on Figures 3.3-1 through 3.3-26. This information supplements the summary presented in paragraph 3.2. Additional events for days 3 through 19 will be defined as mission plans become better defined.

3.4 CREW SCHEDULE SUMMARY

Data are presented in Figures 3.4-1 and 3.4-2 which define a typical crew schedule for each mission day through five. Specific experiments have not been selected; therefore, only gross times were included in the schedule for experiment activity. The following data describe the assumptions and legend:

a. Astronauts sleep at same time, 7.5 hours/day - divided into two periods of 6 and 1.5 hours nap. Time between sleep varies from 6 and 10 hours.

b. Two meals and one snack per day - 45 minutes per meal and 30 minutes per snack.

c. A CSM check every 8 hours, $\pm$ 1 hour.

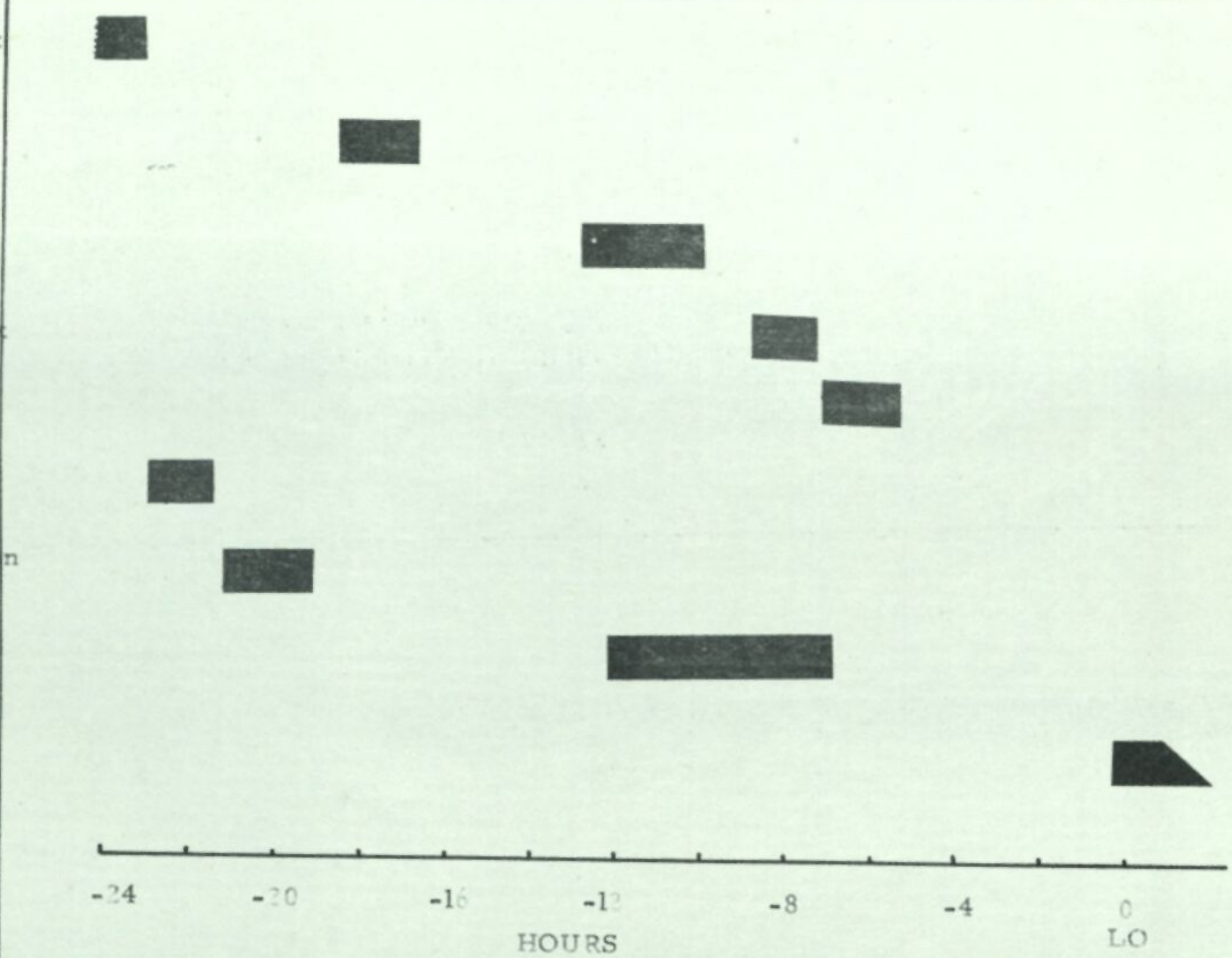
d. Periodic safety check by each astronaut each 12 hours.

e. Two personal hygiene periods of 30 minutes each - one period after each sleep.

f. For each 4-hour period (max) in tank, a period of 12 hours out is required. Two astronauts maximum in tank at one time.

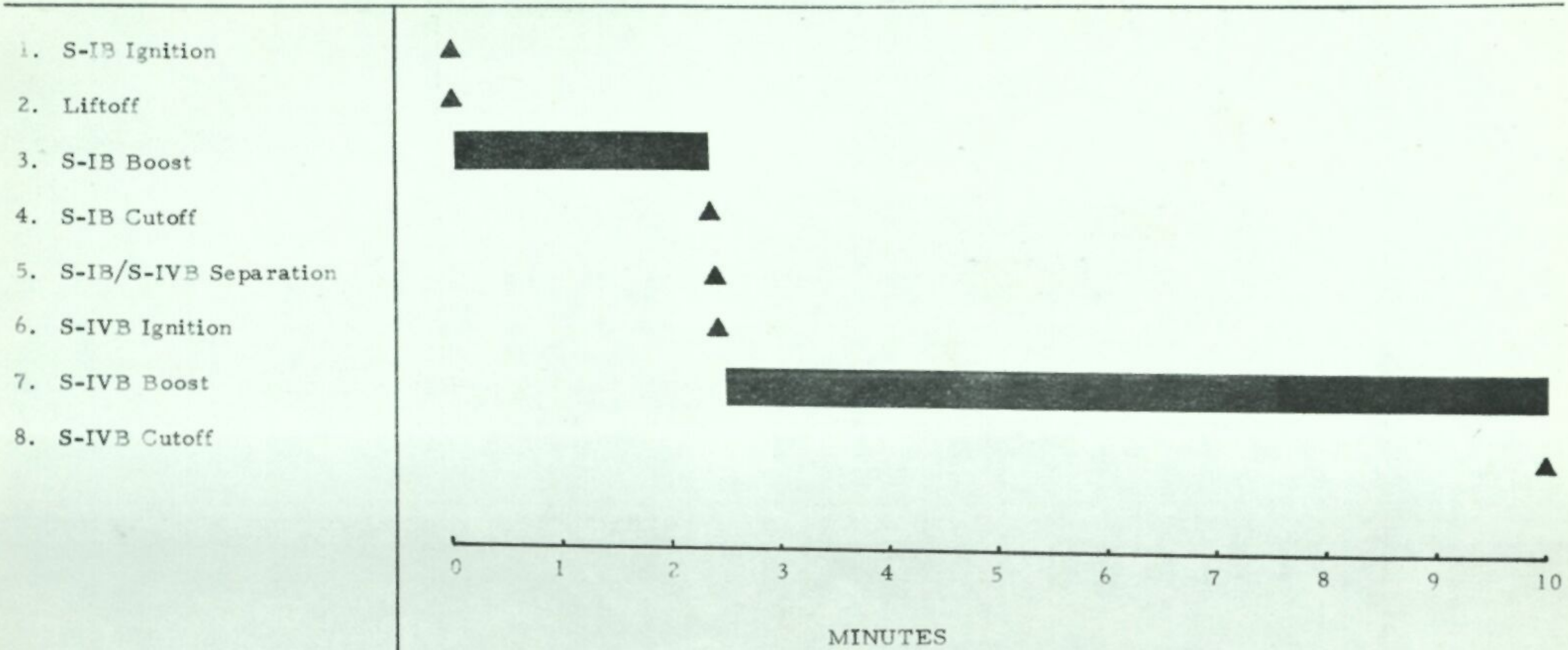
FIGURE 3.2-1. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

1. Complete Manual Equipment Check
2. Install Airlock/Workshop Batteries
3. Checkout Stage Passivation Capability
4. Airlock Purge and Leakcheck
5. Pressurize Airlock
6. Gox Sphere Purge and Leakcheck
7. Gox Sphere Prepressurization (1500 psi)
8. Gox Sphere Pressurization (3000 psi)
9. Airlock/Workshop Internal Power Mode on



NOTE: For a typical detailed Saturn IB countdown sequence see MSFC drawing 10M30202.

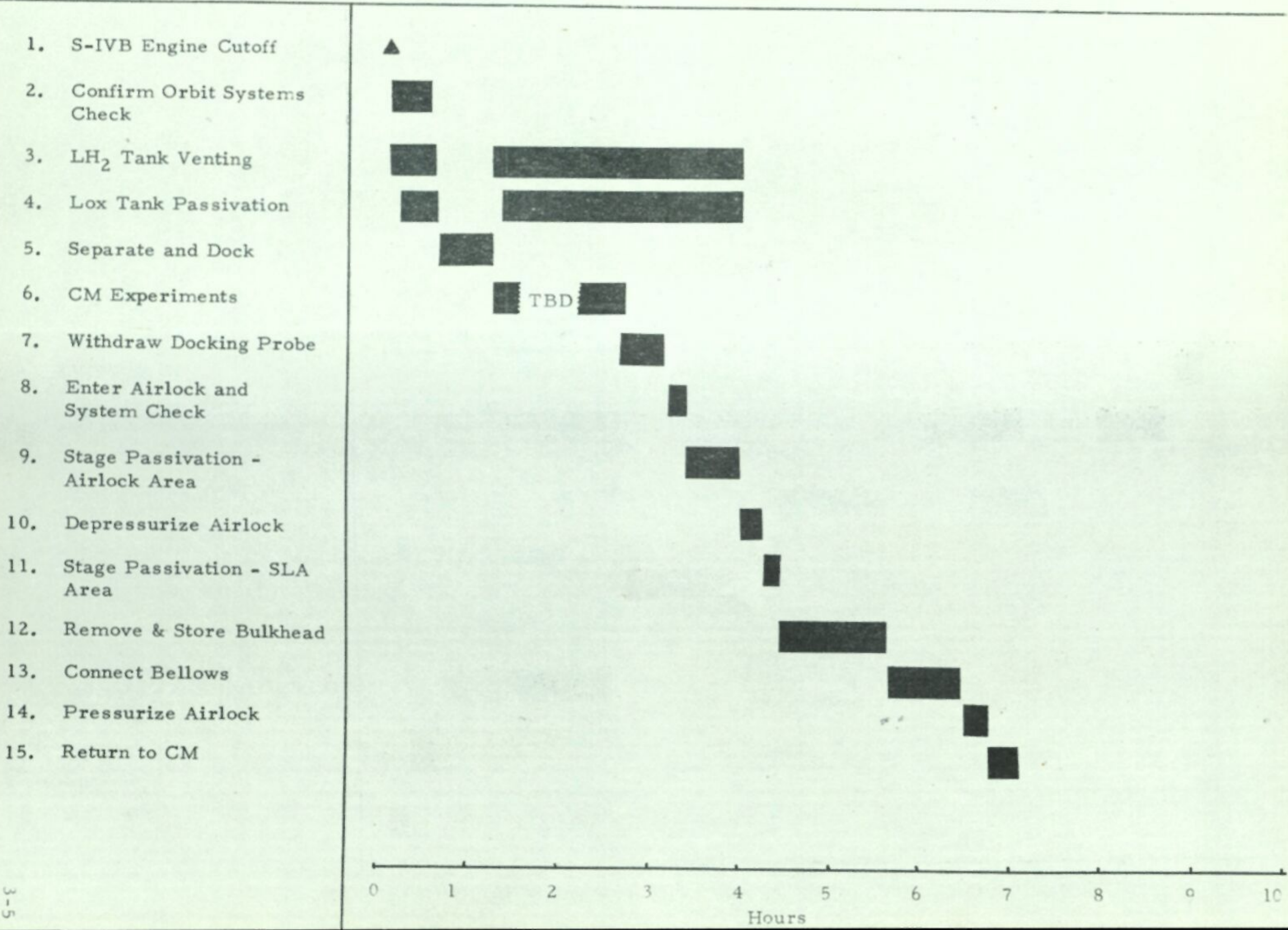
Liftoff thru S-IVB Cutoff FIGURE 3.2-2. - AS-209 DESIGN REFERENCE MISSION SEQUENCE



NOTE: For a typical Saturn IB Flight sequence see MSFC drawing 10M30157.

Day 1

FIGURE 3.2-3. - AS-209 DESIGN REFERENCE MISSION SEQUENCE



Day 2

FIGURE 3.2-4. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

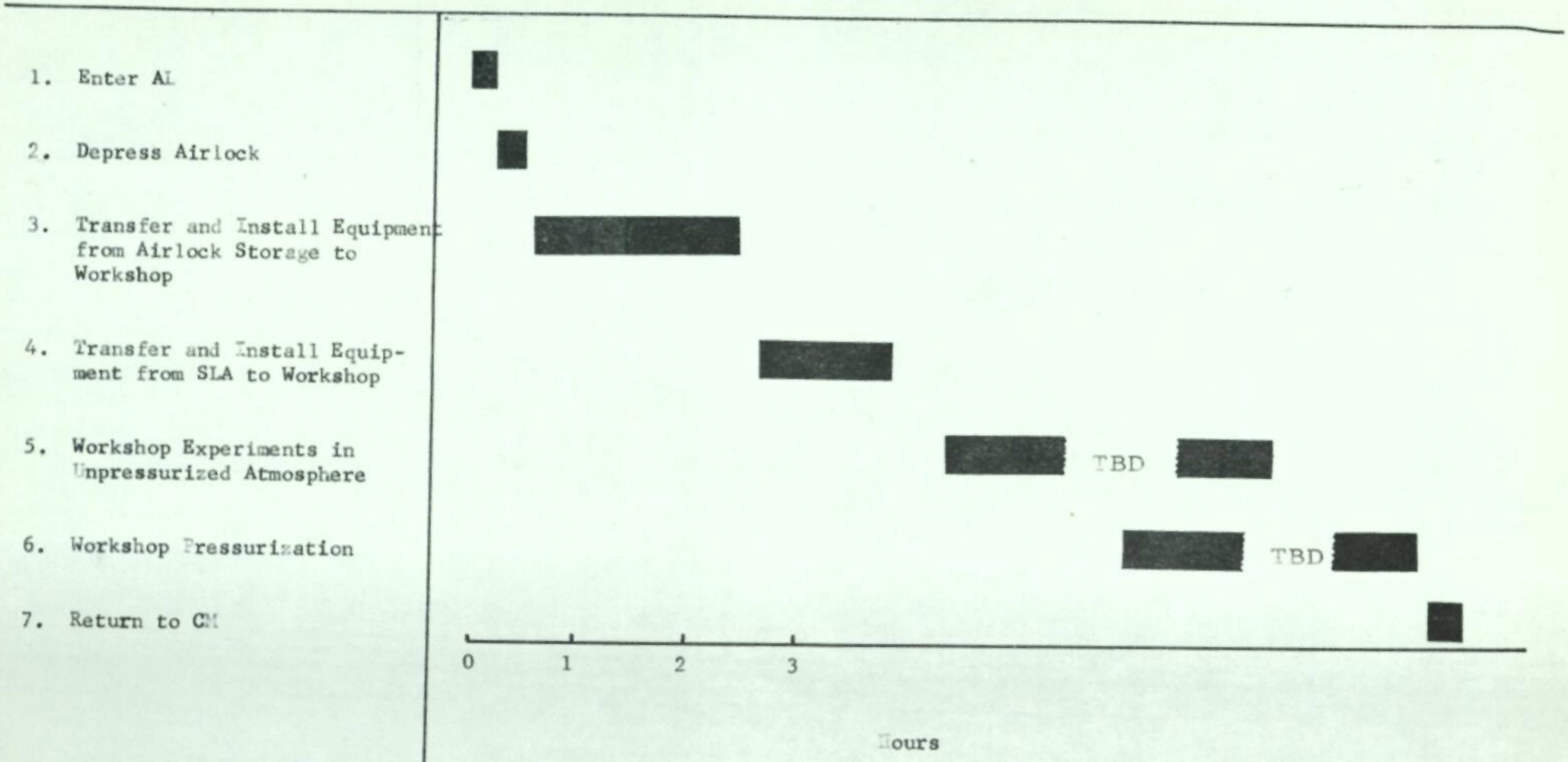
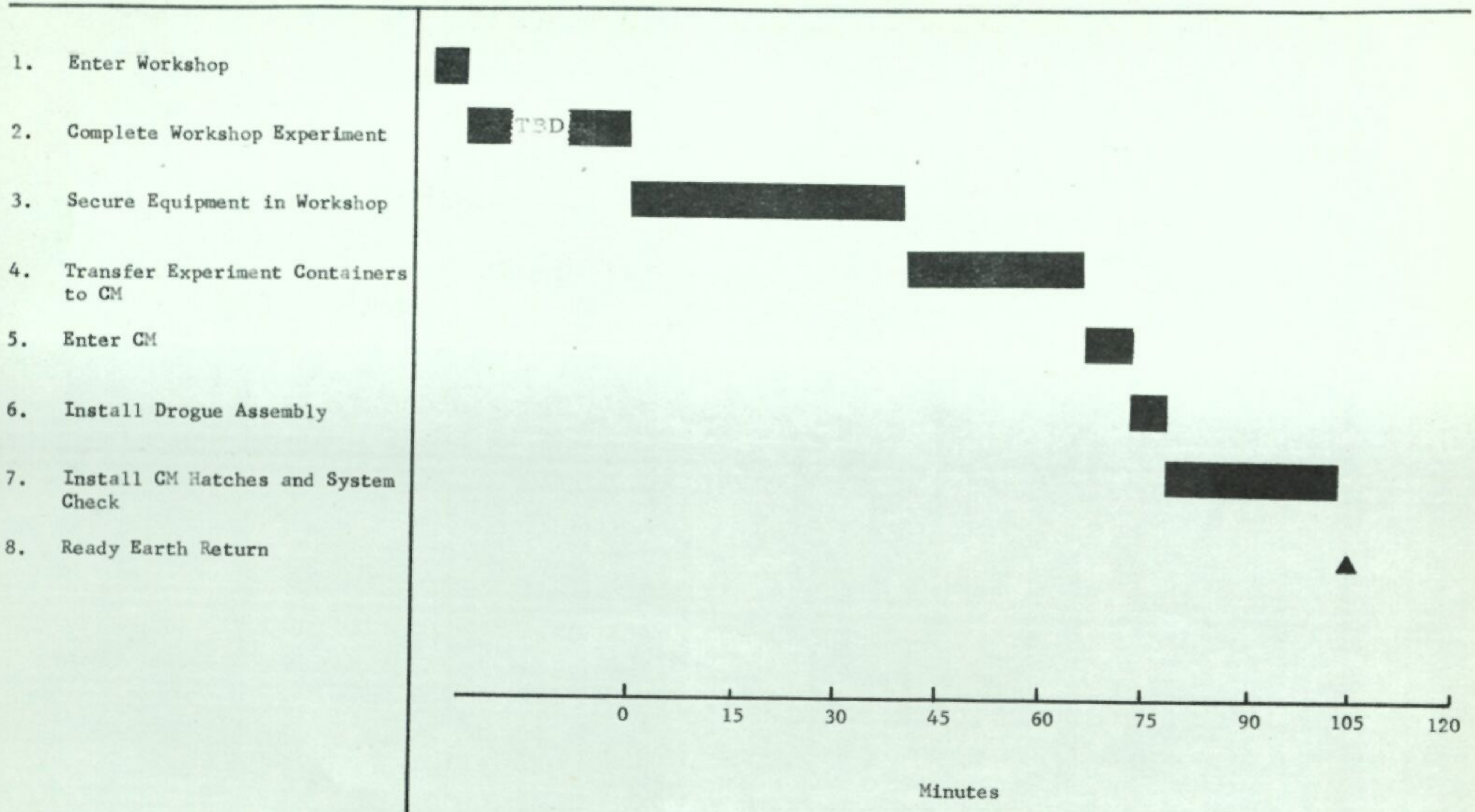


FIGURE 3.2-5. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

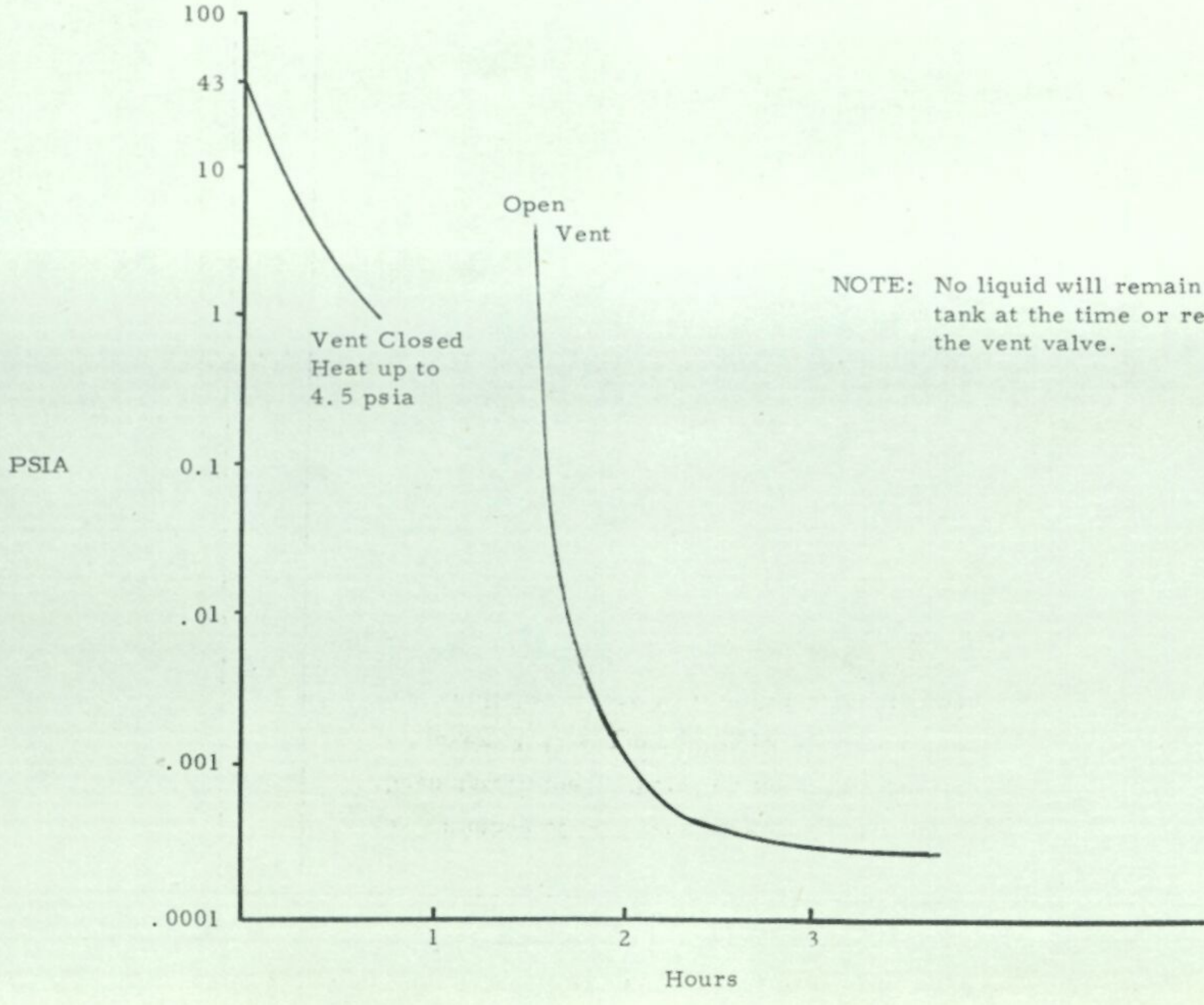
A detailed sequence on Day 3 thru Day 19 will be generated when the detailed list of approved experiments becomes available.

Day 20

FIGURE 3.2-6. - AS-209 DESIGN REFERENCE MISSION SEQUENCE



LH_2 Tank Venting



NOTE: No liquid will remain in the tank at the time or reopening the vent valve.

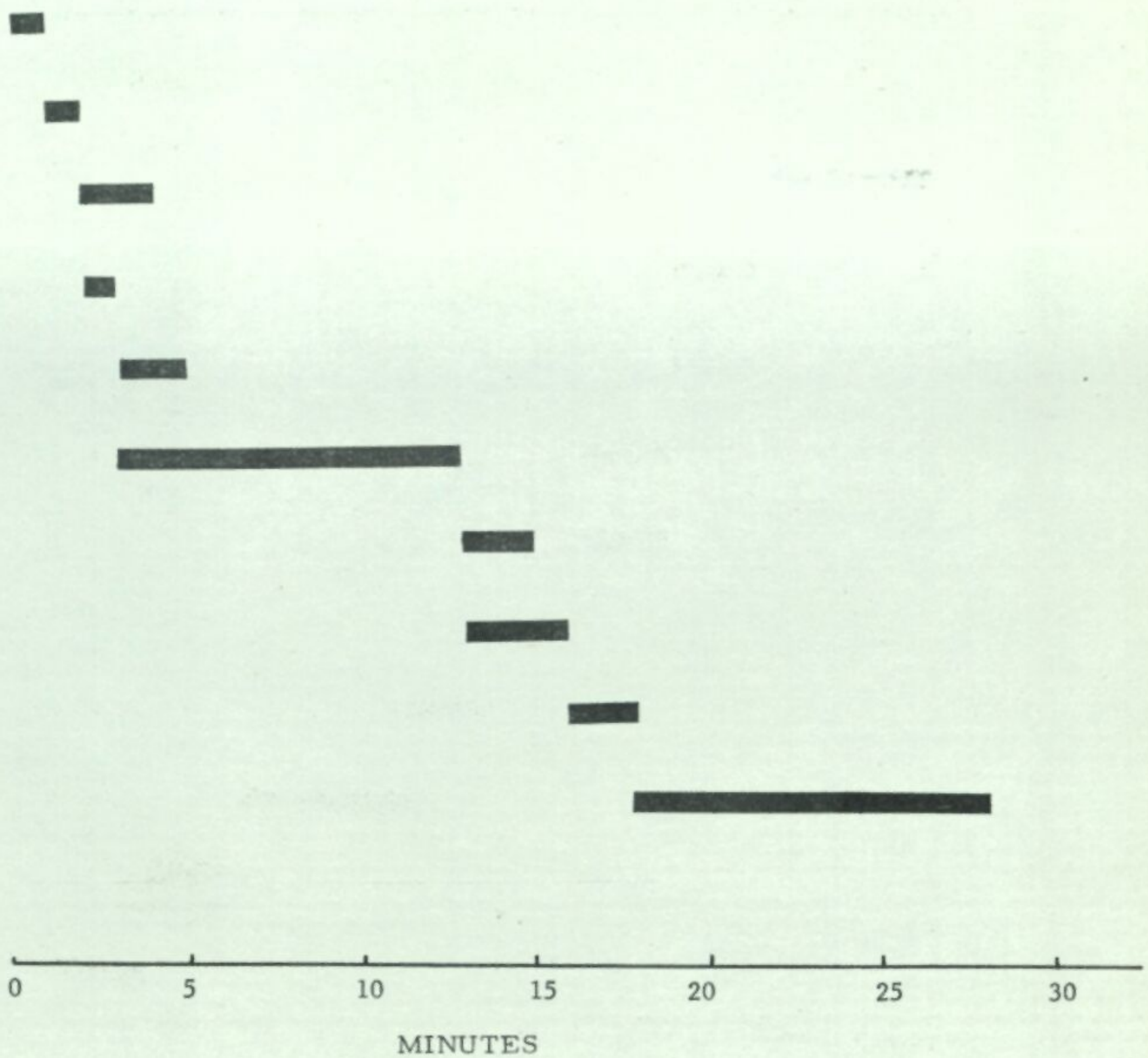
Sub-Event	Man	LOX Tank Venting
		The method of LOX tank passivation has not yet been determined. Based on Recent proposals, however, it is assumed that passivation can be accomplished within a three to four hour time.

Day 1 Event 7

FIGURE 3.3-3. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Withdraw Docking Probe

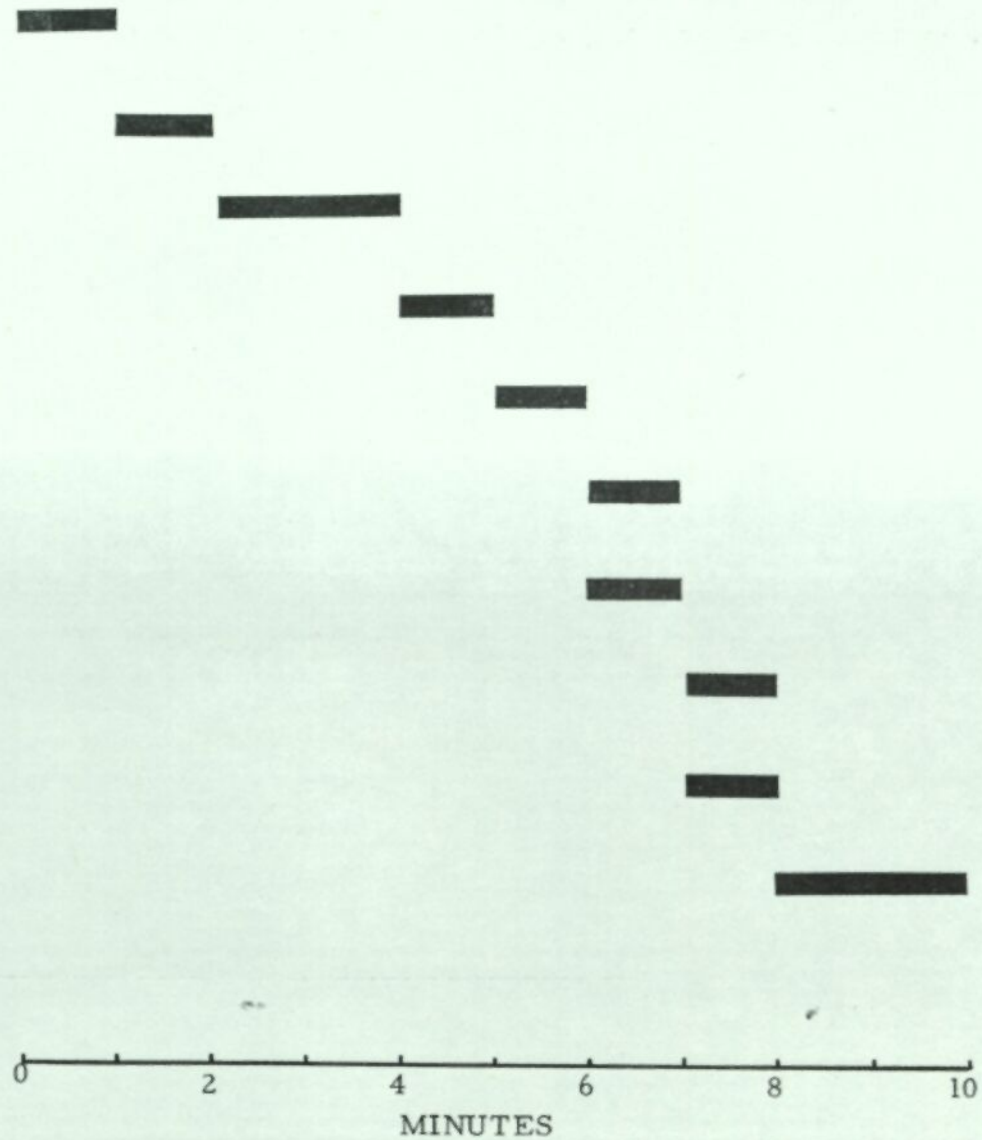
Sub-Event	Man
1. Open CM Dump Valve	2
2. Remove CM Pressurization Hatch	2
3. Store CM Pressurization Hatch	1
4. Remove CM Thermal Hatch	2
5. Stow CM Thermal Hatch	3
6. Remove Docking Probe	2
7. Stow Docking Probe	1
8. Remove Drogue Assembly	2
9. Stow Drogue Assembly	3
10. Secure Final Docking Latches	2



Day 1 Event 8

FIGURE 3.3-4. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man	Enter Airlock and Systems Check
1. Open Airlock Interlock Dump Valve	2	
2. Open AL Forward Hatch	2	
3. Enter Airlock	2 3	
4. Disconnect CM Suit Umbilical and Connect AL Suit Umbilical	2 3	
5. Communications Check	2 3	
6. Close CM Pressure Hatch	1	
7. Close Forward AL Pressure Hatch	3	
8. Close CM Interlock Dump Valve	1	
9. Close AL Interlock Dump Valve	3	
10. Verify Operation Complete	1 2 3	

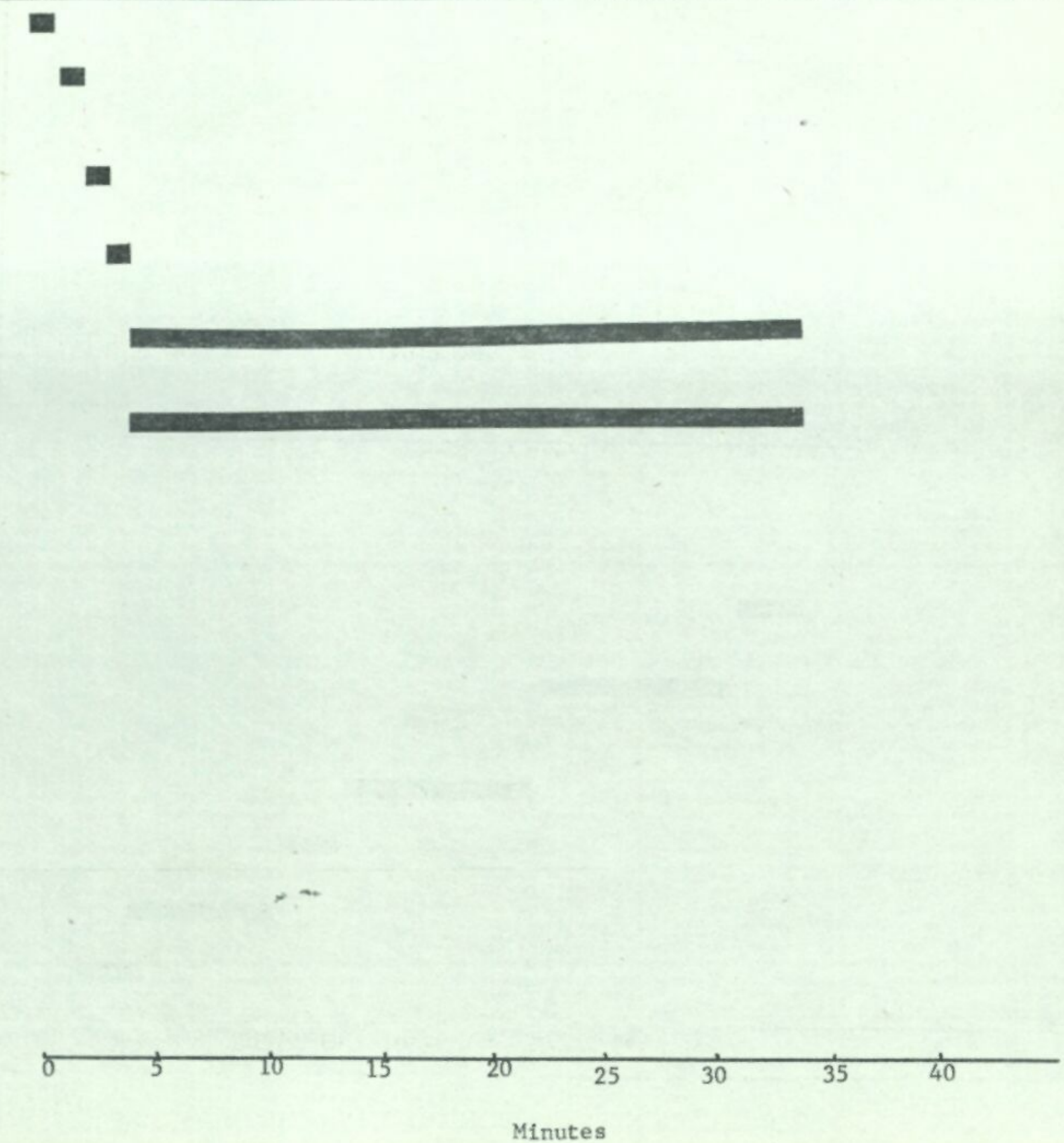


Day 1 Event 9

FIGURE 3.3-5. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

STAGE PASSIVATION - AIRLOCK AREA

Sub-Event	Man
1. Activate Passivation Panel	2
2. Activate Switch to Vent Engine Start Bottle, Engine Pneumatic Bottle, Cold Helium Spheres	2
3. Activate Switch to Vent Stage Pneumatic Helium Bottle	2
4. Activate Switch to Vent APS Helium	2
5. Monitor Pressure Decay on all Bottles	3
6. Prepare for EVA (Suits, PLSS, etc.)	2

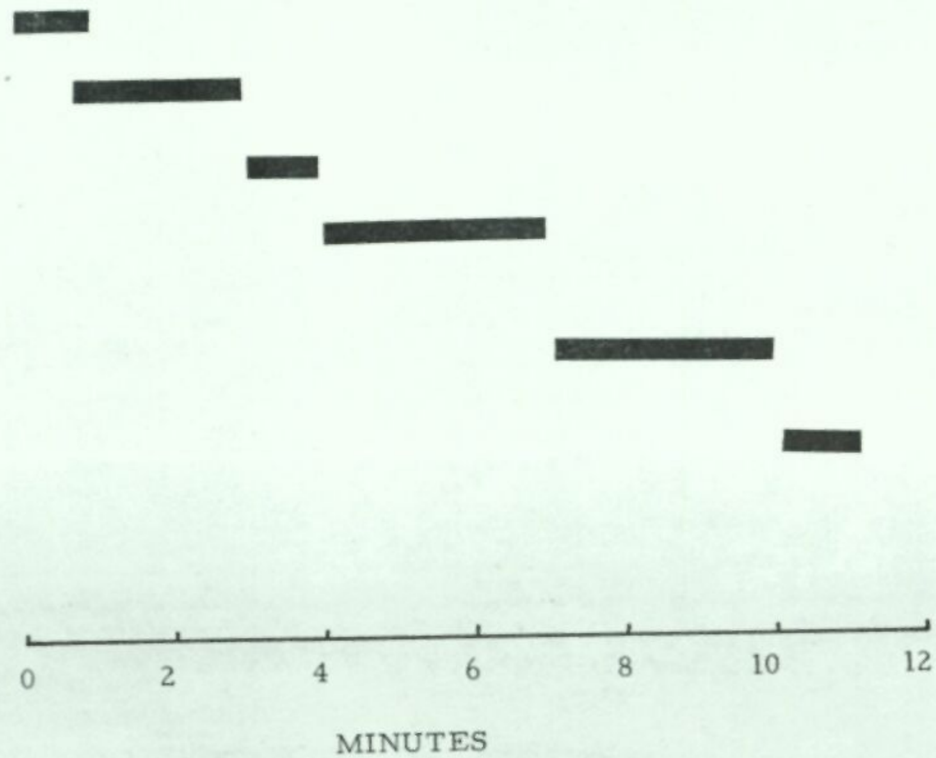


Day 1 Event 11

FIGURE 3.3-6. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Stage Passivation - SLA Area

Sub-Event	Man
1. Open Airlock Side Hatch	2
2. Translate to SLA Area	2
3. Deactivate S&A Device	2
4. Check LH_2 Pressure and Vent if Needed	2
5. Translate to Airlock and Enter	2
6. Close Airlock Side Door	1

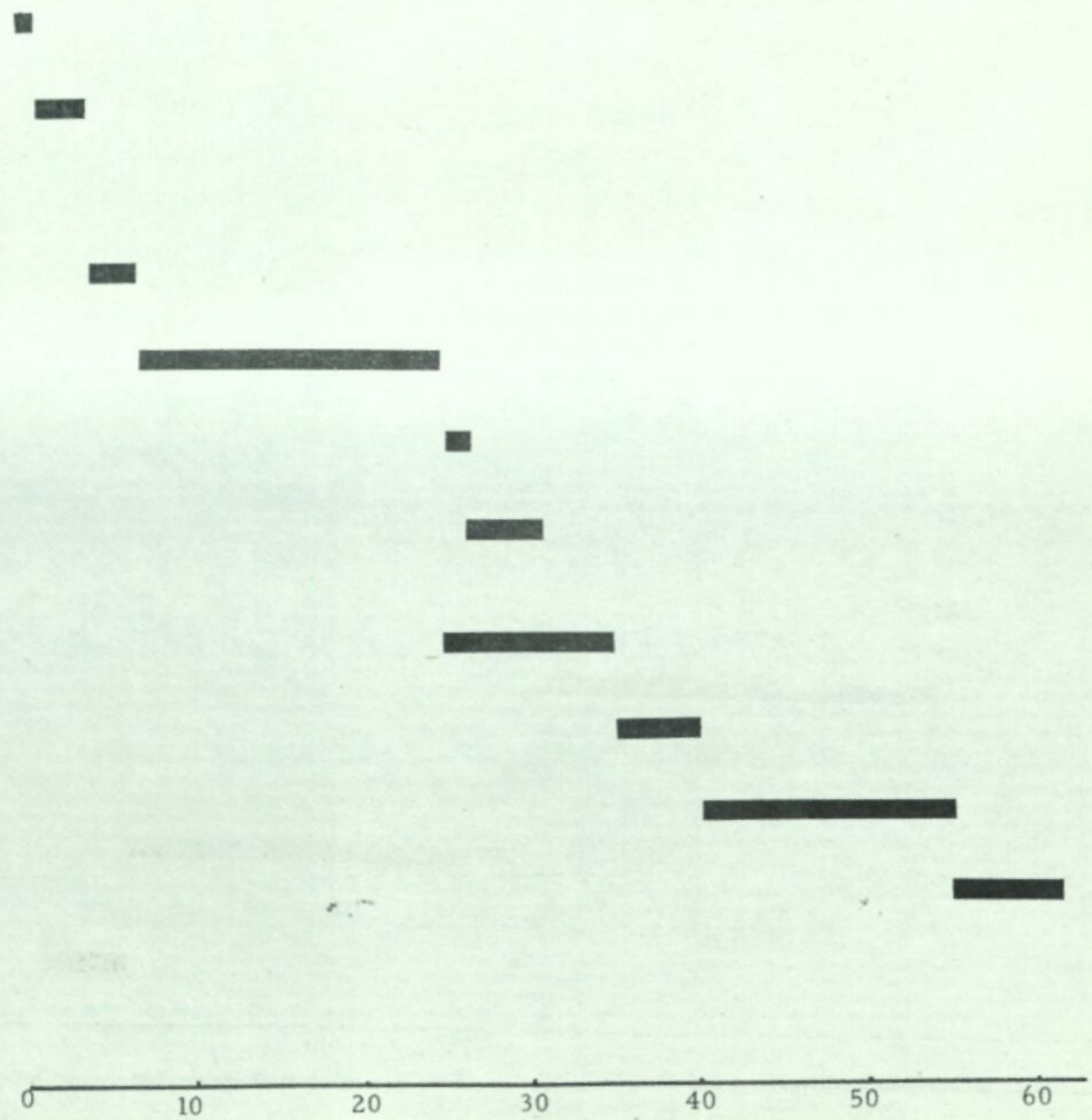


Day 1 Event 12

FIGURE 3.3-7. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man
1. Open Airlock Aft Hatch	2
2. Attach Lights	2 3
4. Remove Reactionless Tool from Storage	3
5. Loosen 72 Bolts	2
6. Stow Reactionless Tool	3
7. Remove Airlock Umbilical, Open Airlock Side Door and Translate to SIVB Forward Area	3
8. Remove Bolts and Place in Utility Bag	2
9. Remove Bulkhead and Slide out to number 3	2 3
10. Secure Bulkhead to Cable Rack	3
11. Return to Airlock and Connect Airlock Umbilical	3

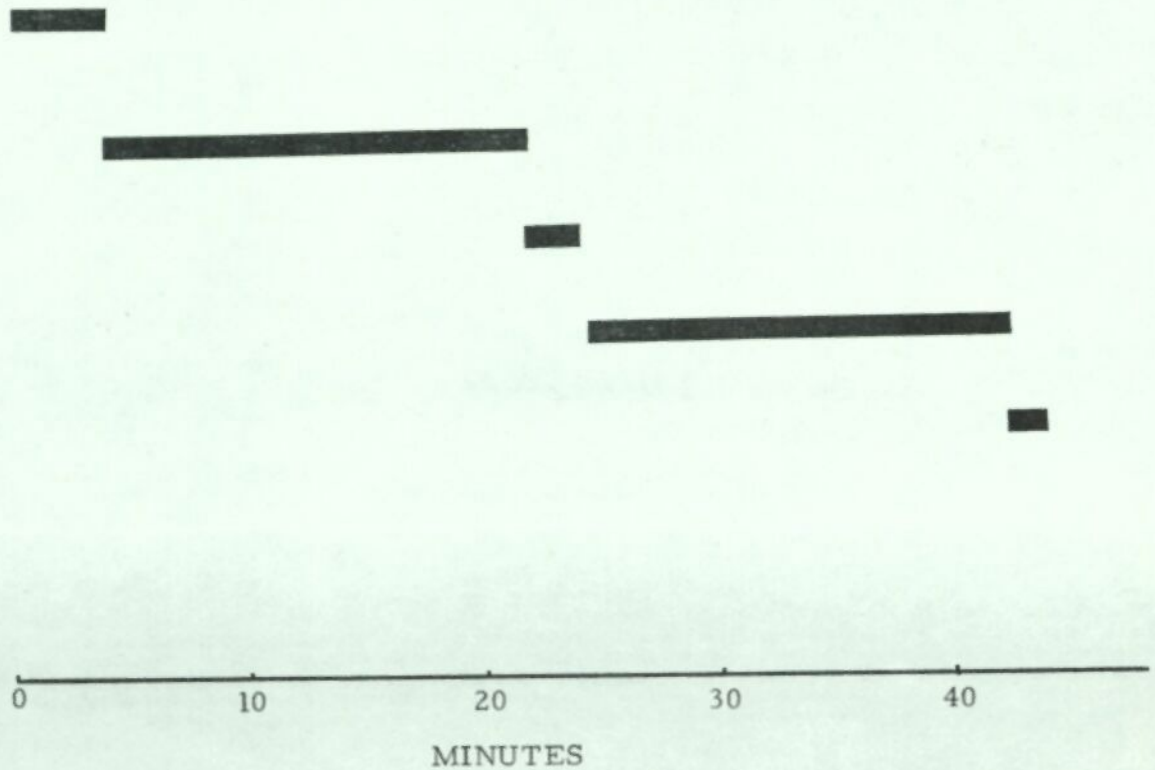
Remove and Store S-IVB Bulkhead Cover



Day 1 Event 13 FIGURE 3.3-8. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man
1. Release Bellows from Retainers and Allign at S-IVB Tank Opening	2
2. Thread 72 Bolts to Connect Bellows to Tank	2
3. Remove Reactionless Tool from Storage	3
4. Tighten Bolts	2
5. Store Reactionless Tool	3

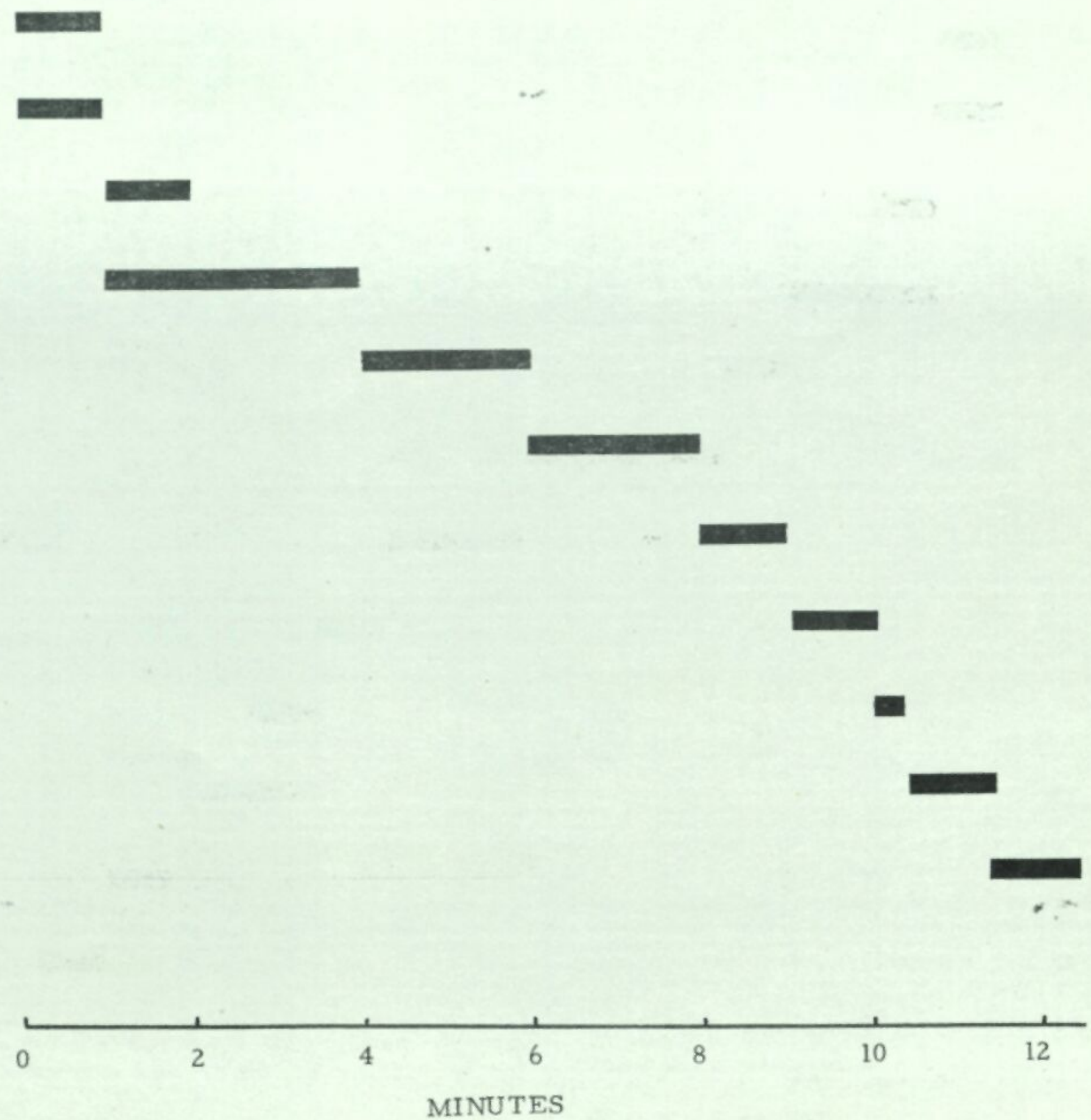
Connect Bellows



Day 1 Event 15 FIGURE 3.3-9. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man
1. Open Airlock Interlock Valve	3
2. Open CM Interlock Valve	1
3. Open Airlock Forward Pressure Hatch	3
4. Open and Stow CM Pressure Hatch	1
5. Pass CM Umbilicals into Airlock	1
6. Disconnect Airlock Umbilicals and Stow Connect CM Umbilicals	2 3
7. Enter CM	2 3
8. Close Airlock Forward Hatch	2
9. Check Interlock Valve Position	2
10. Install and Close CM Pressure Hatch	1
11. Check Interlock Valve Position	1

Return to CM

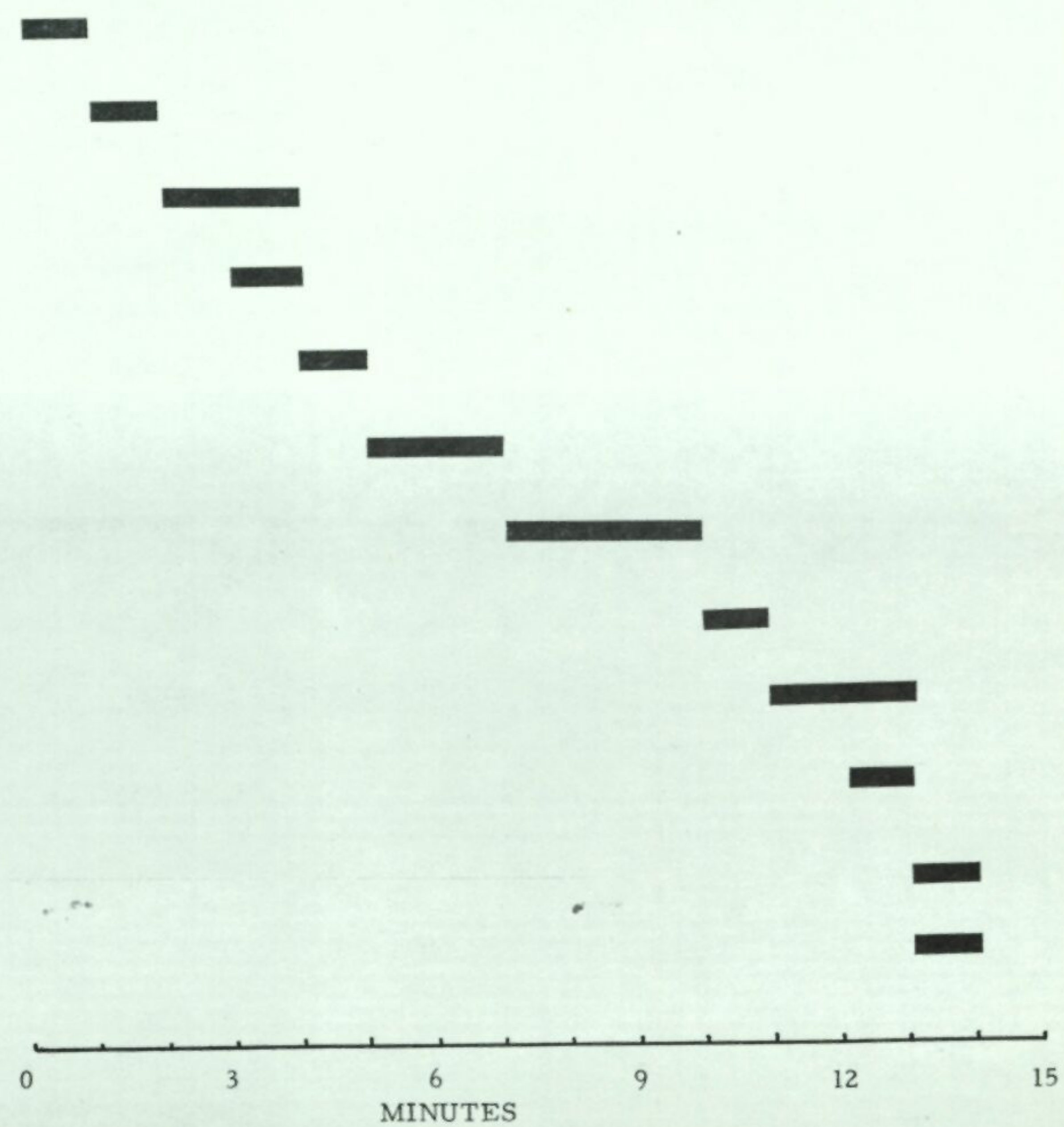


Day 2 Event 1

FIGURE 3.3-10. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man
1. Open CM Interlock Dump Valve	2
2. Remove CM Pressure Hatch	2
3. Store CM Pressure Hatch	1
4. Open Airlock Interlock Valve	2
5. Open Airlock Forward Hatch	2
6. Enter Airlock	2 3
7. Connect Airlock Suits Umbilicals Remove CM Suits Umbilical	2 3
8. Check Communications	1 2 3
9. Install CM Hatch	1
10. Close Airlock Forward Pressure Hatch	3
11. Close CM Interlock Dump Valve	1
12. Close Airlock Interlock Valve	

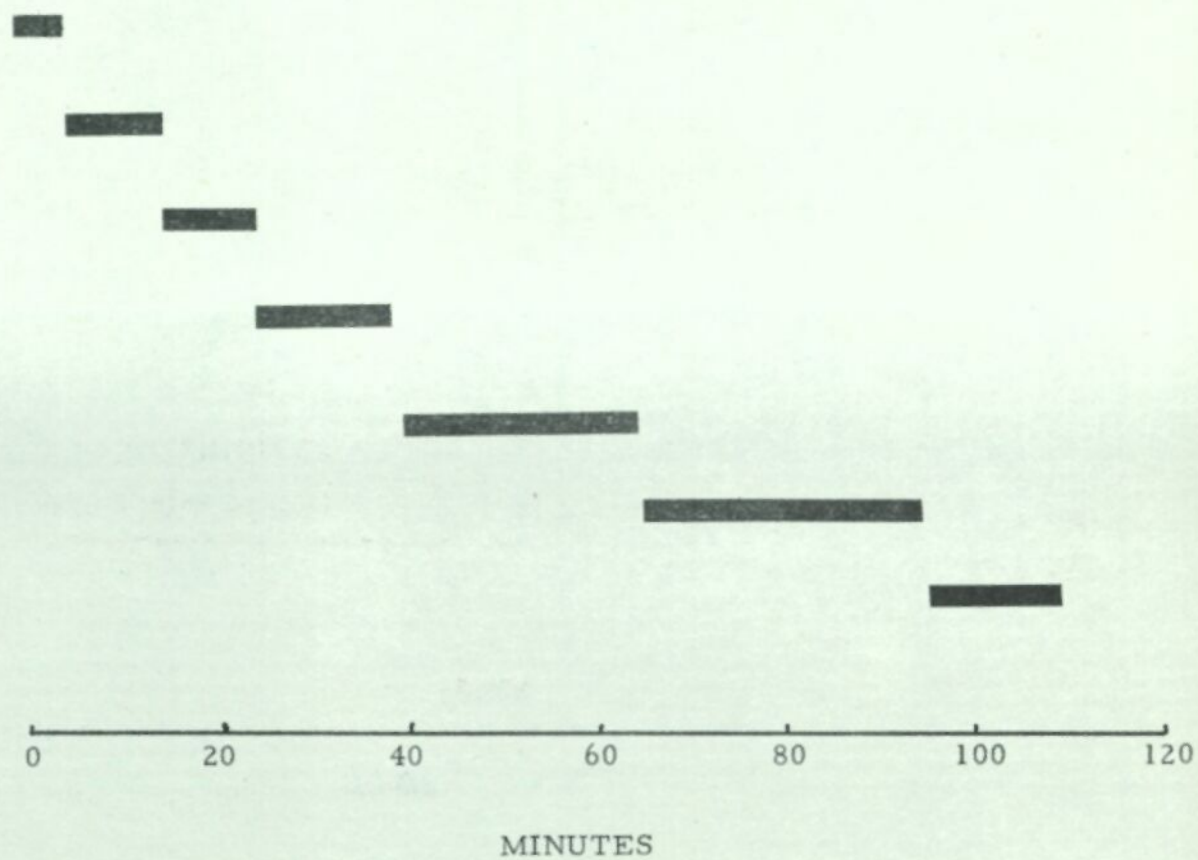
Enter Airlock



Day 2 Event 3 FIGURE 3.3-11. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man
1. Install Temporary lights	2 3
2. Attach Tethers	2 3
3. Transfer and install Handholds	2 3
4. Transfer and install Tool Kit	2 3
5. Transfer and install six Equipment Racks	2 3
6. Transfer and install Lights and Fixtures	2 3
7. Transfer and install two Fans	2 3

Transfer and Install Equipment from Airlock Storage to Workshop

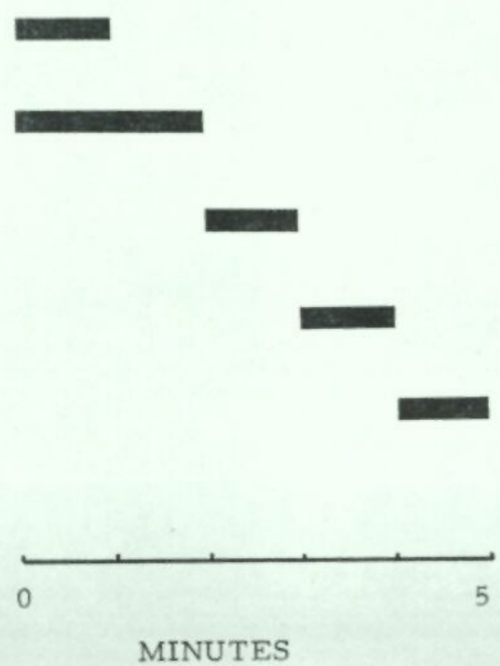


NOTE: The events on this page are broken down into more detail in the following seven pages.

Day 2 Event 3-1 FIGURE 3.3-12. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

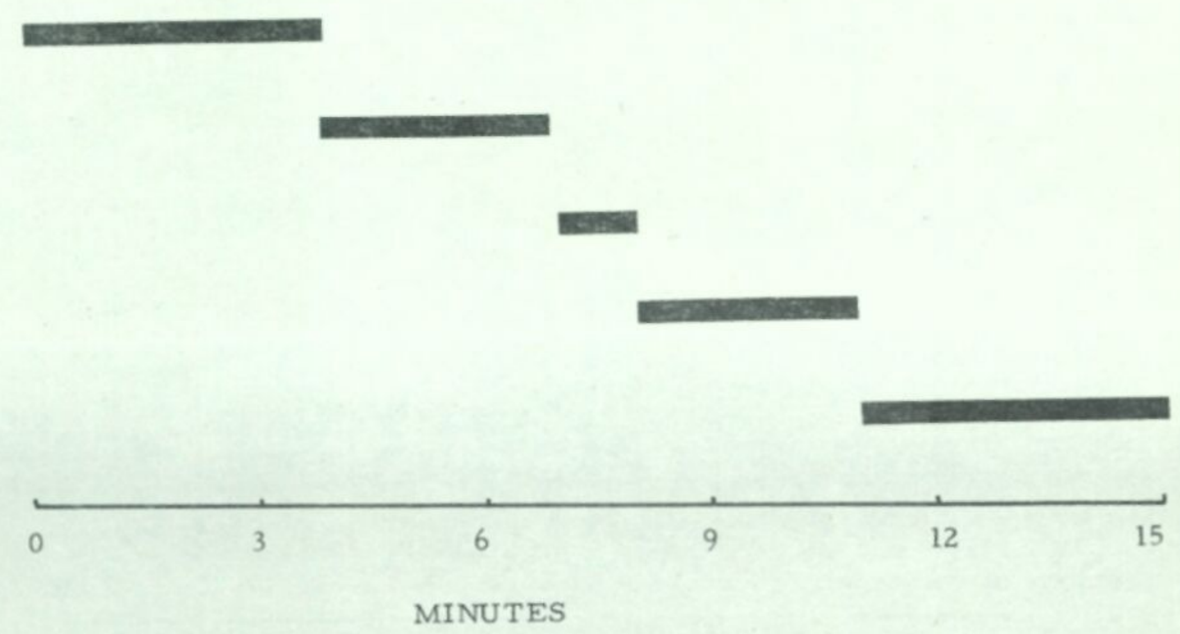
Sub-Event	Man
1. Open Aft Airlock Hatch	2
2. Remove Light Bank From Airflow Storage	3
3. Enter Workshop	2
4. Transfer Light to Workshop	3
5. Clamp Light to LH_2 Tank Fuel Probe	2

Workshop Entry - Install Temporary Lights



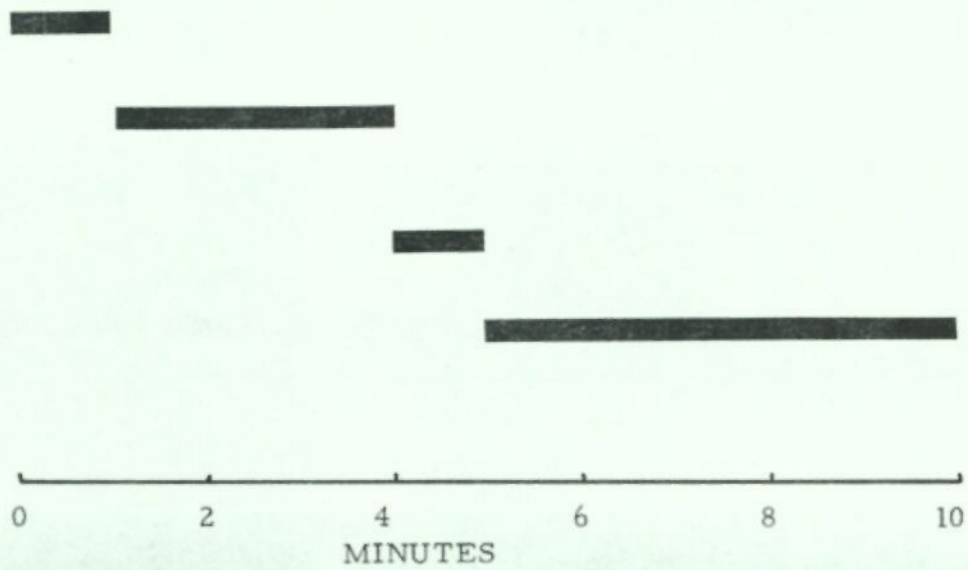
Day 2 Event 3-2 FIGURE 3.3-13. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man	Attach Tethers
1. Remove Tethers from Airlock Storage and Hand to number 2	2 3	
2. Attach Tethers to Probe	2	
3. Enter Workshop	3	
4. Attach Tethers to S-IVB Aft	2 3	
5. Attach Second Tether		



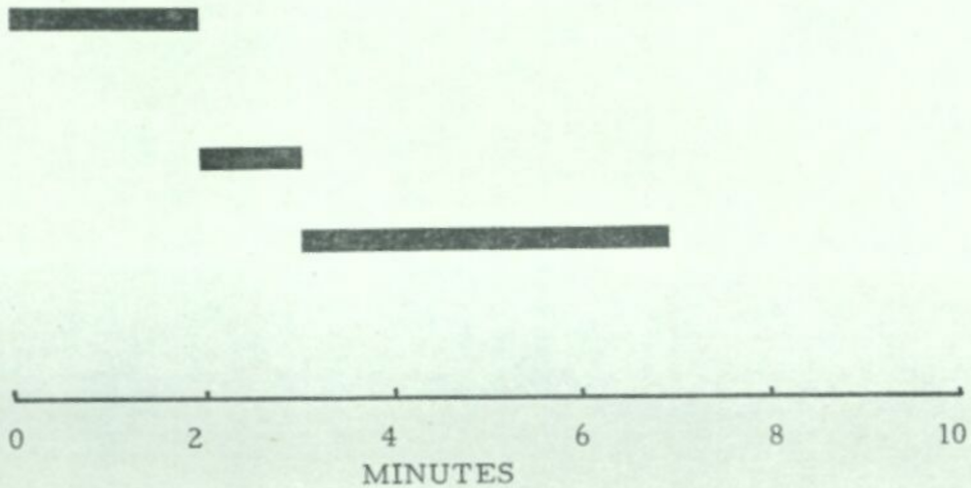
Day 2 Event 3-3 FIGURE 3.3-14. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man	Transfer and Install Handholds
1. Enter Airlock (From Workshop)	3	
2. Remove Handloads from Airlock Storage and Transfer to number 2	3	
3. Attach Handholds on Probe	2	
4. Transfer and Permanently Attach Handholds	2	



Day 2 Event 3-4 FIGURE 3.3-15. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

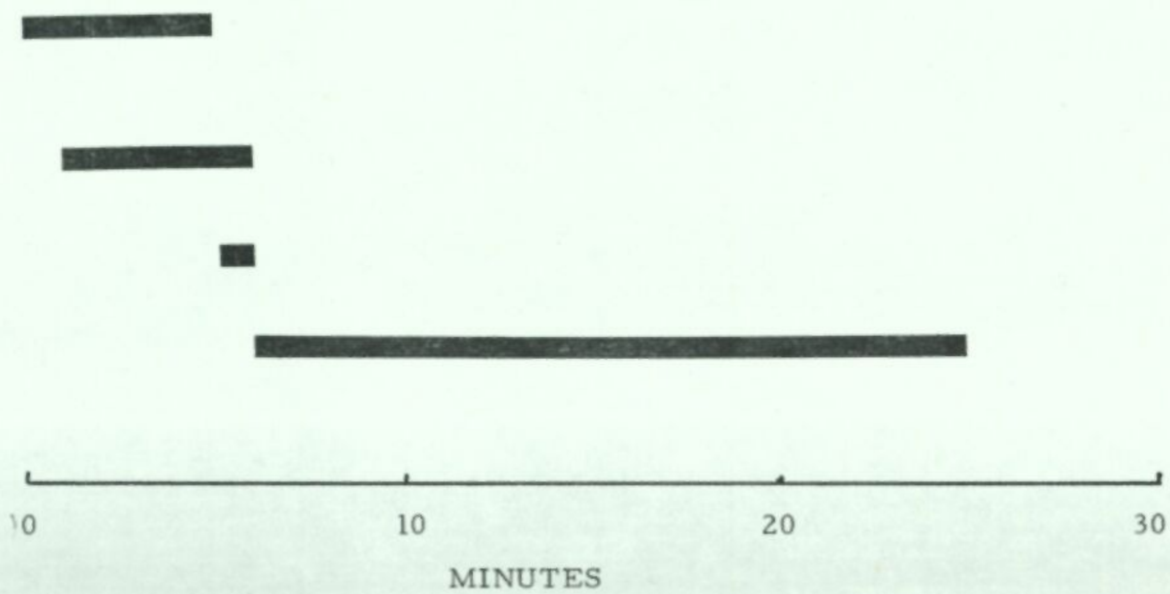
Sub-Event	Man	Transfer and Install Tool Kit
1. Remove Tool Kit From Airlock Storage and Transfer to number 2	3	
2. Attach Tool Kit to Probe	2	
3. Transfer to Permanent Tool Kit Location and Install	2	



Day 2 Event 3-5 FIGURE 3.3-16. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

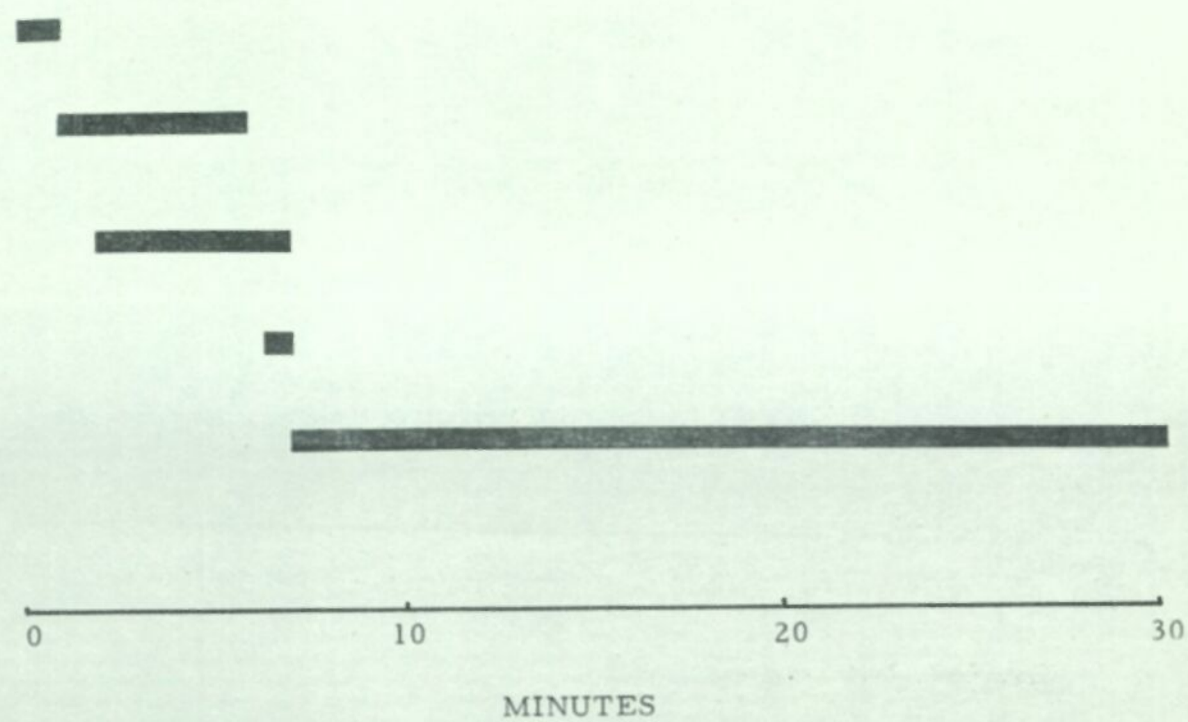
Sub-Event	Man
1. Remove Equipment Racks from Airlock Storage and Transfer to number 2	3
2. Attach each Rack to Probe (Temporary)	2
3. Enter Airlock to Assist number 2	3
4. Install Racks - one at a time	2 3

Transfer and Install Six Equipment Racks



Day 2 Event 3-6 FIGURE 3.3-17. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

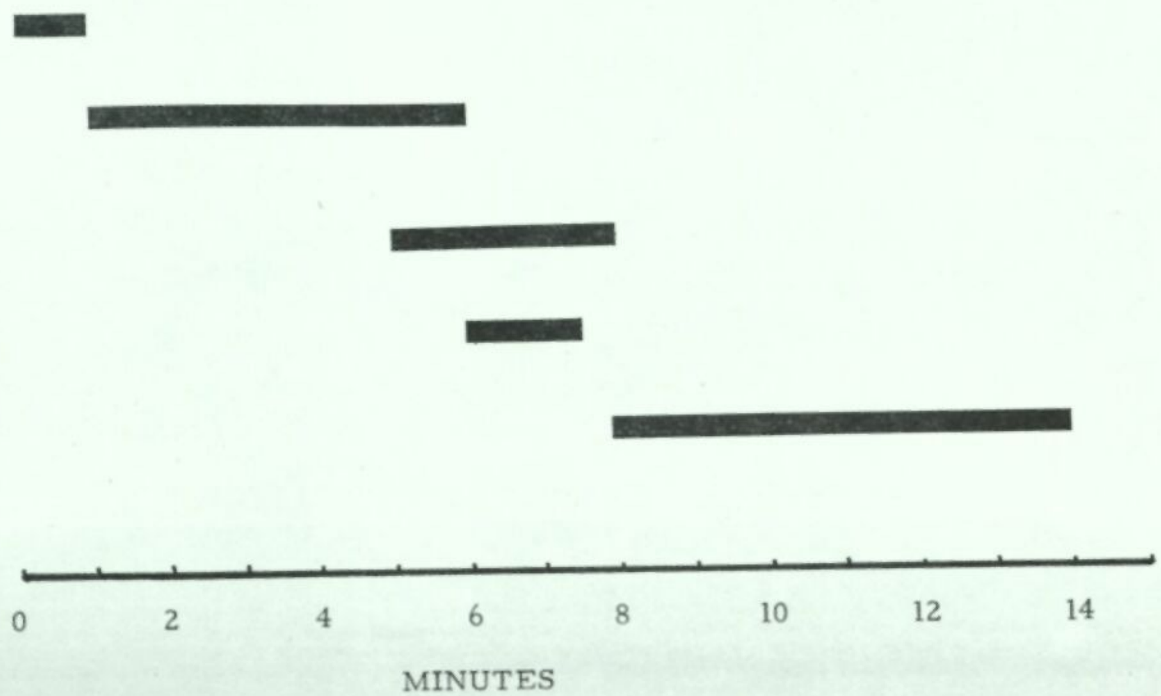
Sub-Event	Man	Transfer and Install Lights and Fixtures
1. Enter Airlock (from Workshop)	3	
2. Remove Lights and Fixtures from Airlock Storage and hand to number 2 - one at a time	3	
3. Attach to Probe	2	
4. Enter Workshop to Assist	3	
5. Install Lights and Fixtures - One at a time to permanent location	2 3	



Day 2 Event 3-7 FIGURE 3.3-18. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man
1. Enter Airlock (from Workshop)	3
2. Remove Fans from Airlock Storage and Transfer to number 2	3
3. Attach Fans to Probe	2
4. Enter Workshop to Assist	3
5. Attach to Permanent Locations	2 3

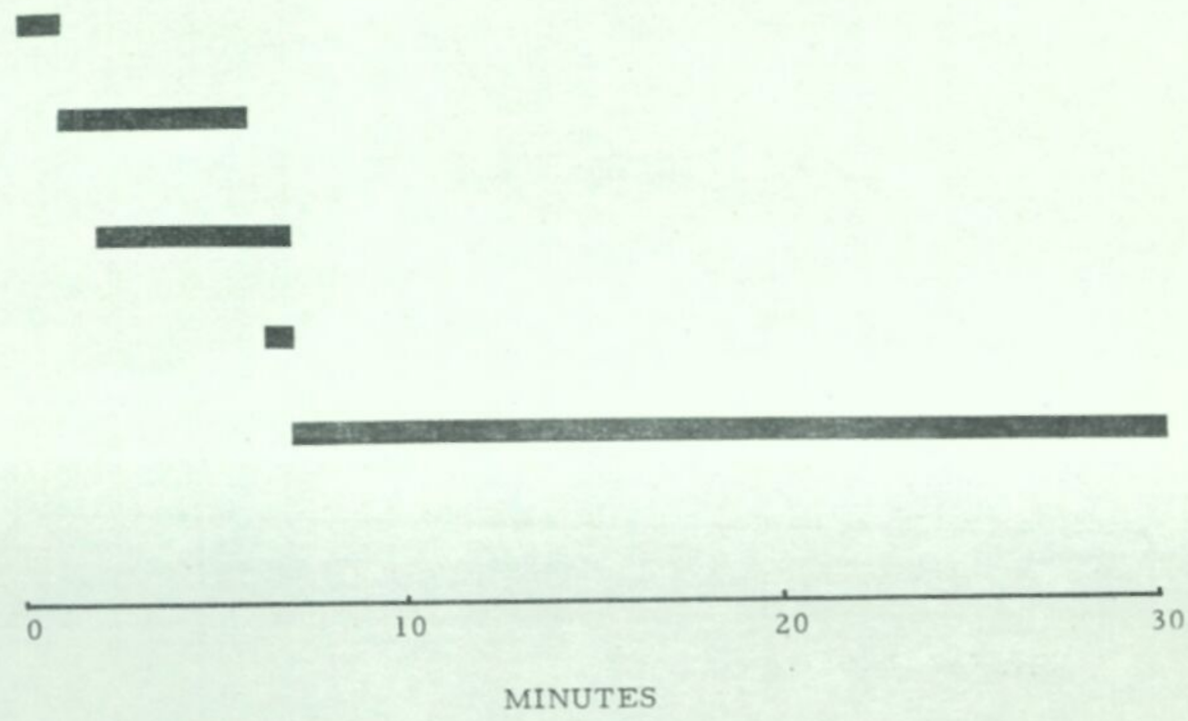
Transfer and Install Two Fans



Day 2 Event 3-6 FIGURE 3.3-17. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Transfer and Install Lights and Fixtures

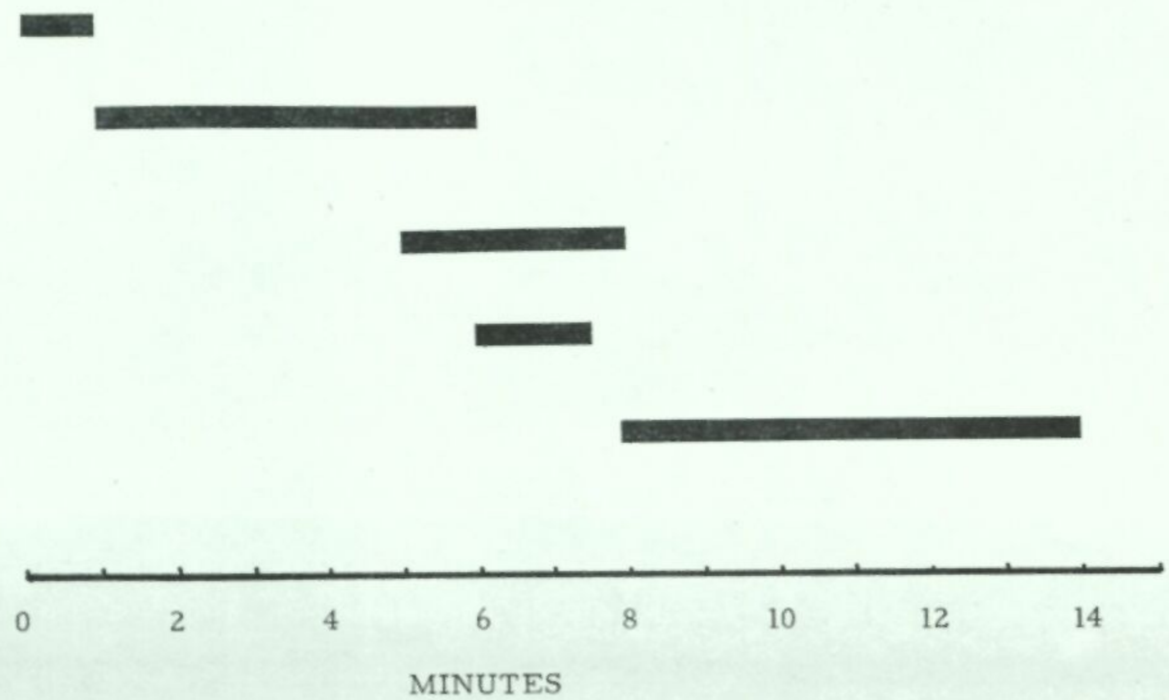
Sub-Event	Man
1. Enter Airlock (from Workshop)	3
2. Remove Lights and Fixtures from Airlock Storage and hand to number 2 - one at a time	3
3. Attach to Probe	2
4. Enter Workshop to Assist	3
5. Install Lights and Fixtures - One at a time to permanent location	2 3



Day 2 Event 3-7 FIGURE 3.3-18. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

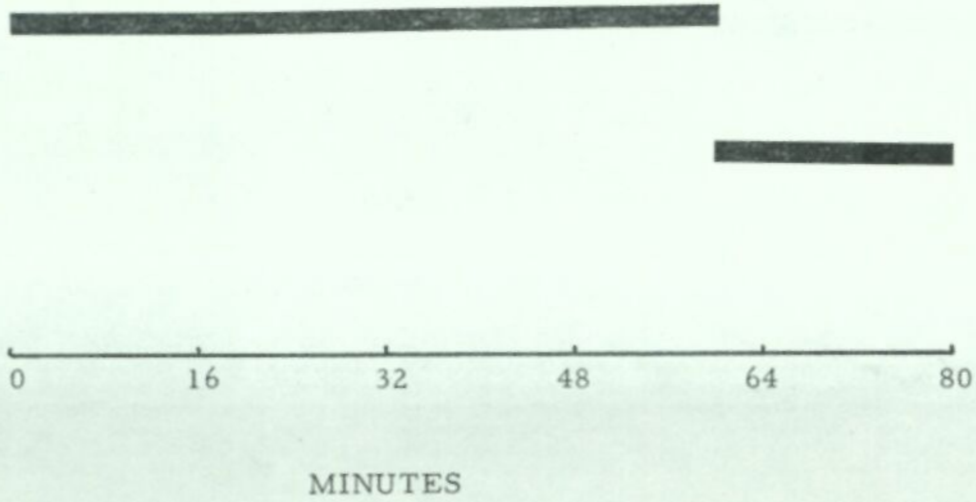
Sub-Event	Man
1. Enter Airlock (from Workshop)	3
2. Remove Fans from Airlock Storage and Transfer to number 2	3
3. Attach Fans to Probe	2
4. Enter Workshop to Assist	3
5. Attach to Permanent Locations	2 3

Transfer and Install Two Fans



Day 2 Event 4 FIGURE 3.3-19. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man	Transfer and Install Equipment from SLA to Workshop
1. Transfer and Install three Equipment Storage Assemblies (ESAs)	2 3	
2. Transfer and Install one Scientific Equipment Pod.	2 3	

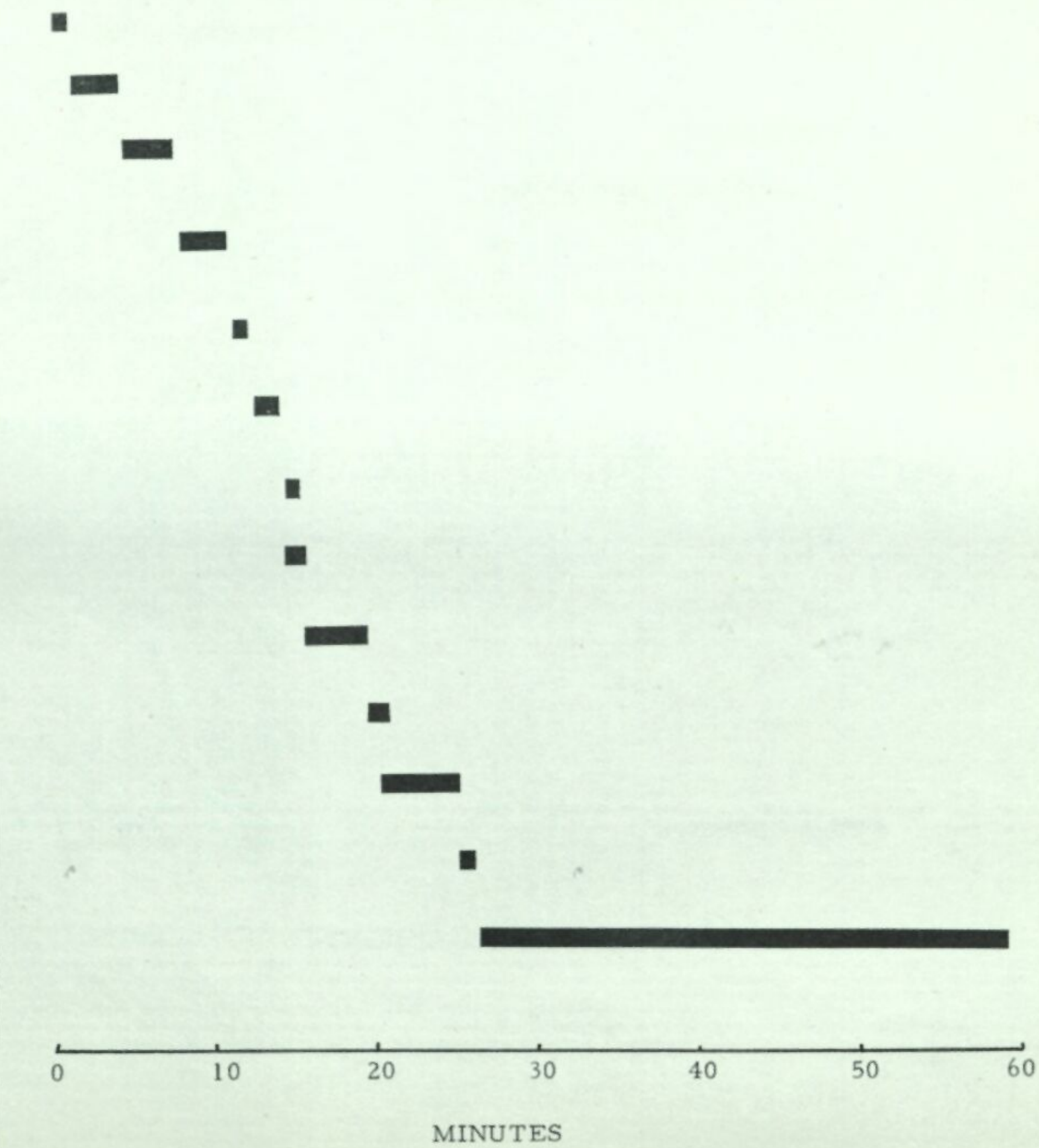


NOTE: The events on this page are broken down into more detail on the following two pages.

Day 2 Event 4-1 FIGURE 3.3-20. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Transfer and Install Three Equipment Storage Assemblies (ESA's)

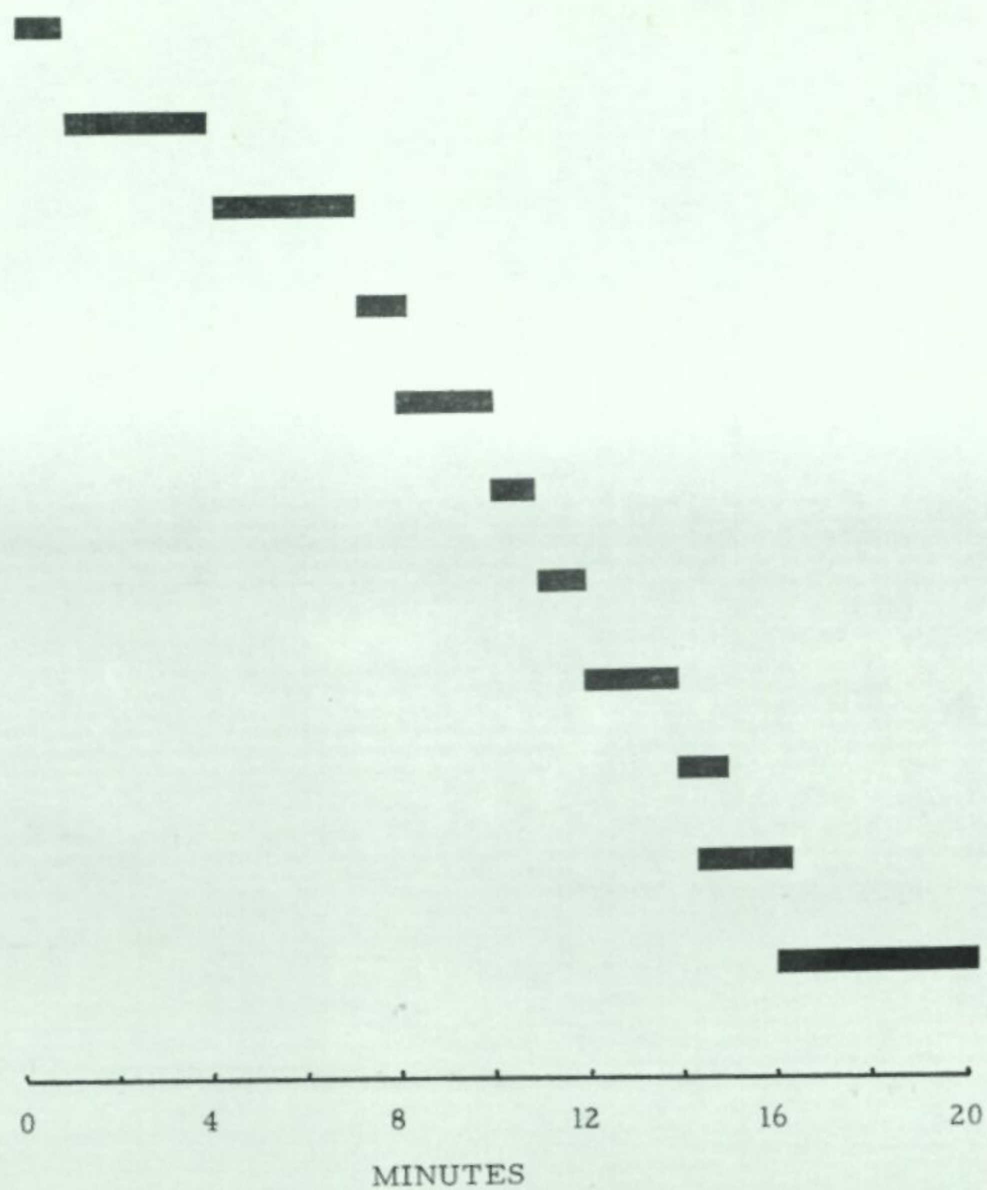
Sub-Event	Man
1. Enter Airlock	3 2
2. Disconnect Airlock Umbilicals	3
3. Open Airlock Side Door and Translate to SLA	3
4. Unlatch ESA and Transfer to Airlock Access Hatch	3
5. Attach Tethers to ESA (both ends)	2 3
6. Transfer ESA to Airlock (to Workshop Opening)	
7. Enter Airlock	3
8. Enter Workshop and Translate to Point of EAS Attachment	2
9. Move ESA to Attachment Point	2 3
10. Translate to ESA Attachment	3
11. Attach ESA to Probe (Permanent)	2 3
12. Return to Airlock	2 3
13. Repeat 2 thru 11 twice for 2 ESA's	2 3



Day 2 Event 4-2 FIGURE 3.3-21. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man
1. Enter Airlock	2 3
2. Enter SLA	3
3. Unlatch SEP and Transfer to Airlock Side Hatch	3
4. Attach Tethers - Both Ends	2 3
5. Pass SEP into Airlock (to Workshop Opening)	2 3
6. Enter Airlock	3
7. Enter Workshop - Move to SEP Attach Point	2
8. Move SEP to Attach point	2 3
9. Enter Workshop and Move to SEP Attach Point	3
10. Remove Equipment from POD	2 3
11. Install Equipment on racks	2 3

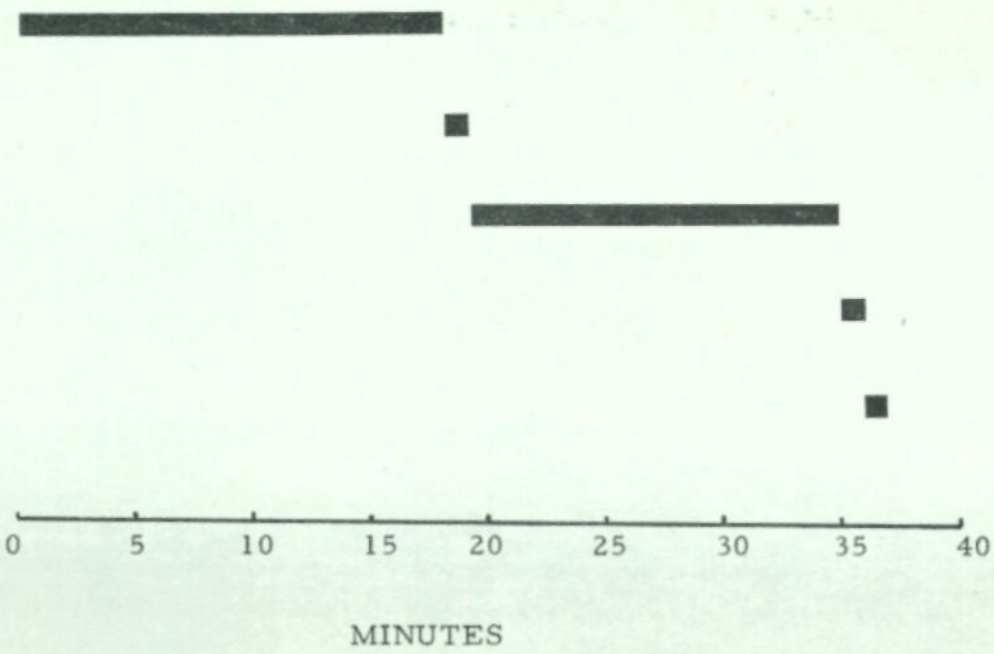
Transfer and Install One Scientific Equipment Pod (SEP)



Day 20 Event 3 FIGURE 3.3-22. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man
1. Secure Equipment in Workshop Aft Area	2 3
2. Translate To Workshop Forward Area	2 3
3. Secure Forward Area Equipment	2 3
4. Enter Airlock	2 3
5. Close Airlock Aft Hatch	3

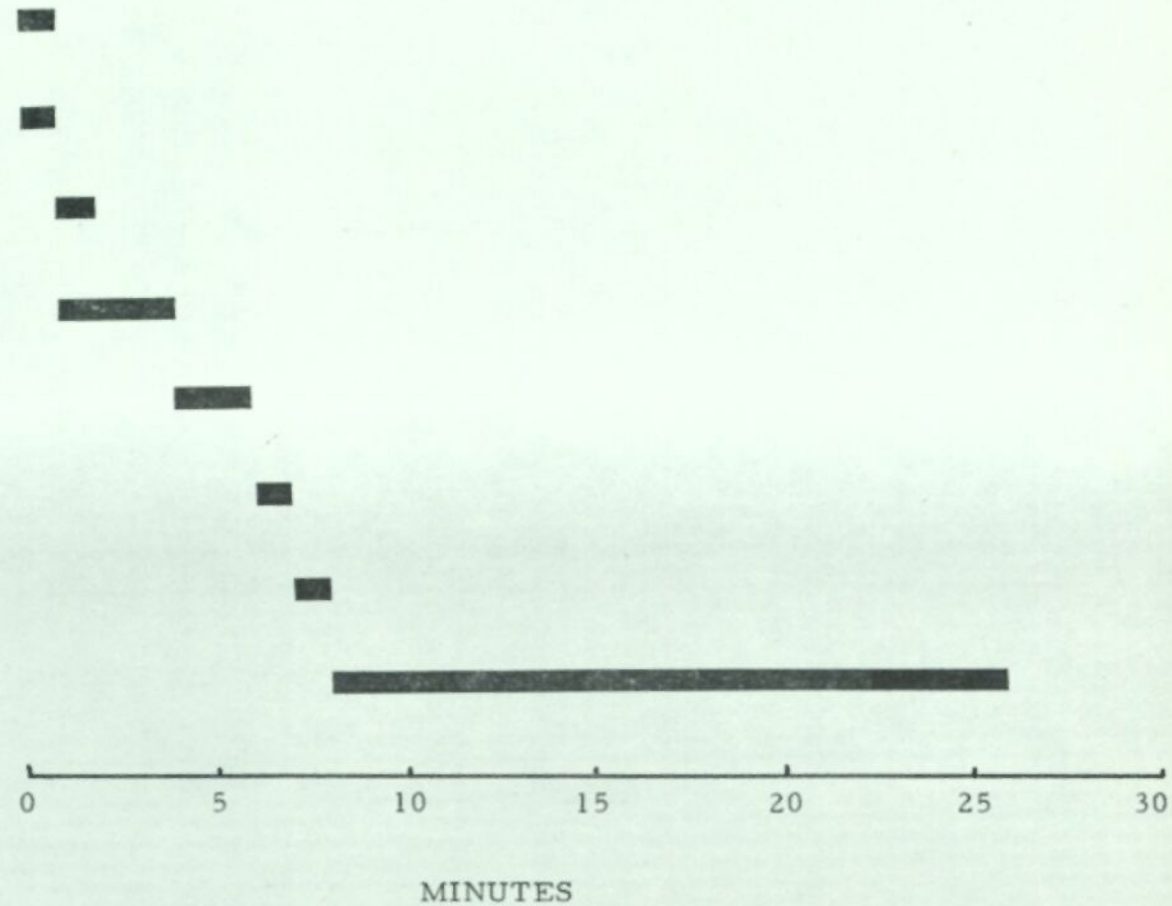
Secure Equipment in Workshop



Day 20 Event 4 FIGURE 3.3-23. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Transfer Equipment Containers to CM

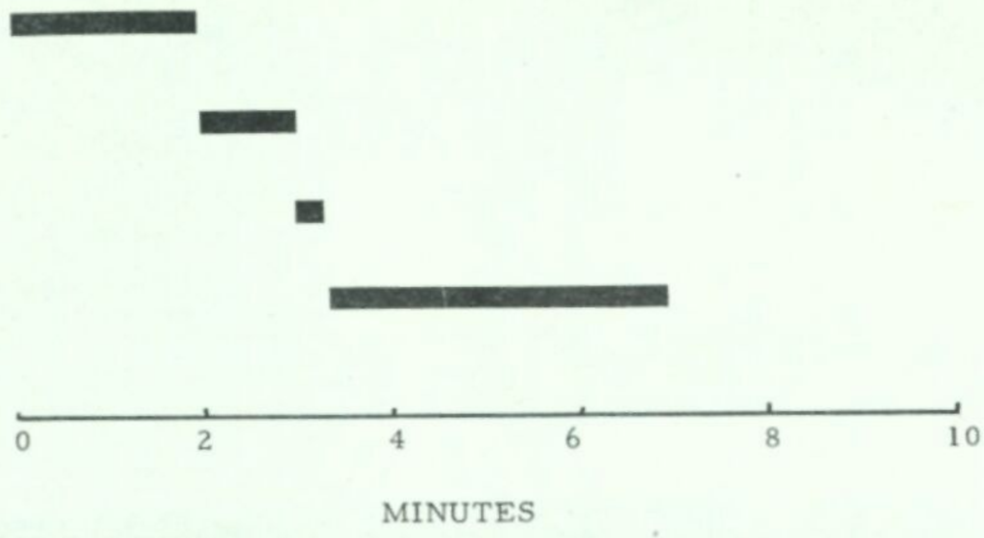
Sub-Event	Man
1. Open Forward Airlock Interlock Valve	2
2. Open CM Interlock Valve	1
3. Open Airlock Forward Pressure Hatch	2
4. Open CM Pressure Hatch and Stow	1
5. Remove CM Umbilicals from Storage and Pass into Airlock	1
6. Connect CM Umbilicals	2 3
7. Disconnect Airlock Umbilicals and Store	2 3
8. Transfer Experiment Containers to CM	1 2
9.	



Day 20 Event 5 FIGURE 3.3-24. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

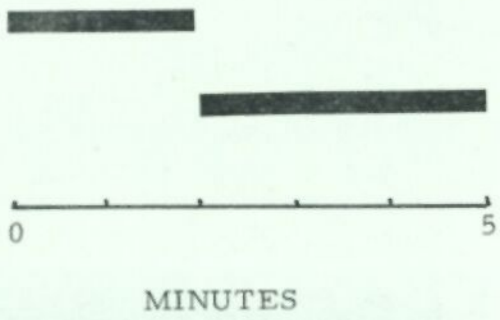
Sub-Event	Man
1. Enter CM	3 2
2. Close Airlock Forward Pressure Hatch	2
3. Verify Interlock Valve Closed	2
4. Release Manual Docking Latches	2

Enter CM



Day 20 Event 6 FIGURE 3.3-25. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man	Install Drogue
1. Remove Drogue Assembly from CM Storage	3	
2. Install Drogue Assembly	2	



Day 20 Event 7

FIGURE 3.3-26. - AS-209 DESIGN REFERENCE MISSION SEQUENCE

Sub-Event	Man
1. Remove CM Thermal Hatch from Storage	3
2. Install CM Thermal Hatch	2
3. Remove CM Pressure Hatch from Storage	1 3
4. Install CM Pressure Hatch	2
5. Disconnect Umbilicals and Stow	2 3
6. Remove PGA Suits	2 3
7. Review Tasks Preformed Checklist	

Install CM Hatches and Systems Check

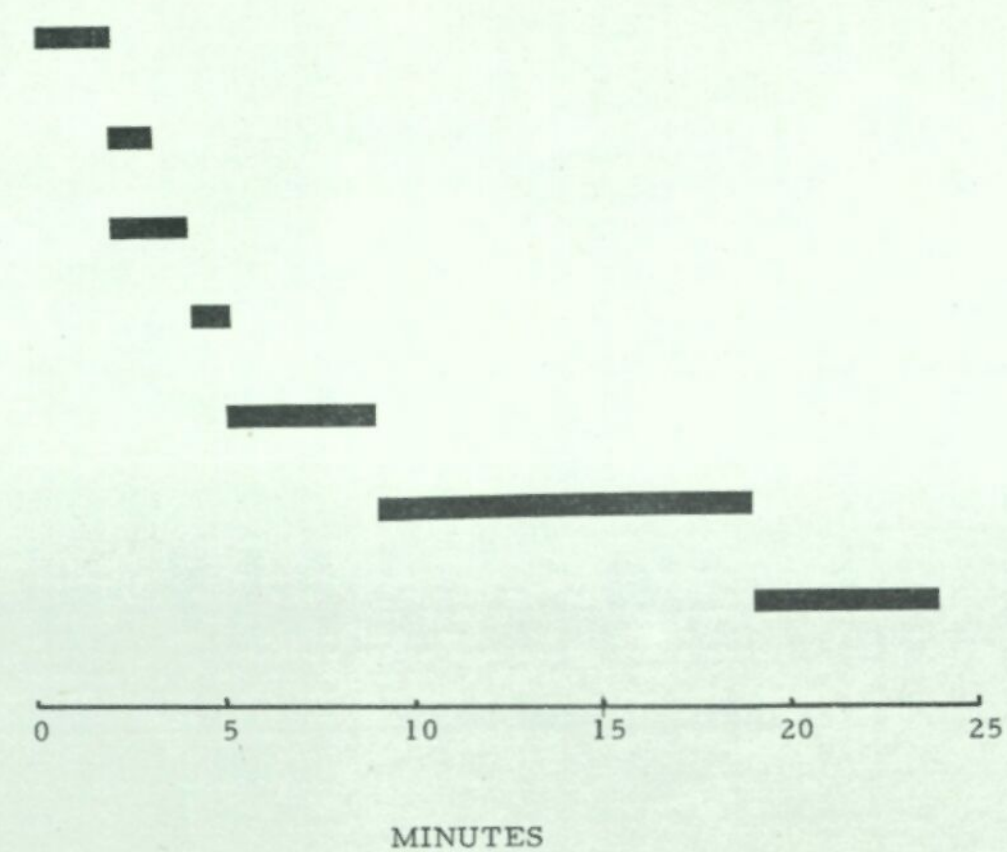


FIGURE 3.4-1. - CREW SCHEDULE

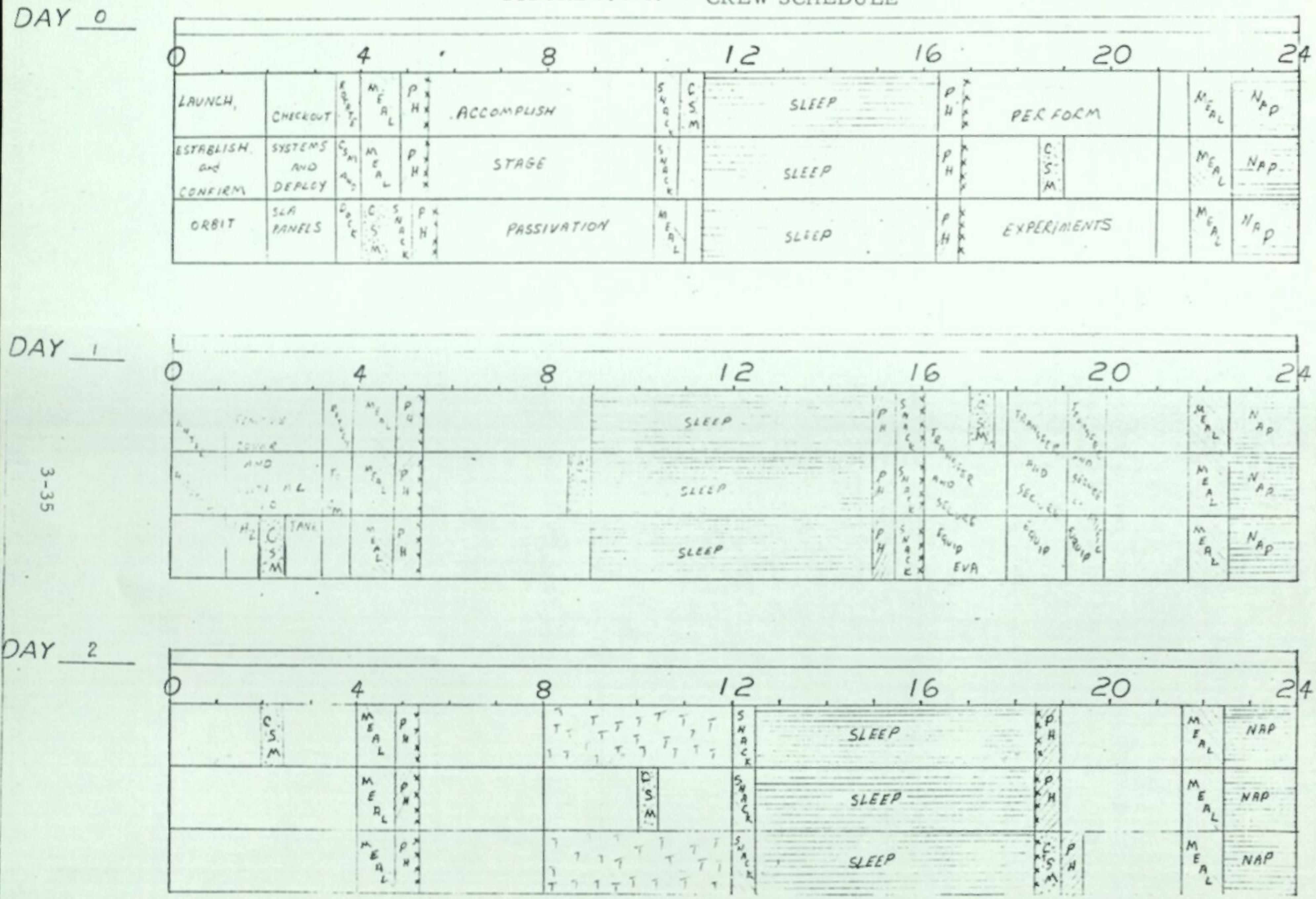
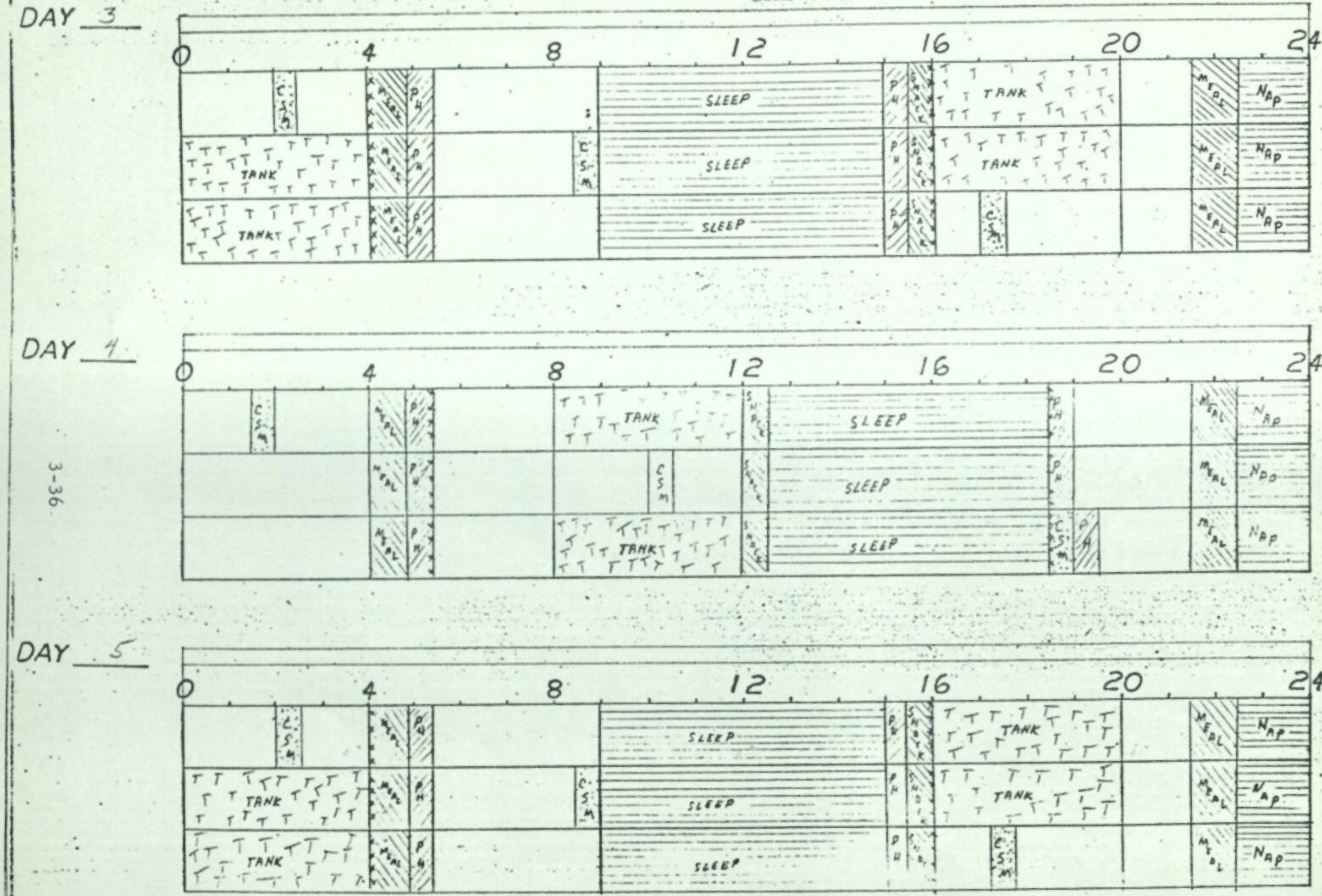


FIGURE 3.4-2. - CREW SCHEDULE



SECTION 4.0 VIBRATION AND ACOUSTIC TESTING

4.1 ACOUSTIC TEST PROCEDURES

4.1.1 Requirements

Acoustic environmental qualification testing will be performed in a reverberation chamber. Requirements are outlined in Table 4.1-1.

4.1.2 Reverberation Chamber Testing

a. The test chamber volume shall be such that the physical bulk of the item under test will not interfere with the generation and maintenance of test conditions.

b. The sound pressure field shall be measured with the test item or a suitable dummy mounted in the test chamber. Acoustic measurements shall be made in proximity to each major, dissimilar surface of the test specimen. The overall sound pressure level, reduced by six decibels, shall be introduced into the test chamber and adjusted to conform with the specified acoustic spectrum. The time required to conduct the survey shall be less than one-fourth of the specified test time, unless the specimen is replaced with a dummy. The sound pressure level and the survey time are reduced to avoid possible premature damage to the test item. The microphone shall be moved around the test item maintaining a distance of approximately 18 inches from the specimen. The measurements made within this volume shall then be averaged and the extreme values shall be noted.

c. When (b) is accomplished, the sound pressure level shall be raised to the design specification value and the test shall commence.

4.1.3 Test Spectrum

The acoustic test levels shall be those in the specification.

4.1.4 Test Duration

Generally the test shall consist of a high-level exposure, immediately followed by a low-level exposure. Time durations for the high- and low-level exposures are given in the specification.

TABLE 4.1-1. - EXTERNAL AND INTERNAL ACOUSTIC SPECIFICATIONS

One-third Octave Band Geometric Mean Freq. (cps)	External Sound Pressure Levels		Internal Sound Pressure Levels	
	High Level (dB)	Low Level (dB)	High Level (dB)	Low Level (dB)
5.0			106.5	100.0
6.3			109.0	102.5
8.0			112.5	106.0
10.0			115.5	109.0
12.5			118.0	111.5
16.0			121.5	115.5
20.0			124.5	118.0
25.0			127.5	121.0
31.5			130.5	124.0
40.0	Not Applicable	Not Applicable	133.0	126.5
50.0			136.0	129.5
63.0			139.0	132.5
80.0			139.5	133.0
100.0			139.5	133.0
125.0			140.0	133.5
160.0			140.0	133.5
200.0			140.0	133.5
250.0			140.5	134.0
315.0			140.5	134.0
400.0			141.0	134.5
500.0			138.5	132.0
630.0			136.5	130.0
800.0			135.0	128.5
1000.0			134.0	127.5
1250.0			133.0	126.5
1600.0			131.0	124.5
2000.0			129.5	123.0
2500.0			127.0	120.5
3150.0			124.5	118.0
4000.0			121.5	115.0
5000.0			118.0	111.5
6300.0			115.0	108.5
8000.0			111.0	104.5
10,000.0			107.5	101.0
Overall Sound Pressure Level			151.0	144.5

TABLE 4.1-1. - Concluded

STAGE:	S-IVB
MAJOR ZONE:	15, Station 1541 to Station 1663 - The portion of the S-IVB Stage lying between the plane of juncture of the LH_2 container cylindrical section with the forward LH_2 bulkhead and the plane of the field splice with the IU.

One-Third Octave Band Acoustical Specifications in dB re 2×10^{-5} N/M^2

Test Duration:	High Level 3.0 Minutes
	Low Level 15.0 Minutes

4.1.4 Tolerances

a. The test time shall be within -0 to +10 percent of the time set forth in the test specifications.

b. For reverberation chamber testing, the overall sound pressure level and the individual one-third octave band, sound pressure levels shall be within -0 to +4 decibels of the levels set forth in the test specification with the test specimen installed.

4.2 VIBRATION AND SHOCK CRITERIA

4.2.1 General

Preliminary flight vibration and shock criteria for the S-IVB Spent Stage Experiment SSESM are presented below, and in Figures 4.2-1 through 4.2-10. Vibration criteria are presented for (1) Saturn IB primary structure input to the SSESM assembly, and (2) primary unloaded SSESM structure. Detailed individual component vibration test specifications will be derived as required.

4.2.2 Air lock Assembly Shock and Vibration Criteria

a. Sinusoidal Vibration Criteria (see Figure 4.2-1)

5 to 14 cps @ .044 In. Double Amp. Disp.
14 to 50 cps @ 0.44 g's peak
50 to 111 cps @ 0.0034 In. Double Amp. Disp.
111 to 600 cps @ 2.2 g's peak
600 to 2000 cps @ -1 g's Peak/Octave
2000 cps @ 0.46 g's peak

b. Random Vibration Criteria (see Figure 4.2-2). - Shall consist of three minutes of random noise over the frequency band 5 to 2000 cps at the following input levels:

5 cps @ 0.000204 g^2/cps
5 to 35 cps @ 6 db/octave
35 to 400 cps @ 0.01 g^2/cps
400 to 2000 cps @ -2 db/octave
2000 cps @ 0.00343 g^2/cps

Composite Level = 3.5 G_{rms}

c. Assembly Shock Criteria

(1) Lift-off and separation shock pulse shall consist of a 10-g half sine wave for a duration of 10 milliseconds.

(2) Docking shock pulse shall consist of a 20-g half sine wave for a duration of 10 milliseconds.

4.2.3 SSESM Unloaded Structure Vibration Criteria

a. Skin Panel Structure

(1) Sinusoidal Vibration Criteria

(a) Lift-off and mainstage sinusoidal vibration criteria (see Figure 4.2-3).

5 to 70 cps @ 0.03 In. Double Amp. Disp.
70 to 210 cps @ 7.5 g's peak
210 to 305 cps @ .0033 In. Double Amp. Disp.
305 to 500 cps @ 15.6 g's peak
500 to 2000 cps @ -6.45 g's peak/octave
2000 cps @ 2.7 g's peak

(b) Mach 1 and Max Q sinusoidal vibration criteria (see Figure 4.2-4).

5 to 66 cps @ 0.0705 In. Double Amp. Disp.
66 to 210 cps @ 15.6 g's peak
210 to 305 cps @ 0.0069 In. Double Amp. Disp.
305 to 500 cps @ 33 g's peak
500 to 2000 cps @ -13.8 g's peak/octave
2000 cps @ 5.4 g's peak

(2) Random Vibration Criteria

(a) Lift-off and mainstage random vibration criteria (see Figure 4.2-5). - Shall consist of 2 minutes of random noise over the frequency band 20 to 2000 cps at the following levels:

20 cps @ 0.0023 g^2/cps
20 to 63 cps @ 9 db/octave
63 cps @ 0.07 g^2/cps
63 to 380 cps @ 3.4 db/octave
380 to 420 cps @ 0.54 g^2/cps

420 to 800 cps @ -3.75 db/octave
800 cps @ 0.24 g^2/cps
800 to 2000 cps @ -9 db/octave
2000 cps @0.155 g^2/cps
Composite Level = 17.41 G_{rms}

(b) Mach 1 and Max Q random vibration criteria (see Figure 4.2-6). - Shall consist of one minute of random noise over the frequency band 20 to 2000 cps at the following levels:

20 cps @ 0.01 g^2/cps
20 to 63 cps @ 9 db/octave
63 cps @ 0.31 g^2/cps
63 to 380 cps @ 3.4 db/octave
380 to 400 cps @ 2.4 g^2/cps
400 to 850 cps @ -3.5 db/octave
850 cps @ 1.0 g^2/cps
850 to 2000 cps @ -1.5 db/octave
2000 cps @ 0.065 g^2/cps

Composite Level = 45.38 G_{rms}

(3) Shock Criteria. - The shock pulse shall consist of a 20-g half sine wave for a duration of 10 milliseconds.

b. Skin Stiffener Structure

(1) Sinusoidal Vibration Criteria

(a) Lift-off and mainstage sinusoidal vibration criteria (see Figure 4.2-7)

5 to 50 cps @ 0.0354 In. Double Amp. Disp.
50 to 158 cps @ 4.5 g's peak
158 to 200 cps @ 0.00351 In. Double Amp. Disp.
200 to 500 cps @ 7.2 g's peak
500 to 2000 cps @ -2.4 g's peak/octave
2000 cps @ 2.4 g's peak

(b) Mach 1 and Max Q sinusoidal vibration criteria (see Figure 4.2-8)

5 to 50 cps @ 0.075 In. Double Amp. Disp.
50 to 169 cps @ 9.6 g's peak
169 to 210 cps @ 0.0066 In. Double Amp. Disp.
210 to 500 cps @ 15 g's peak
500 to 2000 cps @ -4.8 g's peak/octave
2000 cps @ 5.4 g's peak

(2) Random Vibration Criteria

(a) Lift-off and mainstage random vibration criteria (see Figure 4.2-9). - Shall consist of 2 minutes of random noise over the frequency band 20 to 2000 cps at the following levels:

20 cps @ 0.0008 g^2/cps
20 to 72 cps @ 8 db/octave
72 cps @ 0.027 g^2/cps
72 to 400 cps @ 2.8 db/octave
400 cps @ 0.13 g^2/cps
400 to 1000 cps @ -3 db/octave
1000 cps @ 0.052 g^2.cps
1000 to 1600 cps @ -10.5 db/octave
1600 to 2000 cps @ 0.01 g^2/cps

Composite Level = 6.76 G_{rms}

(b) Mach 1 and Max Q random vibration criteria (see Figure 4.2-10). - Shall consist of one minute of random noise over the frequency band 20 to 2000 cps at the following levels:

20 cps @ 0.0035 g^2/cps
20 to 70 cps @ 3 db/octave
70 cps @ 0.12 g /cps
70 to 400 cps @ 2.65 db/octave
400 cps @ 0.56 g^2/cps
400 to 1000 cps @ -2.8 db/octave
1000 cps @ 0.24 g^2/cps
1000 to 1600 cps @ -10.8 db/octave
1600 to 2000 cps @ 0.044 g^2/cps

Composite Level = 10.85 G_{rms}

(3) Shock Criteria. - The shock pulse shall consist of a 20-g half sine wave for a duration of 10 milliseconds.

FIGURE 4.2-1

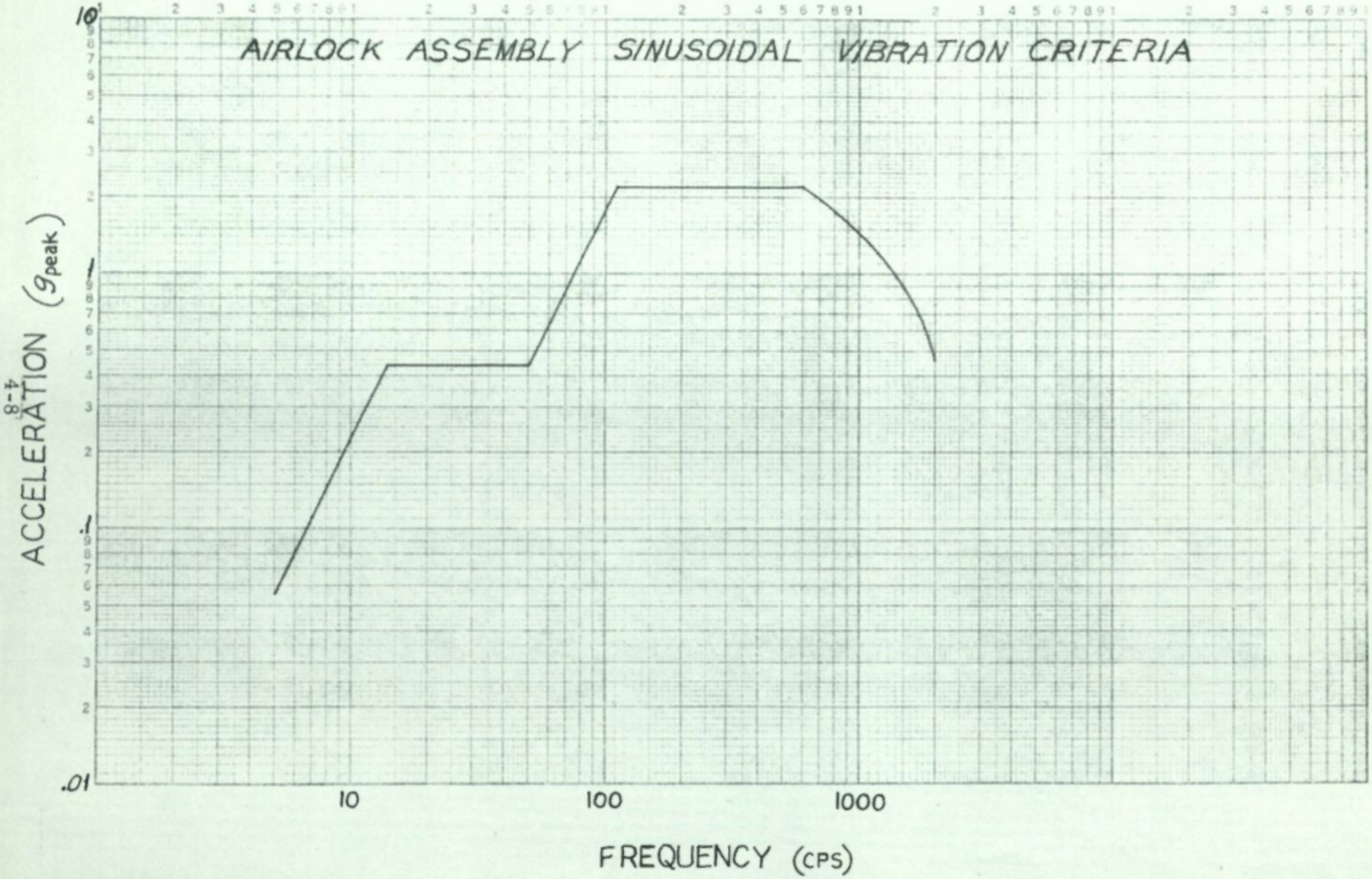

AIRLOCK ASSEMBLY SINUSOIDAL VIBRATION CRITERIA
ACCELERATION (g_{peak})
FREQUENCY (CPS)
10
100
1000
.01
.1
1
10

FIGURE 4.2-2

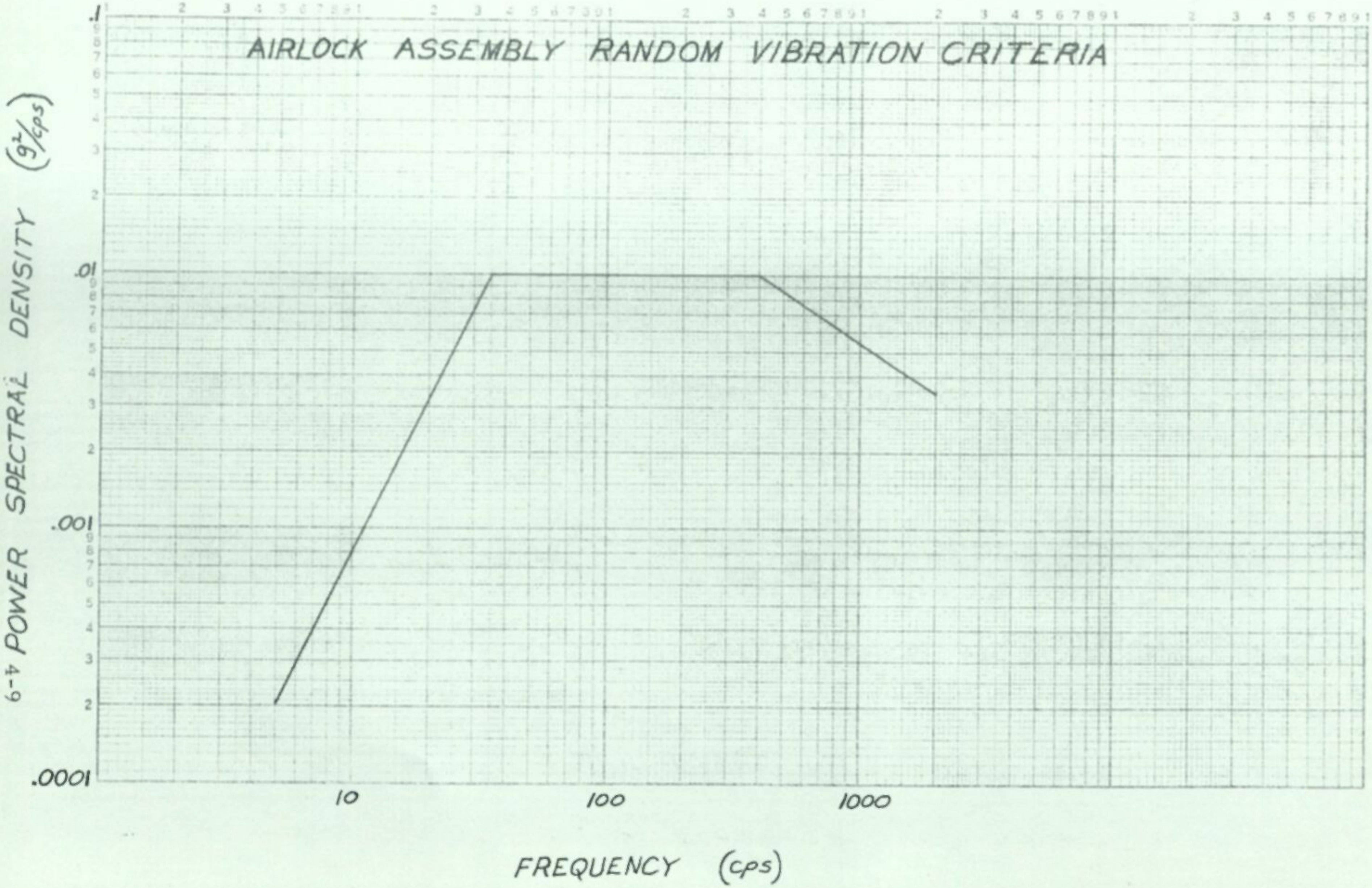

AIRLOCK ASSEMBLY RANDOM VIBRATION CRITERIA
POWER SPECTRAL DENSITY (g^2/cps)
.1
.01
.001
.0001
10
100
1000
FREQUENCY (cps)

FIGURE 4.2-3

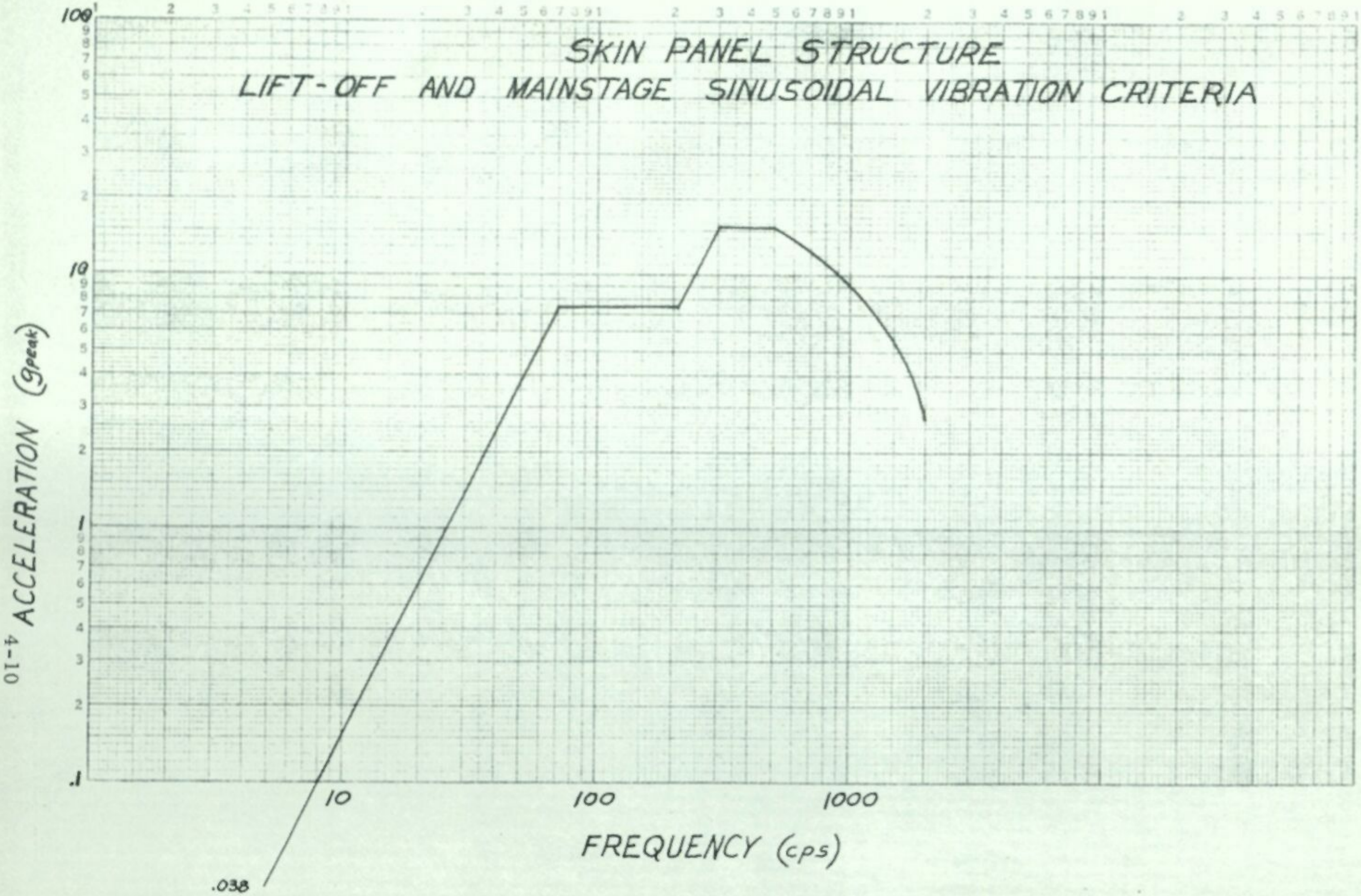

SKIN PANEL STRUCTURE
LIFT-OFF AND MAINSTAGE SINUSOIDAL VIBRATION CRITERIA
ACCELERATION (gpeak)
FREQUENCY (cps)
100
10
1
.1
10
100
1000
.038

FIGURE 4.2-4

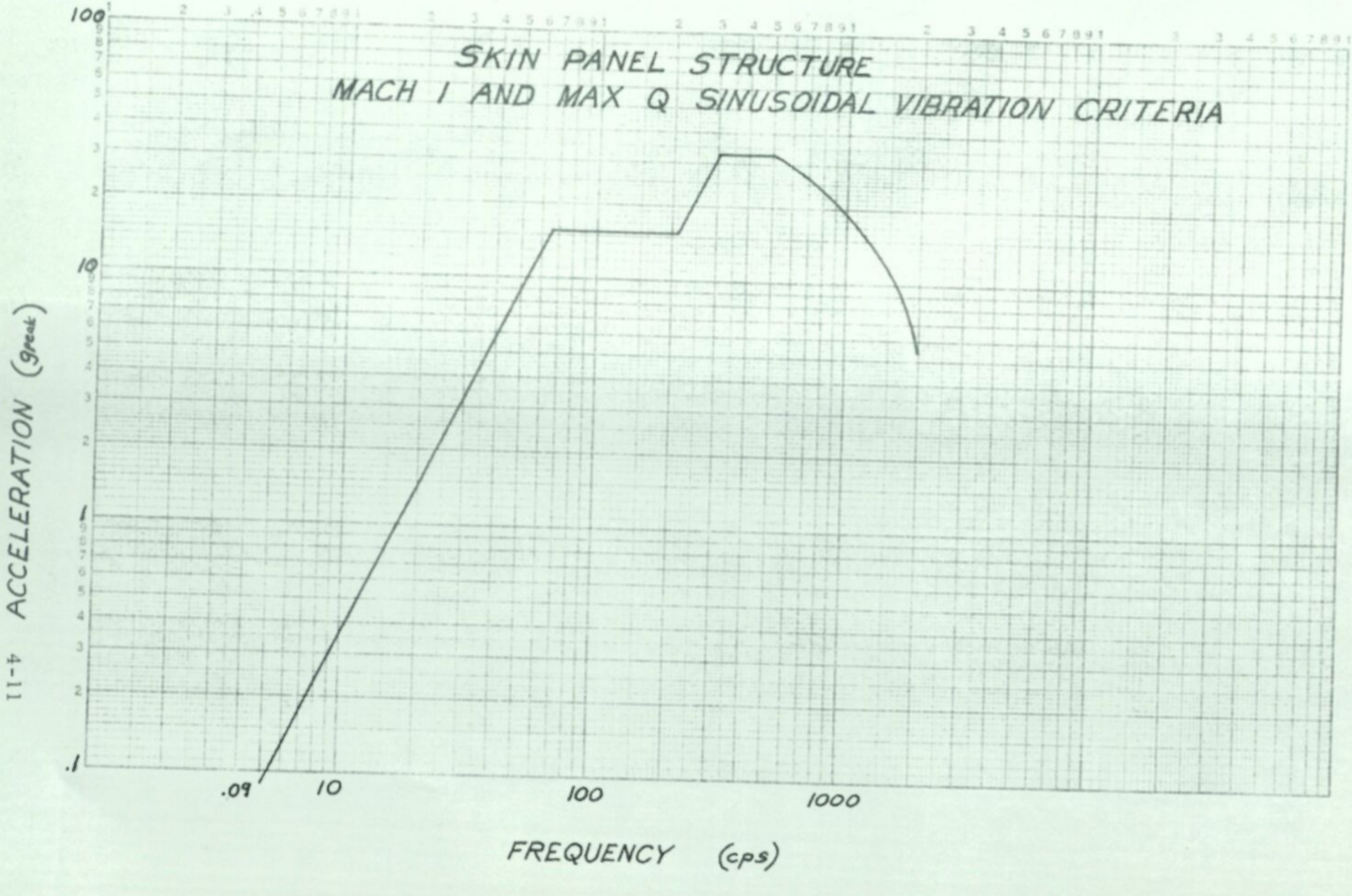

SKIN PANEL STRUCTURE
MACH I AND MAX Q SINUSOIDAL VIBRATION CRITERIA
ACCELERATION (g peak)
FREQUENCY (cps)
100
10
1
.1
.09
10
100
1000

FIGURE 4.2-5

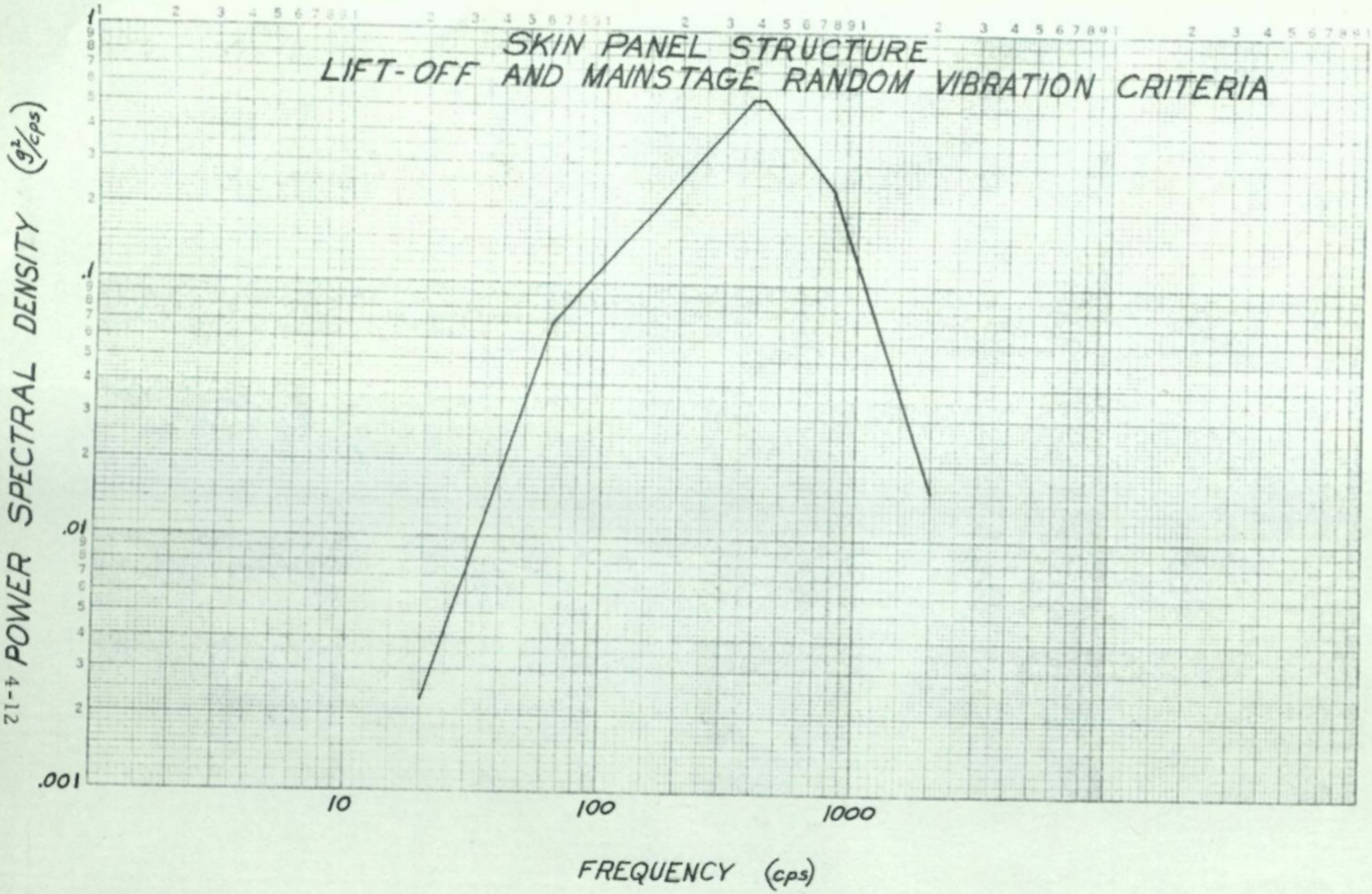

SKIN PANEL STRUCTURE
LIFT-OFF AND MAINSTAGE RANDOM VIBRATION CRITERIA
POWER SPECTRAL DENSITY (g²/cps)
FREQUENCY (cps)
.001
.01
.1
1
10
100
1000

FIGURE 4.2-6

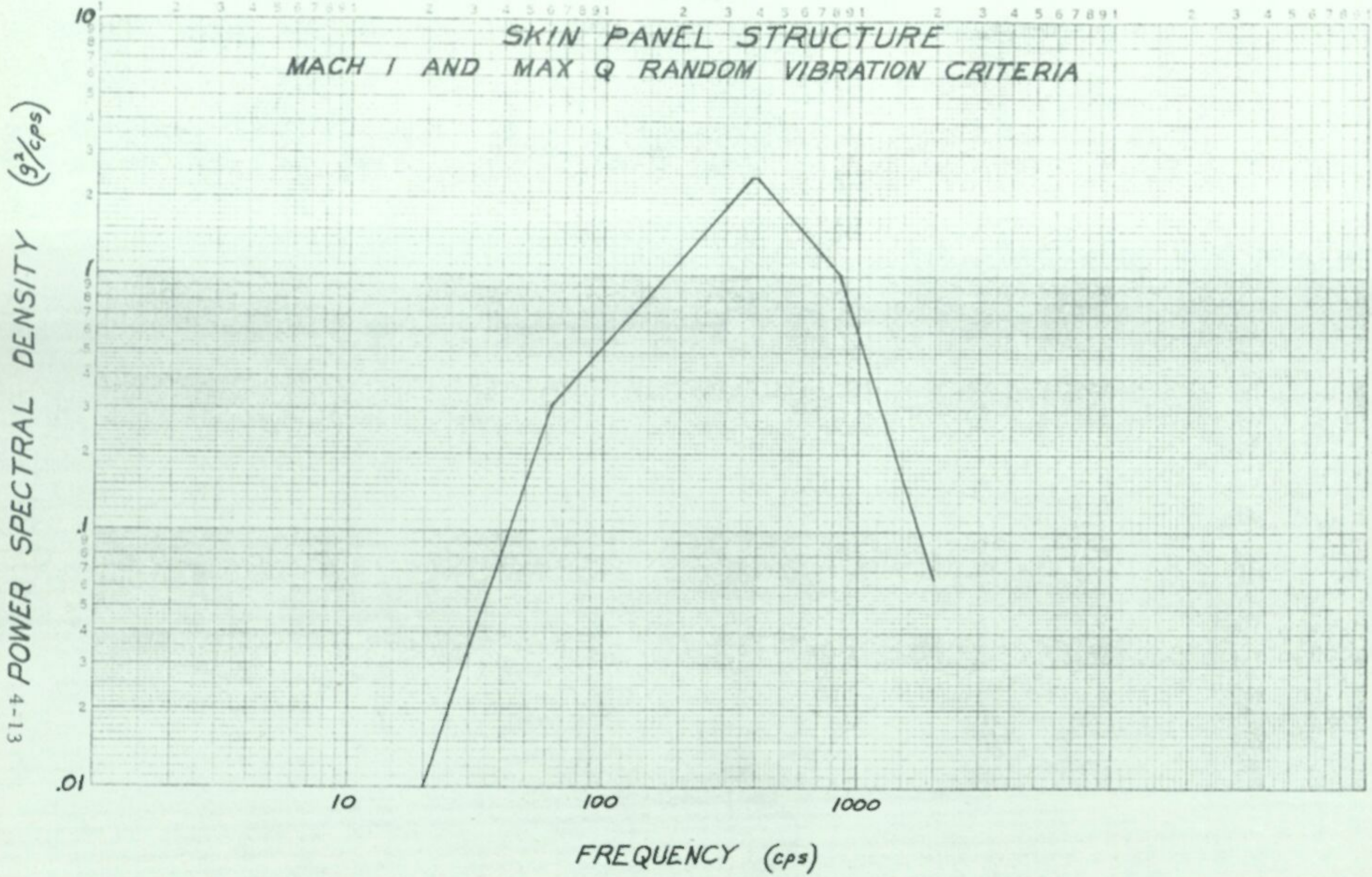

SKIN PANEL STRUCTURE
MACH I AND MAX Q RANDOM VIBRATION CRITERIA
POWER SPECTRAL DENSITY (g^2/cps)
FREQUENCY (cps)
10
1
.1
.01
10
100
1000

FIGURE 4.2-7

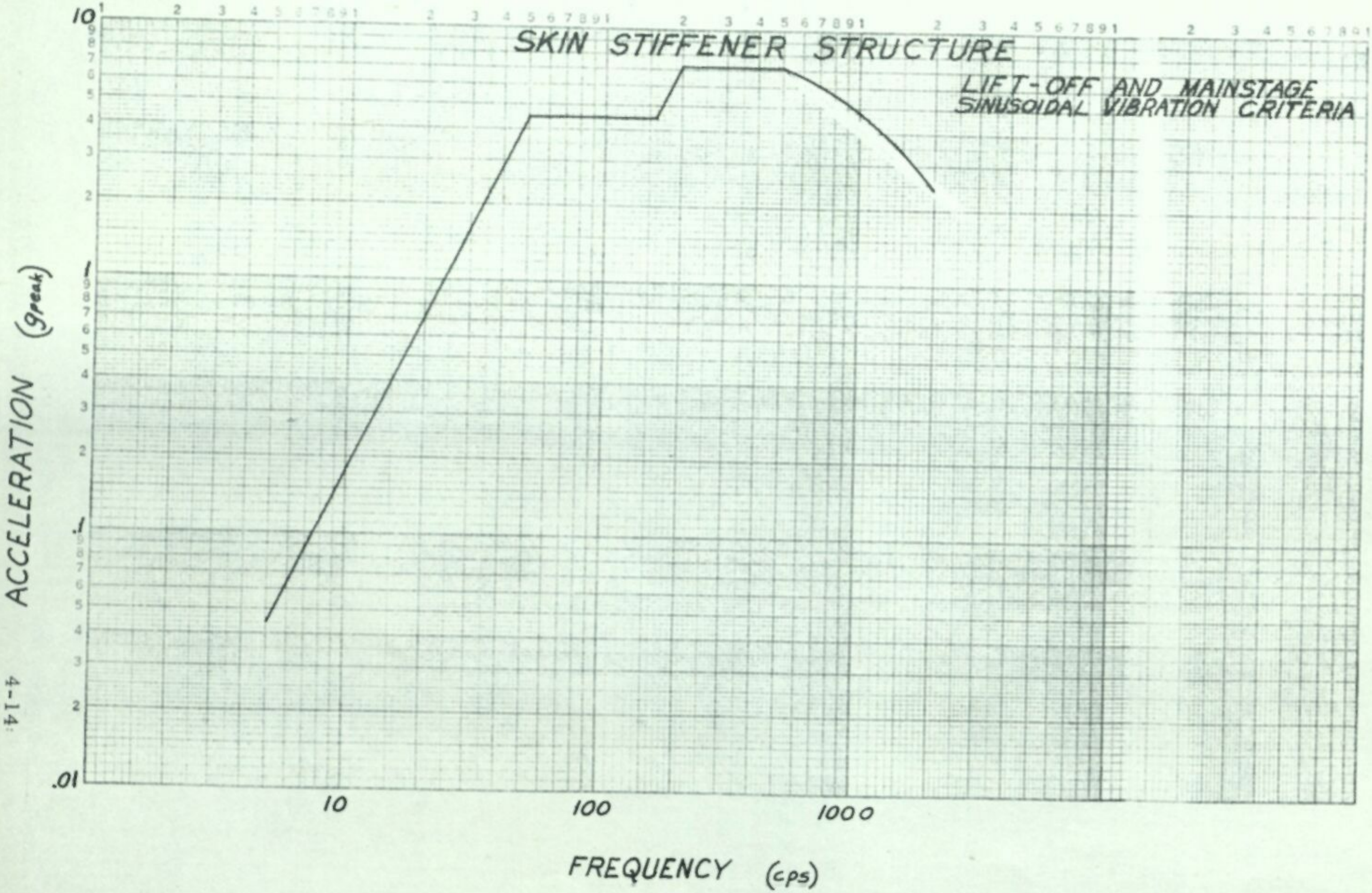

SKIN STIFFENER STRUCTURE
LIFT-OFF AND MAINSTAGE
SINUSOIDAL VIBRATION CRITERIA
ACCELERATION (gpeak)
10
1
.1
.01
10
100
1000
FREQUENCY (cps)

FIGURE 4.2-8

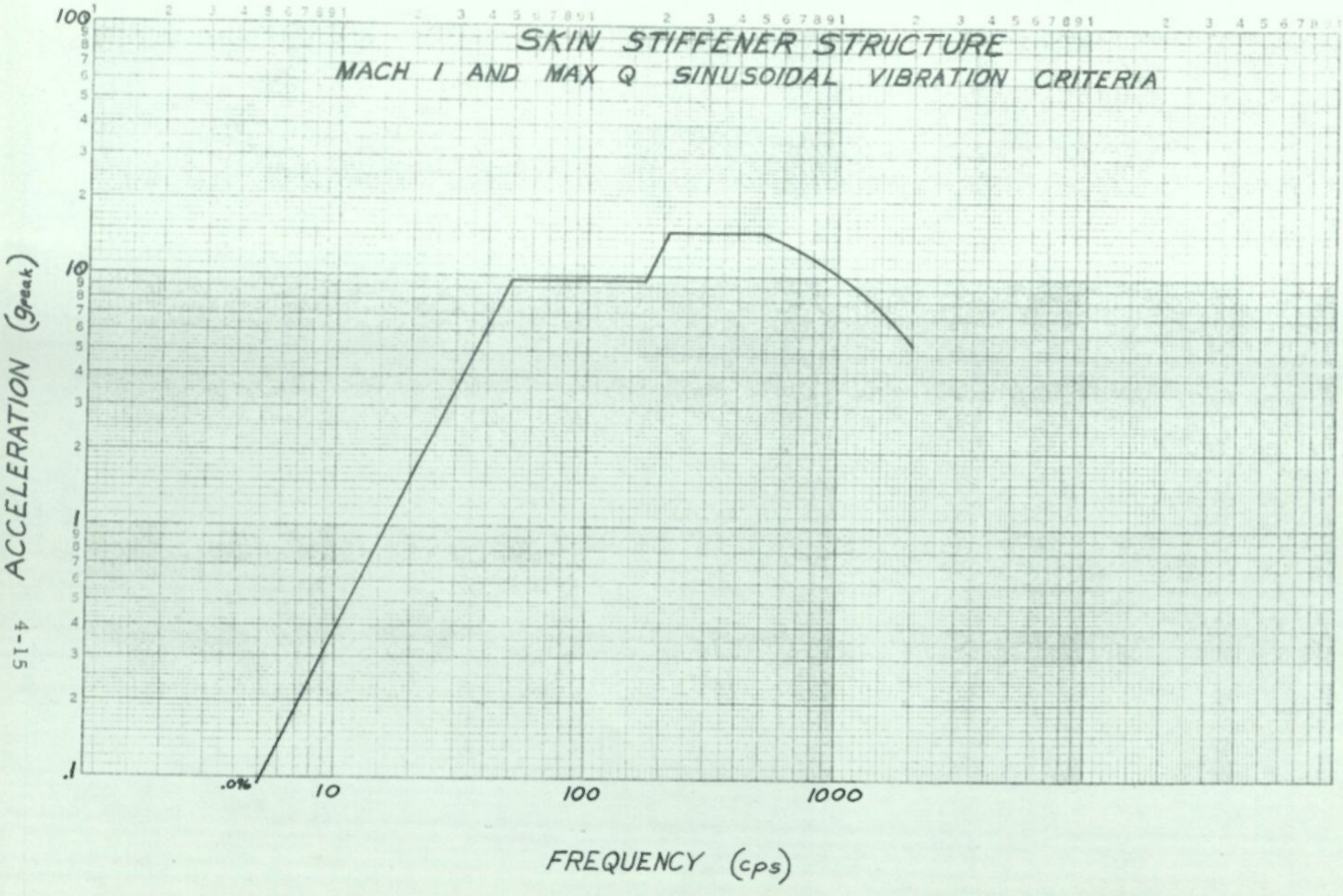

SKIN STIFFENER STRUCTURE
MACH 1 AND MAX Q SINUSOIDAL VIBRATION CRITERIA
ACCELERATION (gpeak)
FREQUENCY (cps)
100
10
1
.1
.0%
10
100
1000

FIGURE 4.2-9

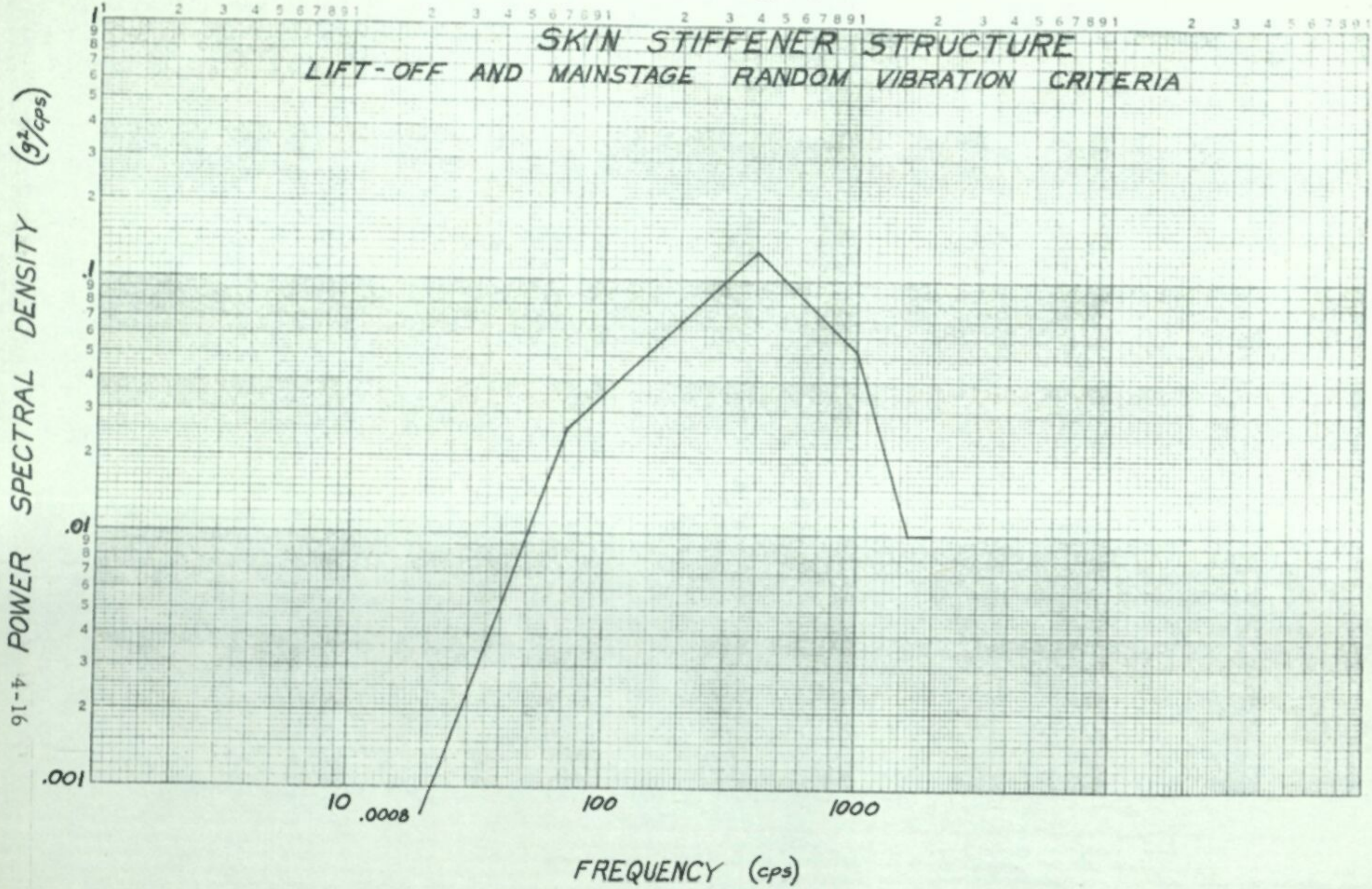
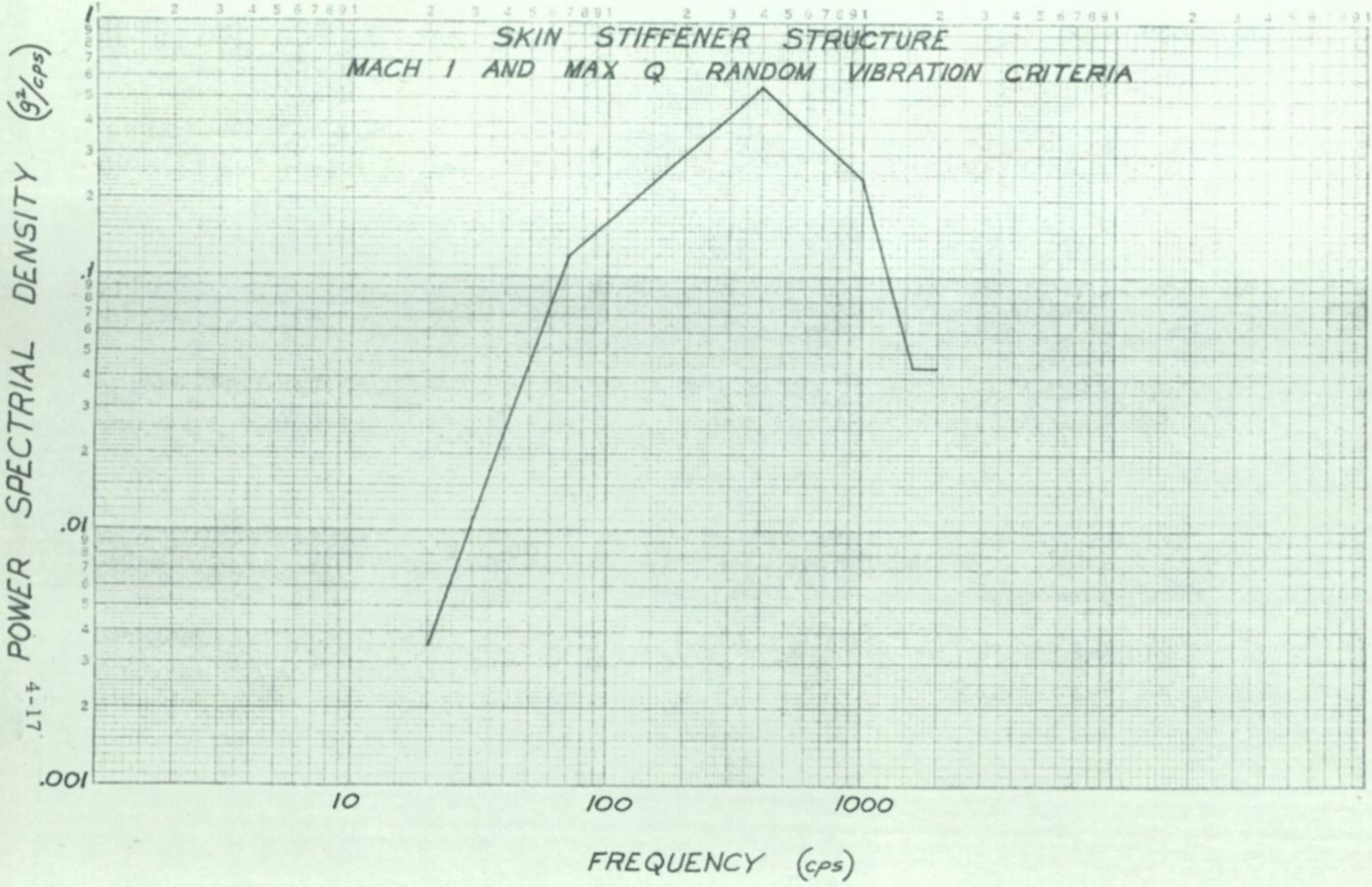

SKIN STIFFENER STRUCTURE
LIFT-OFF AND MAINSTAGE RANDOM VIBRATION CRITERIA
POWER SPECTRAL DENSITY (g²/cps)
FREQUENCY (cps)
1
.1
.01
.001
10
100
1000
.0008

FIGURE 4.2-10

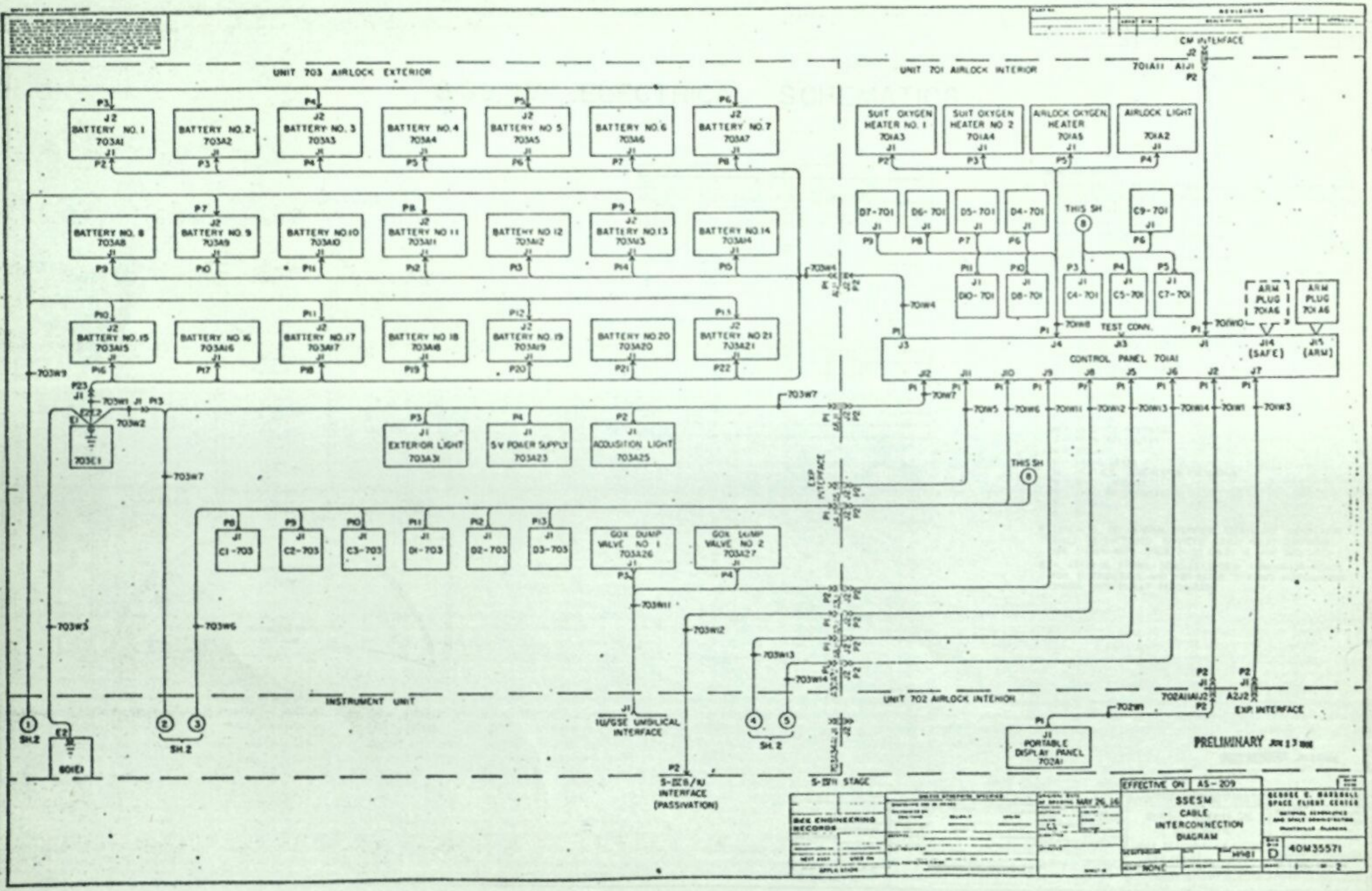


SKIN STIFFENER STRUCTURE
MACH I AND MAX Q RANDOM VIBRATION CRITERIA
POWER SPECTRIAL DENSITY (g²/cps)
1
.1
.01
.001
10
100
1000
FREQUENCY (cps)

SECTION 5.0 ELECTRICAL SYSTEM SCHEMATICS

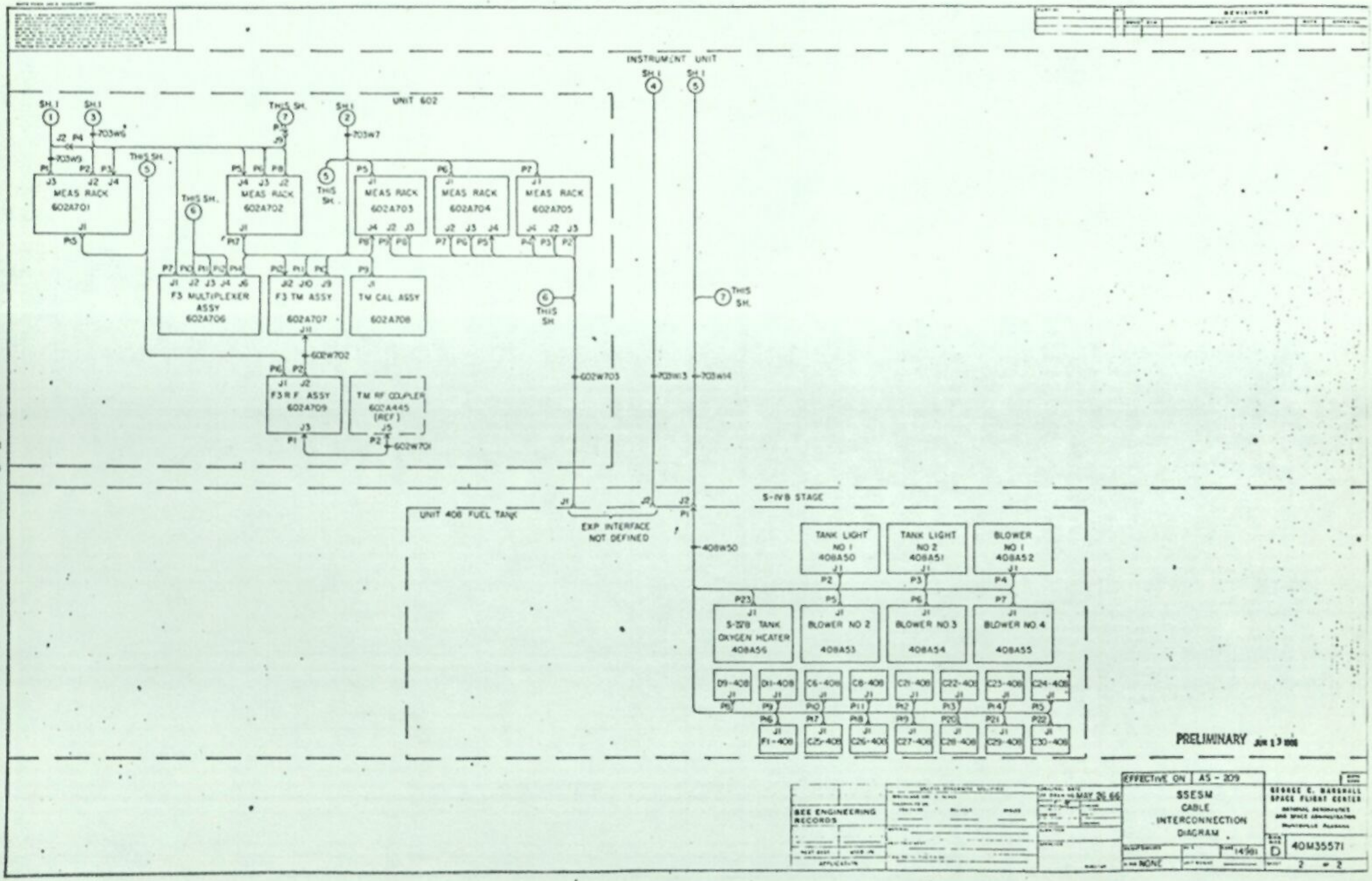
Preliminary schematics are provided here to further define the design and electrical system interfaces as presented in the proposal document. Figures 5.0-1 and -2 define the cable interconnect diagram for the entire electrical power system. Figures 5.0-3 through -19 are schematics outlining, in detail, interfaces of the electrical power distribution system. No provision has been included in this distribution system for corollary experiments.

Figure 5.0-1



UNIT 703 AIRLOCK EXTERIOR
UNIT 701 AIRLOCK INTERIOR
CM INTERFACE
BATTERY NO. 1 703A1
BATTERY NO. 2 703A2
BATTERY NO. 3 703A3
BATTERY NO. 4 703A4
BATTERY NO. 5 703A5
BATTERY NO. 6 703A6
BATTERY NO. 7 703A7
SUIT OXYGEN HEATER NO. 1 701A3
SUIT OXYGEN HEATER NO. 2 701A4
AIRLOCK OXYGEN HEATER 701A5
AIRLOCK LIGHT 701A2
CONTROL PANEL 701A1
EXTERIOR LIGHT 703A31
5V POWER SUPPLY 703A23
ACQUISITION LIGHT 703A25
GOX DUMP VALVE NO. 1 703A26
GOX DUMP VALVE NO. 2 703A27
EXP INTERFACE
INSTRUMENT UNIT
UNIT 702 AIRLOCK INTERIOR
IU/GSE UMBILICAL INTERFACE
S-IVB/IU INTERFACE (PASSIVATION)
S-IVB STAGE
PORTABLE DISPLAY PANEL 702A1
PRELIMINARY
SSESM CABLE INTERCONNECTION DIAGRAM
EFFECTIVE ON AS-209
GEORGE C. MARSHALL SPACE FLIGHT CENTER
40M35571

Figure 5.0-2


INSTRUMENT UNIT
UNIT 602
MEAS RACK 602A701
MEAS RACK 602A702
MEAS RACK 602A703
MEAS RACK 602A704
MEAS RACK 602A705
F3 MULTIPLEXER ASSY 602A706
F3 TM ASSY 602A707
TM CAL ASSY 602A708
F3 R.F. ASSY 602A709
TM RF COUPLER 602A445 (REF)
602W702
602W701
602W703
703W13
703W14
S-IVB STAGE
UNIT 408 FUEL TANK
EXP INTERFACE NOT DEFINED
408W50
TANK LIGHT NO 1 408A50
TANK LIGHT NO 2 408A51
BLOWER NO 1 408A52
S-IVB TANK OXYGEN HEATER 408A56
BLOWER NO 2 408A53
BLOWER NO 3 408A54
BLOWER NO 4 408A55
PRELIMINARY
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EFFECTIVE ON AS - 209
SSESM CABLE INTERCONNECTION DIAGRAM
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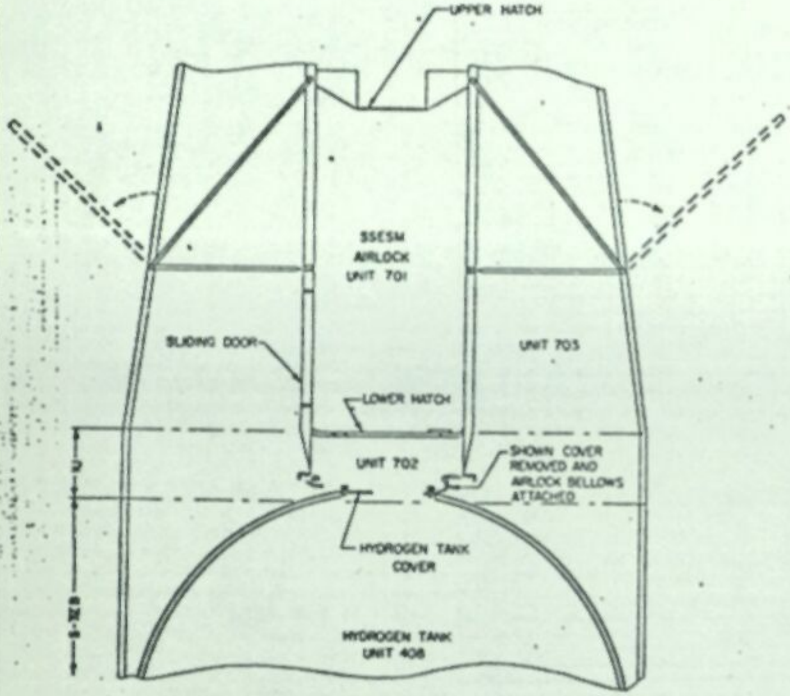
NONE

Figure 5.0-3

SSESM ELECTRICAL SCHEMATICS



INDEX	
SH	TITLE
1	UNIT DESIGNATIONS, INDEX & GENERAL NOTES
2	COMPONENT INDEX, CONTROL PANEL
3	COMPONENT INDEX, PORTABLE DISPLAY PANEL
4	POWER DISTRIBUTION
5	POWER DISTRIBUTION, CONTROL AND DISPLAY PANEL
6	POWER DISTRIBUTION
7	POWER DISTRIBUTION
8	S-IVB STAGE PASSIVATION SYSTEM
9	TELEMETRY POWER DISTRIBUTION
10	TELEMETRY POWER DISTRIBUTION
11	MEAS RACK 602A701 CHANNELS 1-10
12	MEAS RACK 602A701 CHANNELS 11-20
13	MEAS RACK 602A702 CHANNELS 1-10
14	MEAS RACK 602A702 CHANNELS 11-20
15	ECS PRESSURE MEASUREMENTS
16	EVENT MEASUREMENTS
17	CURRENT VOLTAGE AND EVENT MEASUREMENTS
18	
19	
20	

GENERAL NOTES:

1. ELECTRICAL REFERENCE DESIGNATIONS ARE IN ACCORDANCE WITH MSFC-STD-349. THE UNIT DIVISION OF THE SSESM IS SHOWN TO THE LEFT OF THIS SHEET.
2. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN WHERE THE APPROPRIATE UNITS, ASSEMBLIES, AND SUB-ASSEMBLIES ARE EVIDENT FOR COMPLETE REFERENCE DESIGNATION PREFIX WITH UNIT AND/OR ASSEMBLY DESIGNATION.
3. EACH MEASUREMENT IS DENOTED BY A MEASUREMENT NUMBER AS LISTED IN THE INSTRUMENTATION PROGRAM AND COMPONENT LIST. THIS NUMBER IS COMPOSED OF A LETTER INDICATING THE PARAMETER MEASURED, ONE OR MORE DIGITS INDICATING THE SEQUENCE OF EACH MEASUREMENT OF A PARAMETER AND A DASH NUMBER INDICATING THE UNIT IN WHICH THE MEASUREMENT ORIGINATES.
   THE PARAMETERS ARE DESIGNATED AS FOLLOWS:
   A – ACCELLERATION
   B – ACCOUSTICS
   C – TEMPERATURE
   D – PRESSURE
   E – VIBRATION
   F – FLOW RATE
   G – POSITION
   H – GUIDANCE & CONTROL
   J – RF & TELEMETRY
   K – SIGNAL
   L – LIQUID LEVEL
   M – VOLTAGE, CURRENT & FREQUENCY
   N – MISCELLANEOUS
   R – ANGULAR VELOCITY
   S – STRAIN
   R – RPM
4. CONTACTS OF GENERAL PURPOSE RELAYS ARE SHOWN WITH COILS DE-ENERGIZED. MAGNETIC LATCH RELAY CONTACTS ARE SHOWN WITH COILS 21-22 OR 21-19 LAST ENERGIZED.
5. * ASTERISK SYMBOL DENOTES SHIELD TERMINATION POINTS FOR DISTRIBUTORS AND FOR CABLE SHIELDED WIRES UNLESS SHOWN INDIVIDUALLY TERMINATED.

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SSESM ELECTRICAL SCHEMATIC
UNIT DESIGNATIONS, INDEX, AND GENERAL NOTES

GEORGE C. MARSHALL SPACE FLIGHT CENTER

D 40M35572

SCALE NONE

SHEET 1 OF 17

Figure 5.0-4

CONTROL PANEL 701A1						
RESISTOR DESIG	POS NO	PURPOSE	SH NO	RATING W	RATING Ω	TYPE OR DWG NO
701A1R1		SHUNT	5			
701A1R2		SHUNT	5			
701A1R3		SHUNT	5			
701A1R4		IMPEDANCE MATCHING	5			
701A1R5		IMPEDANCE MATCHING	5			
701A1R6		IMPEDANCE MATCHING	5			
701A1R7		IMPEDANCE MATCHING	5			
701A1R8		IMPEDANCE MATCHING	5			
701A1R9		IMPEDANCE MATCHING	5			
701A1R10		VOLTAGE DIVIDER	17			
701A1R11		VOLTAGE DIVIDER	17			
701A1R12		VOLTAGE DIVIDER	17			
701A1R13		VOLTAGE DIVIDER	17			
701A1R14		VOLTAGE DIVIDER	17			
701A1R15		VOLTAGE DIVIDER	17			
701A1R16		VOLTAGE DIVIDER	17			
701A1R17		VOLTAGE DIVIDER	17			
701A1R18		VOLTAGE DIVIDER	17			
701A1R19		VOLTAGE DIVIDER	17			
701A1R20		VOLTAGE DIVIDER	17			
701A1R21		VOLTAGE DIVIDER	17			
701A1R22		VOLTAGE DIVIDER	17			
701A1R23		VOLTAGE DIVIDER	17			
701A1R24		VOLTAGE DIVIDER	17			
701A1R25		VOLTAGE DIVIDER	17			
701A1R26		VOLTAGE DIVIDER	17			
701A1R27		VOLTAGE DIVIDER	17			
701A1R28		VOLTAGE DIVIDER	17			
701A1R29		VOLTAGE DIVIDER	17			
701A1R30		VOLTAGE DIVIDER	16			
701A1R31		VOLTAGE DIVIDER	16			
701A1R32		VOLTAGE DIVIDER	16			
701A1R33		VOLTAGE DIVIDER	16			
701A1R34		VOLTAGE DIVIDER	16			
701A1R35		VOLTAGE DIVIDER	16			
701A1R36		VOLTAGE DIVIDER	16			
701A1R37		VOLTAGE DIVIDER	15			
701A1R38		CURRENT LIMITER	15			
701A1R39		CURRENT LIMITER	15			
701A1R40		CURRENT LIMITER	15			
701A1R41		CURRENT LIMITER	15			
701A1R42		CURRENT LIMITER	15			
701A1R43		CURRENT LIMITER	15			
701A1R44		CURRENT LIMITER	15			
701A1R45		CURRENT LIMITER	15			
701A1R46		CURRENT LIMITER	15			
701A1R47		CURRENT LIMITER	15			
701A1R48						

CONTROL PANEL 701A1			CONTACTS AND COIL LOCATIONS BY SHEETS													
RELAY DESIG	POS NO	RELAY PURPOSE	CONTACTS 1-2	1-3	4-5	4-6	7-8	7-9	10-11	10-12	13-14	13-15	16-17	16-18	COIL	X2
701A1K1		ENERGIZE EMERGENCY POWER BUS (+7010 VOLTAGE LOW)		4		5	–	–	–	–	–	–	–	–	4	
701A1K2		ENERGIZE EMERGENCY POWER BUS (+7010 VOLTAGE LOW)		4		5	–	–	–	–	–	–	–	–	4	
701A1K3-1		MEASUREMENT TRANSFER	10	10	10	10	10	10	15	15	–	–	–	–	11	
701A1K3-2		MEASUREMENT TRANSFER			15	15	15	15	17	17	–	–	–	–	11	
701A1K3-3		MEASUREMENT TRANSFER	17	17	17	17	17	17							11	
701A1K4		RF ASSEMBLY INHIBIT	9				–	–	–	–	–	–	–	–	6	
701A1K5		HOUSEKEEPING MEASUREMENT GROUP INHIBIT	9				–	–	–	–	–	–	–	–	6	
701A1K6		ACQUISITION LIGHT INHIBIT	6				–	–	–	–	–	–	–	–	6	

CONTROL PANEL 701A1			
SWITCH DESIG	PURPOSE	SH NO	TYPE OR DWG NO
701A1S1	ECS TEMPERATURE SELECT	5	
701A1S2	ECS PRESSURE SELECT	5	
701A1S3	BUS VOLTAGE MONITOR SELECT	5	
701A1S4	BUS CURRENT SELECT (+7010/+7050)	5	
701A1S5	BUS CURRENT SELECT (+7030/+7050)	5	
701A1S6	MANUAL SWITCHING EMER POWER	5	
701A1S7	CMD VOLTAGE DET NO 1 ON/OFF RESET	5	
701A1S8	CMD VOLTAGE DET NO 2 ON/OFF RESET	5	
701A1S9	ACTIVATE PASSIVATION COMPONENTS	8	
701A1S10	ACTIVATE PASSIVATION COMPONENTS	8	
701A1S11	ACTIVATE PASSIVATION COMPONENTS	8	
701A1S12	CMD - CALIBRATION/POWER	9	

CONTROL PANEL 701A1				
CIRCUIT BREAKER DESIG	PURPOSE	SH NO	AMPERE RATING	TYPE OR DWG NO
701A1CB1	EXTERIOR LIGHT +7010 POWER	6		
701A1CB2	ACQUISITION LIGHT +7010 POWER	6		
701A1CB3	AIRLOCK LIGHT +7010 POWER	6		
701A1CB4	TANK LIGHT NO 1 +7010 POWER	6		
701A1CB5	TANK LIGHT NO 2 +7010 POWER	6		
701A1CB6	TANK BLOWERS +7010 POWER	6		
701A1CB7	TANK OXYGEN HEATER +7010 POWER	7		
701A1CB8	AIRLOCK OXYGEN HEATER +7010 POWER	7		
701A1CB9	SUIT OXYGEN HEATER NO 1 +7010 POWER	7		
701A1CB10	SUIT OXYGEN HEATER NO 2 +7010 POWER	7		
701A1CB11	STAGE PASSIVATION +7010 POWER	8		
701A1CB12	RF ASSEMBLY +7010 POWER	9		
701A1CB13	HOUSEKEEPING INSTR +7010 POWER	9		
701A1CB14	EXPERIMENT MEAS RACKS +7010 POWER	10		
701A1CB31	EXTERIOR LIGHT +7030 POWER	6		
701A1CB32	SPARE			
701A1CB33	AIRLOCK LIGHT +7030 POWER	6		
701A1CB34	TANK LIGHT NO 1 +7030 POWER	6		
701A1CB35	TANK LIGHT NO 2 +7030 POWER	6		
701A1CB36	TANK BLOWERS +7030 POWER	6		
701A1CB37	TANK OXYGEN HEATER +7030 POWER	7		
701A1CB38	AIRLOCK OXYGEN HEATER +7030 POWER	7		
701A1CB39	SUIT OXYGEN HEATER NO 1 +7030 POWER	7		
701A1CB40	SUIT OXYGEN HEATER NO 2 +7030 POWER	7		
701A1CB41	STAGE PASSIVATION +7030 POWER	8		
701A1CB42	RF ASSEMBLY +7030 POWER	9		
701A1CB43	HOUSEKEEPING INSTR GP +7030 POWER	9		
701A1CB44	EXPERIMENT MEAS RACKS +7030 POWER	10		
[illegible]	SUPPLY MAIN BUS +7050	5		
[illegible]	MAIN BUSES TIE BREAKER	5		
[illegible]	SUPPLY MAIN BUS +7030	5		

CONTROL PANEL 701A1			
LAMP DESIG	PURPOSE	SH NO	TYPE OR DWG NO
701A1DS1	INDICATION +7010 VOLTAGE LOW	5	
701A1DS2	INDICATION +7030 VOLTAGE LOW	5	
701A1DS3	INDICATION EMERGENCY POWER ON	5	
701A1DS4	INDICATION PASSIVATION READY (+7010)	5	
701A1DS5	INDICATION PASSIVATION READY (+7030)	5	

CONTROL PANEL 701A1			
METER DESIG	PURPOSE	SH. NO	TYPE OR DWG. NO
701A1M1	MONITOR ECS TEMPERATURE	5	
701A1M2	MONITOR ECS PRESSURES	5	
701A1M3	MONITOR BUS VOLTAGE	5	
701A1M4	MONITOR BUS +7010 & BUS +7050 CURRENT	5	
701A1M5	MONITOR BUS +7030 & BUS +7050 CURRENT	5	

CONTROL PANEL 701A1				
DIODE DESIG	PURPOSE	SH. NO	RATING (PIV)	TYPE OR DWG NO
701A1CR1	BLOCKING	8		
701A1CR2	↑	8		
701A1CR3	│	8		
701A1CR4	│	8		
701A1CR5	│	8		
701A1CR6	│	8		
701A1CR7	│	8		
701A1CR8	│	8		
701A1CR9	│	6		
701A1CR10	│	6		
701A1CR11	│	6		
701A1CR12	│	6		
701A1CR13	│	6		
701A1CR14	│	6		
701A1CR15	│	6		
701A1CR16	│	6		
701A1CR17	│	6		
701A1CR18	│	6		
701A1CR19	↓	6		
701A1CR20	BLOCKING	6		

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SHEET 2

Figure 5.0-5

PORTABLE DISPLAY PANEL 7024l

RESISTOR DESIG	POS NO	PURPOSE	SH NO	RATING W	RATING Ω	TYPE OR DWG NO
7024R1		IMPEDANCE MATCHING	5			
7024R2		IMPEDANCE MATCHING	5			
7024R3		IMPEDANCE MATCHING	5			
7024R4		IMPEDANCE MATCHING	5			

PORTABLE DISPLAY PANEL 7024l

SWITCH DESIG	PURPOSE	SH. NO	TYPE OR DWG NO
7024lS1	ECS TEMPERATURE SELECT	5	
7024lS2	ECS PRESSURE SELECT	5	

PORTABLE DISPLAY PANEL 7024l

METER DESIG	PURPOSE	SH NO	TYPE OR DWG NO
7024lM1	MONITOR ECS TEMPERATURE	5	
7024lM2	MONITOR ECS PRESSURE	5	

PORTABLE DISPLAY PANEL 7024l

LAMP DESIG	PURPOSE	SH NO	RATING (W)	TYPE OR DWG NO
7024lDS1	INDICATION EMERGENCY PWR ON	5		

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INDEX

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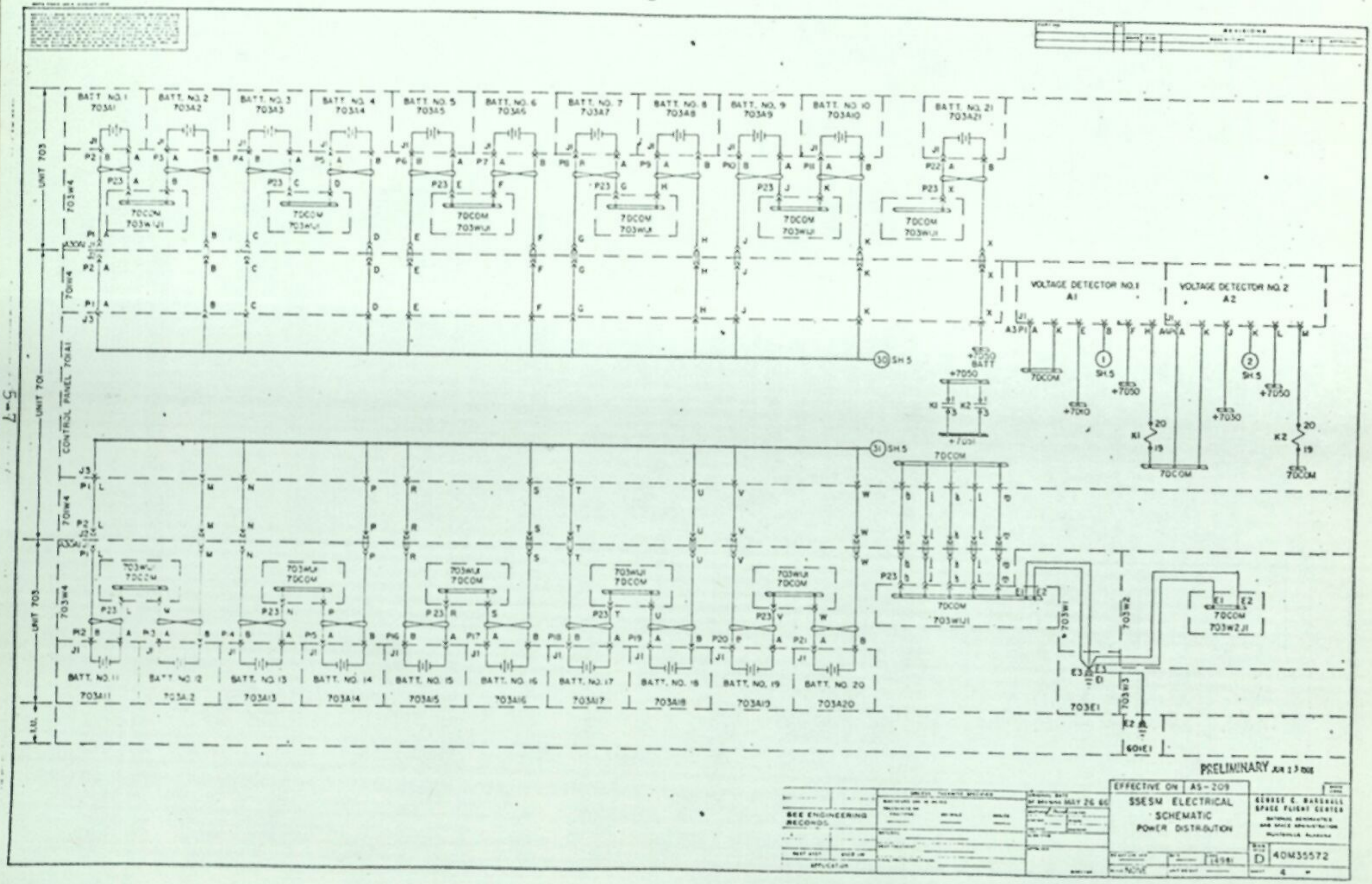
HUNTSVILLE, ALABAMA

14981 D 40M35572

SCALE NONE

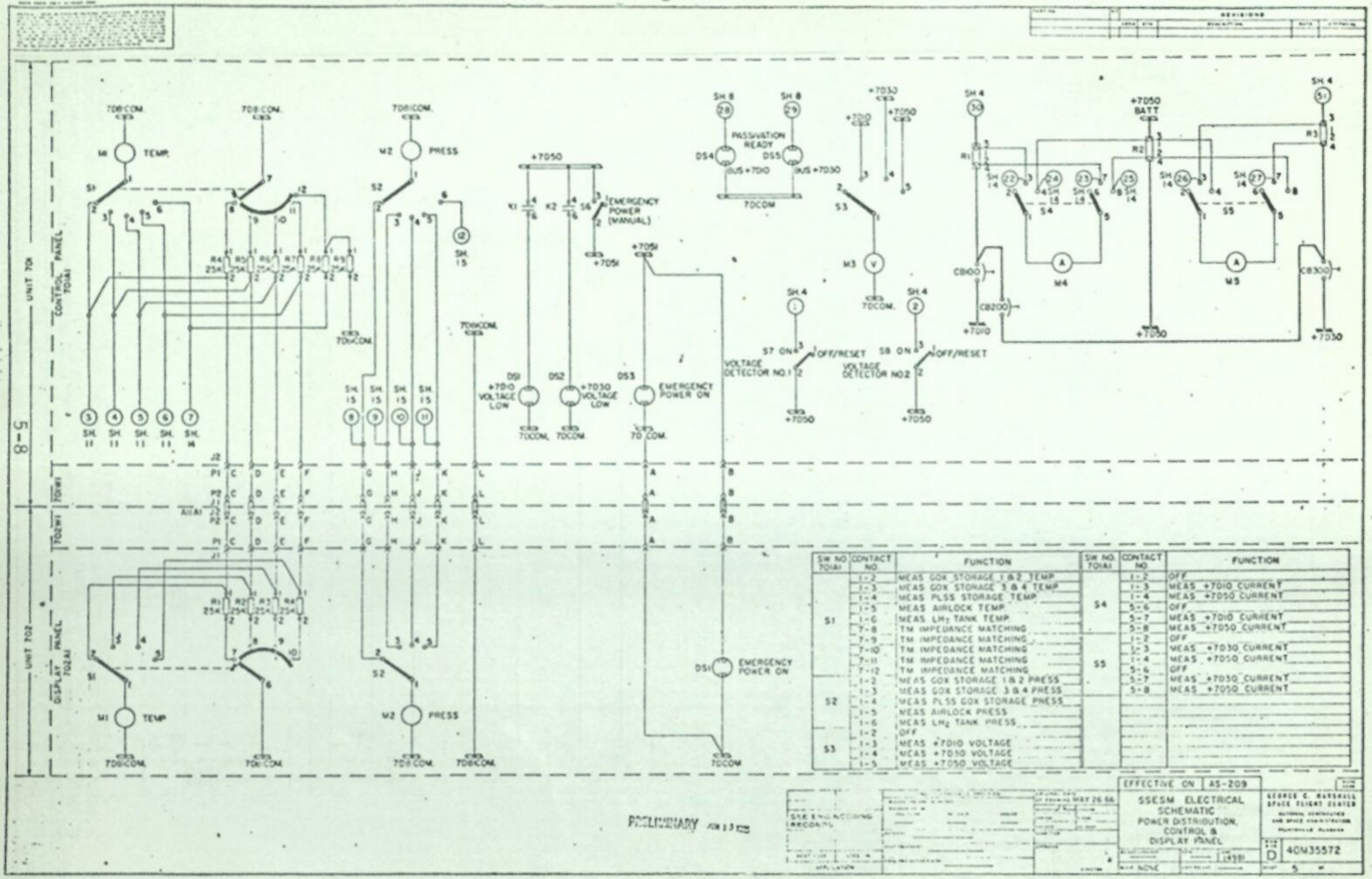
SHEET 3

Figure 5.0-6



BATT. NO. 1
703A1
BATT. NO. 2
703A2
BATT. NO. 3
703A3
BATT. NO. 4
703A4
BATT. NO. 5
703A5
BATT. NO. 6
703A6
BATT. NO. 7
703A7
BATT. NO. 8
703A8
BATT. NO. 9
703A9
BATT. NO. 10
703A10
BATT. NO. 21
703A21
VOLTAGE DETECTOR NO. 1
A1
VOLTAGE DETECTOR NO. 2
A2
UNIT 703
UNIT 701
CONTROL PANEL 701A1
703W4
701W4
BATT. NO. 11
703A11
BATT. NO. 12
703A12
BATT. NO. 13
703A13
BATT. NO. 14
703A14
BATT. NO. 15
703A15
BATT. NO. 16
703A16
BATT. NO. 17
703A17
BATT. NO. 18
703A18
BATT. NO. 19
703A19
BATT. NO. 20
703A20
7DCOM
703W1J1
703E1
601E1
I.U.
PRELIMINARY
EFFECTIVE ON AS-209
SSESM ELECTRICAL
SCHEMATIC
POWER DISTRIBUTION
GEORGE C. MARSHALL
SPACE FLIGHT CENTER
D
40M35572

Figure 5.0-7



SW NO 701A1	CONTACT NO	FUNCTION
S1	1-2	MEAS GOX STORAGE 1 & 2 TEMP
	1-3	MEAS GOX STORAGE 3 & 4 TEMP
	1-4	MEAS PLSS STORAGE TEMP
	1-5	MEAS AIRLOCK TEMP
	1-6	MEAS LH_2 TANK TEMP
	7-8	TM IMPEDANCE MATCHING
	7-9	TM IMPEDANCE MATCHING
	7-10	TM IMPEDANCE MATCHING
	7-11	TM IMPEDANCE MATCHING
	7-12	TM IMPEDANCE MATCHING
S2	1-2	MEAS GOX STORAGE 1 & 2 PRESS
	1-3	MEAS GOX STORAGE 3 & 4 PRESS
	1-4	MEAS PLSS GOX STORAGE PRESS
	1-5	MEAS AIRLOCK PRESS
	1-6	MEAS LH_2 TANK PRESS
S3	1-2	OFF
	1-3	MEAS +7010 VOLTAGE
	1-4	MEAS +7030 VOLTAGE
	1-5	MEAS +7050 VOLTAGE

SW NO. 701A1	CONTACT NO	FUNCTION
S4	1-2	OFF
	1-3	MEAS +7010 CURRENT
	1-4	MEAS +7050 CURRENT
	5-6	OFF
	5-7	MEAS +7010 CURRENT
	5-8	MEAS +7050 CURRENT
S5	1-2	OFF
	1-3	MEAS +7030 CURRENT
	1-4	MEAS +7050 CURRENT
	5-6	OFF
	5-7	MEAS +7030 CURRENT
	5-8	MEAS +7050 CURRENT

EFFECTIVE ON AS-209

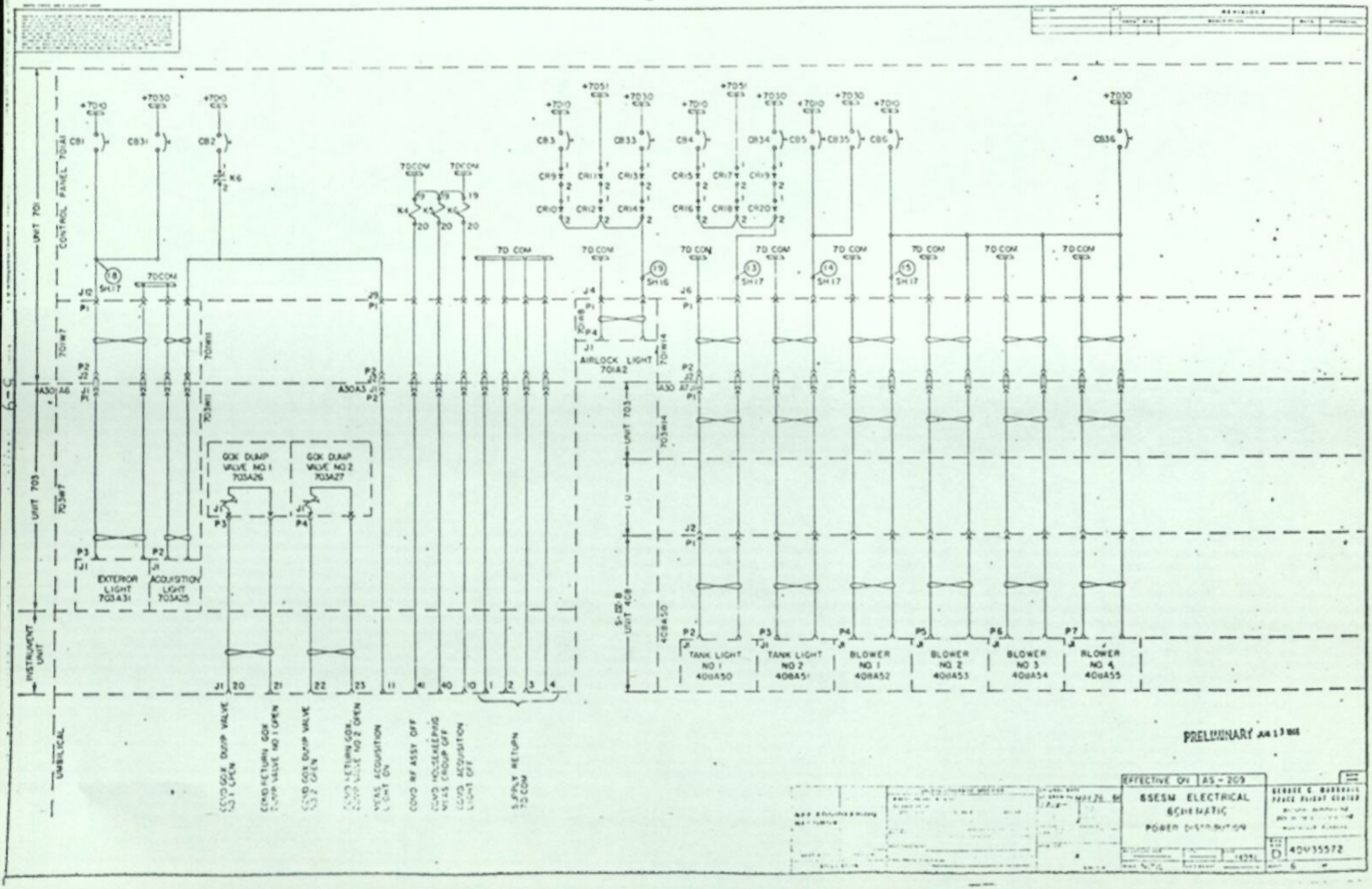
SSESM ELECTRICAL SCHEMATIC
POWER DISTRIBUTION, CONTROL & DISPLAY PANEL

GEORGE C. MARSHALL SPACE FLIGHT CENTER

MAY 26 66

D 40M35572

Figure 5.0-8



CONTROL PANEL 701A1
UNIT 701
UNIT 703
INSTRUMENT UNIT
UMBILICAL
EXTERIOR LIGHT 703A31
ACQUISITION LIGHT 703A25
GOX DUMP VALVE NO.1 703A26
GOX DUMP VALVE NO.2 703A27
AIRLOCK LIGHT 701A2
TANK LIGHT NO 1 408A50
TANK LIGHT NO 2 408A51
BLOWER NO 1 408A52
BLOWER NO 2 408A53
BLOWER NO 3 408A54
BLOWER NO 4 408A55
S-IV-B UNIT 408
SUPPLY RETURN 7D COM
PRELIMINARY
EFFECTIVE ON AS-209
SSESM ELECTRICAL SCHEMATIC
POWER DISTRIBUTION
40M35572

Figure 5.0-9

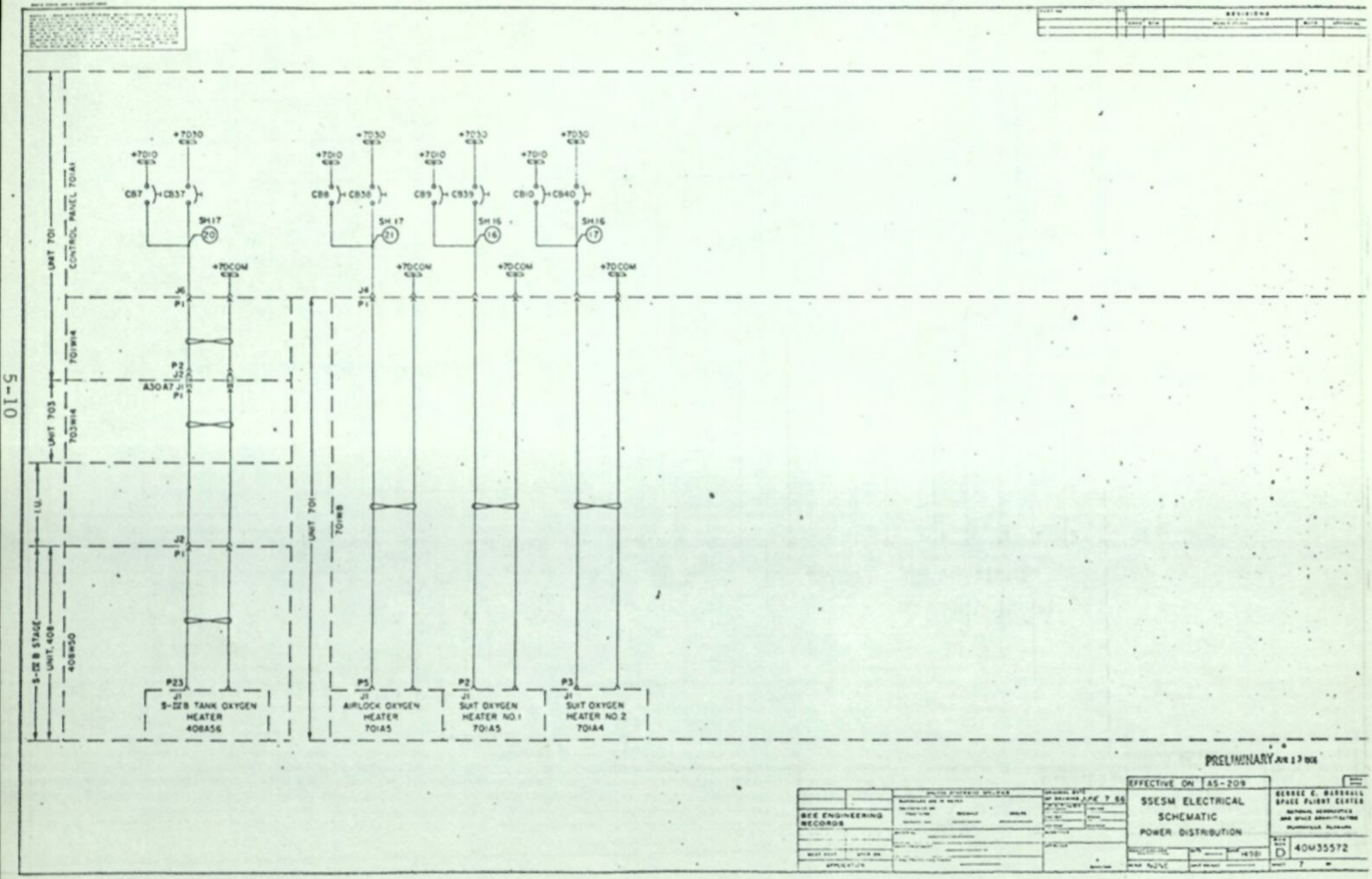
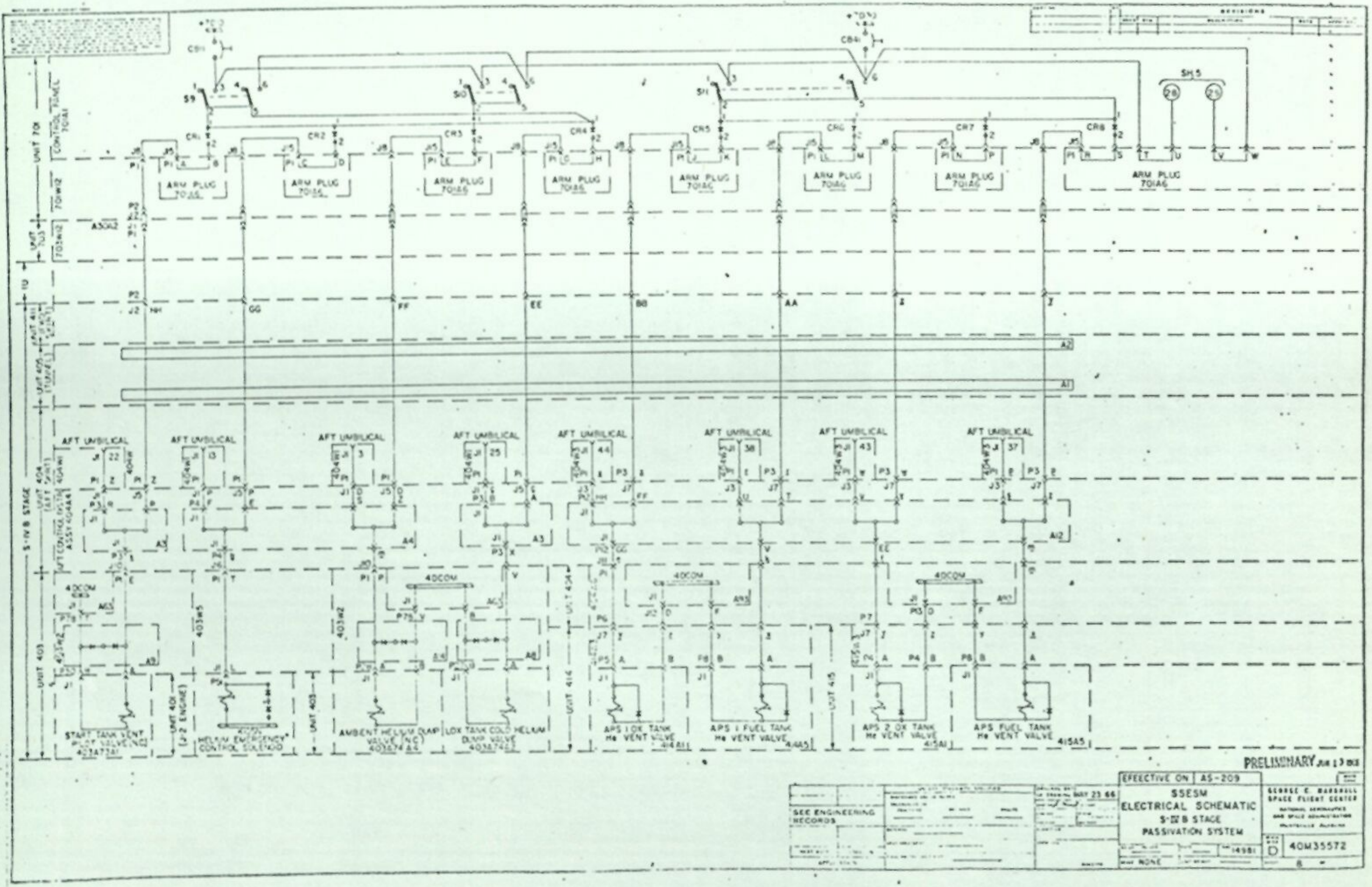
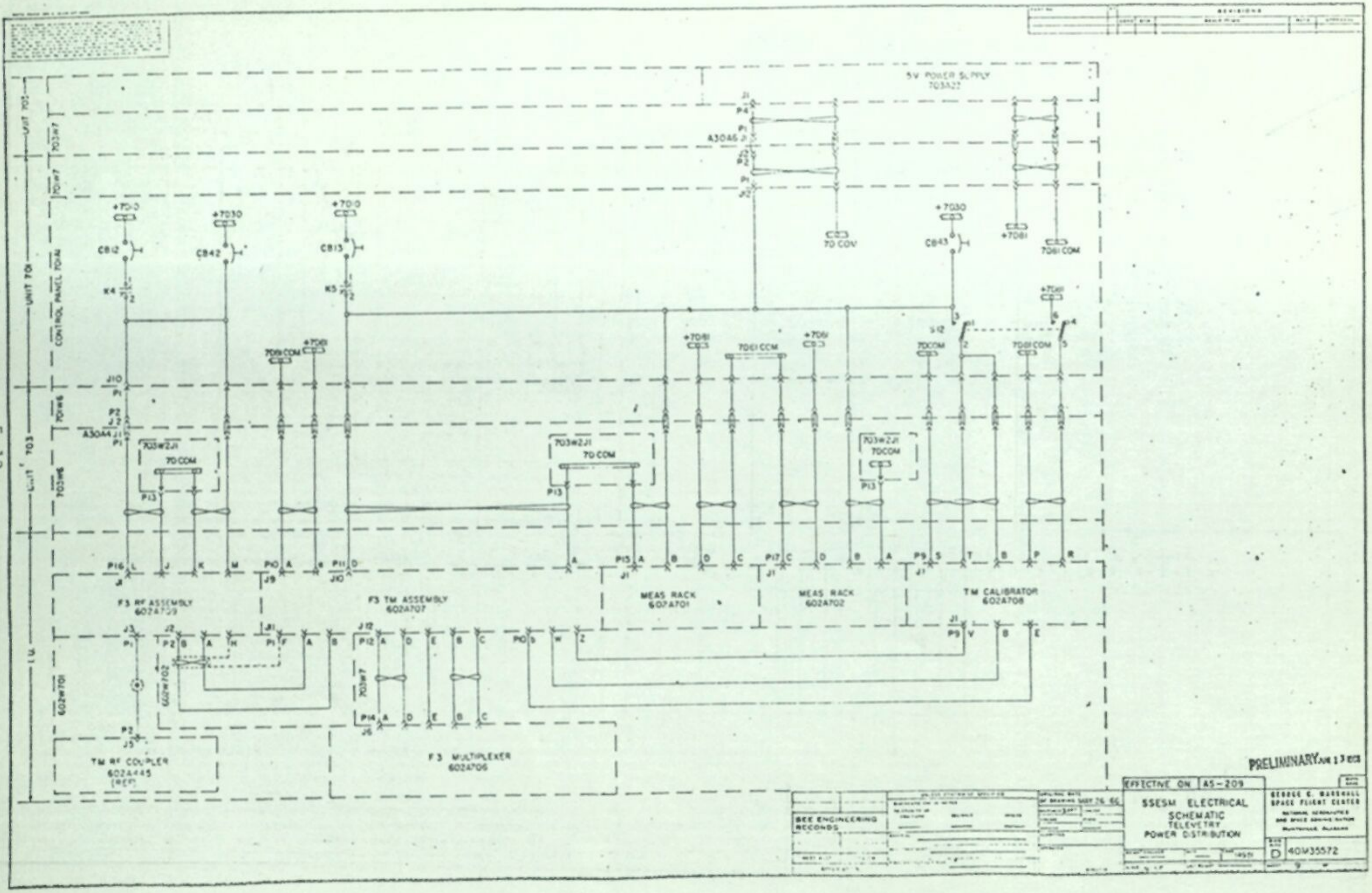

+7D10
+7D30
CB7
CB37
CB8
CB38
CB9
CB39
CB10
CB40
SH 17
SH 16
+7DCOM
UNIT 701
CONTROL PANEL 701A1
701W14
UNIT 703
703W14
I.U.
S-IVB STAGE
UNIT 408
408W50
701W8
J6
P1
P2
J2
A30A7 J1
J2
P23
P5
P2
P3
J1
S-IVB TANK OXYGEN HEATER 408A56
AIRLOCK OXYGEN HEATER 701A5
SUIT OXYGEN HEATER NO.1 701A5
SUIT OXYGEN HEATER NO.2 701A4
PRELIMINARY
SEE ENGINEERING RECORDS
EFFECTIVE ON AS-209
SSESM ELECTRICAL SCHEMATIC
POWER DISTRIBUTION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
D
40M35572

Figure 5.0-10



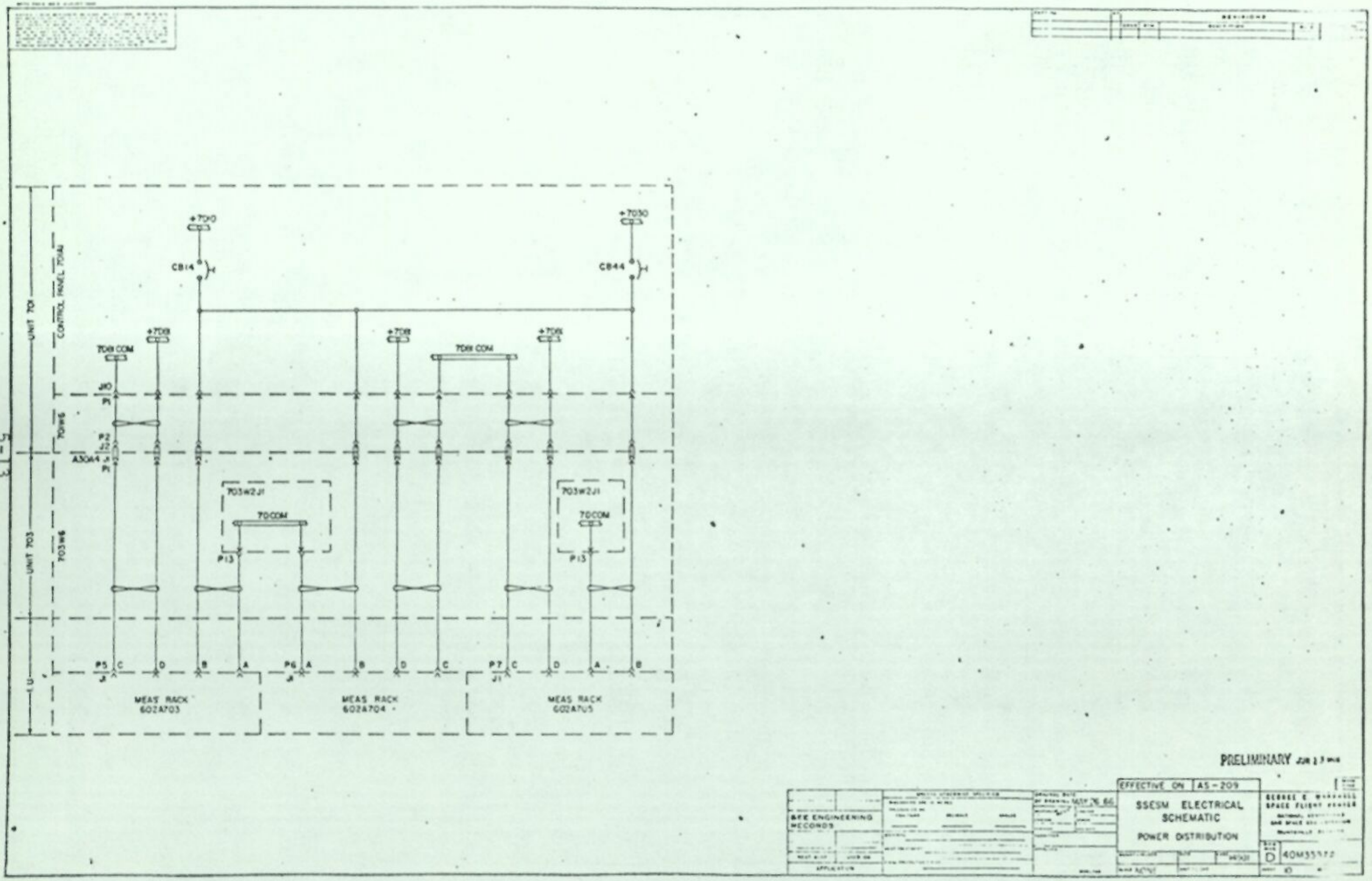
ARM PLUG
AFT UMBILICAL
40COM
START TANK VENT PILOT VALVE (NC) 403A73A1
HELIUM EMERGENCY CONTROL SOLENOID
AMBIENT HELIUM DUMP VALVE (NC) 403A74A4
LOX TANK COLD HELIUM DUMP VALVE 403A74A2
APS 1 OX TANK He VENT VALVE 414A1
APS 1 FUEL TANK He VENT VALVE 414A5
APS 2 OX TANK He VENT VALVE 415A1
APS FUEL TANK He VENT VALVE 415A5
S-IVB STAGE
UNIT 403
UNIT 404
UNIT 414
UNIT 415
PRELIMINARY
EFFECTIVE ON AS-209
S5ESM
ELECTRICAL SCHEMATIC
S-IVB STAGE
PASSIVATION SYSTEM
SEE ENGINEERING RECORDS
GEORGE C. MARSHALL SPACE FLIGHT CENTER
40M35572

Figure 5.0-11



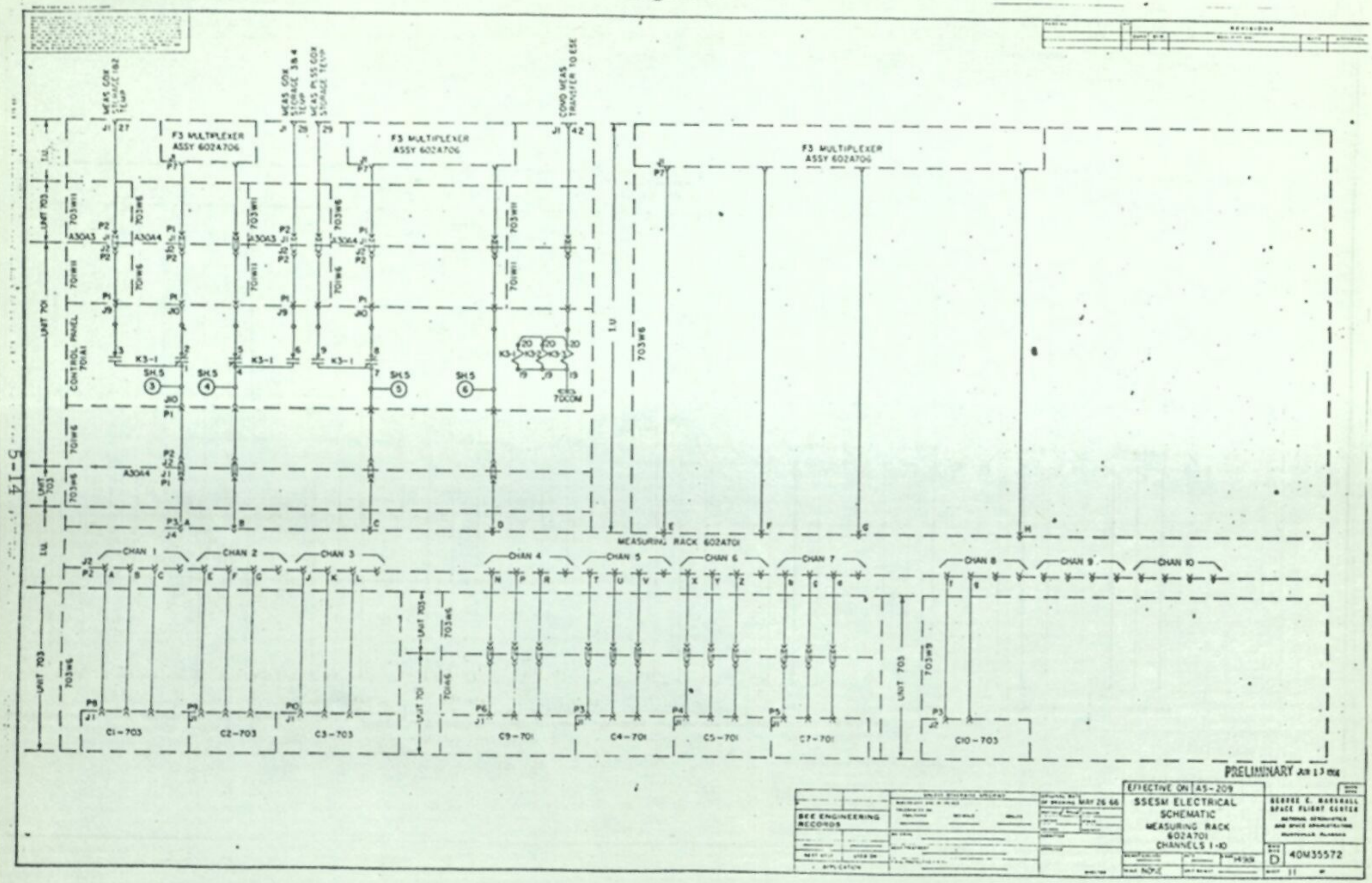
5V POWER SUPPLY
703A22
+7010
+7030
+7081
7081 COM
70 COM
CB12
CB42
CB13
CB43
K4
K5
S12
703W2J1
CONTROL PANEL 701A1
UNIT 701
UNIT 703
UNIT 702
F3 RF ASSEMBLY
602A709
F3 TM ASSEMBLY
602A707
MEAS RACK
602A701
MEAS RACK
602A702
TM CALIBRATOR
602A708
TM RF COUPLER
602A445
(REF)
F3 MULTIPLEXER
602A706
PRELIMINARY
EFFECTIVE ON AS-209
SSESM ELECTRICAL
SCHEMATIC
TELEMETRY
POWER DISTRIBUTION
GEORGE C. MARSHALL
SPACE FLIGHT CENTER
D
40M35572

Figure 5.0-12



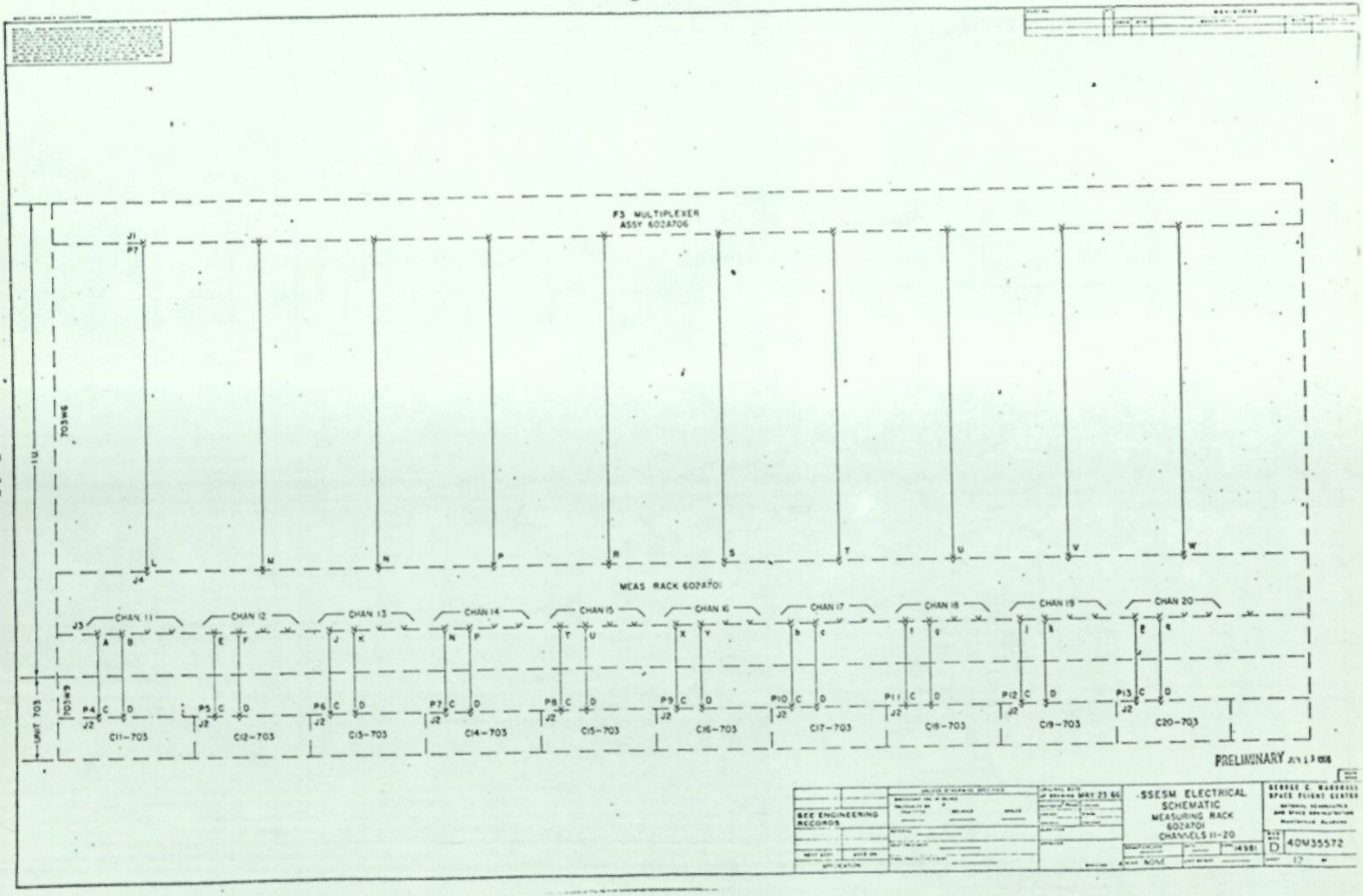
UNIT 701
CONTROL PANEL 701A1
UNIT 703
703W6
701W6
A30A4
+7010
+7030
CB14
CB44
7018 COM
+7018
703W2J1
70COM
P13
P5
P6
P7
J1
J10
MEAS RACK
602A703
MEAS RACK
602A704
MEAS RACK
602A705
PRELIMINARY
EFFECTIVE ON AS-209
SSESM ELECTRICAL SCHEMATIC
POWER DISTRIBUTION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
D 40M35572

Figure 5.0-13



F3 MULTIPLEXER ASSY 602A706
MEAS GOX STORAGE 1&2 TEMP
MEAS GOX STORAGE 3&4 TEMP
MEAS PL55 GOX STORAGE TEMP
COND MEAS TRANSFER TO ESE
CONTROL PANEL 701A1
UNIT 701
UNIT 703
A30A3
A30A4
K3-1
SH.5
MEASURING RACK 602A701
CHAN 1
CHAN 2
CHAN 3
CHAN 4
CHAN 5
CHAN 6
CHAN 7
CHAN 8
CHAN 9
CHAN 10
C1-703
C2-703
C3-703
C9-701
C4-701
C5-701
C7-701
C10-703
PRELIMINARY
BEE ENGINEERING RECORDS
MAY 26 66
EFFECTIVE ON AS-209
SSESM ELECTRICAL SCHEMATIC MEASURING RACK 602A701 CHANNELS 1-10
D
40M35572

Figure 5.0-14



F3 MULTIPLEXER
ASSY 602A706
703W6
MEAS RACK 602A701
CHAN 11
CHAN 12
CHAN 13
CHAN 14
CHAN 15
CHAN 16
CHAN 17
CHAN 18
CHAN 19
CHAN 20
C11-703
C12-703
C13-703
C14-703
C15-703
C16-703
C17-703
C18-703
C19-703
C20-703
UNIT 703
PRELIMINARY
SEE ENGINEERING RECORDS
SSESM ELECTRICAL SCHEMATIC
MEASURING RACK
602A701
CHANNELS 11-20
40M35572

Figure 5.0-15

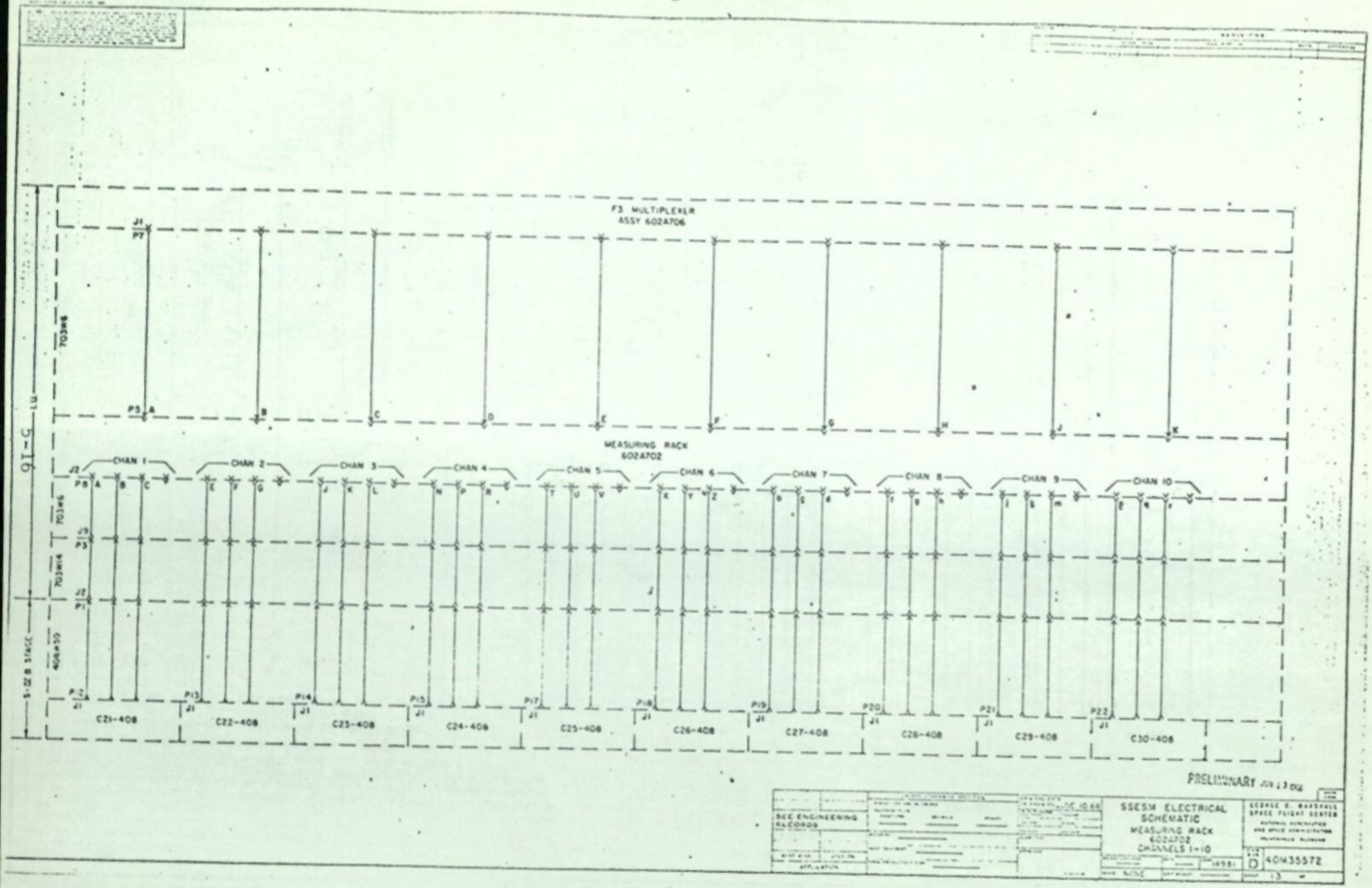
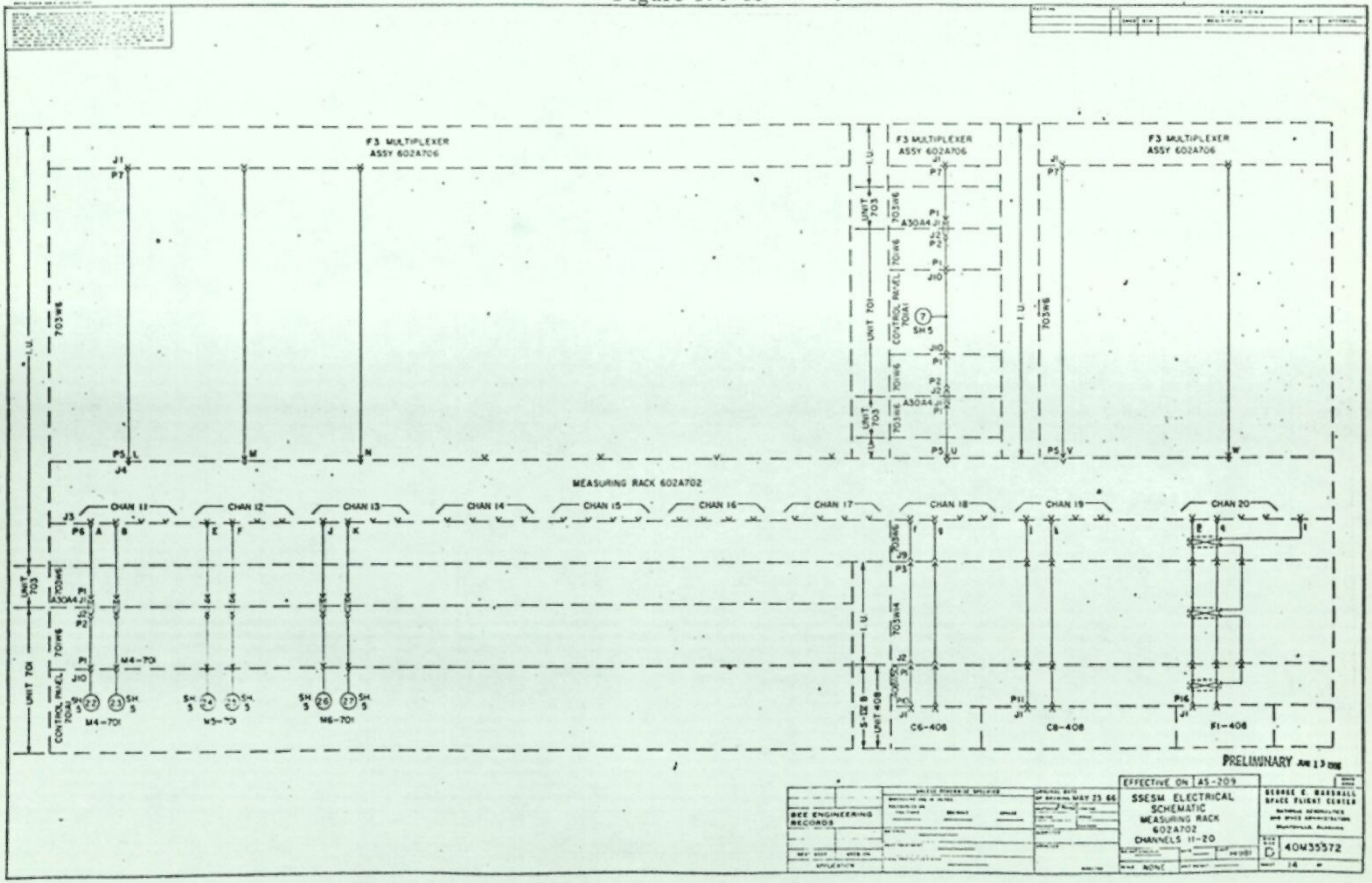

F3 MULTIPLEXER
ASSY 602A706
MEASURING RACK
602A702
CHAN 1
CHAN 2
CHAN 3
CHAN 4
CHAN 5
CHAN 6
CHAN 7
CHAN 8
CHAN 9
CHAN 10
C21-408
C22-408
C23-408
C24-408
C25-408
C26-408
C27-408
C28-408
C29-408
C30-408
PRELIMINARY
SEC ENGINEERING RECORDS
SSESM ELECTRICAL SCHEMATIC
MEASURING RACK
602A702
CHANNELS 1-10
GEORGE C. MARSHALL SPACE FLIGHT CENTER
40M35572

Figure 5.0-16



5-17

Figure 5.0-17

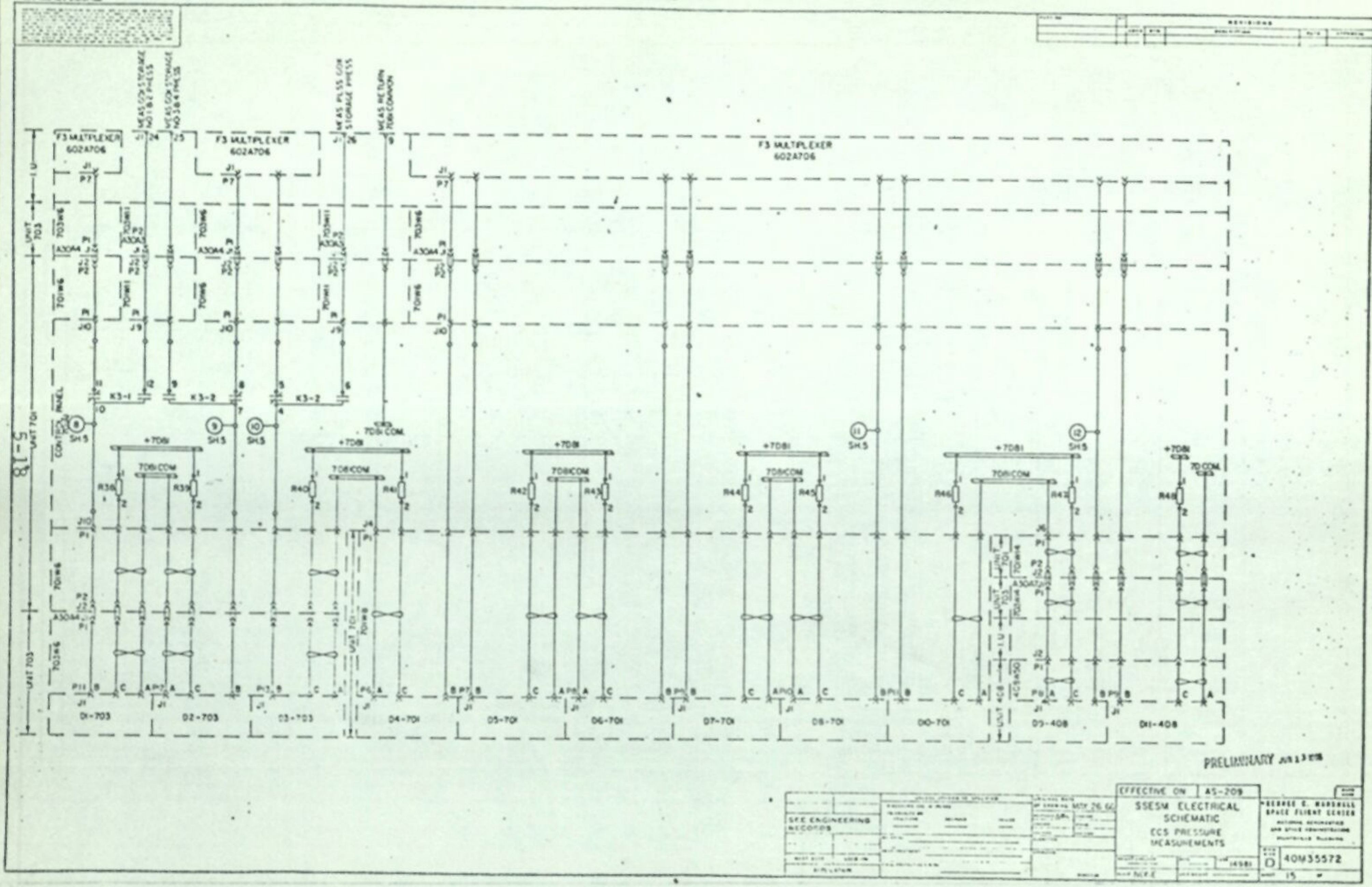

F3 MULTIPLEXER
602A706
PRELIMINARY
EFFECTIVE ON AS-209
SSESM ELECTRICAL SCHEMATIC
ECS PRESSURE MEASUREMENTS
SFC ENGINEERING RECORDS
GEORGE C. MARSHALL SPACE FLIGHT CENTER
40M35572

Figure 5.0-18

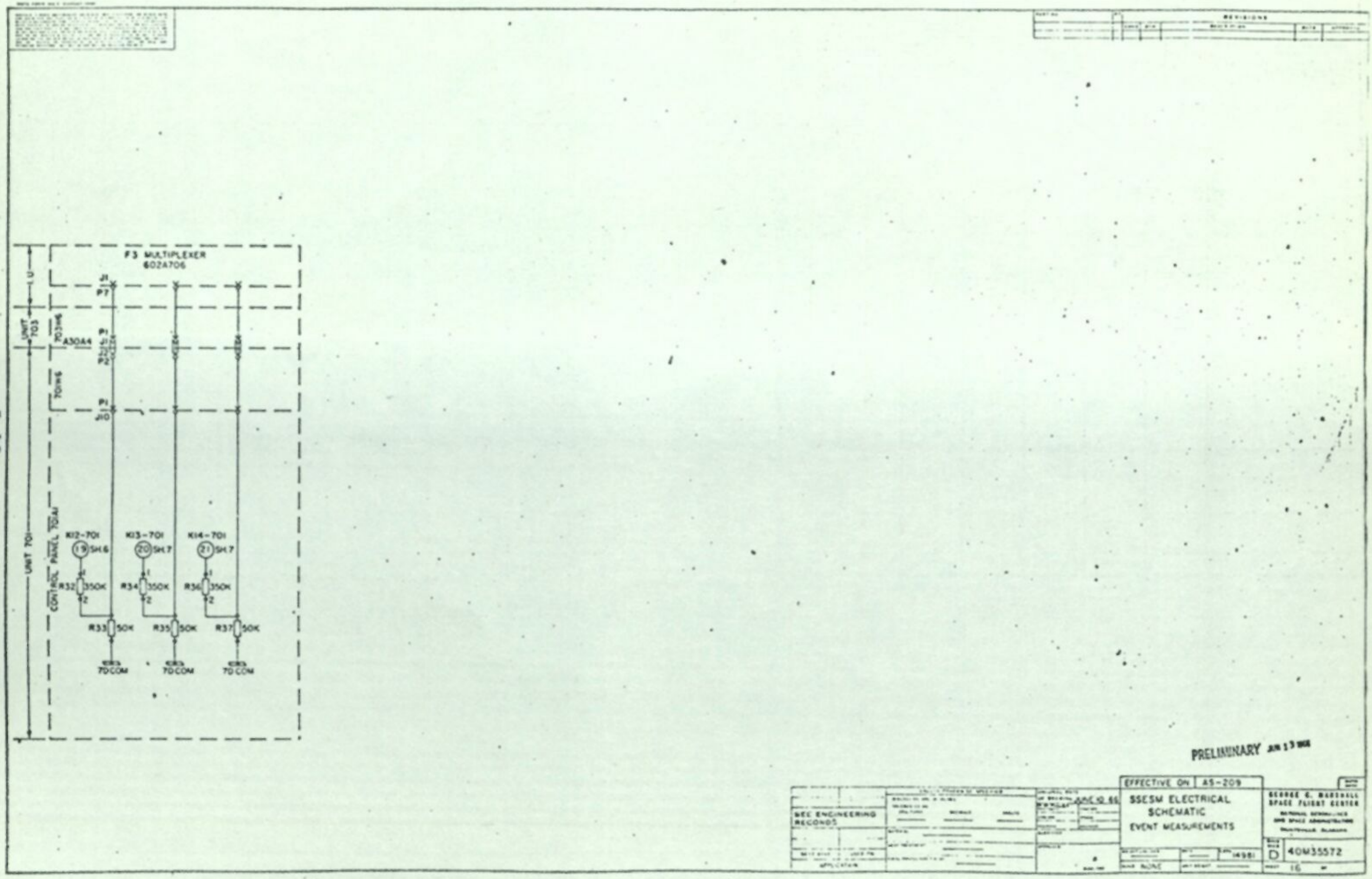
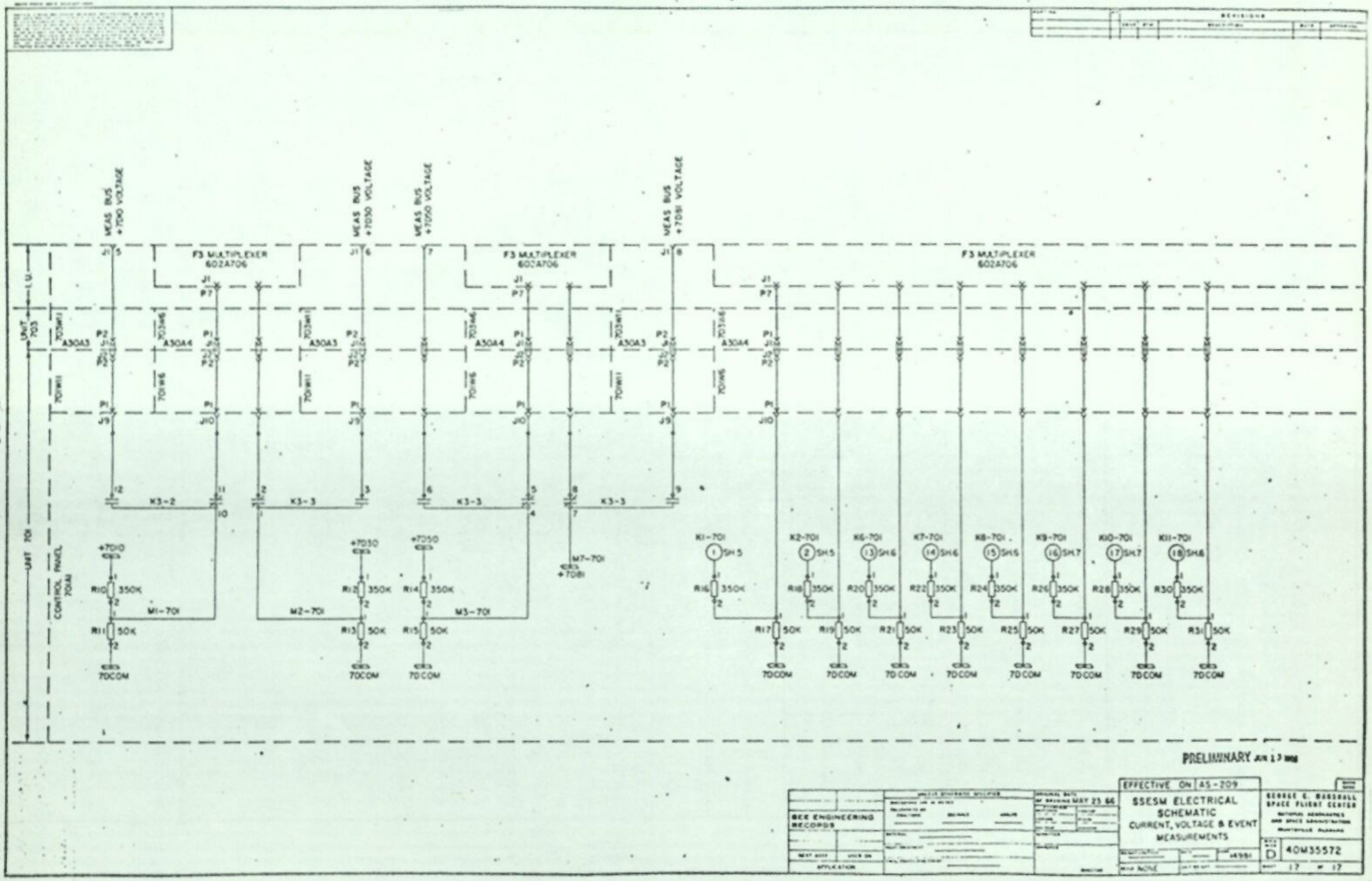

F3 MULTIPLEXER
602A706
UNIT 703
A30A4
CONTROL PANEL 70A1
UNIT 701
K12-701
K13-701
K14-701
R32 350K
R34 350K
R36 350K
R33 50K
R35 50K
R37 50K
7DCOM
7DCOM
7DCOM
PRELIMINARY
EFFECTIVE ON AS-209
SSESM ELECTRICAL
SCHEMATIC
EVENT MEASUREMENTS
GEORGE C. MARSHALL
SPACE FLIGHT CENTER
40M35572

Figure 5.0-19



MEAS BUS +7010 VOLTAGE
MEAS BUS +7050 VOLTAGE
MEAS BUS +7050 VOLTAGE
MEAS BUS +7081 VOLTAGE
F3 MULTIPLEXER 602A706
UNIT 703
UNIT 701
CONTROL PANEL 701A1
A30A3
A30A4
K3-2
K3-3
M1-701
M2-701
M3-701
M7-701
70COM
PRELIMINARY
EFFECTIVE ON AS-209
SSESM ELECTRICAL SCHEMATIC
CURRENT, VOLTAGE & EVENT MEASUREMENTS
SEE ENGINEERING RECORDS
GEORGE C. MARSHALL SPACE FLIGHT CENTER
40M35572

SECTION 6.0 INSTRUMENTATION PROGRAM AND COMPONENTS

A listing of the measuring system hardware, composed of telemetry, measuring, and RF components, which are not associated with particular measurements is presented in Table 6.0-1. Also presented, in Tables 6.0-2 through -13 is the complete instrumentation program, which consists of measurements, telemetry channels, applicable measuring components, range, and other pertinent information.

INSTRUMENTATION PROGRAM & COMPONENTS

PARAMETER Equipment VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
		Measuring Rack 703A404	50M12271								
		Measuring Rack 703A405	50M12271								
		Measuring Rack 703A406	50M12271								
		Measuring Rack 703A407	50M12271								
		Measuring Rack 703A408	50M12271								
		Fl RF Assy 703A401	50M12205								245.3 MC
		Fl Tm Assy 703A402	50M12206								
		Fl Multiplexer 703A403	50M12212								
		Tm Calibrator Assy	50M12416								

TABLE 6.0-1

MSFC - Form 593-1 (Rev February 1965)

INSTRUMENTATION PROGRAM & COMPONENTS

PARAMETER Temperature VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	C1-703	Temp. Oxygen Storage Tank No. 1	-125 to +100°C				EF3-X-01-01	12S	Y	01	4)
		Temp. Gauge									
		DC Amplifier	50M12400								
	C2-703	Temp. Oxygen Storage Tank No. 2	-125 to +100°C				EF-X-01-02	12S	Y	01	4)
		Temp. Gauge									
		DC Amplifier	50M12400								
	C3-703	Temp. Oxygen Storage Tank No. 3	-125 to +100°C				EF3-X-01-03	12S	Y	01	4)
		Temp. Gauge									
		DC Amplifier	50M12400								
	C4-701	Temp. Reg. (8A) Inlet	-125 to +100°C				EF3-X-01-04	12S	Y	01	4)
		Temp. Gauge									
		DC Amplifier	50M12400								

TABLE 6.0-2

MSFC - Form 593-1 (Rev February 1965)

INSTRUMENTATION PROGRAM & COMPONENTS

PARAMETER Temperature VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	C5-701	Temp. Reg. (8A) Outlet	-125 to 70°C				EF3-X-01-05	12S	Y	01	4)
		Temp. Gauge									
		DC Amplifier	50M12400								
	C6-408	Temp. Valve (5c) Outlet	-75 to +40°C				EF3-X-01-06	12S	Y	01	4)
		Temp. Gauge									
		DC Amplifier	50M12400								
	C7-701	Temp. Suit Loop Supply	5 to 15°C				EF3-X-01-07	12S	Y	01	4)
		Temp. Gauge									
		DC Amplifier	50M12400								
	C8-408	Temp. Reg. (9B) Inlet	-125 to +100°C				EF3-X-01-08	12S	Y	01	5)
		Temp. Gauge									
		DC Amplifier	50M12400								
	C9-701	Temp. Airlock	-100 to +125°F				EF3-X-01-09	12S	Y	01	4)
		Temp. Gauge									
		DC Amplifier	50M12400								

TABLE 6.0-3

INSTRUMENTATION PROGRAM & COMPONENTS

PARAMETER Temperature VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	C10-703	Temp. Battery No. 1	0 to 70°C				EF3-X-01-10	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								
	C11-703	Temp. Battery No. 3	0 to 70°C				EF3-X-02-01	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								
	C12-703	Temp. Battery No. 5	0 to 70°C				EF3-X-02-02	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								
	C13-703	Temp. Battery No. 7	0 to 70°C				EF3-X-02-03	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								
	C14-703	Temp. Battery No. 9	0 to 70°C				EF3-X-02-04	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								

TABLE 6.0-4

INSTRUMENTATION PROGRAM & COMPONENTS

PARAMETER Temperature VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	C15-703	Temp. Battery No. 11	0 to 70°C				EF3-X-02-05	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								
	C16-703	Temp. Battery No. 13	0 to 70°C				EF3-X-02-06	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								
	C17-703	Temp. Battery No. 15	0 to 70°C				EF3-X-02-07	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								
	C18-703	Temp. Battery No. 17	0 to 70°C				EF3-X-02-08	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								
	C19-703	Temp. Battery No. 19	0 to 70°C				EF3-X-02-09	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								
	C20-703	Temp. Battery No. 21	0 to 70°C				EF3-X-02-10	12S	Y	02	
		Temp. Gauge									
		DC Amplifier	50M12400								

TABLE 6.0-5

INSTRUMENTATION PROGRAM & COMPONENTS

PARAMETER Temperature VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	C21-408	Temp LH2 Tank, Int	30 to 65°C				EF3-X-05-02	12S	Y	01	5)
		Temp Gauge									
		DC Amplifier	50M12400								
	C22-408	Temp LH2 Tank, Int	30 to 65°C				EF3-X-05-03	12S	Y	01	5)
		Temp Gauge									
		DC Amplifier	50M12400								
	C23-408	Temp LH2 Tank, Int	30 to 65°C				EF3-X-05-04	12S	Y	01	5)
		Temp Gauge									
		DC Amplifier	50M12400								
	C24-408	Temp LH2 Tank, Int	30 to 65°C				EF3-X-05-05	12S	Y	01	5)
		Temp Gauge									
		DC Amplifier	50M12400								
	C25-408	Temp LH2 Tank, Int	30 to 65°C				EF3-X-05-06	12S	Y	01	6)
		Temp Gauge									
		DC Amplifier	50M12400								
	C26-408	Temp LH2 Tank, Int	30 to 65°C				EF3-X-05-07	12S	Y	01	6)
		Temp Gauge									
		DC Amplifier	50M12400								
	C27-408	Temp LH2 Tank, Int	30 to 65°C				EF3-X-05-08	12S	Y	01	6)
		Temp Gauge									
		DC Amplifier	50M12400								
	C28-408	Temp LH2 Tank, Int	30 to 65°C				EF3-X-05-09	12S	Y	01	6)
		Temp Gauge									
		DC Amplifier	50M12400								

TABLE 6.0-6

INSTRUMENTATION PROGRAM & COMPONENTS

PARAMETER Temperature VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	C29-409	Temp LH2 Tank, Ext	-60 to 100°C				EF3-X-05-10	12S	Y	01	6)
		Temp Gauge									
		DC Amplifier	50M12400								
	C30-409	Temp LH2 Tank Ext	-60 to 100°C				EF3-X-06-01	12S	Y	01	6)
		Temp Gauge									
		DC Amplifier	50M12400								

TABLE 6.0-7

MSFC - Form 593-1 (Rev February 1965)

INSTRUCTMENTATION PROGRAM & COMPONENTS

PARAMETER Pressure VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	D1-703	Pressure Oxygen Storage Tank No. 1 Press. Gauge	0 to 3500 psi 50M12344				EF3-Y-03-01	12S	Y	01	Hardwire Display for preflight 4) 6)
	D2-703	Pressure, Oxygen Storage Tank No. 2 Press. Gauge	0 t o 3500 psi 50M12344				EF3-X-03-02	12S	Y	01	Hardwire Display for preflight 4)6)
	D3-703	Pressure, Oxygen Storage Tank No. 3 Press. Gauge	0 to 3500 psi 50M12344				EF3-X-03-03	12S	Y	01	Hardwire Display for preflight 4)6)
	D4-701	Inlet Pressure, Oxygen Supply System Press. Gauge	0 to 3500 psi 50M12344				EF3-X-03-04	12S	Y	01	4)

TABLE 6.0-8

INSTRUCTION PROGRAM & COMPONENTS

PARAMETER Pressure VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	D5-701	Regulator (8A) Outlet Pressure Press Gauge	0 to 400 PSI				EF3-X-03-05	12S	Y	01	4)
	D6-701	Pressure, Suit Loop Supply Press Gauge	0 to 15 PSI 50M10262				EF3-X-03-06	12S	Y	01	4)
	D7-701	Regulator (7A) Outlet Pressure Press Gauge	05 to 1500 PSI				EF3-X-03-07	12S	Y	01	4)
	D8-701	Airlock Pressure Press Gauge	0 to 20 PSI 50M10259				EF3-X-03-08	12S	Y	01	Hardwire Display for preflight 4) 5) 6)
	D9-408	Pressure, LH2 Tank Press Gauge	0 to 10 PSI				EF3-X-03-09	12S	Y	01	4) 5) 6)

TABLE 6.0-9

INSTRUCTIONS

INSTRUMENTATION PROGRAM & COMPONENTS

PARAMETER Pressure VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	D10-201	CO2 Partial Pressure Airlock Gauge Assy	0 to .15 psi				EF3-X-03-10	12S	Y	01	4) 6)
	D11-408	CO2 Partial Pressure LH2 Tank	0 to .15 psi				EF3-X-04-01	12S	Y	01	4) 5)

TABLE 6.0-10

INSTRUCTIONATION PROGRAM & COMPONENTS

PARAMETER Flow VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	F1-408	Flow- ECS Flowmeter DC Amplifier	0.2 to 3 lb/hr 50M12400				EF3-X-05-01	45	Y	01	5)

TABLE 6.0-11

INSTRUMENTATION PROGRAM & COMPONENTS

PARAMETER Signal VEHICLE SSESM DWG. NO ______ PAGE ______

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	K1-701	Voltage Sensor No. 1	0 or 5 VDC				EF3-X-04-02	12S	Y	02	
	K2-701	Voltage Sensor No. 2	0 or 5 VDC				EF3-X-04-03	12S	Y	02	
	K6-701	Lights LH2 Tank	0 or 5 VDC				EF3-X-05-05	12S	Y	02	
	K7-701	Lights LH2 Tank	0 or 5 VDC				EF3-X-05-06	12S	Y	02	
	K8-701	Blowers On	0 or 5 VDC				EF3-X-05-07	12S	Y	02	
	K9-701	Oxygen Heater 701A6 On	0 or 5 VDC				EF3-X-05-08	12S	Y	02	
	K10-701	Oxygen Heater 701A7 On	0 or 5 VDC				EF3-X-05-08	12S	Y	02	
	K11-701	Exterior Lights On	0 or 5 VDC				EF3-X-05-09	12S	Y	02	
	K12-701	Airlock Light On	0 or 5 VDC				EF3-X-05-10	12S	Y	02	

TABLE 6.0-12

INSTRUMENTATION PROGRAM & COMPONENTS

PARAMETER Voltage, Current & Frequency VEHICLE SSESM DWG. NO PAGE

LINE	MEAS. NR.	MEASUREMENT NAME AND OR COMPONENT	RANGE OR PART NO.	FLT. PER.	% POS. ERR	INS. ENG.	TELEMETER CHANNEL	RES.	FLT. CAL	REQ	REMARKS
	M1-701	Voltage Bus 7D10	0 to 28 VDC				EF3-X-04-04	12S	Y	02	4)
	M2-701	Voltage Bus 7D30	0 to 28 VDC				EF3-X-04-05	12S	Y	02	4)
	M3-701	Voltage Bus 7D50	0 to 28 VDC				EF3-X-04-06	12S	Y	02	4)
	M4-701	Current Bus 7D10 DC Amplifier	0 to 120 Amps				EF3-X-04-07	12S	Y	02	4)
	M5-701	Current Bus 7D30 DC Amplifier	0 to 24 Amps				EF3-X-04-08	12S	Y	02	4)
											4)
	M6-701	Current Bus 7D50 DC Amplifier	0 to 120 Amps				EF3-X-04-09	12S	Y	02	4)
	M7-701	Voltage 5 VDC Measuring Supply	0 to 5 VDC				EF3-X-04-10	12S	Y	02	

TABLE 6.0-13

SECTION 7.0 HANDLING SEQUENCE

7.1 GENERAL

This Section describes receiving the SSESM at KSC, checkout of SLA, SSESM installation in SLA, SLA and IU mating, and spacecraft mating and forward buildup.

7.2 RECEIVING OF SSESM AT KSC (Figures 7.2-1 through -3)

7.2.1 The SSESM is shipped from MSFC, Huntsville, to KSC.

7.2.2 The SSESM is transferred to Manned Spacecraft Operations Building (MSOB), MILA.

7.2.3 The SSESM is removed from the shipping container by:

a. Removal of upper section of the container.

b. Installation of handling ring on SSESM.

c. Removal of all clamping devices on the SSESM, freeing it from the lower section of the shipping container.

d. Using a hoisting sling and the crane facilities at MSOB.

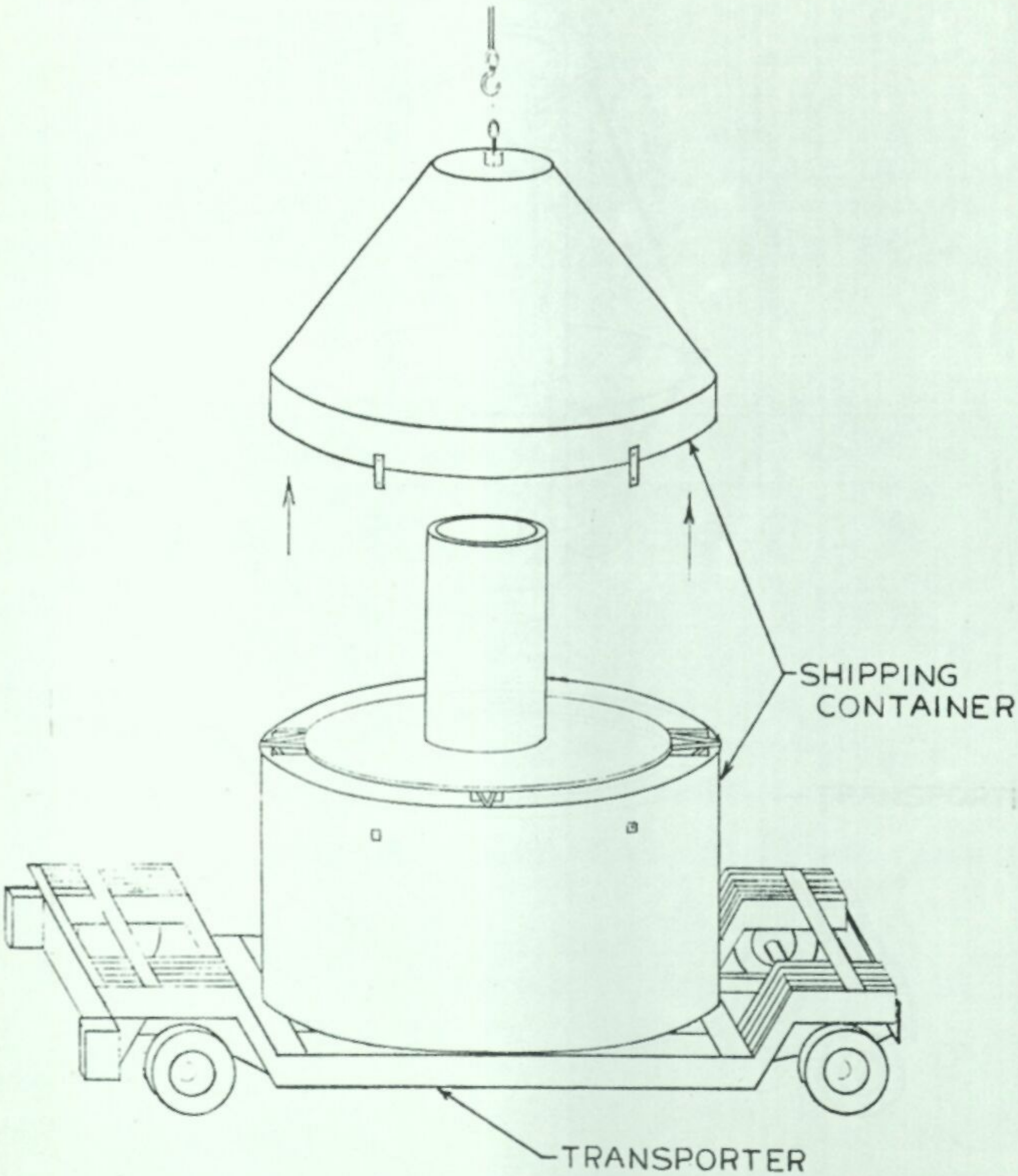


FIGURE 7.2-1 - ARRIVAL OF SSESM AT THE TEST AND CHECKOUT FACILITIES

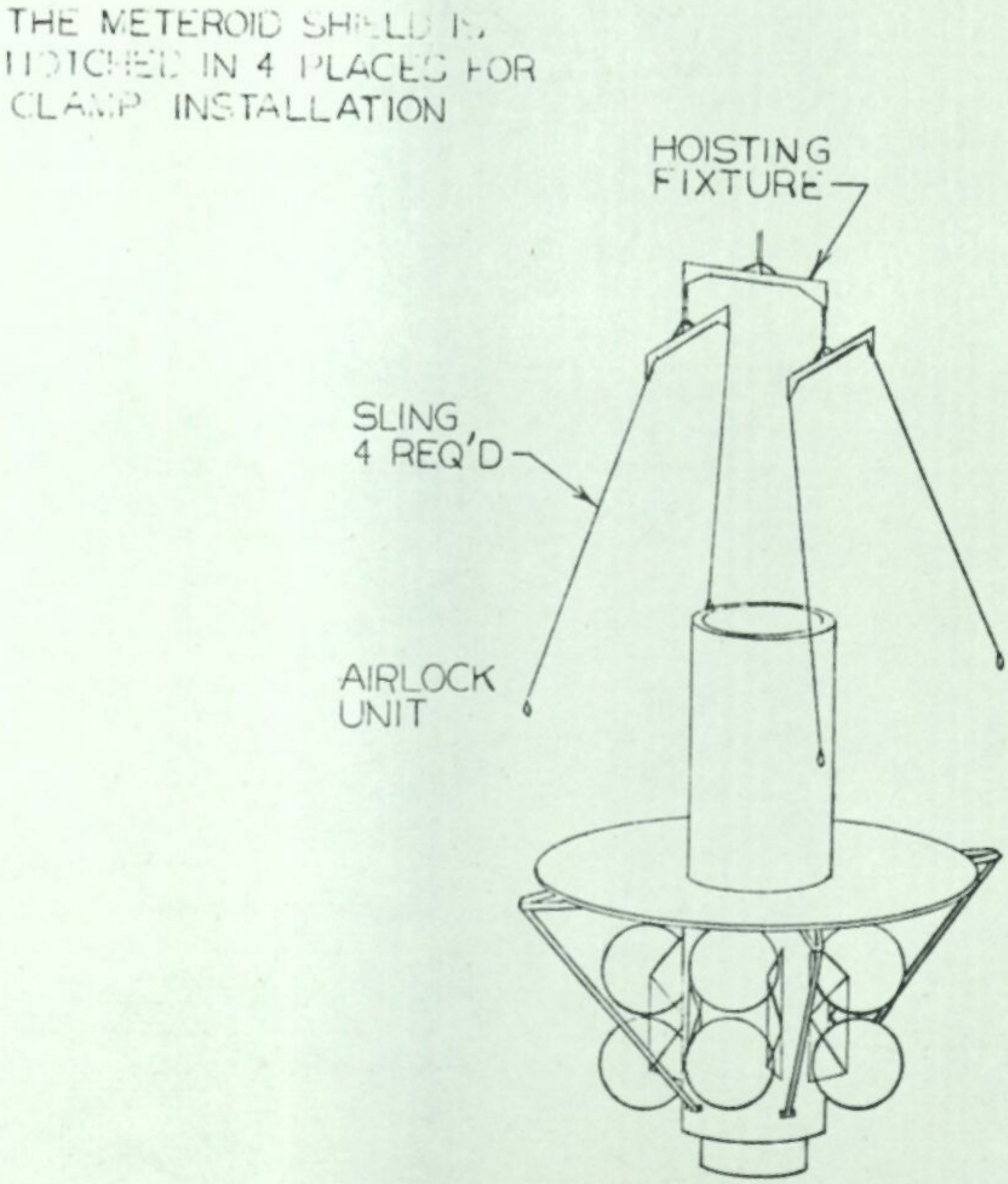


FIGURE 7.2-2 - METHOD OF HOISTING SSESM

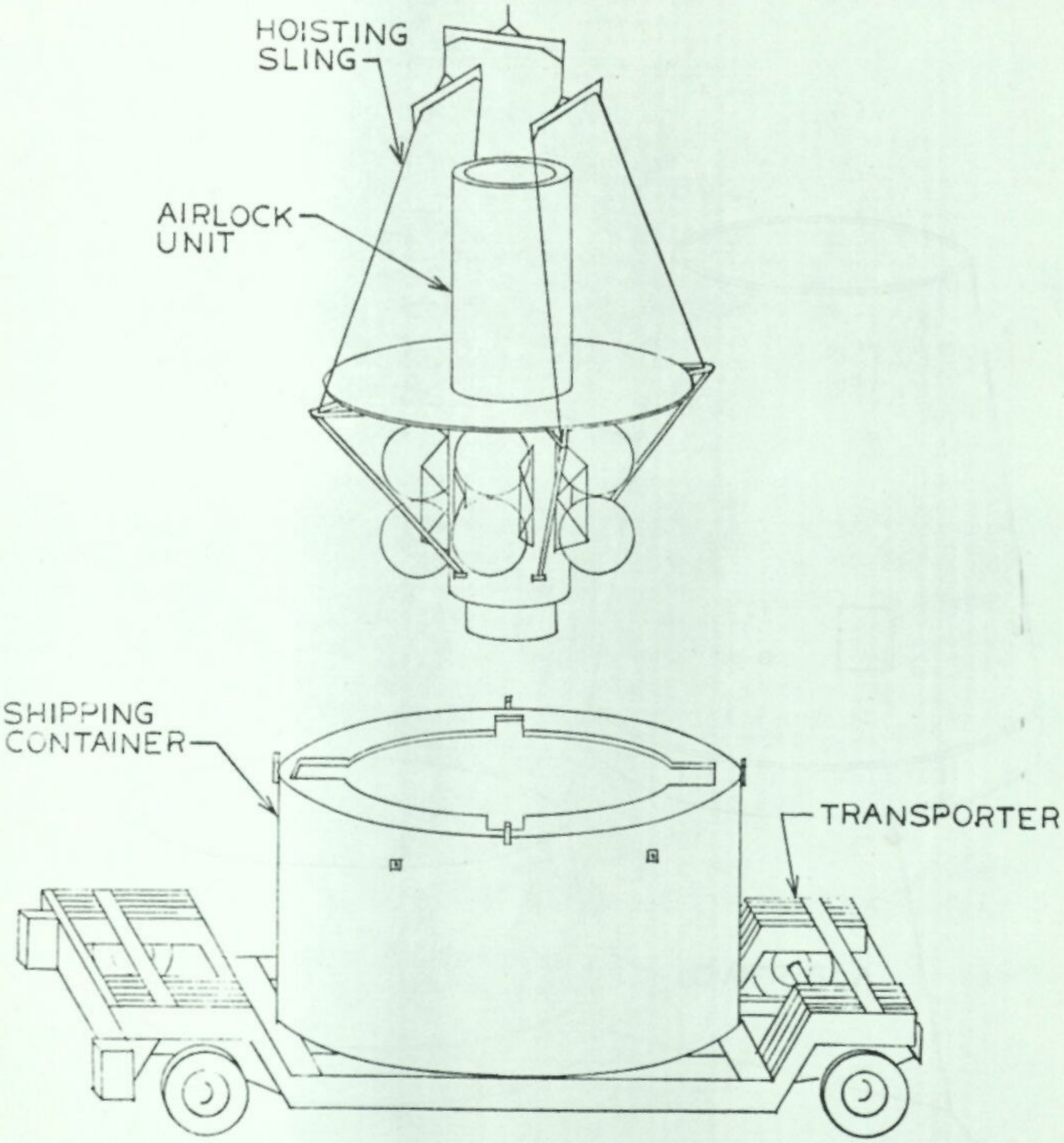


FIGURE 7.2-3 - REMOVAL OF SSESM FROM STORAGE CONTAINER

7.3 CHECKOUT OF SLA PRIOR TO SSESM INSTALLATION (Figure 7.3-1)

7.3.1 Receive SLA and install in the work stand at MSOB.

7.3.2 Perform inspection.

7.3.3 Install open items:

a. Separation system

b. Umbilical

c. Associated wiring

d. Instrumentation

7.3.4 Perform continuity check.

7.3.5 Demate SLA.

7.3.6 Transfer SLA upper section to the next station.

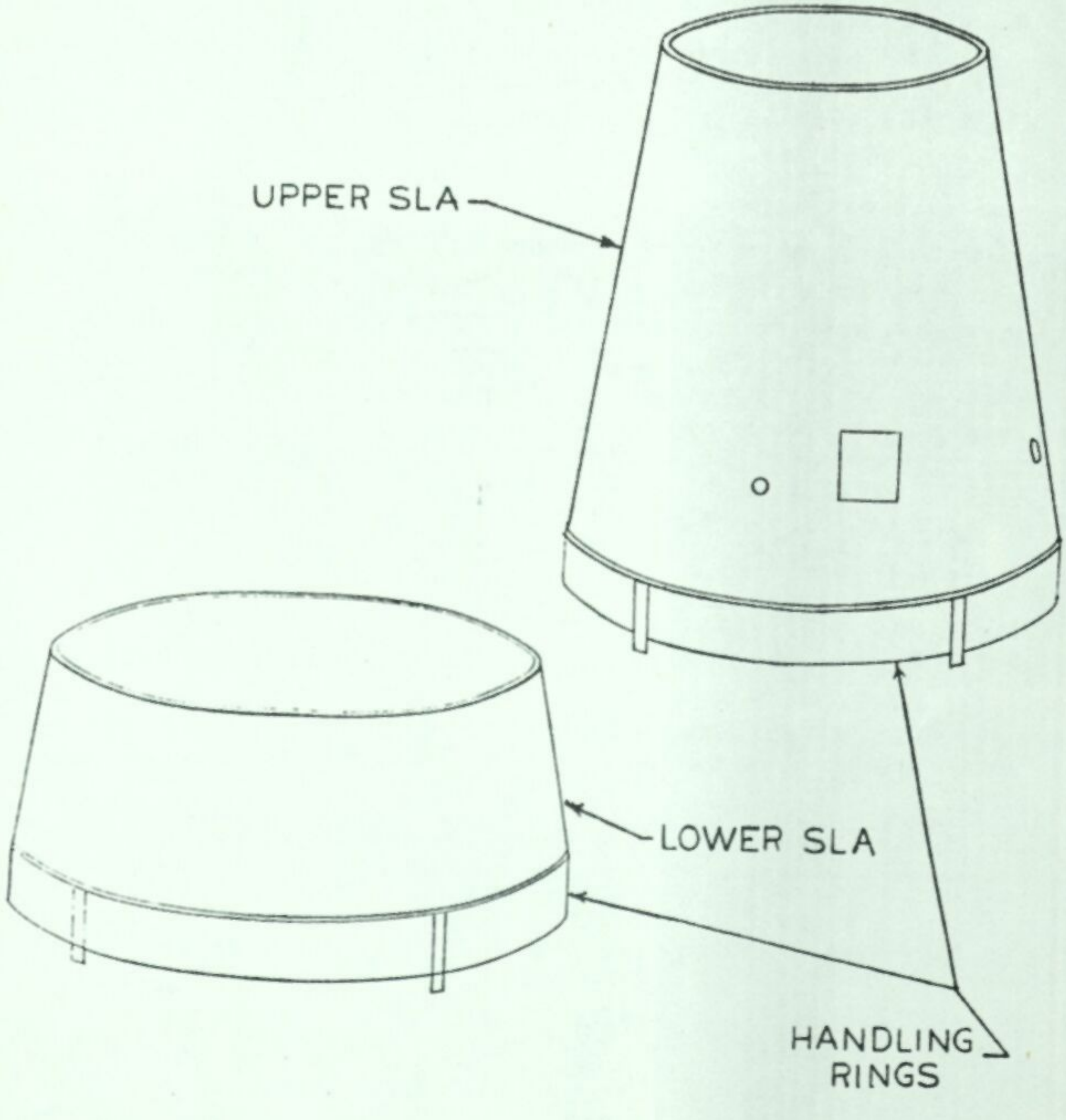


FIGURE 7.3-1 - SLA SEPARATED

7.4 SSESM INSTALLATION IN SLA LOWER SECTION (Figures 7.4-1 through -3)

7.4.1 Install SSESM in the SLA lower section.

7.4.2 Adjust the attachment fittings.

7.4.3 Verify the alignment.

7.4.4 Mate the electrical connectors and verify their compatibility.

7.4.5 Demate.

7.4.6 Transfer the SSESM to the next station.

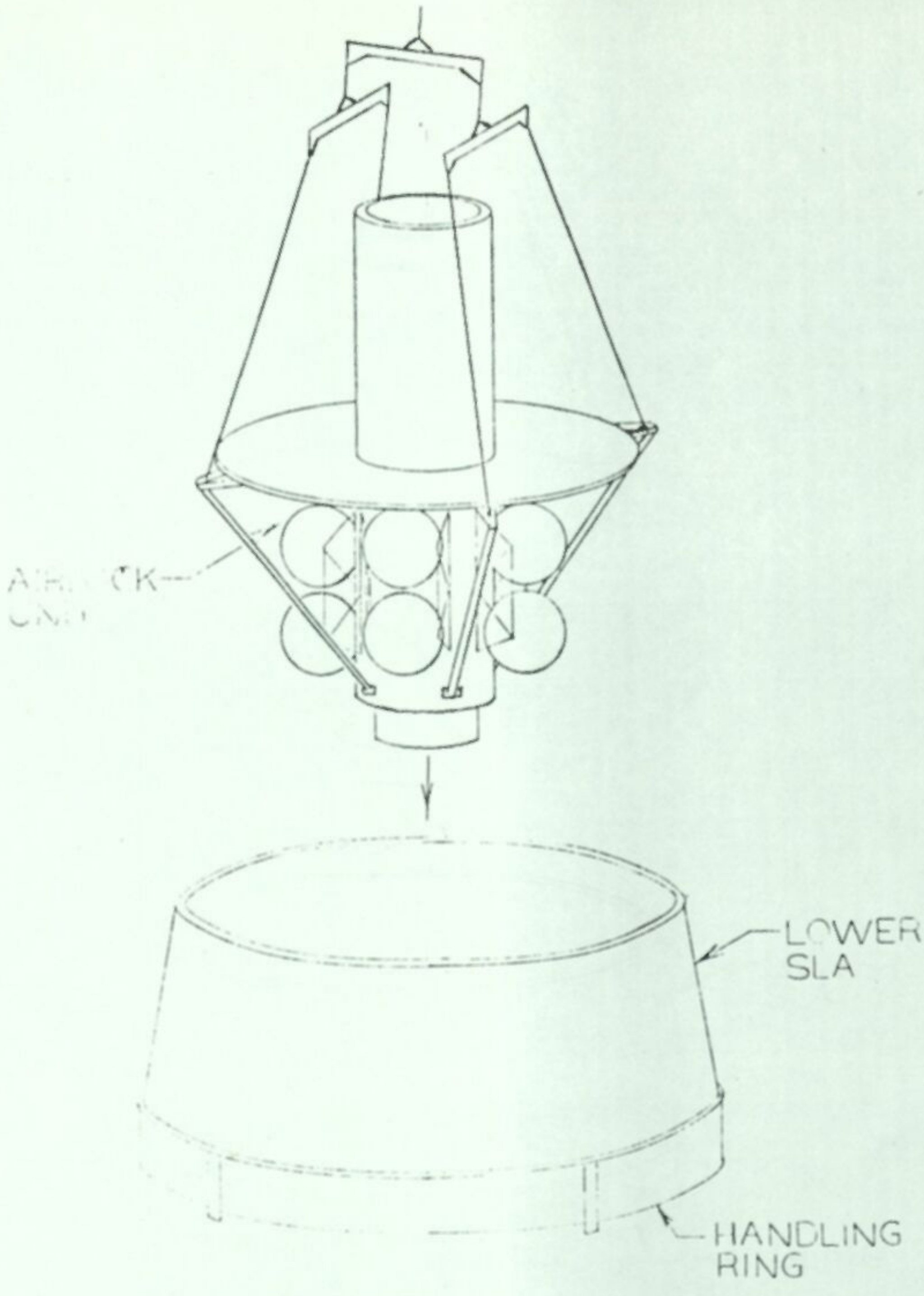


FIGURE 7.4-1 - INSTALLATION OF SSESM IN LOWER SLA FOR TEST AND CHECKOUT

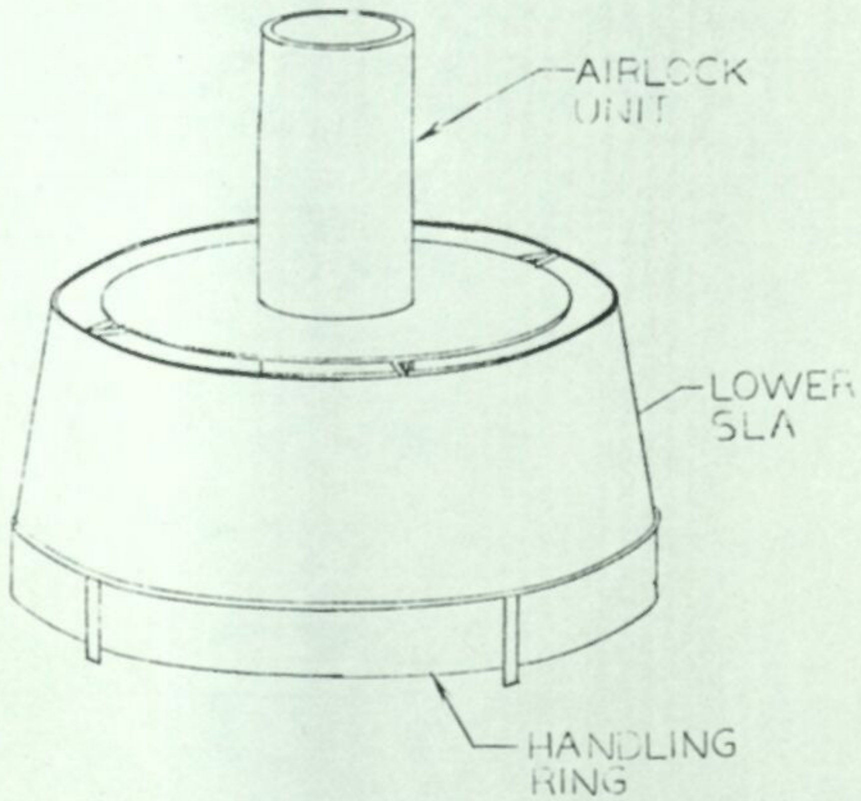


FIGURE 7.4-2 - SSESM AND LOWER SLA ASSEMBLY

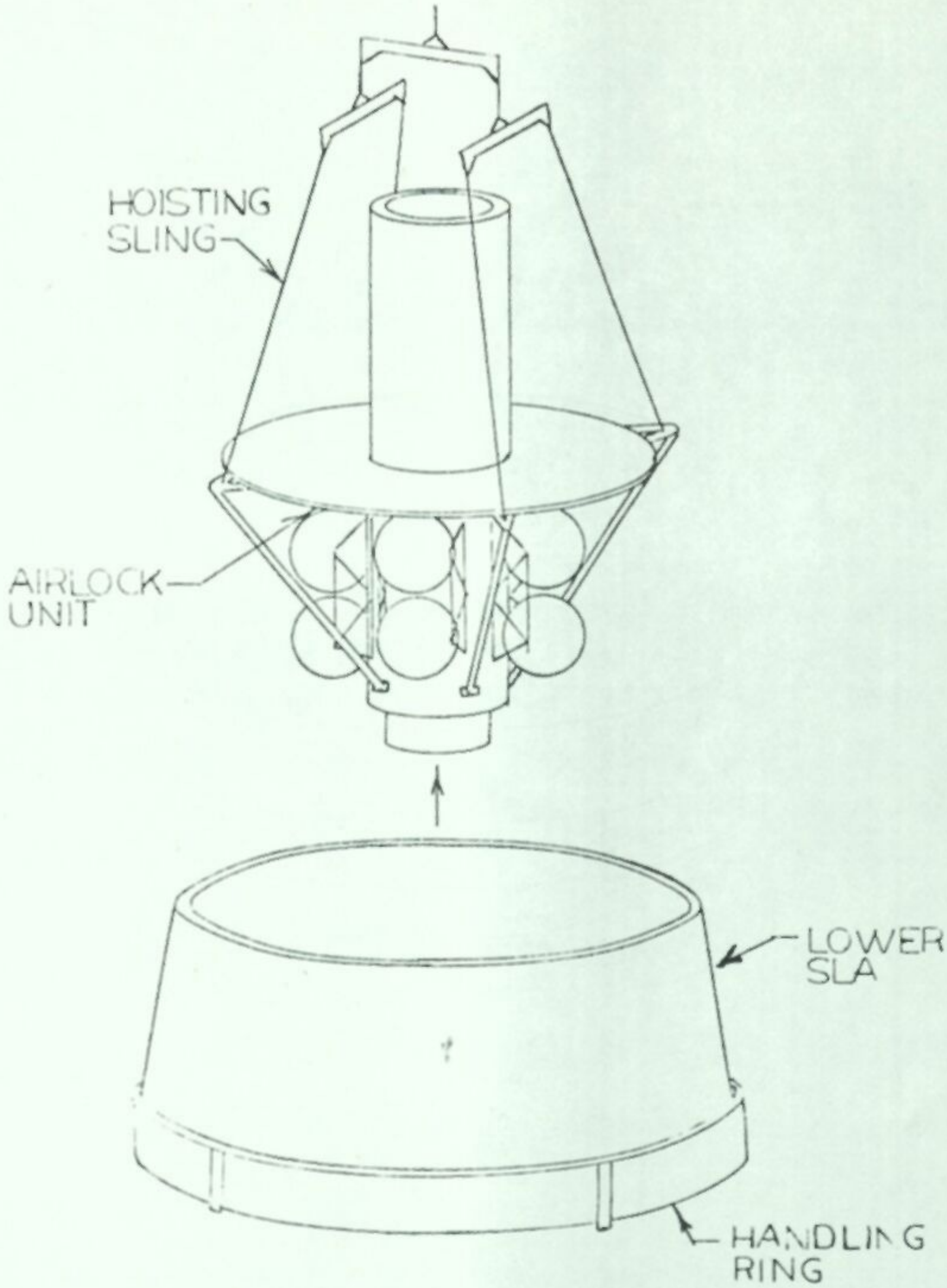


FIGURE 7.4-3 - SSESM REMOVAL FOR FURTHER TESTING OF LOWER SLA

7.5 SLA LOWER SECTION AND IU MATING FOR TEST AND CHECKOUT (Figure 7.5-1)

7.5.1 Receive IU.

7.5.2 Mate SLA lower section to IU.

7.5.3 Perform mechanical fit check and verify mechanical alignment.

7.5.4 Perform electrical fit check.

7.5.5 Demate SLA from IU.

7.5.6 Transfer IU and SLA lower section to the next station.

7.5.7 Not shown: Verification of CM/SLA mechanical compatibility and storage of SLA.

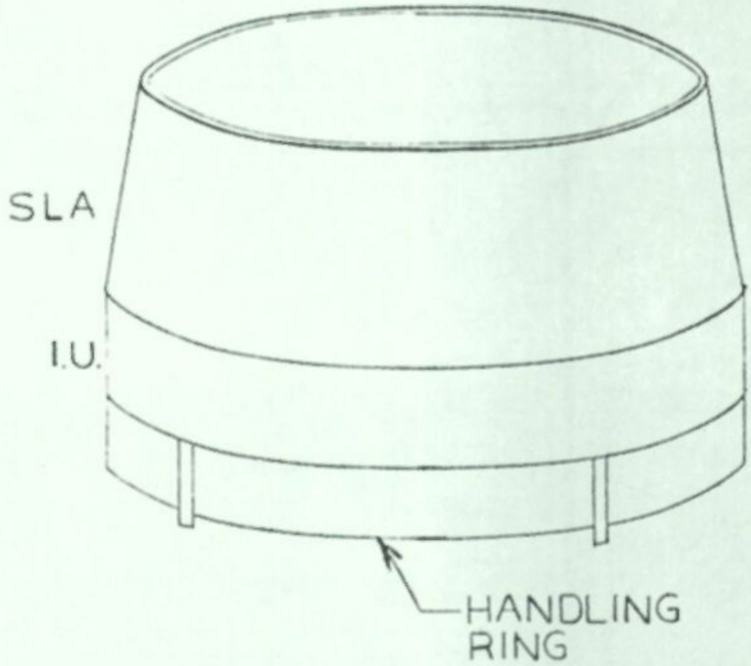


FIGURE 7.5-1 - LOWER SLA MATED TO IU FOR TEST AND CHECKOUT

7.6 SPACECRAFT MATE AND FORWARD BUILDUP (Figure 7.6-1 through -3)

7.6.1 Install complete SSESM in SLA lower section.

7.6.2 Verify interface and alignment.

7.6.3 Mate SLA upper section to SLA lower section.

7.6.4 Install internal access platform set.

7.6.5 Mechanically mate CSM to SLA.

7.6.6 Verify CSM/SLA mechanical alignment.

7.6.7 Electrically mate CSM to SLA.

7.6.8 Verify CSM/SLA electrical interfaces.

7.6.9 Buildup forward deck.

7.6.10 Install forward heat shield.

7.6.11 Install ordnance devices.

7.6.12 Spacecraft transferred to Launch Complex (LC).

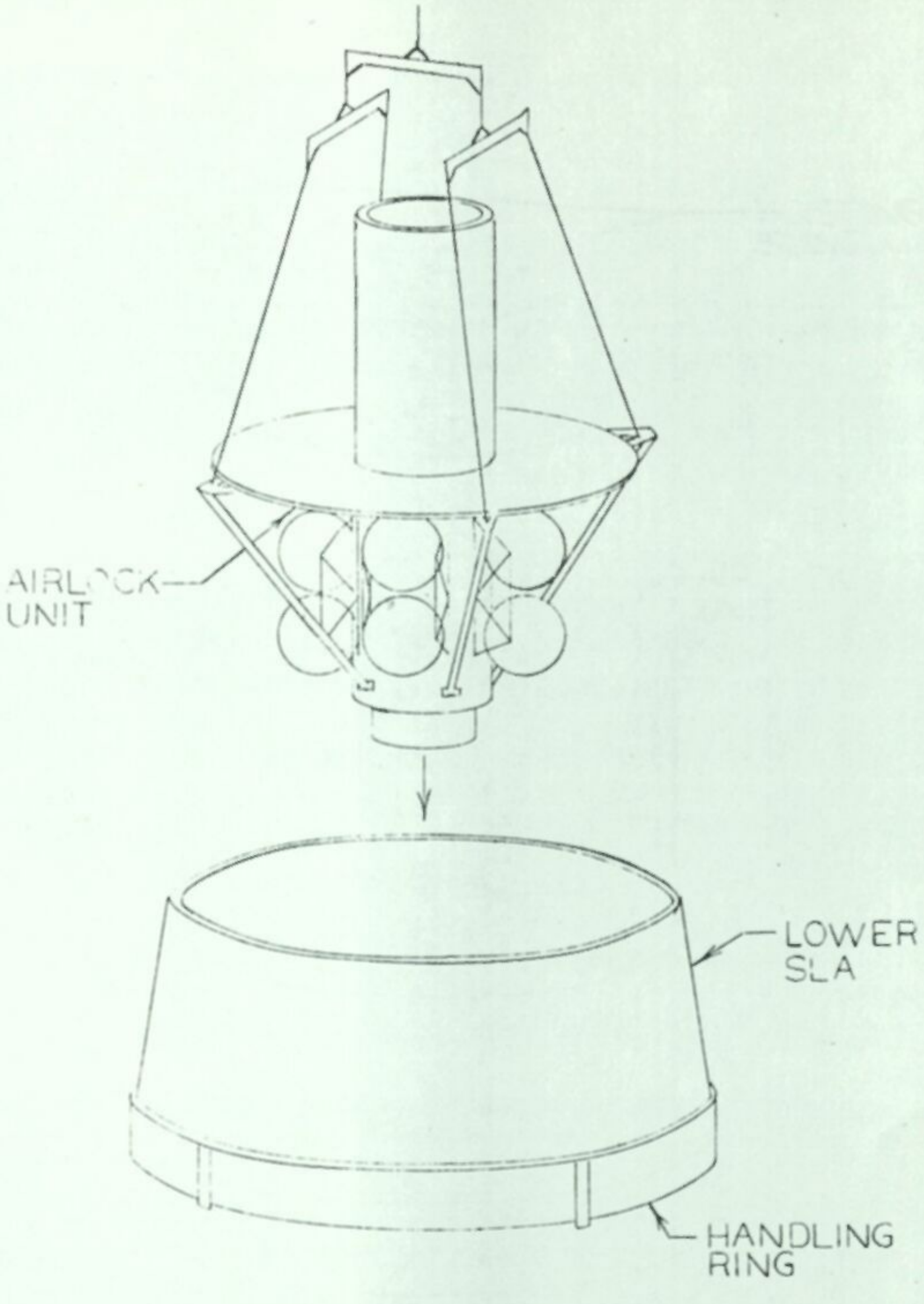


FIGURE 7.6-1 - SSESM INSTALLATION IN LOWER SLA PRIOR TO MATING WITH THE FLIGHT VEHICLE

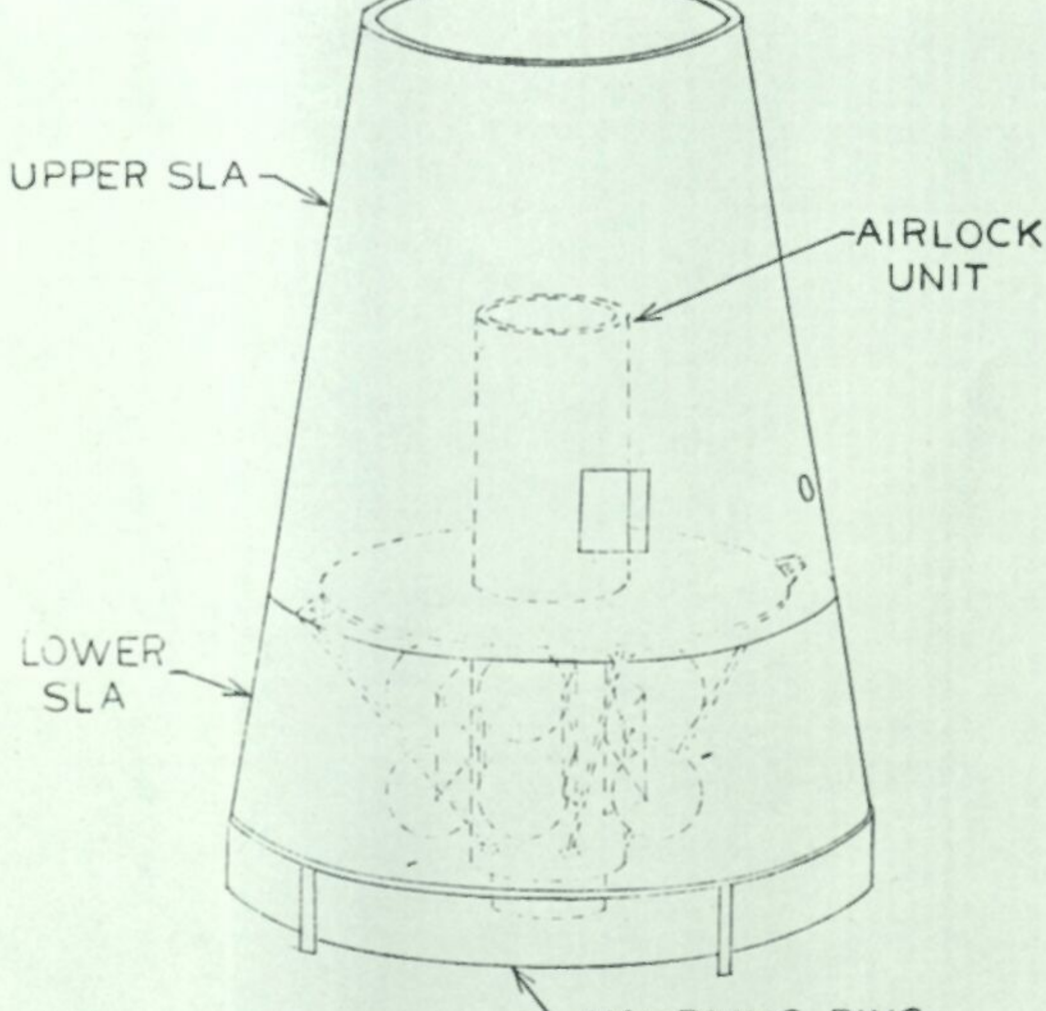


FIGURE 7.6-2 - SSESM INSTALLED IN SLA ASSEMBLY

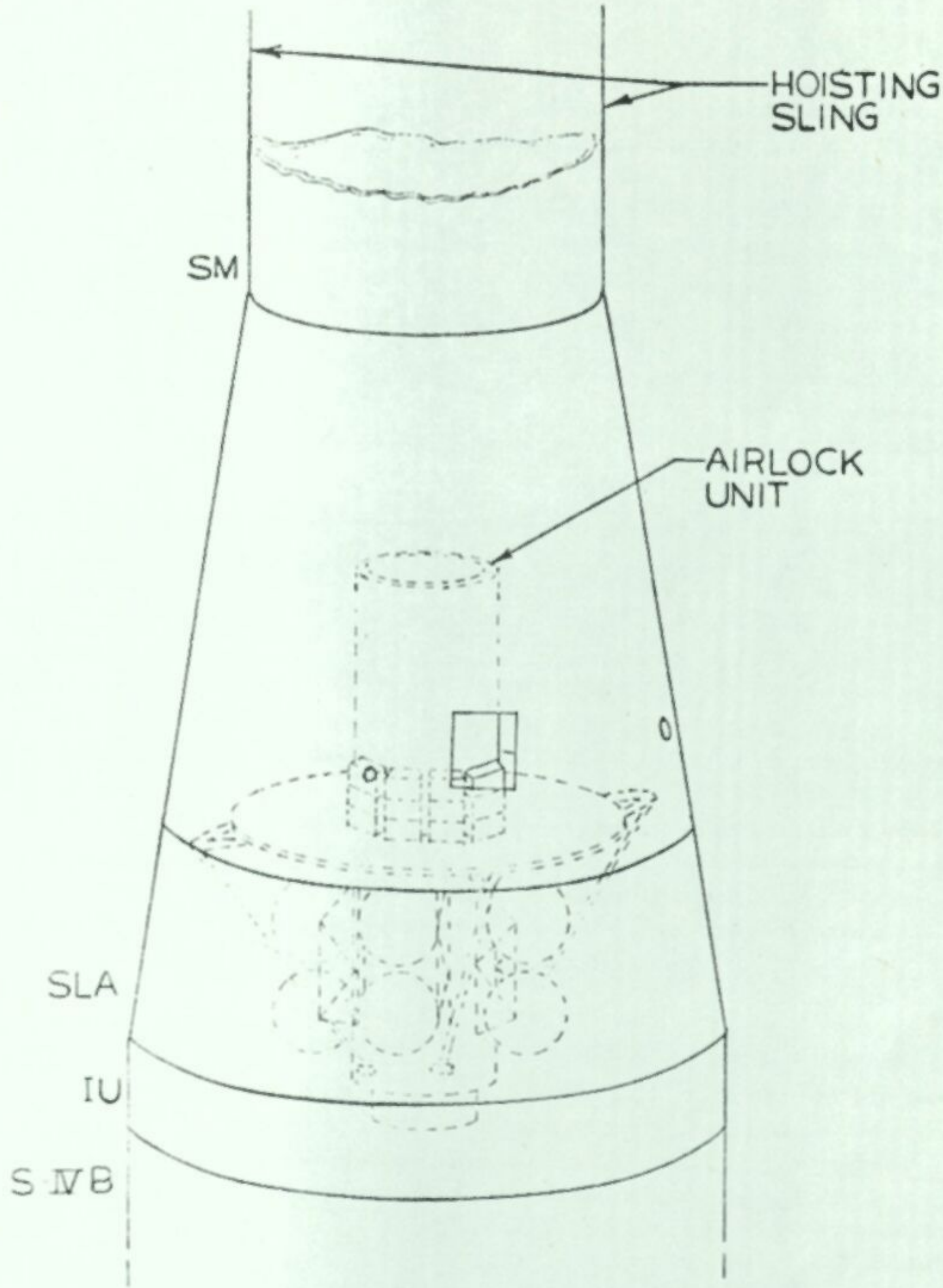


FIGURE 7.6-3 - CM/SM/SLA/ SSESM MATING TO VEHICLE

SECTION 8.0 MAINTENANCE CONCEPT

8.1 INTRODUCTION

8.1.1 Purpose

The maintenance concept for the SSESM is presented in this Section. It shall be used by MSFC and contractors when developing maintenance program plans to insure adequate maintenance for the SSESM.

8.1.2 Scope

This concept applies to all orbital maintenance activities occurring on the SSESM system after docking takes place.

8.1.3 Objectives

The principal objective of this maintenance concept is to provide a baseline for systematic maintenance planning for the SSESM logistics support. Systematic maintenance planning is required in order to accomplish the following:

a. Increased equipment availability.

b. Increased repair reliability.

c. Increased safety for equipment and personnel.

d. Reduced probability of human error.

The above objectives are attained by achieving the following:

a. Verified maintenance procedures and maintenance technical support data.

b. Compatible man-machine relationships for successful completion of maintenance activities.

c. Adequate training for personnel to perform maintenance of the SSESM.

8.1.4 Concept Revisions

This concept provides the preliminary maintenance program for all organizations performing logistics planning functions. As analysis and program definition proceed, this concept will be subject to additions, deletions, and modifications. These changes should be justified by appropriate technical or management studies.

8.1.5 Applicable Documents

The following documents shall be used for reference to aid in the maintenance planning for the SSESM. In case of conflict between this document and the referenced documents, the referenced documents shall apply:

Astronaut Training Plan (not released)

Apollo Logistics Support Plan (NHB 7500.1)

SSESM Maintenance Plan (not released)

8.2 BASIC CONCEPTS

8.2.1 Mission Concept

The present mission concept requires that, in the event of a malfunction in any critical system, the mission will be aborted. It is the intent of this maintenance concept to extend the mission concept to permit an attempt to repair the system prior to issuing an order to abort.

8.2.2 Spares Concept

A limited number of spare parts will be provided for in-space maintenance. Candidates for spares will be identified as the result of performance of a maintenance requirements analysis. The actual spares to be transported with the SSESM will be determined from a detailed spare parts analysis. This spare parts analysis will consider, as a minimum, the following: (a) Reliability; (b) Criticality; (c) Feasibility; (d) Weight Constraints. Spare parts will only be considered for support of the Environmental Control System (ECS).

8.2.3 Maintenance Concept

Maintenance on the SSESM will be performed by removing and replacing malfunctioned components. Disposal of defective components will be accomplished by stowing them in appropriate locations in the Spent Stage. No attempt will be made to return defective components to Earth. Structural repair will be considered, depending on development of adequate repair techniques. The maintenance requirements, tool requirements, astronaut training requirements, etc., will be identified by a maintenance analysis (to be performed in accordance with NHB 7500.1). Repair, in lieu of component replacement, will be considered if justification is provided by means of maintenance analysis or other trade studies. Components which are capable of being removed and replaced or repaired will be identified in the SSESM maintenance plan (to be developed at a later date). Maintenance will be considered only on the SSESM Environmental Control System (ECS) due to the high mission criticality of this system.

8.3 TYPES OF MAINTENANCE

8.3.1 Preventive Maintenance (Scheduled Maintenance)

Preventive maintenance is defined as any planned maintenance action which is performed to maintain the system in a satisfactory operational condition. This consists, normally, of systematic inspections, servicing, and the detection and correction of incipient malfunctions before they occur or develop into major malfunctions.

8.3.2 Corrective Maintenance (Unscheduled Maintenance)

Corrective maintenance is any maintenance action which is performed as the result of a failure and is performed in order to restore the equipment to satisfactory operational condition.

8.4 MAINTENANCE LEVELS

Levels of maintenance have been identified in order to categorize maintenance activities on a functional and location basis. Levels of maintenance for the S-IVB Workshop are described as follows:

8.4.1 First Level

First-level maintenance includes all maintenance activities accomplished directly on system-installed hardware. This includes fault isolation, removal and replacement of components, servicing, replenishing, inspection, and repair-in-place activities performed on the Workshop whether it be in space or on the ground prior to launch.

8.4.2 Second Level

Second-level maintenance includes all activities performed in direct support of first-level maintenance and involves disposition or repair of hardware removed during first-level maintenance activities. In view of the philosophy discussed in paragraph 10.2.3, no second-level or lower-level maintenance will be required.

8.5 MAINTENANCE STANDARDS

Space maintenance activities demand the application of high quality standard maintenance proctices. Specifications must be developed which delineate in-space maintenance requirements to be met in regard to torque, cleanliness, bonding soldering, and lockwiring. Maintenance directives and procedures shall implement these specifications as applicable.

SECTION 9.0 TEST AND SIMULATION FACILITIES

9.1 GENERAL

Substantial test facility capability exists at the MSFC with present and planned facilities. The applicability of the existing facilities to the development and test of a SSESM is discussed in this Section.

9.2 EXISTING FACILITIES

To supplement the mechanically-induced vibration spectrum, use could be made of the recently-completed acoustical Test Position 116. This unique facility provides a clean acoustical environment which can subject the SSESM to a simulated acoustical spectrum equivalent to that encountered during CM detaching and docking maneuvers.

The structural integrity of the air lock and the docking structure could be verified by tethering both the assembled air lock and CM from the top of the 425-foot-high Saturn V Dynamic Test Stand. The extreme length of the suspension cables would induce negligible horizontal components and permit simulated in-space docking maneuvers.

The Saturn V Dynamic Test Stand also houses the largest U.S. Low Gravity Test Facility. This facility could be utilized to verify the design and to establish in-flight fluid flow characteristics such as would be encountered by the environmental control and other gaseous or fluid systems.

The CTL Area can accommodate component system development and verification tests involving hazardous propellants and high-pressure gases as employed by the slug environmental control system. In addition, newly and especially developed components, such as valves, regulators, switches, gauges, and heat exchangers, could be evaluated for system compatibility and response characteristics.

The recently-completed Test Position 500 could be employed in the development of hazardous cryogenic handling, transfer, storage, and dumping techniques as would be encountered during orbital hydrogen tank blowdown, as well as facilitate the solution to inevitable unforseen problems which frequently occur in system design and development efforts.

The currently-functional GSE Area could be utilized in development of SLA panel explosive removal techniques. The random motion devices could be employed to simulate the action of the S-IVB Workshop in a perturbed orbit while activating SLA panel deployment.

In general, the aforementioned test facilities are but a few of those existing which could considerably benefit an austere in-house development of the SSESM. All of the test positions and areas are fully instrumented to sense and record the required design and test phenomena. As the program guidelines and operational requirements solidify, it is anticipated that other existing Test Laboratory facilities and component test positions can be used to greater advantage than presently envisioned.

SECTION 10.0 CREW FAMILIARIZATION PLAN

10.1 GENERAL

A description of a proposed Crew Familiarization Program for the S-IVB Workshop and spent stage experiments is presented in this Section. This plan will assure timely identification and integration of all familiarization resources and services necessary to insure adequate, timely, and economical familiarization support for the crew members. This plan shall be conducted within the guidelines and ground rules established for the overall astronaut familiarization program and shall be controlled and monitored by MSC.

This plan conforms to NHB-7500.1, Apollo Logistics Requirements Plan, November 1965; MSFC Logistics Support Requirements Plan, January 1966; and NPC 500.1, Apollo Configuration Management Manual, May 1964..

10.2 FAMILIARIZATION CONCEPT

10.2.1 Description

This familiarization concept is a proposed method of accomplishing crew familiarization for the S-IVB spent stage, the SSESM, and the experiments. This concept will assure the effective control and management required to identify, develop, provide, and maintain a familiarization program for the orbital workshop.

All crew members will be trained in the deployment and use of air lock and workshop equipment, including equipment required in MSFC-developed experiments. Contingency time will be included throughout the familiarization program to allow for unexpected events or task difficulties.

It is estimated that three or four months will be required for actual crew familiarization. This will cover five primary familiarization areas and will be divided into four phases.

10.2.2 Familiarization Areas

The primary familiarization areas are as follows:

a. Crew system equipment handling and operation.

b. S-IVB Workshop activation and passivation procedures.

c. Experiment equipment transfer, operation, and data collection.

d. S-IVB Workshop shutdown.

e. Safety procedures and contingencies.

10.2.3 Familiarization Phase

The program will be divided into the following phases:

a. Orientation of mission requirements and subsystems capabilities. Astronaut/equipment interface will be defined and component functions will be introduced.

b. Simulation of man-machine mission requirements to validate equipment locations and layout.

c. Simulation of man-machine mission requirements incorporating recommended modifications.

d. Total mission simulation; reduced gravity, high fidelity simulation of equipment and man-equipment functional requirements.

After the orientation period, integrated mission simulation will be conducted in a Spent Stage functional mockup. Reduced gravity, vacuum, and atmospheric conditions to be encountered during the actual mission will be simulated where necessary. A continuous evaluation of the familiarization program will be conducted to determine that familiarization course objectives are met.

10.2.4 Elements Required

The elements required to identify, provide control of, and manage the familiarization program are the following:

a. Familiarization Requirements Analysis. - A systematic familiarization requirements analysis will be made of the post docking to CSM-SSESM separation sequence of events, systems analysis, maintenance analysis, and experiment outputs to identify those crew member tasks that require familiarization and associated familiarization equipment. The familiarization requirements analysis will be made along the guidelines detailed in paragraph 10.3. The analysis will form the basis of the familiarization plans and familiarization equipment specification.

b. Familiarization Plans. - Familiarization plans will be developed to cover equipment and familiarization requirements identified in the familiarization requirements analysis. Each will be developed along the guidelines detailed in paragraph 10.4. A program plan will be developed that will give visibility to the total familiarization requirements and will indicate areas for cross-training and unscheduled redundancies.

c. Implementation. - Some of the prime considerations during the implementation period are inter-Center schedule milestones, interface familiarization requirements, and mission requirements. MSFC will provide a technical coordinator to NASA Headquarters and MSC.

d. Management. -MSC will provide the necessary program coordination and control to assure that the familiarization program covered herein meets MSC program milestones and standards. Necessary management control through directives, instructions, and procedures will be provided. Techniques such as PERT, EDS, configuration management, etc., will be utilized for effective and economical management of the familiarization program.

10.3 FAMILIARIZATION REQUIREMENTS ANALYSIS

10.3.1 Purpose

The purpose of the familiarization requirements analysis is to identify specific familiarization requirements and familiarization equipment for the S-IVB Workshop mission. This analysis will be a systematic review of the SSESM experiments and their related operations and maintenance tasks. A part of this operations and maintenance analysis has already been accomplished.

10.3.2 Flight Equipment Analysis

Flight equipment that requires crew familiarization for satisfactory operation will be identified and categorized in accordance with its mission criticality, complexity of operation, physical constraints imposed upon crew members, interface with other equipment, safety considerations, and contingencies. Expendable and recoverable equipment will be identified and their stowage procedures defined.

10.3.3 Task Analysis

Tasks required to perform each normal/emergency operational function will be defined. A comprehensive and systematic review of the flight equipment and task analyses will be conducted to determine total task familiarization and individual task familiarization requirements. Specific task procedures will be defined. Estimates of time, in minutes, required to perform each task will be made. These estimates will be revised at the end of the crew familiarization program to indicate a more realistic task time factor based upon simulated operation time. Each task will be identified to indicate its criticality to mission success, degradation of equipment, perceptual requirements, motor skill demands, judgmental requirements, and number of crew members required.

10.3.4 Familiarization Equipment and Facilities Analysis

Familiarization equipment and facilities analyses will be made to determine requirements and availability dates. Selection and provisioning of familiarization equipment will be made based on this analysis. Before fabrication, familiarization equipment specification will be prepared and approved for each familiarization equipment end item. Appropriate configuration control procedures will be implemented to maintain familiarization equipment end item compatibility with the operational program equipment.

10.3.5 Nature of Familiarization

The most economical and effective methods of teaching will be used. Familiarization aids, components, operational equipment, and simulators will be used for orientation and task-based familiarization. Orientation of mission requirements, subsystem capabilities and component functions is required to familiarize the crew members with tasks to be performed. Equipment built to actual operational system specifications and simulators will be used to develop exact unique skills and to meet specific familiarization objectives. Existing operational equipment and simulators will be fully utilized. Familiarization facilities, as determined by the facilities analysis, will be provided. Extensive renovation will not be accomplished unless it is considered critical to the familiarization program mission.

10.3.6 Familiarization Outline

A familiarization outline will be prepared from the familiarization requirements analysis data. The outline will define the courses, equipment, integrated resources, and services necessary for crew familiarization in each program phase as stated in paragraph 10.2. This outline will provide a basis for the familiarization plans, and the estimated time required to complete each course.

10.4 FAMILIARIZATION PLANS

10.4.1 Purpose

The familiarization plan will provide documented sources for identifying lesson plans, resources and controls to assure that familiarization requirements are met.

10.4.2 Course Description and Outline

A course description and outline will be prepared from the familiarization outline data for each program phase (see paragraph 10.2). It will contain the basic organization material and an itemized listing of each familiarization requirement, including the time element required for familiarization. The data will contain information such as security classification, course objective and scope, course length in manhours, location of familiarization, familiarization methods to be used, required familiarization equipment, and contingencies. The course description and outline data will be used to develop lesson plans.

10.4.3 Lesson Plans

Lesson plans will be prepared for each program operation to define the familiarization accomplishments required for daily performance. In addition to operational and equipment procedures, the lesson plans will include contingencies, equipment relationships and interfaces, mission criticality, safety procedures, evaluation data, and conditions that would necessitate abort. Simultaneous crew participation at different work stations will be covered.

10.4.4 Schedules

Schedules will be developed from the course description and outline, the latest Apollo Program schedules, and MSC astronaut familiarization schedule. They will contain provisioning data relative to familiarization equipment, facilities, lesson plans, instructors, and crew members. This part of the familiarization plan will give visibility to the total crew familiarization program and will clearly portray major familiarization milestones, critical familiarization events, schedule slippage or compromise provisioning inadequacies and current status.

10.4.5 Familiarization Evaluation

A performance measurement system will be developed to assure an effective familiarization program and crew-system integration. MSC will evaluate the crew proficiency in relation to the familiarization course objectives. Approval of crew efficiency to successfully conduct mission operations will be the responsibility of MSC.

10.5 IMPLEMENTATION

The preparation for crew familiarization will consist of the following:

a. A detailed preparation and presentation of data identified in the familiarization requirements analysis and familiarization plans.

b. Design and fabrication of additional familiarization equipment defined in the familiarization requirements analysis.

c. Utilization of equipment and facilities identified in the familiarization requirements analysis.

d. An evaluation of knowledge and skills required to conduct crew familiarization.

To assure crew proficiency, crew familiarization will be conducted using the course description and outline, lesson plans, familiarization equipment and facilities identified/developed in the technical requirements analysis and familiarization plan developed phases.

NASA configuration management techniques will be used for familiarization equipment provisioning and control to assure that the equipment is current with flight hardware configuration and program schedules.

A monthly status report will be submitted. In addition to the information required by the reporting procedures, the report will contain any problem encountered and the solution, schedule slippages with justification and recommended corrective action, and current status.

Familiarization evaluation reports will be submitted by the instructor at the completion of each lesson. This report will contain lesson number and title, name of instructor, names of crew members participating, actual time required for course completion, evaluation of crew proficiency, degree of familiarization equipment efficiency, recommendations to improve lesson plan, and recommendations concerning crew-system interfaces.

10.6 FAMILIARIZATION MANAGEMENT

The methods and procedures specified herein will provide assurance that the crew familiarization requirements for the S-IVB Spent Stage Experiment will be satisfied. It will assure that requirements are identified and satisfied in a manner and time frame permitting effective integration and control of this program with the MSC astronaut training program.

Major milestones, program elements, and functional flow paths are shown in Figure 10.6-1. Each function is shown within its program element and is defined within the program element text shown for that function. Each function will be further defined and maintained during the life of the program.

The documentation developed for each of the functions is shown in Figure 10.6-2. The documentation used will be structured to permit common use in establishing the familiarization baselines and in performing program requirements. Documentation will be revised throughout the program to maintain familiarization and equipment current with program configuration and schedules.

FIGURE 10.6-1 **FAMILIARIZATION PLAN FLOW PATH**

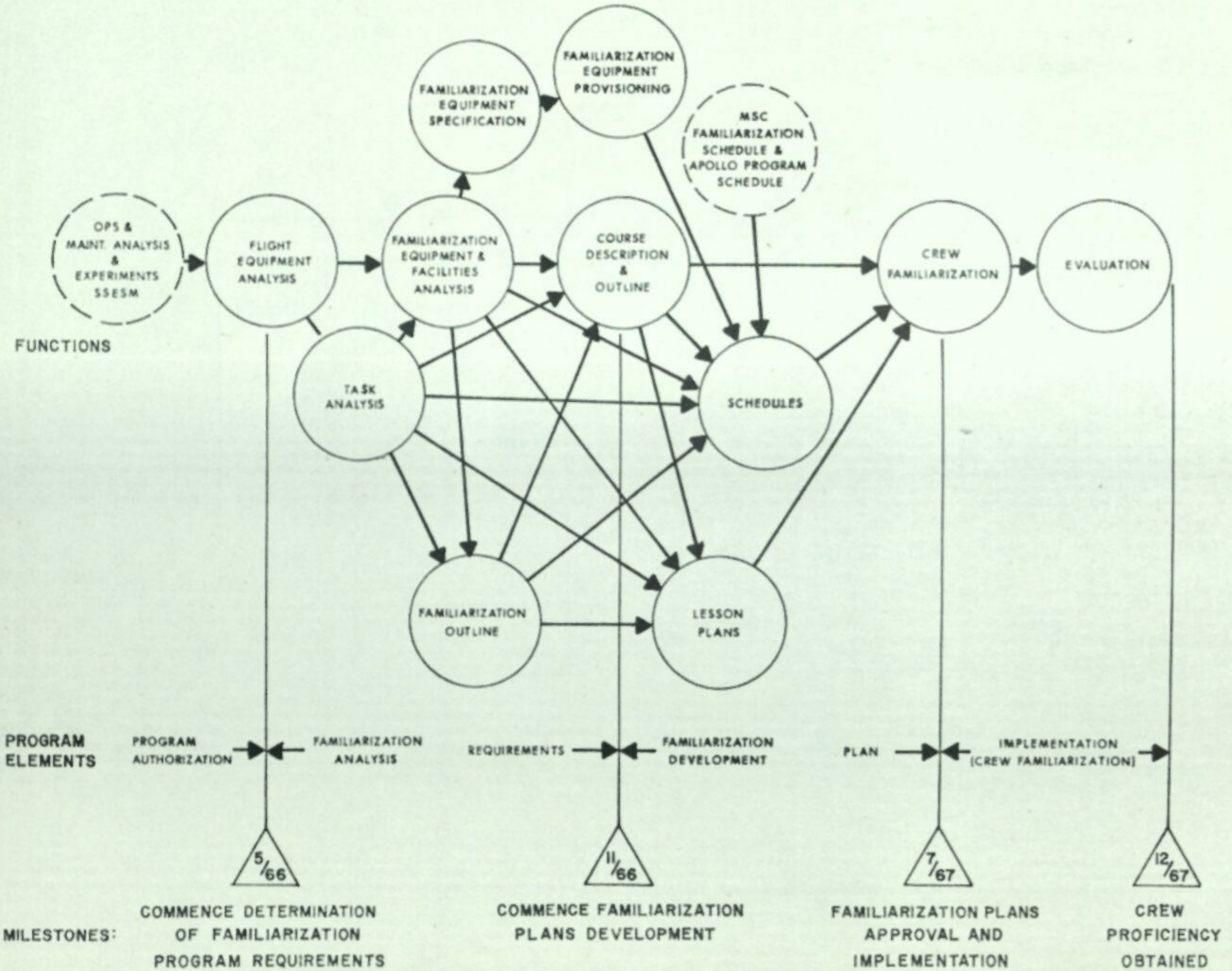


FIGURE 10.6-2 - FAMILIARIZATION FUNCTIONS AND RELATED DOCUMENTATION