SID 66-1424

MISSION MODULAR DATA BOOK

Second Block I Manned Mission

1 November 1966

SYSTEMS ENGINEERING, APOLLO

NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION

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Approved by

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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

TECHNICAL REPORT INDEX/ABSTRACT

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*TEST OBJECTIVES

ABSTRACT

TO BE USED IN CONJUNCTION WITH SID 66-1177, MISSION MODULAR DATA BOOK, FIRST BLOCK I MANNED MISSION. PRESENTS ONLY THE DATA WHICH ARE SIGNIFICANTLY DIFFERENT FROM SID 66-1177.

FOREWORD

The Mission Modular Data Book, Second Block I Manned Mission, was prepared by the Spacecraft Requirements Group in accordance with ACN 1252, which defines the revised NAA support to the NASA mission planning effort. This book presents only the data which are significantly different from those in SID 66-1177. Therefore, it should be used in conjunction with the Mission Modular Data Book, First Block I Manned Mission.

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ILLUSTRATIONS

TABLES

1.0 INTRODUCTION

1.1 SCOPE OF THE MMDB

In view of the similarity between the spacecraft to be used on the first and second Block I manned missions, this report has been prepared for use in conjunction with the Mission Modular Data Book, First Block I Manned Mission, SID 66-1177, dated 1 September 1966 (hereafter referred to as SID 66-1177). The mission planning data presented in SID 66-1177 are given in parametric form as functions of spacecraft weight, time, maneuvering rate, deadband width, etc., which are within the range of the existing spacecraft variations.

Of the seven sections in SID 66-1177, only three are changed in this volume:

Section 1.0	Introduction
Section 6.0	Building Blocks
Section 7.0	Test Objectives

The remaining sections—i.e., 2.0 Spacecraft Constraints, 3.0 Electrical Power, 4.0 Communications, and 5.0 Propellant Requirements—are directly applicable to this data book. The common-level concept and techniques for mission synthesis, as described in SID 66-1177, remain the same.

1.2 BUILDING BLOCKS

Of the twenty-five building blocks presented in SID 66-1177, one block has been changed (BB-17: Experiments) and one block added (BB-19: Rendezvous and Simulated Docking). Although some of the scientific experiments are the same as those performed on the first Block I manned mission, they have been included in Building Block 17 of this volume to provide full block coverage for each spacecraft.

As discussed in the Introduction to SID 66-1177, the information presented is applicable to earth-orbital manned missions at altitudes less than 450 nautical miles. The building blocks are self-contained packages of information for each function and/or spacecraft event. Since a rendezvous and simulated docking maneuver was not a test objective for the first manned mission, Building Block 19 has been prepared to cover this event. It would be identified as a category C operation in Table 1-1 of SID 66-1177.

6.0 BUILDING BLOCKS

The two building blocks included in this volume represent the changes to Section 6.0 of SID 66-1177 that arê unique to the second Block I manned mission. All blocks presented in SID 66-1177 that are not specifically mentioned herein are assumed to require no changes and may be used directly for either mission.

BUILDING BLOCK 17: EXPERIMENTS

17.1 INTRODUCTION

This section contains information on the spacecraft in-flight experiment requirements. The experiments are classified as medical (M), scientific (S), and technological (T) experiments. They are listed in the Summary (Table 6-1). Spacecraft stowage volumes are defined in Figure 6-1. A detailed list of experiment equipment stowed in each volume is presented in Table 6-2.

All experiments will be subject to the following rules:

1. Experiments shall not interfere with the crew's primary activities or responsibilities.

2. Experiments shall not be performed during emergency conditions.

17.2 SUMMARY

Table 6-1 summarizes this block.

Table 6-1. Summary of BB-17: Experiments

Experiments			Block Para.	Requirements for Experiment			
Number		Title		Spacecraft Power	Attitude Hold	Astronauts Participating	Remarks
Old	New						
M-4A	M-004	In-flight Phono-cardiogram	17.3	0.8 + 7.2 watts for MDAS	None	Commander and navigator	Data recorded on MDAS power
M-5A	M-005	Biomedical Assays, Body Fluids	17.4	None	None	All	Experiment limited by number of sample bags
M-6A	M-006	Bone Demineral-ization	17.5	None	None	All	No in-flight interface

Table 6-1. Summary of BB-17: Experiments (Cont)

Experiments			Block Para.	Requirements for Experiment			
Number		Title		Spacecraft Power	Attitude Hold	Astronauts Participating	Remarks
Old	New						
M-7A	M-007	Calcium Balance Study	17.6	None	None	All	M-5A equipment plus fecal canister
M-11	M-011	Cytogenetic Blood Studies	17.7	None	None	All	No in-flight interface
M-12	M-012	Exercise Ergometer	17.8	4 watts + 7.2 watts for MDAS	None	All	No ΔV's permitted during experiment. M-012 performed in conjunction with M-019 and M-020
M-19	M-019	Metabolic Rate Measurement	17.9	3.5 watts + 7.2 watts for MDAS	None	Any one astronaut	Utilizes MDAS. Performed in conjunction with M-012 and M-020
M-20	M-020	Pulmonary Function	17.10	3.5 watts + 7.2 watts for MDAS	None	Any one astronaut	Utilize M-019 gas meter and MDAS
M-23	M-023	Lower Body Negative Pressure	17.11	None	None	Any one astronaut	No in-flight interface
S-5A	S-005	Synoptic Terrain Photography	17.12	None	SC-Z axis perpendicular to earth	Any one astronaut	20 lb of RCS fuel allotted
S-6A	S-006	Synoptic Weather Photography	17.13	None	SC-Z axis perpendicular to earth	Any one astronaut	20 lb of RCS fuel allotted
S-14	T-004	Orbital Otolith Function	17.14	20 watts continuous + 49.5 peak during experiment readout	None	Any one astronaut	Shares data handling sys and display controls with S-017
S-15	S-015	Zero-g Single Human Cell	17.15	7.5 watts	None	One astronaut	

Table 6-1. Summary of BB-17: Experiments (Cont)

Experiments				Requirements per Experiment			
Number							
Old	New	Title	Block Para.	Spacecraft Power	Attitude Hold	Astronauts Participating	Remarks
S-16	S-016	Trapped Particle Asymmetry	17.16	None	Orient SC to the direction of the earth's magnetic field	One astronaut	±2 degrees attitude constraint. 48 lb of RCS fuel required. Utilizes airlock
S-17	S-017	X-ray Astronomy	17.17	102.5 watts +20 watts if active thermal control used	Manually point +Z in the desired direction during experiment performance	One astronaut	100 lb of RCS fuel required
S-18	S-018	Micrometeorite Collection	17.18	None	None	One astronaut	Total exposure of 8 hr utilizing airlock without attitude control
		Medical Data System (MDAS)	17.19	6.0 watts continuous +1.2 watts when recorder is on	NA	NA	
		Experiments Airlock	17.20	None	NA	NA	Used for experiments S-016 and S-018

17.3 M-004 IN-FLIGHT PHONOCARDIOGRAM

17.3.1 Introduction

The purpose of experiment M-004 is to obtain functional status information on the astronaut's heart during prolonged space flight. An in-flight recording of the phonocardiographic heart sounds will be compared with a simultaneous recording of the highest EKG signal to determine the time interval between electrical activation of the heart muscle (myocardium) and the onset of ventricular systole (heart contraction).

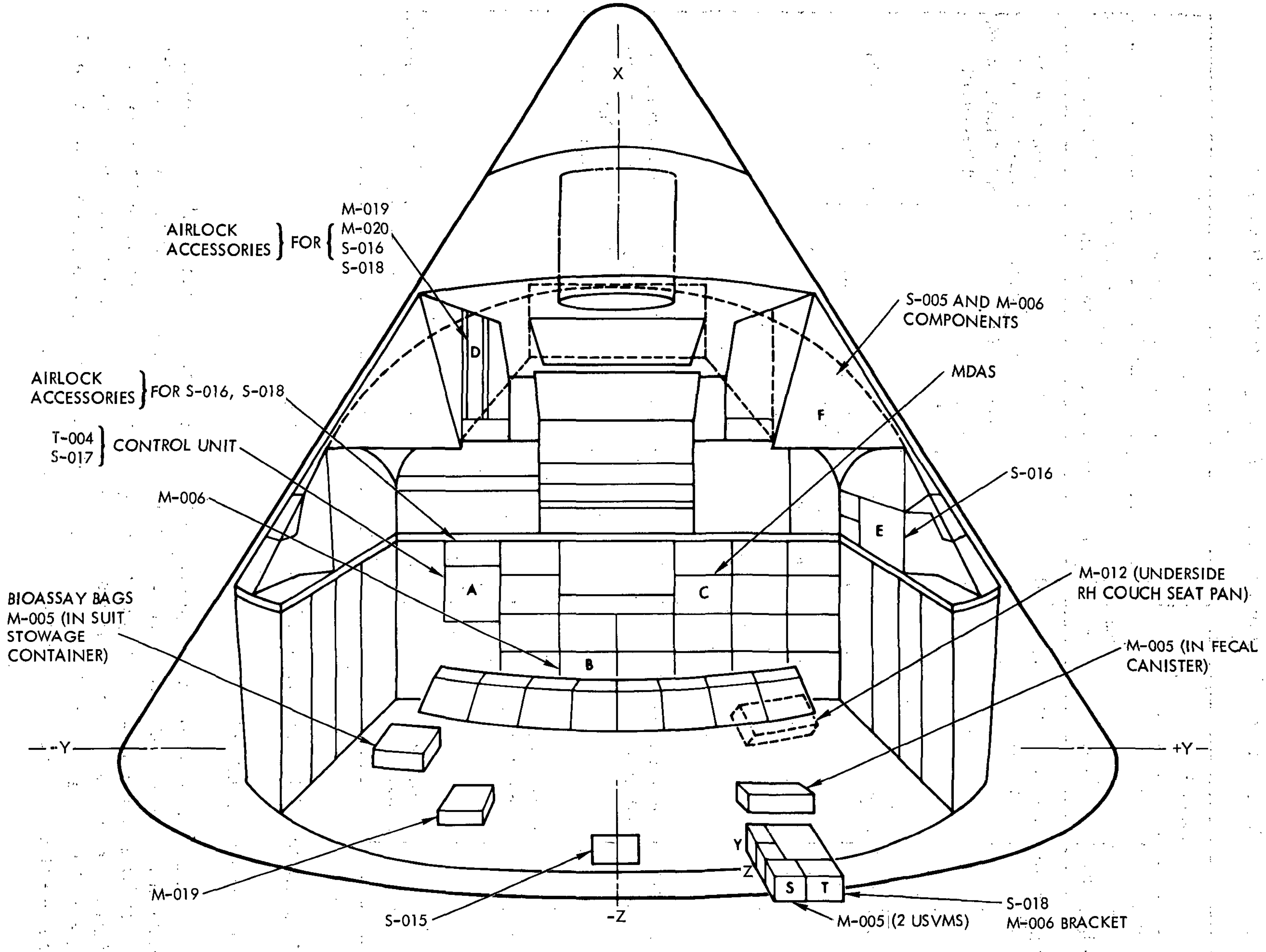


Figure 6-1. Spacecraft Experiment Stowage Locations

Table 6-2. Experiment Equipment Stowage

Equipment	Stowage Volume									Utilization
	A	B	C	D	E	F	S	T	Y	
Controls and displays panel	1									T-004 and S-017
Standpipe	1									(Airlock) S-016 and S-018
Extension rod	1									(Airlock) S-016 and S-018
Handle rod	1									(Airlock) S-016 and S-018
Ablator door rod	1									(Airlock) S-016 and S-018
70-mm film packs		8								S-005 and operational
MDAS			1							MDAS
Interconnecting hose (3/4 OD x 24. 11)				1						M-019 and M-020
Nose clip				3						M-019 and M-020
Mouthpiece				3						M-019 and M-020
Breathing valve				1						M-019 and M-020
Airlock handle				1						(Airlock) S-016 and S-018
Pulmonary gas bag assembly				3						M-020
Protractor				1						
Active unit					1					S-016
Calibration unit					1					S-016
70-mm camera and ring sight						1				S-005 and operational
70-mm film pack						3				S-005 and operational
Spot meter						1				S-005 and operational
Exposure dial						1				S-005 and operational
250-mm lens						1				S-005 and operational
USVMS unit							2			M-005
Receivers							3			M-005
Filter (USVMS valve assembly)							1			M-005
S-018 experiment								1		S-018
Camera bracket								1		S-006
Octopus cable						1				S-005

Additional experiment stowage locations:

Suit storage container (under LH couch)
- 2 M-005 bags (V16-750098-41 and -51 assemblies)
- 112 M-005 sample bags (total -41 and -51)
- 21 plastic bags (under main lid -41 and -51) M-005
- 2 cuff bags
- 2 mixing bags (M-005)

M-012 Ergometer (under RH couch seat pan)
S-015 Experiment (1) (aft of center couch on aft bulkhead)
M-019 Experiment (1) (aft bulkhead aft of LH couch)
1 USVMS unit (M-005) in fecal canister

17.3.2 General Information

Performance of the experiment is dependent upon the prior connection of the octopus cable to the medical data acquisition system (MDAS) and to the power source. The biomedical instrumentation interfaces with the MDAS by means of a "T" adapter installed at the cobra cable/spacecraft electrical interface of each crew position. There will be three T adapters. The octopus cable is connected to the T adapter of the crewman to be recorded, and the telemetry input biomedical switch is set to either crewman. Test subjects will be the commander and navigator.

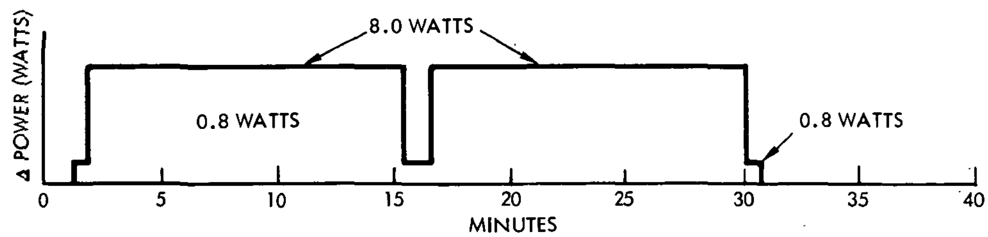
17.3.3 Operational Timeline Segment

Time (min:sec)	Function	ΔTime (min:sec)
t_o + 00:00	Connect octopus cable to T adapter of crewman to be recorded	00:50
t_o + 00:50	Perform required electrical switching for recording of data	00:10
t_o + 01:00	Record data	15:00
t_o + 16:00	Biomedical tape recorder selector switch to OFF	00:10
t_o + 16:10	Transfer cable to T adapter of next subject	00:50
t_o + 17:00	Perform required electrical switching for recording of data	00:10
t_o + 17:10	Record data	15:00
t_o + 32:10	Biomedical tape recorder selector switch to OFF	00:10
t_o + 32:20	Cycle complete	

Minimum total time = 32:20

17.3.4 Power Requirement

The electrical power profile is depicted as follows. M-004 requires 0.8 watts continuously while operating. The MDAS requires 6.0 watts continuously plus 1.2 watts for the recorder.



17.4 M-005 BIOMEDICAL ASSAYS, BODY FLUIDS

17.4.1 Introduction

The purpose of experiment M-005 is to identify body changes that occur within the astronauts during weightlessness. This is accomplished by a careful postflight analysis of body fluids collected during flight. Urinalysis will yield medical information on such biochemical constituents as body steroids, catecholamines, enzymes, and salts. This experiment utilizes a radioactive aqueous solution for the urine volume/sample correlation. The radioactive course is tritium in nondangerous quantities.

17.4.2 General Information

Two crewmen will participate in the experiment, and each will have his own personal urine sampling and volume measuring system (USVMS) unit. All urine eliminations are collected by means of the urine sampling devices, and a tritium tracer is introduced. A 75 cc sample of each micturition is taken, and the remainder is dumped overboard. The tritium radioactivity cannot penetrate its containers, either in the accumulator on the USVMS or in the sample bags. The potential experimental limitations are the quantity of sample bags (112), the supply of tritium in the USVMS, and the available entry stowage volume. After completion of the experiment, the crew will use the operational WMS for voiding.

17.4.3 Operational Timeline Segment

Time (min:sec)	Function	Δ Time (min:sec)
t_o + 00:00	Place bio-assay bag in operational stowage, LEB	01:15
t_o + 01:15	Ingress to aft equipment bay from LEB	01:00
t_o + 02:15	Obtain urine sampling devices from stowage, aft bay	00:45
t_o + 03:00	Ingress to LEB from aft equipment bay	01:00
t_o + 04:00	Prepare urine sampling device for use	02:05
t_1 + 00:00	Obtain and stow urine sample, LEB	12:05
t_2 + 00:00	Secure urine sampling device, LEB	02:20
t_2 + 02:20	Ingress to aft equipment bay from LEB	01:00
t_2 + 03:20	Stow urine sampling device, aft equipment bay	00:55
t_2 + 04:15	Ingress to LEB from aft equipment bay	01:00
t_3 + 00:00	Place bio-assay bag in boost/entry stowage, aft equipment bay	01:30
t_3 + 01:30	Complete cycle	

Minimum total time = 24:55

17.5 M-006 BONE DEMINERALIZATION

The purpose of experiment M-006 is to determine the effect of weightlessness and immobilization during space flight on the demineralization of certain bones within the body of each astronaut. (NOTE: No in-flight interface)

17.6 M-007 CALCIUM BALANCE STUDY

17.6.1 Introduction

The purpose of this experiment is to determine the rates of muscle and bone catabolism (nitrogen and calcium balance studies) on prolonged space flights.

17.6.2 General Information

Astronauts will be maintained on a 0.8 to 1.0 gram calcium diet for two weeks prior to flight, during flight, and for two weeks postflight. Careful recording of intake and output will be required, and 100 cc aliquots of timed urine specimens will be analyzed. Dietary intake will be carefully analyzed for calcium content, and a careful dietary record must be maintained. A mild laxative will be required postflight. Two 5-cc blood samples will be required before and after flight with approximately a week between each sample. Urine will be analyzed for phosphorus, nitrogen, other minerals, and hydroxproline. Nitrogen balance determinations will be made. Total fecal specimens shall be stored.

17.6.3 Operational Timeline Segment

To be added at a later date.

17.6.4 Power Requirement

None

17.6.5 RCS Propellant Requirement

None

17.7 M-011 CYTOGENETIC BLOOD STUDIES

The purpose of experiment M-011 is to conduct preflight and postflight analyses to determine if space environment produces cellular changes in the blood of the astronauts. These changes may not be apparent from routine monitoring procedures. (NOTE: No in-flight interface)

17.8 M-012 EXERCISE ERGOMETER

17.8.1 Introduction

The purpose of experiment M-012 is to determined the benefits of exercise during space flight.

17.8.2 General Information

This experiment will be performed by each of the three crewmen, one time on the fourth, eighth, and twelfth day of the mission. Additional exercise requirements will be satisfied by using a bungee.

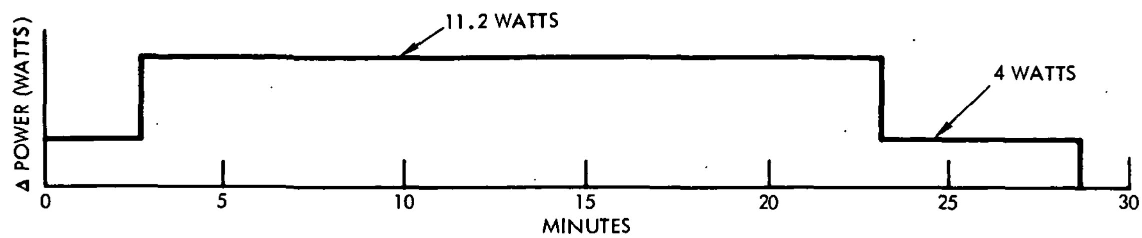
17.8.3 Operational Timeline Segment

Time (min:sec)	Function	Δ Time (min:sec)
t_o + 00:00	Unstow ergometer and prepare for use	03:10
t_1 + 00:00	Obtain couch pads and position for exercise	01:30
t_1 + 01:30	Remove clinical monitoring equipment from stowage	00:41
t_1 + 02:11	Activate biomedical tape recorder and monitor blood pressure, oral temperature and biomedical functions	04:41
t_1 + 06:52	Exercise	15:00
t_1 + 21:52	Monitor blood pressure, oral temperature, and biomedical functions	03:02
t_1 + 24:54	Deactivate recorder and stow clinical equipment	01:31
t_1 + 26:25	Remove pads from exercise position and install on center couch	01:15
t_2 + 00:00	Stow ergometer	05:31
t_2 + 05:31	Complete cycle	

Minimum total time = 36:21

17.8.4 Power Requirement

The electrical power profile for M-012 is presented as follows. The M-012 requires 4 watts for operation. The MDAS requires 6.0 watts continuously plus 1.2 watts for 3 recorders.



17.9 M-019 METABOLIC RATE MEASUREMENT

17.9.1 Introduction

The purpose of the experiment is to measure the metabolic rates of the astronauts during space flight. This measurement will provide data concerning the activity level of the astronauts in the gravity-free environment of the CSM. Information will be provided which is essential for the establishment of physiological requirements in the areas of respiration, nutrition, and thermal balance.

17.9.2 General Information

An established method for the determination of metabolic rate is that of indirect calorimetry in which oxygen consumption is determined from the measurement of respired gases. This method is appropriate for spacecraft use. An astronaut is required to assemble equipment and perform the experiment two or three times per 24-hour period. The astronaut removes the gas meter from the stowed position and places the instrument on the food shelf. He removes from Volume D a nose clip, mouthpiece, breathing valve, and connecting tubing and cables. After assembling this equipment, he breathes into the gas meter during periods of rest and at varying activity levels. Experiment duration will be 10 to 20 minutes.

17.9.3 Operational Timeline Segment

To be added when available.

17.9.4 Power Requirement

The M-019 gas meter requires 3.5 watts continuously while operating, plus 7.2 watts required for the MDAS and recorders.

17.10 M-020 PULMONARY FUNCTION

17.10.1 Introduction

The purpose of experiment M-20 is to investigate and measure the changes in vital capacity, residual volume, and maximum breathing capacity of astronauts functioning in a space environment.

17.10.2 General Information

Vital capacity, tidal volume, and expiratory reserve volume are determined by standard exhalation spirometric maneuvers. A nose clip, mouthpieces, a breathing valve and dry gas meter (M-019) type spirometer are used. Respiratory rates are obtained from the operational safety monitoring impedance pneumograph and are used along with the total volume expired (as measured by the gas meter) to obtain an average tidal volume over a timed interval. A crew member connects the 80-liter lightweight plastic film bag to the gas meter, and all the gas within the bag is evacuated through the meter for volume measurements. Expired volumes for maximum voluntary ventilation are collected over a 15-second period of maximum effort. The collection will be for a 30-second timed period. The exercise rate will be 3000 ft-lb/minute for 15 minutes. Expired volumes or resting minute volumes will be collected through a 15-minute pre-exercise resting period.

17.10.3 Operational Timeline Segment

To be added when available.

17.10.4 Power Requirement

This utilizes the M-019 gas meter which requires 3.5 watts continuously while operating plus 7.2 watts required for the MDAS and recorder.

17.11 M-023 LOWER BODY NEGATIVE PRESSURE

17.11.1 Introduction

The purpose of this experiment is to assess any progressive decrement in integrity of the cardiovascular system following prolonged space flight.

17.11.2 General Information

This experiment will be pre- and postflight tests only. There are no spacecraft requirements. The mission requirements are:

1. Preflight tests:

   a. One day (10 to 12 hours) one month before flight

   b. Fifteen minutes before or after each preflight tilt

2. Postflight tests:

   — Fifteen minutes before or after each postflight tilt

17.11.3 Operational Timeline Segment

Not applicable.

17.11.4 Power Requirement

None

17.12 S-005 SYNOPTIC TERRAIN PHOTOGRAPHY

17.12.1 Introduction

The purpose of experiment S-005 is to obtain photographs of selected areas of the earth from the spacecraft at orbital altitude. These photographs are required for research in geology, geophysics, geography, and oceanography.

17.12.2 General Information

This experiment consists of photographing certain areas and features along the spacecraft flight path. The desired camera angle for taking pictures (with spacecraft window in shade) will be 90 degrees from spacecraft level flight to local horizontal over the earth. Service module RCS propellant required for spacecraft orientation to conduct S-005 and S-006 is approximately 0.5 pounds per cycle. Photographs will also be taken from other camera angles. The photographs may be taken by any crew member, and from any window. A total of four magazines, two color, one black-and-white, and one infrared, will be provided for both experiments S-005 and S-006. It is not known what film will be used for each experiment. A written log of each photograph, including time, object, magazine number, and frame number, will be maintained. Attitudes and rates are not critical so long as motions do not disturb the taking of photographs; however, data on attitudes and rates will be useful as backup information for target locations. Photography may be conducted from 9:00 a.m. to 3:00 p.m. local time (approximately 22.5 minutes per orbit are available). There is a spacecraft temperature limit of 120 F for this experiment.

17.12.3 Operational Timeline Segment

Time (min:sec)	Function	Δ Time (min:sec)
t_o + 00:00	Unstow 70-mm camera and film magazines (Volume A)	01:00
t_o + 01:00	Stow camera and film magazines in operational stowage	01:00
t_o + 02:00	Ingress crew couch	00:06
t_1 + 00:00	Remove 70-mm camera and film magazines from operational stowage	00:45
t_1 + 00:45	Exchange film magazine as required	00:10
t_1 + 00:55	Photograph targets Interior lights OFF	00:45
t_1 + 01:40	Return camera and film magazines to operational stowage	01:00
t_2 + 00:00	Egress crew couch	00:06
t_2 + 00:06	Remove 70-mm camera and film magazines from operational stowage	01:00
t_2 + 01:06	Stow camera and film magazines (Volume A)	00:10
t_2 + 01:16	Cycle complete	

Minimum total time = 6:02

17.12.4 Power Requirements

None

17.12.5 RCS Propellant Requirement

This experiment requires 20 pounds of RCS fuel.

17.13 S-006 SYNOPTIC WEATHER PHOTOGRAPHY

17.13.1 Introduction

The purpose of experiment S-006 is to obtain selective, high-quality photographs of cloud patterns taken from the spacecraft at orbital altitude. These photographs will be used for studies of weather system structures around the earth.

17.13.2 General Information

Same as 17.8.2.

17.13.3 Operational Timeline Segment

Same as 17.8.3.

17.13.4 Power Requirement

None

17.13.5 RCS Propellant Requirement

This experiment requires 20 pounds of RCS fuel.

17.14 T-004 ORBITAL OTOLITH FUNCTION

17.14.1 Introduction

The purpose of experiment T-004 is to record directly the changes in activity of the otolith system which might take place in orbital flight (using bullfrogs as subjects).

17.14.2 General Information

The orbital otolith experiment is designed to record the bioelectric action potentials in the bullfrog during weightlessness and repeated accelerations (obtained by spinning the animals with a small rotator) and to determine the adaptability of the otolith system to weightlessness and acceleration during extended periods of flight. The experiment equipment will have continuous power supplied to it after installation into the spacecraft just before launch. This power will be provided initially by a ground power source. At approximately T-3 hours an astronaut positions the main A nonessential bus to ON and pushes the T-004 experiment circuit breaker in.

This switches power from the ground source to spacecraft power. While the spacecraft is in flight, the stimulus to the otolith system is applied by astronaut-activated rotation (0.5 g) of the specimen capsule.

17.14.3 Operational Timeline Segment

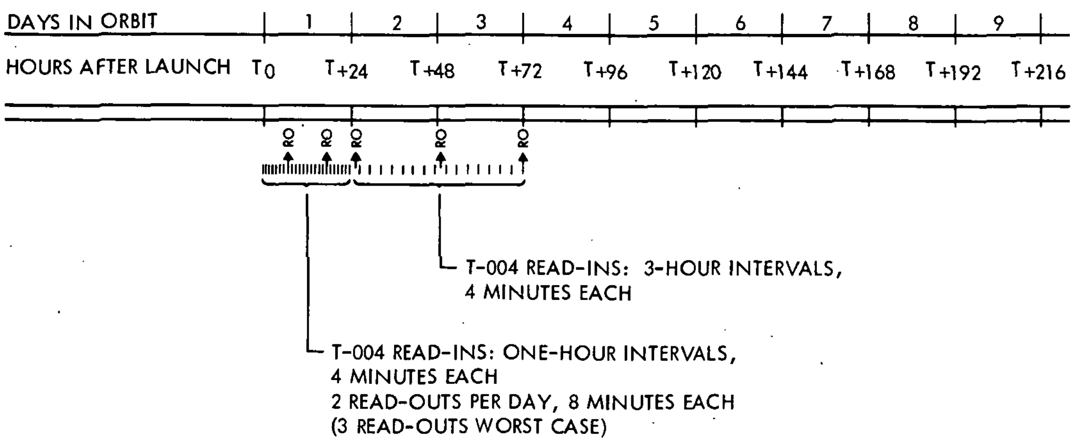
Time (min:sec)	Function	ΔTime (min:sec)
	Activate experiment T-004/S-017 main power	
t_o + 00:00	Open scientific compartment A	00:15
t_o + 00:15	Set T-004 main power switch to ON	00:05
t_o + 00:20	Close scientific compartment A	00:15
	Perform experiment T-004 test cycle	
t_1 + 00:00	Open scientific compartment A	00:15
t_1 + 00:15	Depress FROG PWR ON button on portable control unit	00:05
t_1 + 00:20	Depress RCDR READ IN button on portable control unit	00:05
t_1 + 00:25	Record mission time and frog cycle number on recorder	00:47
t_1 + 01:12	Verify frog cycle number in experiments log	00:20
t_1 + 01:32	Depress VOICE button on portable control unit	00:05
t_1 + 01:37	Announce mission elapsed time and frog cycle number	00:20
t_1 + 01:57	Release VOICE button on portable control unit	00:02
t_1 + 01:59	Depress FROG CENT CYCLE button on portable control unit	00:05
t_1 + 02:04	Record frog cycle number and mission elapsed time in experiments log	01:00
t_1 + 03:04	Wait time: to complete experiment/recording cycle	05:38
	Note: After completion of four experiment cycles, allow the data recorder to operate	4 x 8:42 = 34:48

Time (min:sec)	Function	ΔTime (min:sec)
	until end of tape is reached, as indicated by illuminated RCDR STOP button (approximately two minutes of additional operation).	
t_1 + 34:48	Depress OFF button on portable control unit	00:05
t_1 + 34:53	Close scientific compartment A	00:15
	Perform experiment T-004 data dump procedures	
t_2 + 00:00	Open scientific compartment A	00:15
t_2 + 00:15	Depress FROG PWR ON button on portable control unit	00:05
t_2 + 00:20	Depress REAL TIME DATA button on portable control unit	00:05
	Note: Obtain verification from ground tracking station of satisfactory acquisition.	
t_2 + 00:25	Depress RCDR READ OUT button on portable control unit	00:05
t_2 + 00:30	Note: If ground tracking station indicates probable loss of acquisition before data dump completion, depress OFF button and repeat 88312, 88320, and 88321.	
t_2 + 00:35	Wait time: to permit completion of data readout as indicated by illumination of RCDR STOP button	08:00
t_2 + 08:35	Depress OFF button on portable control unit	00:05
t_2 + 08:40	Close scientific compartment A	00:15
	Deactivate experiment T-004/S-017 main power	
t_3 + 00:00	Open scientific compartment A	00:15
t_3 + 00:15	Set FROG LIFE SUPPORT switch to OFF	00:05
t_3 + 00:20	Close scientific compartment A	00:15

Total time = 45:13

17.14.4 Power Requirement

The T-004 otolith experiment requires 20 watts continuous power dissipation from the time the live specimens are inserted through completion of their operational cycle. The following profile includes this requirement in the total power dissipation analysis.



- RECORDER READ-OUTS REQUIRE 33 WATTS TOTAL POWER DISSIPATION.
- READ-INS REQUIRE 44.5 WATTS NORMAL; 69.5 WATTS FOR 20-SECOND PEAK DURING READ-INS FOR TOTAL POWER DISSIPATION.

17.15 S-015 ZERO-G SINGLE HUMAN CELL

17.15.1 Introduction

The purpose of experiment S-015 is to study the influence of zero gravity on living human cells and tissue cultures. The experiment will try to answer the question of whether or not the absence of gravity has a significant effect on isolated human cells. The investigation will consist of the recording of the morphologic and physiologic functions of the cells and the bio-chemical status of the cells at zero gravity.

17.15.2 General Information

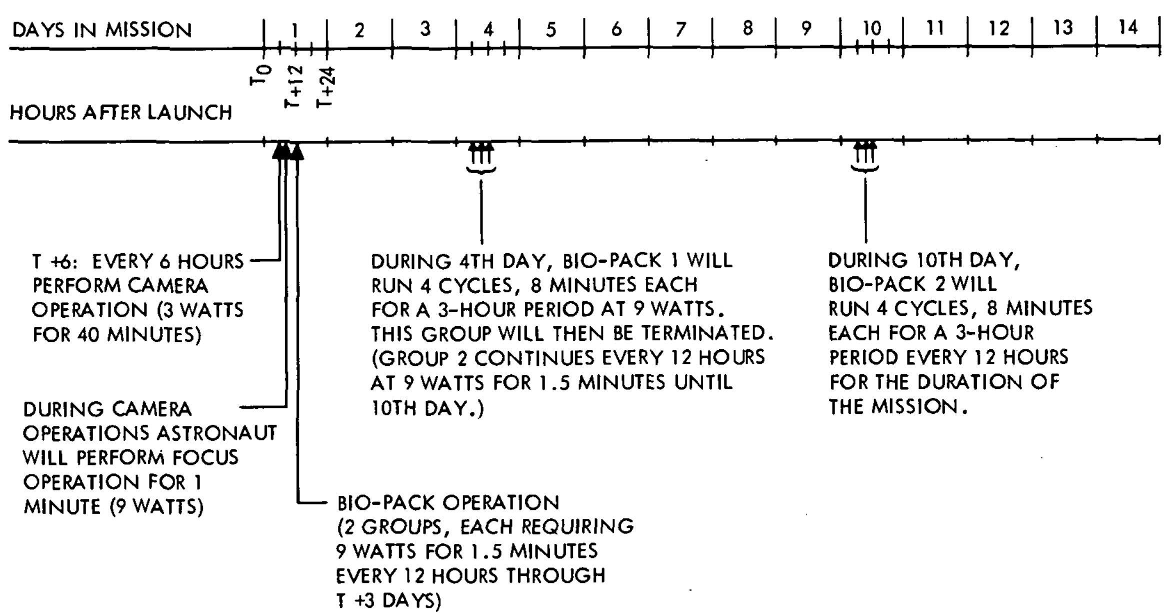
The experiment procedure is to record by phase contrast time-lapse motion pictures the functional and morphological aspects of single living human cells. These will include a study of pinocytosis, mitosis, cell size, and motion. A crew member is required to focus the microscope and turn the camera on and off. Astronauts must be trained sufficiently in basic biology to interpret cell changes that are significant to experiment procedures. During the flight, an astronaut must focus the microscope, operate the camera, and activate the pump, to pump fluid to the culture slide for tracking, preserving, and treating the cells (using a source radiation). This will require a period of time totaling perhaps 5 minutes four to five times during a 24-hour period in flight.

17.15.3 Operational Timeline Segment

To be added when available.

17.15.4 Power Requirement

The S-015 experiment heaters will require 9.9 watts, continuously. If temperature $\ll$ 75 F ambient, heaters may pull 19.8 watts. This is in addition to the power requirements indicated in the following profile.



17.16 S-016 TRAPPED PARTICLE ASYMMETRY

17.16.1 Introduction

The objective of experiment S-016 is to measure the Van Allen proton spectrum to as low as 2-5 Mev, measure the directional differential energy spectra for trapped protons to their maximum energies, and measure the proton pitch-angle distribution; to search for trapped particles heavier than protons; and to estimate the energy deposited in the outer layers of the emulsion by energetic electrons.

17.16.2 General Information

An astronaut deploys the nuclear emulsion stack through the airlock adapter. This package is to be accurately oriented relative to the earth's magnetic field. Exposure time to the outer atmosphere is planned during the last day of the mission until just before entry. The spacecraft will maintain a specific attitude while passing through the South Magnetic Anomaly above 160 nautical miles. There are no requirements for specific attitude when the vehicle is passing through the anomaly under 160 nautical miles. No attitude requirements are in effect anytime the spacecraft is not in the anomaly.

17.16.3 Operational Timeline Segment

Time (min:sec)	Function	ΔTime (min:sec)
	REMOVE ABLATOR DOOR FROM HATCH	
t_o + 00:00	Remove canister from airlock	00:15
t_o + 00:15	Remove ablator rod from stowage	00:30
t_o + 00:45	Insert ablator rod in canister	00:15
t_o + 01:00	Install canister on airlock and latch clamp mechanism	00:30
t_o + 01:30	Open airlock door	01:44
t_o + 03:14	Engage rod in ablator door	00:36
t_o + 04:01	Receive tool E/J assembly and tether	00:20
t_o + 04:21	Lock rod to ablator	00:26

Time (min:sec)	Function	Δ Time (min:sec)
t_o + 04:52	Pull ablator door into canister	00:43
t_o + 05:35	Close airlock door	01:49
t_o + 07:19	Remove canister with ablator door from airlock	01:06
t_o + 08:25	Stow ablator door with rod on main hatch and stow canister temporarily	00:20
	PREPARE S-016 UNIT FOR DEPLOYMENT	
t_1 + 00:00	Attach E/J lanyard to wrist	00:20
t_1 + 00:20	Obtain collar from Volume D	00:21
t_1 +00:41	Obtain standpipe from Volume A	00:26
t_1 + 01:22	Remove canister from temporary stowage	00:15
t_1 + 01:37	Assemble standpipe and collar to canister	00:20
t_1 + 04:44	Assemble deployment rod assembly and insert into standpipe	00:30
t_1 + 05:15	Obtain experiment S-016 unit	00:20
t_1 + 06:00	Attach S-016 unit to deployment rod	01:00
t_1 + 07:00	Install canister with S-016 unit on airlock and latch clamp mechanism	01:05
	DEPLOY EXPERIMENT S-016 NUCLEAR EMULSION DETECTOR UNIT	
t_2 + 00:00	Open airlock	01:44
t_2 + 01:44	Deploy experiment S-016	00:26
t_2 + 02:10	Withdraw experiment S-016 unit into canister	00:50

Time (min:sec)	Function	ΔTime (min:sec)
t_2 + 03:00	Close airlock door	01:09
	SECURE EXPERIMENT S-016	
t_3 + 00:00	Remove canister with experiment from airlock	00:55
t_3 + 00:55	Remove experiment S-016 unit from deployment rod	00:36
t_3 + 01:31	Stow S-016 unit	00:46
t_3 + 02:17	Remove canister and standpipe from deployment rod assembly	01:00
t_3 + 03:17	Stow protractor and handle	00:41
t_3 + 03:58	Disassemble deployment rods	02:26
t_3 + 06:24	Receive canister with standpipe and collar	00:20
t_3 + 06:44	Remove ablator door from stowage on hatch	00:21
t_3 + 07:05	Insert ablator rod with ablator door in canister	01:10
t_3 + 08:15	Install canister on airlock and latch clamp mechanism	00:30
t_3 + 08:45	Open airlock door	01:44
t_3 + 10:29	Install ablator door	00:49
t_3 + 11:18	Receive tool E/J assembly and tether	00:30
t_3 + 11:48	Unlock rod from ablator door	00:31
t_3 + 12:19	Withdraw rod from ablator door	00:36
t_3 + 12:55	Detach and pass tool E/J	00:21

Time (min:sec)	Function	Δ Time (min:sec)
t_3 + 13:16	Close airlock door	01:44
t_3 + 15:00	Remove canister from airlock	00:31
t_3 + 15:31	Remove ablator rod from canister	00:10
t_3 + 15:41	Receive ablator door rod	00:05
t_3 + 15:46	Install plug in canister and stow ablator door in Volume A	00:15
t_3 + 16:01	Install canister on airlock and latch clamp mechanism	00:10

Minimum time = 37:10

17.16.4 Power Requirement

None

17.16.5 RCS Propellant Requirement

This experiment requires 48 pounds of RCS fuel.

17.17 S-017 X-RAY ASTRONOMY

17.17.1 Introduction

The purpose of experiment S-017 is to study X-ray sources outside the solar system. These sources cannot be studied from the earth due to absorption of the X-rays into the atmosphere. The scientific objectives of the proposed experiment are:

1. To determine the positions of the known X-ray sources to a few arc minutes
2. To measure the X-ray spectrum from the stronger sources
3. To observe certain objects of astronomical interest for evidence of X-ray emission. These objects would include strong radio emission centers, the galactic center, the ecliptic and certain extragalactic objects such as supernova remnants.

4. To scan the galactic equator for X-ray sources

5. To measure the relative and absolute strengths of the X-ray emission from the sources

17.17.2 General Information

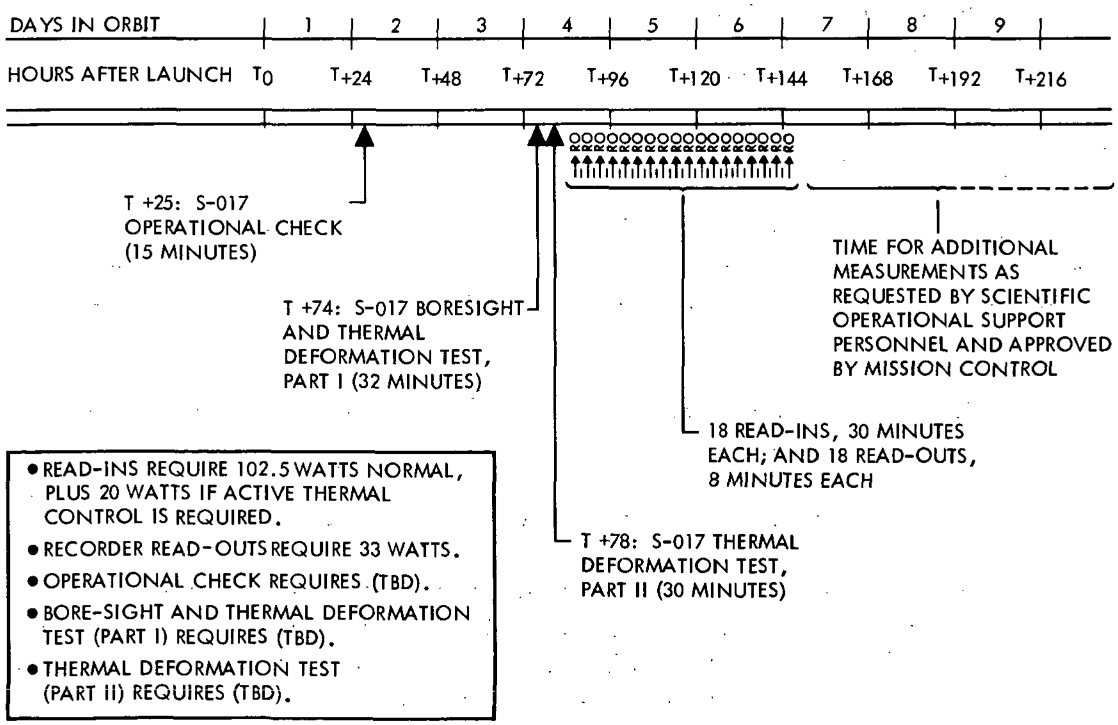
An astronaut performs an in-flight calibration of the position or bore sighting of the X-ray axis. This is done by pointing the star sensor axis at a known star and adjusting the vehicle attitude so that the sensor axis points exactly at the star for an instant. Pressing the MARK button records the G&N (IMU) coordinates at this instant. After this axis calibration, the spacecraft is slewed to observe a known X-ray source or to scan for source. The visual display unit within the command module permits the crew to orient the spacecraft and assists in maintaining the X-ray source in the field of view.

17.17.3 Operational Timeline Segment

To be supplied when available.

17.17.4 Power Requirement

The S-017 experiment requires a total power dissipation of 102.5 watts nominal plus 20 watts if active thermal control is required. The following time-oriented operational profile presents the power dissipation.



17.17.5 RCS Propellant Requirement

This experiment requires 100 pounds of RCS fuel.

17.18 S-018 MICROMETEORITE COLLECTION

17.18.1 Introduction

The purpose of experiment S-018 is to collect small micrometeorites and to measure directly the fluxes of larger micrometeorite particles at satellite altitudes. The secondary purpose is to carry out biological exposure and collection experiments.

17.18.2 General Information

The micrometeorite collection experiment equipment will be stowed in the command module during launch and much of the flight. An astronaut places the collector container in the airlock canister and deploys it by means of an extension rod through the airlock. An in-flight exposure of eight hours is required. This exposure may be continuous or may be conducted during portions of several orbits. There is no requirement for attitude control. The RCS jets will be OFF to prevent collection plate contamination.

17.18.3 Operational Timeline Segment

To be added when available

17.18.4 Power Requirement

None

17.19 MEDICAL DATA ACQUISITION SYSTEM

17.19.1 Introduction

The MDAS is used to record the phonocardiogram (M-004) and biomedical data as well as supporting experiments M-012, M-019, M-020, M-005, and M-007. The biomedical data are used to evaluate experiment M-004. Additionally, timing signals are provided to the onboard voice recorder. The MDAS is installed in Volume C and receives signals and power through the octopus cable. The power is obtained at a connector in Volume A. The tape recorder provides a seven-channel tape record of physiological signals related to the medical experiments. The following data are to be recorded:

1. Impedance pneumograph
2. Electrocardiogram (EKG)
3. Phonocardiogram (PCG)
4. Ergometer work output signal
5. Oral temperature/blood pressure pump
6. Systolic and diastolic markers
7. Time code

17.19.2 General Information

The MDAS recording requirements for this mission are as follows:

Channel	Requirement
1	Impedance pneumograph—2 men 20 minutes each per day
3	Ergometer—3 men 40 minutes each on 4th, 8th, and 12th days
4	ECG 1—2 men 20 minutes each per day
6	ECG 2/phonocardiagram—2 men 20 minutes each per day
7	Timing

17.19.3 Operational Timeline Segment

Time (min:sec)	Function	Δ Time (min:sec)
t_o + 00:00	Unstow octopus cable (Area D)	00:15
t_o + 00:15	Connect octopus cable to biomedical tape recorder	00:10
t_o + 00:25	Verify main power switch OFF	00:02

Time (min:sec)	Function	Δ Time (min:sec)
t_o + 00:27	Route octopus cable and attach to Velcro tabs	02:00
t_o + 02:27	Connect octopus cable to electric power (Area A)	00:10
t_o + 02:37	Connect octopus cable to any crewman's T adapter	00:10
t_o + 02:47	Prepare biomedical tape recorder for service	01:05
t_1 + 00:00	Disconnect octopus cable from crewman's T adapter, electrical power, and biomedical tape recorder Prepare cable for stowage	02:00
t_1 + 02:00	Stow octopus cable (Area D)	00:15
t_1 + 02:15	Cycle complete	

Minimum total time = 6:07

17.19.4 Power Requirement

The MDAS requires 6.0 watts continuously while operating plus 1.2 watts for the biomedical tape recorder plus any additional experiment power requirement.

17.20 EXPERIMENTS AIRLOCK

The airlock experiments canister is utilized for experiments S-016, Trapped Particle Asymmetry, and S-018, Micrometeorite Collection. The airlock consists of an inner hatch pressure door and outer hatch door; inner recessed airlock adapter block; experiment canisters and deployment rods, mechanism, etc. The operation of the airlock system during use for one experiment in flight consists of

1. The inner hatch pressure door is transposed from its closed position to an adjacent open position on the inside surface of the inner structure by means of a hand cranked mechanism.

2. The outer hatch door is withdrawn inward by means of another connector latch rod mechanism so that it clears the inner hatch and then is stored in the inner recessed airlock adapter block.

3. The inner hatch pressure door is reseated to seal the command module.

4. The inner recessed airlock adapter block is removed and stored in spacecraft.

5. The first experiment contained within the canister is clamped and attached to opening flange.

6. The inner hatch pressure door is reopened.

7. The experimental package is deployed beyond the outer mold line by means of a deployment rod.

8. When experiment period is complete, the experiment package is returned within canister.

9. The inner hatch door is closed.

10. The canister with the experiment is removed and stowed.

11. The adapter block which contains the outer hatch door is replaced.

12. The inner hatch door is opened.

13. The outer hatch door is extended into closed position and the deployment rod removed.

14. The inner hatch door is closed.

To run the second experiment, the operation would consist of starting with steps 10 and 11. The first experiment is unloaded and the second experiment fitted in the same canister. The sealing surfaces of the flange are checked, and then steps 4 to 14 are repeated.

BUILDING BLOCK 19: RENDEZVOUS AND SIMULATED DOCKING

19.1 INTRODUCTION

The second Block I manned mission includes a rendezvous and simulated docking maneuver which consists of providing a relative ΔV at CSM/S-IVB separation, so that the CSM passes above and behind the S-IVB, moving away. As the vehicles orbit the earth, the CSM moves below the S-IVB, its velocity increases, and the relative distance between the vehicles decreases. A terminal phase initiation (TPI) maneuver, followed by a braking maneuver, brings the vehicles to a station-keeping configuration, after which the CSM closes on the S-IVB and simulates a docking maneuver.

Building Block 19 (BB-19) differs from the building blocks presented in SID 66-1177 in that a timeline cannot be prepared without knowledge of specific trajectory data. In place of a timeline, a sequence of events is given in Paragraph 19.2.2. In preparing the sequence of events, an attempt was made to utilize those blocks that exist in SID 66-1177. For the phases of Building Block 19 for which this was not possible, recommended procedures are described.

The initial point of reference selected for the sequence of events is the CSM/S-IVB separation (BB-6). This selection provides a convenient reference point and permits a slight alteration in BB-6 without completely rewriting the block.

19.2 OPERATIONAL DATA

19.2.1 General Information

Various assumptions have been made in the preparation of BB-19. Among these assumptions are the following:

1. Prior to CSM/S-IVB separation, an IMU alignment has been performed (BB-7, Case I).

2. The optics have been unstowed and mounted.

3. It is desired to track the S-IVB by optical means following the CSM/S-IVB separation.

4. A docking target will be provided on the simulated lunar module (LM).

5. Acquisition lights will be provided for target identification.

19.2.2 Sequence of Events

The times indicated for each event are approximate and are presented only to ensure that adequate time exists to perform the necessary tasks. Before determining the total electrical power requirements and consumables, it is necessary that the mission planner determine accurate times based on orbital parameters and trajectory data and prorate the applicable blocks identified in the sequence.

Time (Hr:Min:Sec)	Event	Remarks
≈ 00:00:00	CSM/S-IVB Separation	Building Block 6 contains a description of this event. However, the separation velocity for the second Block I manned mission may be other than 3 fps. (Refer to Figure 5-5, Section 5.0, of SID 66-1177 for propellant consumption.) The CSM is in a SCS ΔV mode at this time. Separation can be performed while the S-IVB is maintaining an earth-orbital rate.
≈ 00:07:00	Post-Separation	Following CSM/S-IVB separation, and before the TPI, SCS attitude control (BB-11, AM-2) can be used for planning purposes, since a free-drift mode would prevent optical tracking of the S-IVB. An AGC update (BB-16) will be performed prior to the TPI. The CSM transfer maneuver (TPI) required to bring the two vehicles together is not expected to exceed 2 fps. However, to assure an accurate transfer maneuver, real-time decisions based on MSFN tracking aim parameters are recommended. G&N attitude control (BB-11, AM-1), incorporating the AGC pre-thrusting program, can be used for this purpose.

Time (Hr:Min:Sec)	Event	Remarks
		An SCS attitude maneuver (BB-11, AM-2) will be used to set the required attitude prior to the service module RCS ΔV maneuver. Once attitude is set, control will return to G&N (BB-11, AM-1) for the thrusting program.
≈01:05:00	Terminal Phase Initiation (TPI)	A +X RCS translation maneuver (BB-13, AM-1) will be performed for rendezvous. (Note that the references to the SPS in the timeline and duty cycles of BB-13 are not applicable for this maneuver.) Following the TPI, attitude control will return to the G&N (BB-11, AM-1).
≈01:35:00	Braking Maneuver	A -X RCS translation maneuver will be performed (BB-13, AM-1) to null the relative velocities of the two vehicles. The crewman optical alignment sight (COAS) will be used in conjunction with out-of-the-window reference to determine relative position. Approximately 3 minutes will be required to unstow and mount the COAS.
≈01:36:00	Station Keeping	Prior to the docking simulation, it is anticipated that the CSM will hold a position of <150 feet relative to the S-IVB for an undetermined period of time during which SCS attitude control (BB-11, AM-2) will be used (G&N operating) to continuously refine the attitude alignment.
≈01:50:00	Docking Simulation	For the actual docking simulation, the CSM will be in the SCS attitude control mode (BB-11, AM-2). The couches are in docking position, the translation and rotation controller is unlocked, and the CSM is in minimum deadband control mode. A closing velocity of approximately 0.25 fps is desirable during the last 100 feet. Refinement of the CSM attitude alignment is performed by utilizing the COAS and LM docking target.

Time (Hr:Min:Sec)	Event	Remarks
		Assuming a 100-foot separation at docking initiation, contact will occur after approximately 6 minutes 40 seconds. Following contact, a -X RCS translation maneuver (BB-13, AM-1) will be performed for final CSM/S-IVB separation.

19.2.3 Subsystem Duty Cycles

The preceding paragraph indicates the sequential use of the following blocks from SID 66-1177:

BB-6	CSM/S-IVB Separation
BB-11, AM-2	SCS Attitude Control
BB-16	AGC Update
BB-11, AM-1	G&N Attitude Control
BB-11, AM-2	SCS Attitude Control
BB-11, AM-1	G&N Attitude Control
BB-13, AM-1	RCS Translation
BB-11, AM-1	G&N Attitude Control
BB-13, AM-1	RCS Translation
BB-11, AM-2	SCS Attitude Control

Each of these blocks has a duty-cycle section which has been prepared to reflect the assumptions indicated in the respective timelines of SID 66-1177. Upon determination of the desired block durations for this application, the blocks must be altered, taking into consideration the duration change and applicable assumptions. For instance, the SCS attitude control block (BB-11, AM-2) assumed a 72-degree maneuver followed by a one-hour attitude hold. If, following CSM/S-IVB separation, a 47-degree maneuver followed by a 25-minute hold is desired, the duty-cycle components shown in Table 6-22 (SID 66-1177) would remain the same, but the duty-cycle percentages would be altered accordingly.

19.2.4 Electrical Power

The total average electrical power for this block can be calculated by entering Section 3.0, Electrical Power, of SID 66-1177 with the duty cycles of the blocks revised as described in Paragraph 19.2.3.

19.2.5 Propellant Consumption

Upon determination of block durations, required ΔV's, and attitude maneuvers, which are based upon specific trajectory data including S-IVB orientation during rendezvous, the service module RCS propellant consumption can be determined by entering Section 5.0, Propellant Requirements, SID 66-1177.

19.3 PERFORMANCE DATA

In view of the lack of performance data for a simulated docking maneuver in which neither a probe nor a drogue are involved, the following information is presented to indicate the limits within which actual CSM/LM/S-IVB docking shall occur on future missions.

CSM/LM Initial Docking Contact Velocities

Axial velocity	0.1 to 1.0 fps
Radial velocity	0.0 to 0.5 fps
Angular velocity	0.0 to 1.0 deg/sec about any axis

Alignment of CSM and LM for Initial Docking Contact

Radial alignment	Radial displacement of contacting element centerlines at the docking interface not to exceed 12 inches.
Angular alignment	The included angle measured between the Y-Z planes of the docking interfaces not to exceed 10 degrees
Rotational alignment	The included angle between the command module and LM Z-X planes measured in the command module roll attitude to be -60±10 degrees

7.0 TEST OBJECTIVES

7.1 INTRODUCTION

This section provides the visibility necessary for test objective accomplishment while real-time mission planning redesign is performed by use of building blocks. Accomplishment of test objectives is not an automatic result of performance of building blocks, because the test objective, test condition, and data requirements are not inherent elements of the building blocks. Therefore, a test objective accomplishment data sheet (TOADS) is provided for each objective which lists the test conditions, related objectives, and data requirements.

Test condition identification in the TOADS guides the mission designer by listing either the building blocks, special tests, or unique procedures which permit test objective accomplishment. Where necessary, the deltas (Δ's) to a building block, as a result of test objective accomplishment, are identified as well as any lighting or other restrictive conditions. The mission designer is also provided correlation with the applicable procedure of the AOH.

The TOADS, under Data Requirements, provide the mission designer with sufficient guidelines to enable him to program test objective accomplishment to the highest degree desired. These guidelines consist of pulse code modulation(PCM) data rate at either high bit rate (HBR) or low bit rate (LBR), recommendations with respect to use of telemetry (T/M) or data storage equipment (DSE), frequency and duration of data acquisition, identification with respect to maximum and minimum data acquisition requirements, astronaut support, related objectives, etc.

The heart of this section is the two matrices (Building Block/Test Objective Matrix, Figure 7-1, and Test Objective/Test Objective Matrix, Figure 7-2) which both supplement and summarize the TOADS. The logic used in generating these matrices derives from the fact that real-time mission planning redesign will be achieved by call up of the building blocks. The correlation coding of the matrices identifies which building blocks and/or test objectives accomplish or govern the accomplishment of test objectives as well as the results of mission design decisions as regards data acquisition. The matrices can also be used as a test objective accomplishment checklist during the mission. For convenience, a short-form test objective has been used in the matrices.

The basic assumptions which controlled the matrix correlation of test objectives were as follows:

1. Test objective accomplishment will be achieved by the operational performance of building blocks. Therefore, maneuver and/or mode objectives such as use of proportional rate, wide deadband, etc., are assumed to be achieved during such appropriate mission operations as inertial measurement unit (IMU) alignment, navigation sightings, drifting flight (powered down), etc.

2. All potential data sources (maneuver, operation, etc.) for a given test objective are identified to the fullest extent possible. It is not to be assumed that all indicated sources are required for objective satisfaction. However, it is highly desirable that all operations susceptible to variation as a function of astronaut performance be accomplished by as many astronauts as is practical.

3. Those objectives which do not occur as a result of a building block are identified as a special test (ST) and related to the domain of the objective or building block most closely associated as a function of time, test conditions, or operation.

No attempt has been made to evaluate the degree of test objective accomplishment possible by performing any given building block or objective once or many times. Because the degree of accomplishment is a function of many variables (quantity of data gathered, validity of specific maneuver or operation, repeatability of test parameters, etc.) which are difficult to positively control before a mission, the evaluation has been left as a post-mission or possibly post-test objective task.

Test objective satisfaction implies that a sufficient quantity of data be gathered to support the analytical requirement. Almost all of the test objectives, as identified by the TOADS, require HBR PCM data (51.2 kbps). As building blocks are called up and the concomitant test objectives are accomplished, the relationship between objective duration, Manned Space Flight Network (MSFN) contact, and analytical (i.e., data) requirements must be closely monitored. Certain revolutions over the North American continent during an earth orbital mission provide approximately 16 minutes of continuous real-time PCM T/M. This latter factor makes these revolutions the most desirable for purposes of test objective accomplishment.

The Measurement Operational Readiness Requirements (MORR), Appendix B of SID 65-304-1, supports test objective accomplishment by identifying the measurements required as well as test objective applicability. The MORR may be used for detailed information with respect to measurement test objective support.

7.2 POTENTIAL PROBLEMS

The basic problem of test objective accomplishment in earth orbit is data acquisition. This in turn can be divided into two elements, both of which should be considered by the mission designer. These two elements are the decision as to what quantity of data is to be acquired (identified in the TOADS as the choice between maximum or minimum data acquisition) and when and/or how the DSE will be used to acquire HBR PCM.

Although almost all of the test objectives could be satisfied by the mere fact of their occurrence (i.e., Demonstrate), quantitative analysis, if desired, requires quantitative data. The data acquisition period varies not only from test objective to test objective but also within a test objective as a function of the extent of analysis desired. An example of the latter would be the test objective for demonstration of IMU alignment whose building block can be regarded as a maneuvering sub-block and an alignment sub-block separated by an Apollo guidance computer (AGC) program. If it is sufficient to solely demonstrate alignment, then the minimum data acquisition need consist only of verbal comment and/or PCM T/M or on-board determination of the desired and actual IMU gimbal alignment. If it is desirable that this operation (or governing test objective) be used as a maximum data acquisition (i.e., acquire data on guidance and navigation (G&N) attitude control, proportional rate, maximum deadband, etc.), then the data acquisition period is synonymous with both sub-blocks if not the entire block. Time-over-station (TOS) is now the governing factor in the mission designers decisions. Obviously, the mission designer will have to establish a priority ranking between what he needs as against what he can acquire. This means in effect that the mission designer must plan his data acquisition as well as his sequential operations to assure that sufficient data are acquired coincident with the logical flow of the mission.

Use of the DSE to support the data acquisition periods of test objectives performed fully or partially off-station and whose data requirement is HBR PCM necessitates careful planning. The playback ratio of 1:1 for DSE recorded HBR PCM can introduce severe data management problems. For this reason, some technique of in-flight data management is recommended. Certain of the long-term test objectives whose data are quasi-static have been suggested as being conducive to a technique of real-time editing during data acquisition in their respective TOADS. A typical example would be a thermal oriented objective whose duration of data acquisition is one hour and requires HBR PCM. These data could be gathered by periodic short-burst operation of the DSE during data acquisition so that total data accumulated can be dumped during one station pass (i.e., 5 seconds of data every 5 minutes for one hour for a total of 300 seconds, assuming an average TOS of 5 minutes). Variations of this technique could be used for long-term dynamic objectives by initiating an IMU alignment over Hawaii, record on DSE, complete the alignment over Guaymas, dump the DSE to Corpus Christi, and perform the service propulsion subsystem (SPS) ΔV over Antigua.

7.3 TEST OBJECTIVE ACCOMPLISHMENT DATA SHEETS

The following data sheets are organized sequentially by the test objective numbers identified in Figure 7-2.

Test objective applicability for the MMDB is based on the NASA document 3640-6012-TU-001, Mission Requirements for Apollo Spacecraft Development Mission Apollo Saturn 204A/205, Revision 1, dated February 1966, as amended by NASA document 05952-H001-RU-000, Apollo Saturn Mission 204A Implementation Requirements of Spacecraft Mission Objectives, dated 1 August 1966 (source for test objectives P. 2. 1. 7 and P. 2. 4. 7) and NASA letter PM2-152, "Revision to Mission AS205 Mission Requirements," dated 22 August 1966 (source for test objectives P. 1. 2. 7 and P. 2. 6. 1).

P.1.1.1 Demonstrate astronaut capability to align the IMU using sextant, scanning telescope, and AGC.

This objective will be accomplished in conjunction with objective P. 2. 1. 3. Refer to objective P. 2. 1. 3 for accomplishment data.

P.1.1.2 Demonstrate astronaut capability to align the vehicle to a predetermined inertial attitude by use of the scanning telescope in conjunction with the rotation and attitude impulse controls.

This objective will be accomplished in conjunction with objective P. 2. 1. 4. Refer to objective P. 2. 1. 4 for accomplishment data.

P.1.1.3 Demonstrate astronaut ability to determine orbital parameters by earth landmark tracking using the scanning telescope and the AGC.

This objective will be accomplished in conjunction with objective P. 2. 1. 5. Refer to objective P. 2. 1. 5 for accomplishment data.

P.1.1.4 Demonstrate astronaut capability to support updating of the AGC from MSFN via updata link and voice modes.

This objective will be accomplished in conjunction with objective P. 4. 1. 1. Refer to objective P. 4. 1. 1 for accomplishment data.

P.1.1.5 Deleted

P.1.1.6 Demonstrate astronaut capability to perform a midcourse star-landmark angle measurement using the sextant.

TEST CONDITIONS

No special test conditions or procedures are required other than those identified in BB-8, Celestial Navigation.

DATA REQUIREMENTS

Maximum data acquisition requires either continuous HBR PCM T/M or HBR PCM selectively recorded on DSE by the astronauts throughout the initial maneuvering phase of the building block (approximately 18 minutes) and continuous HBR PCM T/M throughout the succeeding celestial sighting phase of the building block (approximately 10 minutes). Maximum data acquisition only during the second, or celestial sighting, phase of the building block does not assure maximum objective accomplishment. Minimum data acquisition requires approximately 10 seconds of LBR PCM, either T/M or DSE for later dump (5 seconds of display keyboard (DSKY) shaft and trunnion data and 5 seconds of DSKY mark data).

Astronaut support for maximum data acquisition requires identification of the lunar landmark used and the star used, and also subjective comment on procedures, controls, etc. Astronaut support for minimum data acquisition requires the above plus time required for both building block phases.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that related objectives which could always be accomplished are the ECS objectives P. 2. 3. 1, P. 2. 3. 2, P. 2. 3. 4, and P. 2. 3. 6, the consumables objective P. 4. 3, the astronaut-supported objectives S. 2. 3 and S. 2. 4, and the displays and controls (D&C) objective S. 3. 3. All G&N, stabilization and control subsystem (SCS), and thermal control objectives require maximum data acquisition. Of these latter, the minimum impulse controller objectives P. 1. 2. 2 and P. 2. 2. 5 and the minimum deadband objective P. 2. 2. 1 are the most likely to be accomplished during the sighting. Maximum data acquisition through the maneuvering would accomplish the proportional rate objectives P. 1. 2. 1 and P. 2. 2. 4 and the limit cycle objective P. 2. 2. 3. The P. 2. 4. 1 TOADS defines the maximum data acquisition which would be required during the building block to accomplish that objective.

P.1.1.7 Demonstrate astronaut visual observation capability by performing a manual "out-of-window" CSM attitude orientation (simulated deorbit preparations).

TEST CONDITIONS

This objective should be accomplished in both sunlight and earth shadow. Maneuver can be accomplished by either AM-2 or AM-3 of BB-11. Accomplishment by both modes is desirable. Refer to AOH 12. 3. 15 and the current Mission Requirements (MR). It is highly desirable that the IMU be ON. Use of the IMU constitutes a Δ to BB-11 AM-2 and AM-3. Note that BB-25 AM-2 requires this technique.

DATA REQUIREMENTS

Maximum data acquisition requires continuous HBR PCM, either T/M or DSE for later dump, for the duration of the maneuver (approximately 5 minutes). Objective P. 2. 1. 1 would be accomplished both before and after this objective (refer to AOH 8. 6. 5. 1). Minimum data acquisition would consist of the following: (1) accomplishment of the attitude orientation, (2) accomplishment of objective P. 2. 1. 1 before and after the attitude orientation, and (3) astronaut logging and transmission of these data.

Astronauts should log time required for maneuver and any problems encountered.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that related objectives which could always be accomplished are the attitude reference objective P. 2. 1. 1; the ECS objective P. 2. 3. 1; the consumables objective P. 4. 3; the astronaut-supported objective S. 2. 2, S. 2. 3 and S. 2. 4; and the D&C objective S. 3. 3. The proportional rate objectives P. 1. 2. 1 and P. 2. 2. 4 and the wide deadband objective P. 2. 2. 2 require maximum data acquisition. Although the IMU objectives P. 1. 1. 1 and P. 2. 1. 3 must be accomplished prior to the maneuver, they are not part of the objective and not required to be accomplished with the objective.

P.1.2.1 Demonstrate astronaut capability to maintain proportional rate control using the rotation and attitude impulse controls and the flight director attitude indicator (FDAI) attitude display (to be demonstrated for both single- and multi-axis maneuvers).

This objective will be accomplished in conjunction with objective P. 2. 2. 4. Refer to objective P. 2. 2. 4 for accomplishment data.

P.1.2.2 Demonstrate astronaut capability, using the SCS/RCS minimum impulse controller, to support G&N optics measurements.

This objective will be accomplished in conjunction with P. 2. 2. 5. Refer to objective P. 2. 2. 5 for accomplishment data.

P.1.2.3 Deleted

P.1.2.4 Deleted

P.1.2.5 Demonstrate astronaut capability to perform all required pre-ΔV operations in preparation for G&N or SCS thrust vector control (TVC).

TEST CONDITIONS

No special test conditions or procedures are required other than performance of BB-12 in earth orbit and BB-25 for deorbit or BB-26 for contingency deorbit.

DATA REQUIREMENTS

There are no PCM measurements for this specific test objective. During the building block phase beginning with G&N power up, the related test objectives may be accomplished by either maximum or minimum data acquisition according to their respective TOADS. The duration of this phase of the building block is approximately 82 minutes. Objective P. 2. 3. 5 would be accomplished during an SPS cold soak (see P. 2. 3. 5 TOADS).

Astronaut support for either maximum or minimum data acquisition requires objective comment concerning adequacy of functions, time allotted, etc.

RELATED TEST OBJECTIVE

Examination of the test objective matrix (Figure 7-2) shows that related objectives which could always be accomplished are the ECS objectives P. 2. 3. 1, P. 2. 3. 2, P. 2. 3. 4, P. 2. 3. 5 (during the SPS cold soak), and P. 2. 3. 6, the AGC update objectives P. 1. 1. 4 and P. 4. 1. 1, the communication objectives P. 4. 2. 1, P. 4. 2. 3, and P. 4. 2. 4, the consumables objective P. 4. 3, and the D&C objective S. 3. 3. While the IMU objectives P. 1. 1. 1 and P. 2. 1. 3 would be performed, they require continuous maximum data acquisition during an extended period of time for complete satisfaction which the preceding objectives do not. The P. 2. 4. 1 TOADS defines the maximum data acquisition which would be required during the building block to accomplish that objective.

P.1.2.6 Spacecraft 012 only.

P. 1. 2. 7 Demonstrate capability to perform a rendezvous and simulated docking maneuver with the launch vehicle as a target following CSM/S-IVB separation.

TEST CONDITIONS

No special test conditions or procedures are required beyond those required for the performance of BB-19 during which appropriate lighting conditions should exist to support both this test objective and, if possible, P. 2. 7 (refer to P. 2. 7 TOADS). The crewmen optical alignment sight (COAS) will be utilized during the simulated docking. A desirable sequence of test objectives would be P. 2. 1. 7 followed by this objective. Refer to the current MR.

DATA REQUIREMENTS

Maximum data acquisition requires HBR PCM either T/M or on DSE for later dump. These data are to be available periodically throughout accomplishment of the objective as required for definition of spacecraft maneuvering. It is highly desirable that the simulated docking portion of this test objective be continuously available by real-time T/M, as much as possible. Astronaut's objective comment on adequacy of procedures, lighting, target identification, control modes, equipment, etc., would supplement the HBR PCM.

Minimum data acquisition would consist solely of the astronaut's objective comment as previously noted.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objective which could always be accomplished is the D&C objective S. 3. 3. The objectives for proportional rate P. 1. 2. 1 and P. 2. 2. 4, translation control P. 2. 2. 26 and direct ullage P. 2. 2. 7 all require maximum data acquisition. The wide deadband objective P. 2. 2. 2, which also requires maximum data acquisition, may not be adequately accomplished during rendezvous. The SLA photography objective P. 2. 7 could be accomplished concurrently with the docking maneuver.

P. 1. 2. 8 Deleted.

P. 1. 3. 1 Demonstrate a manual SPS start.

TEST CONDITIONS

No special test conditions or procedures are required other than performance of the appropriate procedures of BB-12. The contingency BB-44 requires this technique.

DATA REQUIREMENTS

Data acquisition at the time of SPS manual start requires HBR PCM T/M and DSE for later dump. These data are available because of the data requirement for SPS ΔV (see objective P.2.6.1).

Astronaut support requires objective comment with respect to adequacy of techniques, displays and controls, etc. These data may be available in real-time or on DSE for later dump.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objective which could always be accomplished is the D&C objective S. 3. 3. This manual SPS start objective is one of the test variables which would be accomplished during the SPS objective P. 2. 6. 1.

P.1.4 Deleted

P.1.5 Spacecraft 012 only.

P.2.1.1 Evaluate and compare the performance of the G&N and SCS attitude reference systems during launch, orbital maneuvers and entry.

TEST CONDITIONS

No special test conditions are required other than performance of BB-1, -5, -7, -8, -11, -12, -25, and -26 with the IMU ON. Performance of this test objective in conjunction with a building block that does not otherwise require IMU ON constitutes a Δ to that building block. Refer to AOH 12. 1. 3 (procedure 8. 6. 5. 1). It is highly desirable that this test objective be performed before and/or after those objectives as identified in their respective TOADS.

DATA REQUIREMENTS

Maximum data acquisition for related objectives requires HBR PCM, either T/M or DSE for later dump (approximately 5 seconds per data burst). It is highly desirable that maximum data be acquired by HBR PCM on DSE during an attitude hold maneuver of approximately 1-1/2 hours at a data sample rate of 5 seconds every 5 minutes during the maneuver. Maximum data acquisition during entry requires HBR PCM on DSE beginning 5 seconds before entry and ending 5 seconds after entry.

Minimum data acquisition requires astronaut performance of AOH procedure 8.6.5.1 at all points identified for maximum data acquisition except entry. Minimum data acquisition during entry is not desired. Minimum data acquisition requires astronaut data logging and voice transmission of these data.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objective which would always be accomplished is the D&C objective S.3.3. The attitude reference objective supports accomplishment of the vehicle alignment objectives P.1.1.2 and P.2.1.4 and the out-the-window objective P.1.1.7 as defined in the TOADS for those objectives. The remaining objectives (IMU alignment P.1.1.1 and P.2.1.3, orbital determination P.1.1.3, and P.2.1.5, G&N attitude control P.2.1.2, TVC P.2.1.6, and SPS ΔV P.2.6.1) provide several opportunities for gathering attitude reference data either over long periods of time or under dynamic conditions as defined in their TOADS.

P.2.1.2 Demonstrate performance of G&N subsystem in attitude control, ΔV control, and entry guidance.

TEST CONDITIONS

No special test conditions or procedures are required other than identified in BB-7, -11, -12, and -25 and contingency BB-26 and -44. Refer to AOH 12.4.2.

DATA REQUIREMENTS

Maximum data acquisition requires continuous HBR PCM, either T/M or DSE for later dump. These data are required for the durations indicated in the TOADS for the related test objectives. Entry guidance requires continuous HBR PCM on DSE beginning 5 seconds before initiation of entry guidance and ending 5 seconds after termination of entry guidance.

Minimum data acquisition requires astronaut objective comment with respect to the adequacy of procedures, control modes, etc. These data may also supplement maximum data acquisition.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that attitude and ΔV control is accomplished during IMU alignment P.1.1.1 and P.2.1.3 and SPS ΔV P.2.6.1. The related objective which would always be accomplished is TVC P. 2. 1. 6 during ΔV control. The minimum deadband objective P. 2. 2. 1 could be accomplished during ΔV control because of the data requirement of P. 2. 6. 1 TOADS but would not be accomplished during attitude control and entry guidance if maximum data acquisition were not achieved. The attitude reference objective P. 2. 1. 1 could always be accomplished. The remaining objectives (wide deadband P. 2. 2. 2, limit cycle P. 2. 2. 3, and thermal control P.2.4. 1) are related to attitude control and entry guidance and would not be accomplished if maximum data acquisition were not achieved.

P.2.1.3 Demonstrate performance of the sextant, scanning telescope, and AGC to align the IMU.

TEST CONDITIONS

No special test conditions or procedures are required other than those identified in BB-7. Refer to AOH 12. 2. 1. BB-8, Landmark, requires performance of this operation before BB-8; and BB-12, -25, and -26 include this operation. It is highly desirable that this objective also be accomplished at some time between the end of BB-5 and start of BB-6.

DATA REQUIREMENTS

Maximum data acquisition while the CSM is attached to the SIV-B requires continuous HBR PCM T/M for approximately 15 minutes. Maximum data acquisition for alignment after CSM/SIV-B separation requires continuous HBR PCM T/M for approximately 24 minutes. This latter case may require selective use of DSE. It is highly desirable that the CSM maneuvering period prior to alignment also be covered by maximum data acquisition which requires continuous HBR PCM T/M or selective use of DSE for approximately 17 minutes. Minimum data acquisition requires LBR PCM, either T/M or DSE for later dump, as follows: 5-second data burst of DSKY data at end of alignment; and, after gimbal torquing, a 5-second data burst of DSKY data as obtained by AOH procedure 8. 6. 5. 1.

Test objective P. 2. 1. 1 would be accomplished immediately after the alignment by either maximum or minimum data acquisition as defined by P. 2. 1. 1 TOADS.

Astronaut support requires objective comment with respect to task suitability, attitude control mode suitability, adequacy of time allotment, inadequacies in D&C, etc. These data are applicable to both maximum and minimum data acquisition.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which would always be accomplished are the companion objective P. 1. 1. 1 and the D&C objective S. 3. 3. Other related objectives which could be accomplished are the attitude reference objective P. 2. 1. 1, and ECS objectives P. 2. 3. 1, P. 2. 3. 2, P. 2. 3. 4, and P. 2. 3. 6, and the astronaut supported objectives S. 2. 3 and S. 2. 4. The minimum impulse controller objectives P. 1. 2. 2 and P. 2. 2. 5, attitude control objective P. 2. 1.2, and wide deadband objective P. 2. 2. 2 require maximum data acquisition during the alignment. The proportional rate objectives P. 1. 2. 1 and P. 2. 2. 4 and the limit cycle objective P. 2. 2. 3 require maximum data acquisition during the pre-alignment maneuvering. The P. 2. 4. 1 TOADS defines the maximum data acquisition which would be required during the building block to accomplish that objective.

P.2.1.4 Demonstrate performance of the scanning telescope in conjunction with the rotation and attitude impulse controls to align the vehicle to a predetermined inertial attitude.

TEST CONDITIONS

This is a special test using BB-11 AM-2 after performance of BB-7. Refer to AOH paragraph 8. 6. 5. 10 and the current MR. The IMU will be ON during performance of this test objective, and this constitutes a Δ to BB-11 AM-2. It is highly desirable that this objective be accomplished as soon as practicable following CSM/SIV-B separation. Normal use of BB-12 AM-2, BB-12 AM-3, and BB-25 AM-2, (i. e., G&N OFF) requires this technique.

DATA REQUIREMENTS

Maximum data acquisition requires continuous HBR PCM, either T/M or DSE for later dump, for approximately 5 minutes and 10 seconds beginning 5 seconds prior to the misalignment and ending 5 seconds after the realignment. Objective P. 2. 1. 1 would be accomplished after the maneuver. Minimum data acquisition requires performance of objective P. 2. 1. 1 before misalignment and after realignment as identified by the minimum data acquisition of the P. 2. 1. 1 TOADS.

Astronaut objective comment as to adequacy of procedures, time required, etc., may supplement both maximum and minimum data acquisition.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which would always be accomplished are the companion objective P. 1. 1. 2 and the D&C objective S. 3. 3. Other related objectives which could be accomplished are the attitude reference objective P. 2. 1. 1, the command module habitability portion of the ECS objective P. 2. 3. 1, the consumables objective P. 4. 3, and the astronaut-supported objectives S. 2. 3 and S. 2. 4. The minimum impulse controller objectives P. 1. 2. 2 and P. 2. 2. 5 and the minimum deadband objective P. 2. 2. 1 require maximum data acquisition while aligning the vehicle. The proportional rate objectives P. 1. 2. 1, P. 2. 2. 4, which require maximum data acquisition, could be accomplished during misalignment and attitude reacquisition.

P.2.1.5 Demonstrate performance of the scanning telescope and the AGC to establish orbital parameters.

TEST CONDITIONS

No special test conditions or procedures are required other than performance of BB-8, Landmark Sightings. Refer to AOH 12.2.2. It is highly desirable that this objective also be accomplished at some time between the end of BB-5 and start of BB-6.

DATA REQUIREMENTS

Maximum data acquisition while the CSM is attached to the SIV-B requires continuous HBR PCM T/M for approximately 7 minutes. Repetition sightings would require approximately 10 additional minutes. Maximum data acquisition for sightings after separation have the same requirements as above. It is highly desirable that the CSM maneuvering period prior to alignment also be covered by maximum data acquisition which requires continuous HBR PCM, either T/M or DSE for later dump, for approximately 6 minutes. Minimum data acquisition would consist of a 5-second data burst of LBR PCM, either T/M or DSE for later dump, of all significant DSKY displays.

Test objective P. 2. 1. 1 would be accomplished before and after the sighting by either maximum or minimum data acquisition as defined by P. 2. 1. 1 TOADS.

Astronaut support requires objective comment with respect to task suitability, attitude control mode suitability, adequacy of time allotment, inadequacies in D&C, target acquisition, etc. These data are applicable to both maximum and minimum data acquisition.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which would always be accomplished are the companion objective P. 1. 1. 3 and the D&C objective S. 3. 3. Related objectives which could be accomplished are the attitude reference objective P. 2. 1. 1, the ECS objectives P. 2. 3. 1, P. 2. 3. 2, P. 2. 3. 4, and P. 2. 3. 6, the consumables objective P. 4. 3, and the astronaut-supported objectives S. 2. 3 and S. 2. 4. The minimum impulse controller objectives P. 1. 2. 2 and P. 2. 2. 5 and the wide deadband objective P. 2. 2. 2 require maximum data acquisition where applicable during the sightings. The limit cycle objective P. 2. 2. 3 requires continuous maximum data acquisition throughout the sightings. The P. 2. 4. 1 TOADS define the maximum data acquisition which would be required during the building block to accomplish that objective.

P.2.1.6 Demonstrate performance in the G&N and SCS to control the thrust vector.

TEST CONDITIONS

No special test conditions or procedures are required other than performance of BB-12 and -25 or contingency BB-26 and -44. Refer to AOH procedure 12. 3. 2.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM T/M beginning 5 seconds prior to the ΔV and ending 5 seconds after completion of the ΔV. This time period is included within the data requirement identified in the P. 2. 6. 1 TOADS.

Astronaut support requires objective comment relative to gimbal positioning, apparent TVC, adequacy of mode, use of center-of-gravity determination data, etc.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which would always be accomplished are G&N ΔV control P. 2. 1. 2 and minimum deadband P. 2. 2. 1. The attitude reference objective P. 2. 1. 1 could be accomplished. This TVC objective is one of the test variables which would be accomplished during the SPS objective 2. 6. 1.

P. 2. 1. 7 Obtain data on optical acquisition and tracking of a target vehicle using the sextant.

TEST CONDITIONS

This is a special test to be accomplished during the initial portion of BB-19. Initiation of the test will be under the guidance of MSFN from the MCC at MSC. It is highly desirable that the optics be ON during performance of this objective. It should be noted that a desirable sequence of test objectives would be to follow this objective by P. 1. 2. 7. Refer to the current MR.

DATA REQUIREMENTS

Maximum data acquisition requires HBR PCM either T/M or on DSE for later dump. These data are to be available throughout the time period that encompasses final alignment of the optics and target lock-on and periodically, as required, for definition of optics adjustment throughout the tracking. Astronaut objective comment as to adequacy of controls, target visibility, ease of operation, etc., would supplement the HBR PCM.

Minimum data acquisition would consist of astronaut log of the optics CDU readout and DSKY display of IMU data after initial target acquisition and periodically as required for definition of optics adjustment throughout the tracking. These data would be supplemented by the astronaut objective comment previously noted.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which could always be accomplished are the ECS objectives P. 2. 3. 1 and P. 2. 3. 2, the consumables objective P. 4. 3, and astronaut-supported objectives S. 2. 2, S. 2. 3, and S. 2. 4, as well as the D&C objective S. 3. 3. The proportional rate objectives P.1.2.1 and P.2.2.4 and the minimum impulse controller objectives P.1.2.2 and P.2.2.5 require maximum data acquisition during the maneuvering portion of acquisition and tracking when those objectives are being accomplished. Either the minimum deadband objective P.2.2.1 or the maximum deadband objective P.2.2.2, both of which require maximum data acquisition, could be accomplished during those portions of the acquisition and tracking when those modes are utilized. The limit cycle objective P.2.2.3, which also requires maximum data acquisition, may be accomplished if sufficient data can be acquired.

P.2.2.1 Demonstrate rate damping in all three axes in minimum deadband.

TEST CONDITIONS

No special test conditions or procedures are required other than performance of BB-8, -11, -12, and -25 or contingency BB-26 and -44. It is highly desirable that this objective be performed at more than one level of consumables quantity.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM during the appropriate maximum data acquisition periods of the performed building block as identified by the related test objective TOADS.

A form of minimum data acquisition would be possible by astronaut monitoring and logging of the FDAI rate indication. This mode of data acquisition is not recommended.

Astronaut support requires objective comment relative to adequacy of mode, FDAI indications, D&C procedures, etc.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the objective is accomplished as a function of the vehicle alignment objectives P.1.1.2, P.2.1.4, the celestial navigation objective P.1.1.6, the TVC objective P.2.1.6, and the SPS objective P.2.6.1. The best opportunity for acquisition at varying consumable quantities is during the various SPS ΔV's.

P.2.2.2 Demonstrate SCS attitude hold capability in the propellant conservation (wide deadband) configuration.

TEST CONDITIONS

No test conditions or procedures are required other than identified in BB-6, -7, -8, -11, and -19. It is highly desirable that this objective be performed at more than one level of consumables quantity. It is also desirable that a special test be performed by using BB-11 AM-2 for approximately one hour. Refer to AOH procedure 12. 3. 16.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM during the appropriate maximum data acquisition periods of the performed building block as identified by the related TOADS (see below). Special test maximum data acquisition requires continuous HBR PCM T/M for approximately 5 minutes at the beginning and end of the test and periodically throughout the test at each station contact. These data may be supplemented by periodic one minute bursts on DSE between station contacts. Special test minimum data acquisition requires astronaut logging of the FDAI at the beginning and end as well as periodically throughout the test.

Astronaut support requires objective comment with respect to the adequacy of the mode, D&C, damping, etc.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished as a function of the IMU objectives P. 1. 1. 1 and P. 2. 1. 3, the orbital parameter objectives P. 1. 1. 3 and P. 2. 1. 5, the out-the-window objective P. 1. 1. 7, the simulated docking objective P. 1. 2. 7, the optical tracking objective P. 2. 1. 7, and the SLA panel objective P. 2. 7. During the special test, the related objectives which could be accomplished are the ECS objective P. 2. 3. 1, the consumables objective P. 4. 3, the vibration objective S. 2. 4, and the D&C objective S. 3. 3. The limit cycle objective P. 2. 2. 3 would be accomplished if maximum data acquisition is acquired. The proportional rate objectives P. 1. 2. 1 and P. 2. 2. 4 could be accomplished if maximum data acquisition were acquired where appropriate. The P. 2. 4. 1 TOADS define the maximum data acquisition which would be required during the special test to accomplish that objective.

P.2.2.3 Demonstrate convergence to minimum impulse limit cycle rates during attitude hold in the SCS attitude control mode.

TEST CONDITIONS

No special test conditions or procedures are required other than those identified in BB-7, -8, and -11. It is highly desirable that this objective be performed at more than one level of consumables quantity.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM during the appropriate maximum data acquisition periods of the performed building block as identified by the related TOADS (see below).

Astronaut support requires objective comment relative to adequacy of mode, D&C, etc.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished as a function of the IMU objectives P. 1. 1. 1 and P. 2. 1. 3, the orbital parameter objectives P. 1. 1. 3 and P. 2. 1. 5, the celestial sighting objective P. 1. 1. 6, and the special test of the wide deadband objective P. 2. 2. 2.

P.2.2.4 Demonstrate proportional rate control performance using the rotation and attitude impulse controls and the FDAI attitude display (for both single- and multi-axis maneuvers).

TEST CONDITIONS

No test conditions or procedures are required other than those identified in BB-6, -7, -8, -11 and -19. The single-axis maneuver (pitch only) may be accomplished during BB-6. Accomplishment of roll only and yaw only requires special planning. The multi-axis maneuver may be accomplished during BB-7, -8, and -11.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM during the appropriate maximum data acquisition periods of the performed building block as identified by the related TOADS (see below).

Astronaut support requires objective comment relative to controller displacement, FDAI readability, adequacy of mode, D&C, etc. This latter, if supplemented by astronaut logging of FDAI readout, would be a form of minimum data acquisition, but it is not recommended for that purpose.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished as a function of the maneuvering portions of the IMU objectives P. 1. 1. 1 and P. 2. 1. 3, the vehicle alignment objectives P. 1. 1. 2 and P. 2. 1. 4, the celestial sighting objective P. 1. 1. 6, the out-the-window objective P. 1. 1. 7, the simulated docking objective P. 1. 2. 7, the optical tracking objective P. 2. 1. 7, the special test of the wide deadband objective P. 2. 2. 2, and the maneuvering portion of the SLA panel objective P. 2. 7. The companion objective P. 1. 2. 2 would be accomplished during the appropriate maximum data acquisition periods of the above related objectives.

P.2.2.5 Demonstrate performance of the SCS/RCS minimum impulse controller, in supporting G&N optics measurements.

TEST CONDITIONS

No special test conditions or procedures are required other than those identified in BB-7 and -8.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM during the appropriate maximum data acquisition periods of the performed building block as identified by the related TOADS (see below).

Astronaut support requires objective comment relative to adequacy of controller, procedures, etc.

RELATED OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished as a function of the alignment portions of the IMU objectives P. 1. 1. 1 and P. 2. 1. 3, the vehicle alignment objectives P. 1. 1. 2 and P. 2. 1. 4, the orbital parameters objectives P. 1. 1. 3 and P. 2. 1. 5, and the celestial sighting objective P. 1. 1. 6. The companion objective P. 1. 2. 2 would be accomplished during the appropriate maximum data acquisition periods of the above related objectives.

P.2.2.6 Demonstrate translation performance control in all three axes.

TEST CONDITIONS

No test conditions or procedures are required other than those identified in BB-6, -11, -12, -13, -19, and -25 or contingency BB-26 and -44. It is highly desirable that translation in Y and Z be performed using BB-13 during accomplishment of P.2.7 after BB-6 because normal mission use of these building blocks does not accomplish anything other than ±X translation.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM during the appropriate maximum data acquisition periods of the performed building blocks as identified by the related TOADS (see below).

Astronaut support requires objective comment relative to adequacy of control, D&C, mode, etc. A form of minimum data acquisition would be possible by supplementing the above astronaut support by astronaut logging of FDAI readout for residual rate and cross coupling, but it is not recommended for that purpose.

RELATED OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the +X translation portion of this objective is accomplished during the simulated docking objective P.1.2.7 and the SPS objective P.2.6.1. As previously noted, the SLA panel objective P.2.7 permits accomplishment of translation in Y and Z. Related objectives which can be accomplished are the restraint objective S.2.2, the vibration objective S.2.4, and the D&C objective S.3.3.

P.2.2.7 Demonstrate direct ullage maneuver performance.

TEST CONDITIONS

No special test conditions or procedures are required other than identified in BB-6, -12, -13, and -25 or contingency BB-24. This objective will be accomplished in BB-6 and may be accomplished in any of the remaining building blocks.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM during the appropriate maximum data acquisition periods of the performed building block as identified in the related TOADS (see below).

Astronaut support requires objective comment relative to adequacy of procedures and D&C, as well as monitoring/logging of ΔV indication.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished during the SPS objective P. 2. 6. 1. Related objectives which can be accomplished are the restraint objective S. 2. 2, the vibration objective S. 2. 4, and the D&C objective S. 3. 3.

P.2.3.1 Demonstrate satisfactory command module cabin habitability and equipment temperature control.

TEST CONDITIONS

It is highly desirable that this objective be accomplished during the special test SPS cold and hot soak (BB-12) identified by P. 2. 6. 1 TOADS. Refer to AOH procedure 12. 3. 1 and the current Mission Requirements. No further test conditions or procedures other than accomplishment during BB-1, -5, -7, -8, -9, -10, -11, -12, and -25 or contingency BB-26 are required.

DATA REQUIREMENTS

Maximum data acquisition requires HBR PCM, either T/M or DSE for later dump. These data would consist of periodic bursts of any duration ranging from 5 seconds to 5 minutes throughout the performance of the building blocks or special test previously identified.

Astronaut support requires objective comment, periodic or as required, relative to general comfort, ease of movement in command module, monitoring/logging of appropriate D&C, reporting of such control changes as may be required, command module atmosphere, etc. Minimum data acquisition requires solely the above astronaut support.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished during the various operations and maneuvers objectives (IMU alignment, vehicle alignment, orbital parameters, celestial sighting, out-the-window, wide deadband special test) as well as pre-ΔV operations objective P. 1. 2. 5, and the ECS objectives P. 2. 3. 3, P. 2. 3. 5, and P. 2. 3. 6. Related objectives which can be accomplished are the suit circuit objective P. 2. 3. 2, the water separator objective P. 2. 3. 4, and the D&C objective S. 3. 3. Related objectives which require maximum data acquisition for accomplishment are the thermal control objective P. 2. 4. 1 and the ECS radiator objective P. 2. 4. 4. This ECS objective is of special interest during the special test cold and hot soaks of the SPS objective P. 2. 6. 1.

P.2.3.2 Demonstrate satisfactory command module suit circuit habitability.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment during BB-5, -7, -8, -9, -12, -14, -24, and -25 or contingency BB-26. It is highly desirable that accomplishment encompasses all modes of suit circuit usage. Refer to AOH procedure 12. 2. 8.

DATA REQUIREMENTS

Maximum data acquisition requires HBR PCM, either T/M or DSE for later dump. These data would consist of periodic bursts of any duration ranging from 5 seconds to 5 minutes throughout the performance of the building blocks identified above.

Astronaut support requires objective comment, periodic or as required, relative to general comfort, faceplate fogging, monitoring/logging of appropriate D&C, reporting of such control changes as may be required, suit atmosphere and/or odors, etc. Minimum data acquisition requires solely the above astronaut support.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished during the longer period operations (IMU alignment, orbital parameters, celestial sightings, pre-ΔV operations) where high activity of the astronaut while wearing the PGA is of interest. Related objectives which can be accomplished are the temperature control portion of objective P. 2. 3. 1, the waste management objective P. 2. 3. 3, the water separator objective P. 2. 3. 4, and the pressure control objective P. 2. 3. 6, as well as the D&C objective S. 3. 3. This ECS objective is of interest during the special test cold and hot soaks of the SPS objective P. 2. 6. 1.

P.2.3.3 Demonstrate performance of the waste management subsystem.

TEST CONDITIONS

No special test conditions are required other than accomplishment during BB-9 and -10. It is highly desirable that this test objective be accomplished on a daily basis as indicated below in data requirements. Refer to AOH procedure 12. 2. 4 and the current Mission Requirements.

DATA REQUIREMENTS

Maximum data acquisition requires continuous LBR PCM recorded on DSE for later dump for a minimum of 80 minutes per cycle. It is highly desirable that these data (gas chromatograph) be acquired at least twice daily, one cycle of cabin sample and one cycle of suit sample.

Astronaut support requires objective comment relative to use of fecal canister, fecal bags, urine dump, PGA urinal dump, vacuum cleaner, waste stowage, miscellaneous debris, etc.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which would always be accomplished are the ECS habitability objectives P.2.3.1 and P.2.3.2. Related objectives which can be accomplished are the provisioning objective S.2.1 and the D&C objective S.3.3.

P.2.3.4 Demonstrate performance of the water separators.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment during BB-5, -7, -8, -9, -12, -14, -17, -24, and -25, or contingency BB-26. It is highly desirable that this objective be accomplished during any period of high physical activity. Refer to AOH procedure 12.2.7.

DATA REQUIREMENTS

Maximum data acquisition requires HBR PCM, either T/M or DSE for later dump. These data would consist of periodic bursts of any duration ranging from 5 seconds to 5 minutes throughout the performance of the building block.

Astronaut support requires objective comment relative to condensation/high humidity, D&C, logging of humidity data from the GFE hydrometer, etc. These data are of particular interest during and after experiment M-3A. Minimum data acquisition requires solely the above astronaut support.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished during the longer period operations (IMU alignment, orbital parameters, celestial sightings, pre-ΔV operations) which would involve high physical activity. Related objectives which would always be accomplished are the ECS habitability objectives P.2.3.1 and P.2.3.2 and the condensation objective P.2.4.6. The D&C objective could also be accomplished. This ECS objective may also be of interest after any experiments which involve high levels of astronaut activity.

P.2.3.5 Verify heat rejection of the ECS evaporators.

TEST CONDITIONS

It is highly desirable that this objective be accomplished during the special test SPS cold soak (BB-12) identified by P.2.6.1 TOADS. Refer to AOH procedure 12.3.7. No further test conditions or procedures other than indicated in BB-5 and post BB-5 in earth orbit while the CSM is attached to the S-IVB, and BB-24 are required.

DATA REQUIREMENTS

Maximum data acquisition requires HBR PCM, either T/M or DSE for later dump. These data would consist of 5-second data bursts every 2 minutes for a sufficient time to establish the cooling trend (approximately 20 to 30 minutes) during evaporator operations. If required, these data can be reacquired periodically throughout the building block or special test.

Astronaut support requires objective comment relative to procedures, monitoring/logging of D&C data, etc. Minimum data acquisition requires solely the above astronaut support.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) and the building block matrix (Figure 7-1) shows that this objective is accomplished at specific points in the mission in order to control cabin temperature. Related objectives which would accomplish the ECS objective are the deorbit pre-ΔV operations objective P.1.2.5, and the special test cold soak of the SPS objective P.2.6.1. Related objectives always accomplished are the command module habitability portion of P.2.3.1, the pressure control objective P.2.3.6, and the D&C objective S.3.3.

P.2.3.6 Demonstrate capability of the pressure control circuit to regulate the cabin pressure and the water tank pressure.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment during BB-1, -5, -7, -8, -9, -10, -12, -24, -25, and -35 or contingency BB-26. Refer to AOH procedure 12.2.6.

DATA REQUIREMENTS

Maximum data acquisition requires HBR PCM, either T/M or DSE for later dump. These data would consist of periodic bursts of any duration ranging from 5 seconds to 5 minutes throughout the performance of the building block.

Astronaut support requires objective comment relative to water tank pressure, monitoring/logging of D&C data, reporting of such control changes as may be required, procedures, etc. Minimum data acquisition requires solely the above astronaut support.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished during the longer period operations (IMU alignment, orbital parameters, celestial sightings, pre-ΔV operations) as well as the ECS evaporator objective P. 2.3.5 and the provisioning objective S.2.1. Related objectives which can be accomplished are the ECS objectives P.2.3.1 and P.2.3.2 and the D&C objective S.3.3.

P.2.4.1 Verify CSM thermal control during controlled orientations and obtain data during random drift.

TEST CONDITIONS

It is highly desirable that this objective be accomplished during the BB-12 special test cold and hot soaks of the SPS (see P.2.6.1 TOADS). Refer to AOH procedure 12.3.3 and the current Mission Requirements. No further test conditions or procedures other than accomplishment during BB-5, -7, -8, -9, and -11 are required.

DATA REQUIREMENTS

Data acquisition requires HBR PCM during the appropriate maximum data acquisition periods of the performed building blocks as identified by the related test objective TOADS. These data would consist of periodic bursts of any duration ranging from 5 seconds to 5 minutes throughout the performance of the building blocks. LBR PCM would also suffice except during the special test (see P.2.6.1 TOADS).

Astronaut support requires periodic monitoring/logging of appropriate D&C as well as periodic monitoring/logging of approximate spacecraft drift rate and attitude with respect to the sun during drifting flight (special test).

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished during the longer period operations and maneuvers (IMU alignment, orbital parameters, celestial sightings, pre-ΔV operations, wide deadband special test) as well as the special test cold and hot soaks of the SPS objective P.2.6.1. The related ECS objective P.2.3.1 would always be accomplished. Related objectives which could be accomplished are the service module RCS objectives P.2.4.2 and the ECS and EPS radiator objectives P.2.4.4 and P.2.4.5.

P.2.4.2 Verify service module RCS thermal response characteristics, with RCS thermal control active.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment during BB-9 and -14 and the special test period of BB-12 (see P.2.6.1 TOADS). This is not meant to exclude any other building block as a potential data source. Refer to AOH procedure 12.2.10.

DATA REQUIREMENTS

Data acquisition requires periodic HBR PCM, either T/M or DSE for later dump. These data would consist of periodic bursts of any duration ranging from 5 seconds to 5 minutes throughout the performance of the building block or special test. The exact definition of thermal equipment cyclic operation may not be possible other than by post-analysis.

Astronaut support requires periodic monitoring/logging of service module RCS D&C as well as periodic monitoring/logging of approximate spacecraft drift rate and attitude orientation relative to the sun.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related D&C objective S.3.3 would always be accomplished. The thermal control objective P.2.4.1 and the ECS and EPS radiator objectives P.2.4.4 and P.2.4.5 are related through the special test cold and hot soak of the SPS objective P.2.6.1 and could be accomplished with this service module RCS objective.

P.2.4.3 Verify command module RCS thermal control.

TEST CONDITIONS

No special test conditions or procedures are required other than identified in BB-14 and -25 or contingency BB-26. Refer to AOH procedure 12.4.1. BB-14 would be accomplished at some point between BB-5 and -6. Use of the command module RCS injector valves prior to BB-6 may constitute a Δ to the power load of that portion of the mission.

DATA REQUIREMENTS

Data acquisition requires HBR PCM on DSE for later dump during the appropriate period of the performed building block. Those data would consist of 5-second bursts at approximately one minute intervals.

Astronaut support requires monitoring/logging of minimum and maximum oxidizer valve temperature from the D&C selectable meter as well as logging period of operation. These data may be retained for postmission acquisition or voice-communication during the mission.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the only related objective which would always be accomplished is the D&C objective S.3.3.

P.2.4.4 Verify ECS radiator heat rejection.

TEST CONDITIONS

It is highly desirable that this objective be accomplished during the BB-12 special test cold and hot soaks of the SPS (see P.2.6.1 TOADS). No further test conditions or procedures other than accomplishment during BB-9 are required. This is not meant to exclude any other building block as a potential data source. Refer to AOH procedure 12.2.3 and the current Mission Requirements.

DATA REQUIREMENTS

Data acquisition requires HBR PCM, either T/M or DSE for later dump. These data would consist of periodic bursts of any duration ranging from 5 seconds to 5 minutes throughout the performance of the building block or special test where attitude holds are greater than 30 minutes. It is desirable that these data be available at least once per revolution. LBR PCM would also support this objective, but it is not recommended.

Astronaut support requires periodic monitoring/logging of ECS D&C and approximate spacecraft drift rate and attitude as well as reporting changes to control settings.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which could always be accomplished are the temperature control portion of objective P.2.3.1, the service module RCS objective P.2.4.2, and the EPS radiator objective P.2.4.5. The D&C objective would always be accomplished. The special test cold and hot soak of the SPS objective P.2.6.1 as well as the thermal control objective P.2.4.1 relates this ECS radiator objective to the EPS radiator objective P.2.4.5.

P.2.4.5 Verify electrical power subsystem (EPS) radiator heat rejection.

TEST CONDITIONS

It is highly desirable that this objective be accomplished during the BB-12 special test cold and hot soaks of the SPS (see P.2.6.1 TOADS). No further test conditions or procedures other than accomplishment during BB-9 are required. This is not meant to exclude any other building block as a potential data source. Refer to AOH procedure 12.3.6 and the current Mission Requirements.

DATA REQUIREMENTS

Data acquisition requires HBR PCM, either T/M or DSE for later dump. These data would consist of periodic bursts of any duration ranging from 5 seconds to 5 minutes throughout the performance of the building block or special test. It is desirable that these data be available at least once per revolution.

Astronaut support requires periodic monitoring/logging of EPS D&C and approximate spacecraft drift rate and attitude relative to the sun. These data should be correlated with power demands.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which could always be accomplished are the service module RCS objective P.2.4.2 and the ECS radiator objective P.2.4.4. The D&C objective S.3.3 would always be accomplished. The special test cold and hot soak of the SPS objective P.2.6.1 as well as the thermal control objective P.2.4.1 relates this EPS radiator objective to the ECS radiator objective P.2.4.4. This EPS radiator objective should be correlated with the cryogenic pressure control objective P.2.5.1.

P.2.4.6 Obtain data on cabin and secondary structure condensation areas and degree of condensation as a function of CSM attitude and duration.

TEST CONDITIONS

It is highly desirable that this objective be accomplished during the BB-12 special test hot soak of the SPS (see P.2.6.1 TOADS). No further test conditions or procedures other than accomplishment during BB-9 and BB-24 are required. This is not meant to exclude any other building block as a potential data source. Refer to AOH procedure 12.2.5 and the current Mission Requirements.

DATA REQUIREMENTS

There are no PCM measurements in support of this test objective.

Astronaut support requires objective comment relative to degree and location of condensation, possible cause or source, correlation with work activity, approximate spacecraft attitude, etc. Special attention should be given to observations during pre-entry cooldown (BB-24).

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objective always accomplished is the water separator objective P.2.3.4.

P.2.4.7 Obtain data on degradion of ECS radiator coating and command module thermal coating due to boost environment.

TEST CONDITIONS

This is a special test using BB-11, AM-2. BB-14 may be selectively used during the special test. Refer to current MR. It is highly desirable that this objective be accomplished during the BB-12 special-test cold and hot soaks of the SPS (see P. 2. 6. 1 TOADS). It is desirable that this objective be accomplished during at least one extended period of approximately three revolutions during which the CSM attitude period is constrained with respect to the local vertical.

DATA REQUIREMENTS

Maximum data acquisition requires HBR PCM, either T/M or on DSE for later dump. These data would consist of periodic bursts of approximately one minute in duration every 15 minutes throughout accomplishment of the objective. LBR PCM would also support this objective, but it is not recommended because of the omission of glycol-flow data in this mode of acquisition.

Astronaut support requires periodic monitoring/logging of ECS D&C, specifically space radiator data and spacecraft attitude and rate data.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which would always be accomplished are the ECS objectives P.2.3.1, P.2.3.2, and P.2.3.4 and the thermal control objectives P.2.4.1, P.2.4.4, and P.2.4.5. Related objectives which could be accomplished are the ECS evaporators objective P.2.3.5, the service module RCS objective P.2.4.2, the condensation objective P.2.4.6, the consumables objective P.4.3, the astronaut-supported objectives S.2.2, S.2.3, and S.2.4, and the D&C objective S.3.3. The proportional rate objectives P.1.2.1 and P.2.2.4, as well as the wide deadband objective P.2.2.4, require maximum data acquisition (HBR PCM). The limit cycle objective P.2.2.3, which also requires maximum data acquisition, could be accomplished.

P.2.5.1 Verify automatic and manual operation of the cryogenic pressure control.

TEST CONDITIONS

It is highly desirable that manual operation be scheduled, as a special test, for some continuous 10-hour period as early as possible in the mission during BB-9 AM-1. A recommended period would be the initial SPS cold soak. No further test conditions or procedures other than accomplishment during BB-9 and BB-14 are required. This is not to exclude any other building block as a potential data source for automatic operation. Refer to AOH procedure 12.3.4 and the current Mission Requirements.

DATA REQUIREMENTS

Data acquisition requires LBR PCM, either T/M or DSE for later dump. These data would consist of periodic bursts of any duration ranging from 5 seconds to 5 minutes approximately every 30 minutes throughout the performance of the building blocks. It is highly desirable that the sampling frequency during the special test be at approximately 15-minute intervals. HBR PCM is not required, but it is also acceptable.

Astronaut support requires objective comment with respect to adequacy of procedures, D&C, etc., as well as monitoring/logging of D&C data approximately once per hour during automatic operation and approximately every 15 minutes during manual operation.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objective always accomplished is the D&C objective S.3.3. The related consumables objective P.4.3 could also be accomplished. This cryogenic pressure control objective is related to the special test cold soak of the SPS objective only because of the requirement for manual operations noted above.

P.2.5.2 Verify fuel cell water separation and purity during earth orbital environment.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment during BB-9, -10, and -14. This is not to exclude any other building block as a potential data source. Refer to AOH procedure 12.3.5.

DATA REQUIREMENTS

Data acquisition requires HBR PCM, either T/M or DSE for later dump. These data would consist of periodic data bursts of any duration ranging from 5 seconds to 5 minutes approximately every 30 minutes throughout the building blocks.

Astronaut support requires objective comment as regards purity and availability of water, adequacy of D&C, monitoring/logging of fuel cell activity, etc. These data should be available approximately once per hour.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related test objective which would always be accomplished is the D&C objective S.3.3. The related consumables objective P.4.3 could also be accomplished. This fuel cell water objective is related to the cryogenic pressure control objective P.2.5.1 and the provisioning objective S.2.1 because of the requirement for adequate water in the mission.

P.2.6.1 Verify five SPS duty cycles.

TEST CONDITIONS

No test conditions or procedures are required other than those identified in BB-12 and -25, contingency BB-44 and the controlled orientations for the special test cold soak and solar soak identified in the current Mission Requirements. It is highly desirable that the various ΔV's consist of any or all of the following: Initial ΔV for system performance, restart ΔV for system performance, ΔV following a cold soak, ΔV following a solar soak, long-duration ΔV, minimum impulse ΔV, ΔV at low propellant level, and deorbit ΔV. The cold soak and solar soak burns are identified as a special test within the domain of BB-12 for those TOADS where they impact the accomplishment of those test objectives. In actuality, the possible duration approximately 12 hours) of these attitude control periods precludes their inclusion as an actual part of BB-12. The cold and hot soaks are most likely a combination of BB-11 to establish a particular orientation followed by BB-9 with selective interpolations of BB-11 to update that orientation. Refer to AOH procedure 12.3.2 and the current Mission Requirements. BB-15 may be performed as required during these special tests. It is highly desirable that all recommended ΔV modes be exercised.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM T/M and DSE for later dump, if required. These data are to be available from 2 minutes before the ΔV, through the ΔV, to 2 minutes after the ΔV (not over 5 minutes including duration of ΔV). Flight qualification recorder data would also be required for postmission recovery for the time period from 10 seconds before the ΔV to 10 seconds after the ΔV.

Astronaut support requires objective comment relative to adequacy of procedures, D&C, monitoring/logging of any anomalies encountered, etc. These data are to be available in real-time or as close as practical to the conclusion of the ΔV.

In addition to the above, it is highly desirable that MSFN monitor in real-time the following PCM measurements during both the cold and solar soak: oxidizer and fuel feedline temperatures, pitch and yaw gimbal actuator temperatures, and command module side heat shield bondline temperatures. During the solar soak, it is highly desirable that chamber outer skin and injector manifold temperatures be added to the preceding monitored measurements. These data should be available at least once per revolution.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) as well as the building block matrix (Figure 7-1) shows that almost all test objectives are related in some fashion to this SPS objective. Related objectives which would always be accomplished are the manual start objective P.1.3.1, the G&N ΔV control objective P.2.1.2, the TVC objective P.2.1.6, the minimum deadband objective P.2.2.1, the translation and ullage objectives P.2.2.6 and P.2.2.7, the SPS objectives P.2.6.3 and P.2.6.4, and the D&C objective S.3.3. Objectives which could be accomplished are the attitude reference objective P.2.1.1, the consumables objective P.4.3, and the astronaut supported objectives S.2.2, S.2.3, and S.2.4. The special test cold and hot soaks provide the opportunity for accomplishing the ECS objectives P.2.3.1, P.2.3.2, and P.2.3.5, the thermal control objectives P.2.4.1, P.2.4.2, P.2.4.4, P.2.4.5, P.2.4.6, and P.2.4.7, and the manual cryogenic pressure control objective P.2.5.1. The relating of operations and maneuvers, such as IMU alignment, vehicle alignment, AGC update, out-the-window, and pre-ΔV operations, is included for consistency with the building block and definition of sequential operations.

P.2.6.2 Deleted

P.2.6.3 Verify operation of the engine redundant bipropellant valve.

TEST CONDITIONS

Accomplishment of this objective constitutes a special test during one or more of the ΔV's of BB-12. Refer to AOH procedure 12.3.2 and the current Mission Requirements. It is highly desirable that ΔV's be accomplished using both valve bank A only and valve bank B only.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM to coincide with the data acquisition identified in P.2.6.1 TOADS.

Astronaut support requires objective comment as regards variation in ΔV with single bank operation, adequacy of procedures as well as D&C, etc. These data to be available in real-time or as close as practical to the conclusion of the ΔV.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objective which would always be accomplished is the D&C objective S.3.3. The related gauging objective P.2.6.4 could be accomplished. This bipropellant valve objective is accomplished as one of the test variables during the SPS objective P.2.6.1.

P.2.6.4 Verify operation and accuracy of primary and auxiliary propellant gauging display.

TEST CONDITIONS

Accomplishment of this objective constitutes a special test during one or more of the ΔV's of BB-12. Refer to AOH procedure 12.3.2 and the current Mission Requirements. Scheduling of this objective during the mission would entail correlating the propellant consumed with point sensor location to assure uncovering of a point sensor during the ΔV selected for objective accomplishment.

DATA REQUIREMENTS

Data acquisition requires continuous HBR PCM to coincide with the data acquisition identified in P.2.6.1 TOADS. These data would be gathered with AUXILIARY selected on the gauging display throughout the test period. An alternate method would be to momentarily switch to PRIMARY 2 seconds after crossing each sensor point and then 2 seconds later returning to AUXILIARY.

Astronaut support requires objective comment with regard to anomalies in the D&C, adequacy of procedures, etc. These data are to be available in real-time or as close as practical to the conclusion of the ΔV.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objective which would always be accomplished is the D&C objective S.3.3. The related objectives which could be accomplished are the bipropellant valve objective P.2.6.3 and the consumables objective P.4.3. This gauging objective is accomplished as one of the test variables during the SPS objective P.2.6.1.

P.2.7 Demonstrate SLA panel deployment.

TEST CONDITIONS

No special test conditions or procedures are required other than performance of BB-19 in such a manner that there is sufficient daylight to permit photography of the SLA panels. Note that accomplishment of this objective during BB-19 is essentially a special test within that BB. It is highly desirable that the photographs, which can be taken from the left- or right-hand CSM couches, be taken not only from dead-on but also at various offset angles from the SLA centerline. This permits accomplishment of objective P.2.2.6 using BB-13 during the photography.

DATA REQUIREMENTS

There are no PCM measurements in support of this objective. If BB-13 is used to position the spacecraft for purposes of photography, it is highly desirable that continuous HBR PCM be acquired throughout the maneuvering (approximately 5 minutes). These data would be required in real-time or on DSE for later dump.

Astronaut support requires objective comment relative to SLA panel deployment, S-IVB stabilization, adequacy of control mode, etc. These data are to be available in real-time or as close as practical to conclusion of the objective.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related proportional rate objectives P.1.2.1 and P.2.2.4, the wide deadband objective P.2.2.2, and the translation objective P.2.2.6 all require maximum data acquisition for accomplishment during the maneuvers. The rendezvous objective is the maneuver during the final portions of which this SLA panel objective is accomplished.

P.2.8 Deleted

P.2.9 Deleted

P.2.10 Verify biomedical instrumentation adequacy.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment during BB-1, -5, -9, and -17. This is not to exclude any other building block as a potential data source. Refer to AOH procedure 12.1.4. It is highly desirable that the test pattern, once established, remain constant.

DATA REQUIREMENTS

Data acquisition requires HBR PCM, either T/M or DSE for later dump. DSE would primarily be used to maintain continuity of test pattern for those periods when the spacecraft is out of station contact. These data would be gathered continuously, when required, for any duration ranging from 1 to 5 minutes. Supplemental data would be furnished by postmission recovery of the biomedical recorder.

Astronaut support requires such objective comment as would permit correlation of the PCM data with work-rest cycles, periods of discomfort, exercise periods, etc. These data would be available concurrently with the PCM data.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective could assist in accomplishment of the experiment objective S.6.

P.3 MSFC objective

P.4.1.1 Demonstrate updating of the AGC from MSFN via updata link and voice modes.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment of BB-16. Refer to AOH procedure 12.3.8. This objective would also be accomplished as a part of BB-5 (or post-BB-5 operation), -12 and -25, or contingency BB-26. Accomplishment of this objective with BB-12 AM-2 and -3 would constitute a special test, because it is not normally required.

DATA REQUIREMENTS

Data acquisition for UHF uplink requires approximately one minute of HBR PCM T/M.

Data acquisition for VHF voice uplink requires astronaut objective comment with regard to adequacy of mode, D&C, procedures, etc.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives always accomplished are the companion objective P.1.1.4 and the D&C objective S. 3. 3. The communications objectives P.4.2.1 and P.4.2.4 and the acoustic objective S.2.3 could be accomplished.

P.4.2.1 Verify CSM/MSFN S-band telemetry, television, voice, updata, and tracking capability.

TEST CONDITIONS

Although the updata portion of this test objective may be accomplished during BB-16, in general, this test objective constitutes a special test because S-band is not required for Block I. BB-9 AM-2 offers the best opportunity for accomplishment; however, this is not meant to exclude any other building block as a potential data source. Use of television during BB-9 constitutes a Δ to that building block. Refer to AOH procedure 12.1.2. It is desirable that some exercise of the S-band high power mode be achieved. This latter is also a Δ to BB-9.

DATA REQUIREMENTS

Data acquisition requires HBR or LBR PCM, when required. These data would consist of any duration ranging from 1 to 5 minutes of simultaneous VHF and S-band T/M. S-band tracking, sequentially in both modes (doppler and PRN), would be acquired simultaneously with C-band tracking. HBR-PCM T/M would be available simultaneously with television transmission of a suitable target (approximately 5 minutes duration).

Astronaut support requires objective comment as regards the adequacy of S-band voice vis-a-vis VHF. These data would be derived from either simultaneous or sequential VHF and S-band voice.

It is desirable that 24 hours of S-band operation, primarily in low power mode, be acquired during the first 48 hours of the mission.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related test objectives which could be accomplished are the AGC update objectives P.1.1.4 and P.4.1.1, the data dump objective P.4.2.2, the CTE update objective P.4.2.3, the acoustic objective S.2.3, and the D&C objective S.3.3.

P.4.2.2 Demonstrate the capability of VHF/FM and S-band data dump.

TEST CONDITIONS

This test objective would be a special test capable of accomplishment in either BB-5 or AM-2 of BB-9. Refer to AOH procedure 12.3.13.

DATA REQUIREMENTS

Data acquisition requires simultaneous VHF/FM and S-band data dump of HBR PCM for approximately one minute as well as simultaneous VHF/FM and S-band data dump of LBR PCM for approximately one minute. Alternate data acquisition would be S-band dump of previously transmitted VHF/FM PCM. Less desirable would be S-band dump of PCM not previously transmitted; these data would require qualitative analysis.

Astronaut support requires objective comment relative to procedures and D&C.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related test objectives which could always be accomplished are the S-band objective P.4.2.1, the acoustic objective S.2.3, and the D&C objective S.3.3. The VHF communications objective P.4.2.4 is related because of the requirement for downlink.

P.4.2.3 Verify compatibility of MSFN updata link (UDL) for updating central timing equipment (CTE) by the UHF and S-band links.

TEST CONDITIONS

This test objective would be a special test capable of accomplishment in either BB-5 or AM-2 of BB-9. Refer to AOH procedure 12.3.11. If not operationally required, it is desirable that the test update occur sequentially, i. e., update by UHF and then by S-band.

DATA REQUIREMENTS

Data acquisition requires approximately one minute of HBR PCM T/M for each mode.

Astronaut support, other than appropriate switching as necessary, is not required.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related test objectives which could always be accomplished are the S-band objective P.4.2.1 and the VHF communications objective P.4.2.4.

P.4.2.4 Demonstrate the capability of MSFN and spacecraft crew to maintain VHF communications.

TEST CONDITIONS

No special test conditions or procedures are required other than crew activity as required to maintain VHF communications throughout the mission. Refer to AOH procedure 12.1.1. VHF communications are required for BB-12, -14, -16, and -25 and contingency BB-26. This is not meant to exclude BB-5 and -9, or any other building block as a potential data source.

DATA REQUIREMENTS

Data acquisition requires HBR PCM T/M of any duration ranging from 5 seconds to 5 minutes, as required.

Astronaut support requires objective comment relative to adequacy of procedures, D&C, audio levels, etc.

RELATED TEST OBJECTIVES

Examination of the test objectives matrix (Figure 7-2) shows that the related test objective which would be always accomplished is the D&C objective S.3.3. The related objective which could be accomplished is the acoustic objective S. 3.3. The AGC objectives P. 1. 1.4 and P. 4. 1. 1, the data dump objective P. 4. 2. 2, and the CTE objective P. 4. 2. 3 are related because of the requirement for downlink.

P.4.3 Obtain data on the use of consumables for a long duration earth orbital mission.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment as required by BB-5, -6, -7, -8, -11, -12, -13, -14, -15, -24, and -25 and contingency BB-26. Refer to AOH procedure 12.2.9.

DATA REQUIREMENTS

Data acquisition requires HBR PCM, either T/M or DSE for later dump. These data would consist of any duration ranging from 5 seconds to 5 minutes, as required.

Astronaut support requires logging consumption of such items as potable water, LiOH canisters, etc. These data would be periodically voice-transmitted to MSFN.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective is accomplished as an element of pre-ΔV operations. This objective may also be accomplished after the IMU alignment objectives P.1.1.1 and P.2.1.3, the vehicle alignment objectives P.1.1.2 and P.2.1.4, the orbital parameter objectives P.1.1.3 and P.2.1.5, the celestial sighting objective P.1.1.6, the out-the-window objective P.1.1.7, the simulated docking objective P.2.1.7, the wide deadband special test objective P.2.2.2, the cryogenic pressure objective P.2.5.1, the fuel cell water objective P.2.5.2, and the SPS objectives P.2.6.1 and P.2.6.4.

P.5.1 Deleted.

S.1 Demonstrate CSM and launch vehicle compatibility.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment of BB-1, -5, and -6. Refer to AOH procedure 12.1.8.

DATA REQUIREMENTS

There are no specific PCM measurements in support of this test objective. However, it is highly desirable that continuous HBR PCM T/M be available from T-O to insertion in earth orbit.

Astronaut support requires objective comment with regard to vibration, acoustic phenomena, structural or system anomalies, etc. These data would be available in real-time or as close as practical to the time of occurrence.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that this objective can be accomplished by the related separation objective P.1.2.6. Related objectives which could be accomplished are the astronaut-supported objectives S.2.2, S.2.3, and S.2.4.

S.2.1 Obtain data on food provisioning for a long-duration mission.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment during BB-10. Refer to AOH procedure 12.2.13.

DATA REQUIREMENTS

Data acquisition requires LBR PCM, either T/M or DSE for later dump. These data would consist of approximately 5 seconds of data once every hour or revolution throughout the mission.

Astronaut support requires objective comment with respect to palatability, flavor alteration, etc. These data would be available coincident with meal periods, if possible, or as soon as practical after the meal period.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that related test objectives which could be accomplished are the waste management objective P.2.3.3, the pressure control objective P.2.3.6 and the fuel cell water objective P.2.5.2.

S.2.2 Demonstrate adequacy of the couch restraint system.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment during BB-1, -12, -25, and -35 or contingency BB-26 and -44. Refer to AOH procedure 12.1.5.

DATA REQUIREMENTS

There are no specific PCM measurements in support of this test objective. Flight qualification recorder data would be required during the building block for postmission recovery.

Astronaut support requires objective comment with regard to comfort, adjustability, D&C access, etc. These data would be available in real-time or as close as practical to the time of acquisition.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which function as data sources for this restraint objective are the out-the-window objective P.1.1.7, the translation and ullage objectives P.2.2.6 and P.2.7.7, the SPS objective P.2.6.1, and the compatibility objective S.1.

S.2.3 Obtain data (astronaut-sensed) on acoustic environment.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment during BB-1, -7, -8, -9, -11, -12, -13, -14, -17, -25, and -35 or contingency BB-26. Refer to AOH procedure 12.1.7.

DATA REQUIREMENTS

There are no specific PCM measurements in support of this test objective.

Astronaut support requires objective comment with respect to noise level, possible source, possible remedial action if any, etc. These data would be available in real-time or as close as practical to the time of phenomena detection.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which function as data sources for this acoustic objective are the G&N operation and maneuvering objectives, the SPS objective P.2.6.1, and the communications objectives as well as the compatibility objective S.1. The related objective which could be accomplished with this acoustic objective is the vibration objective S.2.4.

S.2.4 Obtain data (astronaut-sensed) on signs of equipment structure resonant vibration.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment during BB-1, -6, -7, -8, -11, -12, -13, and -25 or contingency BB-26. Refer to AOH procedure 12.1.6.

DATA REQUIREMENTS

There are no specific PCM measurements in support of this test objective.

Astronaut support requires objective comment with respect to detected vibration, possible source or cause, etc. These data would be available in real-time or as close as practical to the time of occurrence.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related objectives which function as data sources for this vibration objective are the G&N operation and maneuvering objectives, the special test wide deadband objective P.2.2.2, the translation and ullage objectives P.2.2.6 and P.2.2.7, the SPS objective P.2.6.1, as well as the compatibility objective S.1. The related objective which could be accomplished with this vibration objective is the acoustic objective S.2.3.

S.3.1 Demonstrate simulated one-man lunar orbit and transearth coast operations.

TEST CONDITIONS

This constitutes a special test which could require the performance of any or all of the following: BB-7, -8, -9, -11, -12, -13, -14, -15, and -16. Accomplishment of this test objective would require the generation within the mission of its own timeline. Refer to AOH procedure 12.3.18.

DATA REQUIREMENTS

Data acquisition requires maximum or minimum data acquisition as identified in those TOADS selected as applicable.

Astronaut required support would be as identified in those TOADS selected as applicable, as well as objective comment relative to one-man operation.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) permits identification of all the operations which could be accomplished by performance of the aforementioned building blocks.

S.3.2 Deleted.

S.3.3 Demonstrate adequacy of displays/controls and compartment lighting.

TEST CONDITIONS

No special test conditions or procedures are required other than performance of all building blocks. Refer to AOH procedure 12.3.12.

DATA REQUIREMENTS

There are no specific PCM measurements in support of this test objective.

Astronaut support requires objective comment relative to the test objective as obtained through performance of the building blocks. It is highly desirable that data be obtained by the astronauts by use of a hand-held light meter to provide quantitative data with respect to light levels. All these data should be periodically transmitted to MSFN.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) and the building block matrix (Figure 7-1) shows that almost all test objectives can function as data sources for the D&C objective.

S.4 Deleted.

S.5 Deleted.

S.6 Conduct medical, scientific, and Department of Defense experiments as assigned to these missions.

TEST CONDITIONS

No special test conditions or procedures are required other than accomplishment of BB-17. Refer to AOH Section 11.

DATA REQUIREMENTS

Data acquisition is defined in BB-17.

RELATED TEST OBJECTIVES

Examination of the test objective matrix (Figure 7-2) shows that the related test objectives which could always be accomplished are the biomedical objective P. 2. 10 and the acoustic objective S. 2. 3. The related water separator objective could be accomplished after any experiment which requires high physical activity.

LEGEND

- P = OBJECTIVE WHICH IS ACCOMPLISHED DURING BUILDING BLOCK
- S = OBJECTIVE WHICH CAN BE ACCOMPLISHED DURING BUILDING BLOCK
- R = OBJECTIVE OR OPERATION WHICH REQUIRES THIS BUILDING BLOCK
- X = OPERATION OR OBJECTIVE WHICH IS REQUIRED BY BUILDING BLOCK
- ΔR = OBJECTIVE OR OPERATION WHICH MUST BE ACCOMPLISHED OR BE PERFORMED PRIOR TO BUILDING BLOCK
- Δ = OBJECTIVE WHICH CAN BE ACCOMPLISHED AFTER BUILDING BLOCK
- ST = SPECIAL TEST (SEE SPECIFIC TEST OBJECTIVE)
- ○ = OBJECTIVE NOT ACCOMPLISHED BY MINIMUM DATA ACQUISITION

RELATED OBJECTIVE

BUILDING BLOCK	P.1.1.1 ASTRONAUT ALIGN IMU	P.1.1.2 ASTRONAUT ALIGN VEHICLE USING SCT	P.1.1.3 ASTRONAUT ORBITAL PARAMETER DETERMINATION	P.1.1.4 ASTRONAUT UPDATE AGC	P.1.1.6 ASTRONAUT MIDCOURSE STAR SIGHTING	P.1.1.7 ASTRONAUT VISUAL ATTITUDE ORIENTATION	P.1.2.1 ASTRONAUT MAINTAIN PROPORTIONAL RATE FDAI	P.1.2.2 ASTRONAUT MINIMUM IMPULSE, OPTICS	P.1.2.5 ASTRONAUT PRE ΔV OPERATIONS	P.1.2.7 ASTRONAUT PERFORM SIMULATED DOCKING	P.1.3.1 ASTRONAUT MANUAL SPS START	P.2.1.1 G&N AND SCS ATTITUDE REFERENCE COMPARISON	P.2.1.2 G&N ATTITUDE ΔV CONTROL AND ENTRY GUIDANCE	P.2.1.3 ALIGN IMU	P.2.1.4 ALIGN VEHICLE USING SCT	P.2.1.5 ESTABLISH ORBIT PARAMETERS	P.2.1.6 G&N AND SCS TVC	P.2.1.7 OPTICAL ACQUISITION AND TRACKING SEXTANT	P.2.2.1 RATE DAMPING MINIMUM DEADBAND	P.2.2.2 SCS ATTITUDE HOLD (WIDE DEADBAND)	P.2.2.3 SCS ATTITUDE HOLD, LIMIT CYCLE	P.2.2.4 PROPORTIONAL RATE FDAI	P.2.2.5 MINIMUM IMPULSE CONTROLLER (OPTICS)	P.2.2.6 TRANSLATION PERFORMANCE	P.2.2.7 DIRECT ULLAGE	P.2.3.1 CM AND EQUIPMENT TEMPERATURE CONTROL	P.2.3.2 SUIT CIRCUIT HABITABILITY	P.2.3.3 WASTE MANAGEMENT PERFORMANCE	P.2.3.4 WATER SEPARATORS PERFORMANCE	P.2.3.5 ECS EVAPORATORS	P.2.3.6 PRESSURE CONTROL CIRCUIT	P.2.4.1 CSM THERMAL CONTROL	P.2.4.2 SM RCS THERMAL CONTROL	P.2.4.3 CM RCS THERMAL RESPONSE	P.2.4.4 ECS RADIATOR CONTROL	P.2.4.5 EPS RADIATOR HEAT REJECTION	P.2.4.6 CABIN CONDENSATION	P.2.4.7 ECS RADIATOR DEGRADATION	P.2.5.1 AUTO AND MANUAL CRYOGENIC PRESSURE CONTROL	P.2.5.2 FUEL CELL WATER SEPARATION AND PURITY	P.2.6.1 SPS ΔV	P.2.6.3 REDUNDANT BIPROPELLANT VALVE	P.2.6.4 PRIMARY AND AUXILIARY GAUGING DISPLAY	P.2.7 SLA PANEL DEPLOY	P.2.10 BIOMEDICAL INSTRUMENTATION	P.3 S-IVB/IU CHECKOUT	P.4.1.1 AGC UPDATE	P.4.2.1 CSM/MSFN S-BAND CAPABILITY	P.4.2.2 VHF/FM, S-BAND DATA DUMP	P.4.2.3 UHF, S-BAND CTE UPDATE	P.4.2.4 VHF COMMUNICATIONS	P.4.3 CONSUMABLES DATA	S.1 CSM/LV COMPATIBILITY	S.2.1 FOOD PROVISIONING DATA	S.2.2 COUCH RESTRAINTS	S.2.3 ACOUSTIC ENVIRONMENT	S.2.4 RESONANT VIBRATION	S.3.1 1-MAN LUNAR ORBIT & TRANSEARTH COAST C°NS	S.3.3 DISPLAYS AND CONTROLS	S.6 EXPERIMENTS
BB-1 ASCENT												Δ														S					S														S								P		P	S	S		P	
BB-2 LET JETTISON																																																											P	
BB-5 POST-INSERTION				P								Δ		P												S	S		S	P	S	S													S		P		ST	ST	S	Δ	S						P	S
BB-6 CSM/S-IVB SEPARATION							P			P										S		P		P	P																			P								Δ	ΔR				S		P	
BB-7 IMU ALIGNMENT	P	Δ					S	P				Δ	P	P	Δ			Δ		P	S	S	P			S	S		S		S	S																				Δ				S	S	S	P	
BB-8 NAVIGATION SIGHTINGS																																																												
LANDMARK	ΔR		P					P				Δ		ΔR		P				P	S		P			S	S		S		S	S																				Δ				S	S	S	P	
CELESTIAL					P		S	P											P		S	S	P			S	S		S		S	S																				Δ				S	S	S	P	
BB-9 DRIFTING FLIGHT																																																												
AM-1 POWERED DOWN																										S	S	P	S		S	S	S		S	S	S		ST	S					S						S					S		S	P	S
AM-2 POWERED UP																		ST								S		S	S		S	S	S		S	S	S		S	S								ST	ST	ST	S					S		S	P	S
BB-10 CREW MAINTENANCE																																																												
MEAL PREPARATION																															P									P												P		P				S	P	
WASTE MANAGEMENT																										P		P																														S	P	
BB-11 ATTITUDE CONTROL																																																												
AM-1 G&N ATTITUDE CONTROL MODE							S					Δ	P						S	S	S	S				S						S																				Δ				S	S	S	P	
AM-2 SCS ATTITUDE CONTROL MODE		ST				R	S			S		Δ			ST			ST	S	ST	S	S		S		S						S						ST														Δ				S	S	S	P	
AM-3 MANUAL ATTITUDE CONTROL MODE						R																				S						S																				Δ				S	S	S	P	
BB-12 SPS ΔV																																																												
AM-1 G&N ΔV MODE	X			X					X		S	Δ	P	X			P		P					P	P	ST	S		S	ST	S	ST	ST		ST	ST	ST	ST			P	ST	ST				X				X	X			P	S	S	S	P	
AM-2 SCS ΔV MODE	ST	X		ST					X		S	Δ		ST	X		P		P					P		ST	S		S	ST	S	ST	ST		ST	ST	ST	ST			P	ST	ST				ST				X	X			P	S	S	S	P	
AM-3 MANUAL ΔV MODE	X	X		ST					X		S	Δ		X	X									P		ST	S		S	ST	S	ST	ST		ST	ST	ST	ST			P	ST	ST				ST				X	X			P	S	S	S	P	
BB-13 RCS TRANSLATION																																																												
AM-1 TRANSLATION CONTROL										S								ST						P																				S								Δ				S	S	S	S	
AM-2 DIRECT ULLAGE										S															P																											Δ				S	S	S	S	
BB-14 SUBSYSTEM STATUS CHECKS																																																												
EPS, ECS, SPS, COMM, SM RCS, CM RCS									S																		S		S				S	P				ST	P	S											X	P				S		S	S	
BB-15 SUBSYSTEM MAINTENANCE																																																												
FUEL CELL PURGING									R																														P													Δ						S	S	
BATTERY CHARGING									R																																																	S	S	
SPS PROPELLANT FEED LINE TEMPERATURE CONTROL																																									ST																	S	P	
BB-16 AGC UPDATE																																																												
MSFN/UPDATA LINK MODE				P					R																																						P	S			X							S	S	
MSFN/VOICE MODE				P					R																																						P	S			X							S	S	
BB-17 EXPERIMENTS																													S																P											S				P
BB-18 CABIN DEPRESSURIZATION																																																											P	
BB-19 RENDEZVOUS AND SIMULATED DOCKING							S			P										P		S		P																				ST																
BB-24 PRE-DEORBIT																											S		S	P	S						S															Δ							P	
BB-25 SPS DEORBIT AND ENTRY																																																												
AM-1 G&N ENTRY (PRIMARY)	X			X					X			Δ	P	X			P		P					P	S	S	S		S		S			P							P		ST				X				X	Δ			P	S	S		P	
AM-2 SCS ENTRY (BACKUP) — LIFTING AND ROLLING		X				X			X						X		P		P					P	S	S	S		S		S			P							P		ST								X	Δ			P	S	S		P	
BB-26 SM RCS DEORBIT AND ENTRY																																																												
G&N ENTRY (PRIMARY)	X			X					X			Δ	P	X			P		P					P		S	S		S		S			P													X				X	Δ			P	S	S		P	
BB-35 PARACHUTE DESCENT AND IMPACT																															P																								P	S			S	
BB-37 POST-LANDING																																																											S	
BB-41 RADIATOR LOSS (ECS AND EPS)																																																											P	
BB-42 LES ABORT																																																					P		P				P	
BB-44 LAUNCH ABORT — SPS											P		P				P		P					P	S																P												P		P				P	
BB-45 WATER BOILER FAILURE																																																											P	

Figure 7-1. Building Block/Test Objective Matrix

LEGEND

P = RELATED OBJECTIVE WHICH IS ACCOMPLISHED CONCURRENTLY WITH SUBJECT OBJECTIVE

S = RELATED OBJECTIVE WHICH CAN BE ACCOMPLISHED CONCURRENTLY WITH SUBJECT OBJECTIVE

R = RELATED OBJECTIVE WHICH ACCOMPLISHES SUBJECT OBJECTIVE

ΔS = RELATED OBJECTIVE WHICH COULD BE ACCOMPLISHED IMMEDIATELY AFTER ACCOMPLISHING SUBJECT OBJECTIVE

ΔR = RELATED OBJECTIVE OR OPERATION WHICH MUST BE ACCOMPLISHED OR BE PERFORMED PRIOR TO SUBJECT OBJECTIVE

Δ = SUBJECT OBJECTIVE COULD BE PERFORMED AFTER RELATED OBJECTIVE

ST = SPECIAL TEST (SEE SPECIFIC TEST OBJECTIVE)

○ = RELATED OBJECTIVE NOT ACCOMPLISHED BY MINIMUM DATA ACQUISITION

SUBJECT OBJECTIVE / RELATED OBJECTIVE	P.1.1.1 ASTRONAUT ALIGN IMU	P.1.1.2 ASTRONAUT ALIGN VEHICLE USING SCT	P.1.1.3 ASTRONAUT ORBITAL PARAMETER DETERMIN	P.1.1.4 ASTRONAUT UPDATE AGC	P.1.1.6 ASTRONAUT MIDCOURSE STAR SIGHTING	P.1.1.7 ASTRONAUT VISUAL ATTITUDE ORIENTATION	P.1.2.1 ASTRONAUT MAINT PROPORTIONAL RATE FDAI	P.1.2.2 ASTRONAUT MINIMUM IMPULSE, OPTICS	P.1.2.5 ASTRONAUT PRE ΔV OPERATIONS	P.1.2.7 ASTRONAUT PERFORM SIMULATED DOCKING	P.1.3.1 ASTRONAUT MANUAL SPS START	P.2.1.1 G&N AND SCS ATTITUDE REFERENCE COMPAR	P.2.1.2 G&N AND SCS ΔV CONT AND ENTRY GUIDANCE	P.2.1.3 ALIGN IMU	P.2.1.4 ALIGN VEHICLE USING SCT	P.2.1.5 ESTABLISH ORBIT PARAMETERS	P.2.1.6 G&N AND SCS TVC	P.2.1.7 OPTICAL ACQUISITION AND TRACKING SEXTANT	P.2.2.1 RATE DAMPING MINIMUM DEADBAND	P.2.2.2 SCS ATTITUDE HOLD (WIDE DEADBAND)	P.2.2.3 SCS ATTITUDE HOLD, LIMIT CYCLE	P.2.2.4 PROPORTIONAL RATE FDAI	P.2.2.5 MINIMUM IMPULSE CONTROLLER (OPTICS)	P.2.2.6 TRANSLATION PERFORMANCE	P.2.2.7 DIRECT ULLAGE	P.2.3.1 CM AND EQUIPMENT TEMPERATURE CONTROL	P.2.3.2 SUIT CIRCUIT HABITABILITY	P.2.3.3 WASTE MANAGEMENT PERFORMANCE	P.2.3.4 WATER SEPARATORS PERFORMANCE	P.2.3.5 ECS EVAPORATORS
P.1.1.1 ASTRONAUT ALIGN IMU							Ⓢ	Ⓟ				ΔS	Ⓟ	P						Ⓟ	Ⓢ	Ⓢ	Ⓟ			S	S		S	
P.1.1.2 ASTRONAUT ALIGN VEHICLE USING SCT	ΔR						Ⓢ	Ⓟ				ΔS		ΔR	P				Ⓟ			Ⓢ	Ⓟ			S				
P.1.1.3 ASTRONAUT ORBITAL PARAMETER DETERMINATION	ΔR							Ⓟ				ΔS		ΔR		P				Ⓟ	Ⓢ		Ⓟ			S	S		S	
P.1.1.4 ASTRONAUT UPDATE AGC																														
P.1.1.6 ASTRONAUT MIDCOURSE STAR SIGHTING							Ⓢ	Ⓟ											Ⓟ		Ⓢ	Ⓢ	Ⓟ			S	S		S	
P.1.1.7 ASTRONAUT VISUAL ATTITUDE ORIENTATION	ΔR						Ⓟ					ΔS		ΔR						Ⓟ		Ⓟ				S				
P.1.2.1 ASTRONAUT MAINTAIN PROPORTIONAL RATE FDAI	R	R			R	R				R				R	R			R		R		Ⓟ								
P.1.2.2 ASTRONAUT MINIMUM IMPULSE, OPTICS	R	R	R		R									R	R	R		R					Ⓟ							
P.1.2.5 ASTRONAUT PRE ΔV OPERATIONS	Ⓟ			P										Ⓟ												S	S		S	S
P.1.2.7 ASTRONAUT PERFORM SIMULATED DOCKING							Ⓟ											Δ		Ⓢ		Ⓟ		Ⓟ	Ⓟ					
P.1.3.1 ASTRONAUT MANUAL SPS START									ΔR																					
P.2.1.1 G&N AND SCS ATTITUDE REFERENCE COMPARISON	Δ	Δ	Δ			Δ							Δ	Δ	Δ	Δ	Δ													
P.2.1.2 G&N ATTITUDE ΔV CONTROL AND ENTRY GUIDANCE	R											ΔS		R			P		S	Ⓢ	Ⓢ									
P.2.1.3 ALIGN IMU	P						Ⓢ	Ⓟ				ΔS	Ⓟ							Ⓟ	Ⓢ	Ⓢ	Ⓟ			S	S		S	
P.2.1.4 ALIGN VEHICLE USING SCT	ΔR	P					Ⓢ	Ⓟ				ΔS		ΔR					Ⓟ			Ⓢ	Ⓟ			S				
P.2.1.5 ESTABLISH ORBIT PARAMETERS	ΔR		P					Ⓟ				ΔS		ΔR						Ⓟ	Ⓢ		Ⓟ			S	S		S	
P.2.1.6 G&N AND SCS TVC												ΔS	P						P											
P.2.1.7 OPTICAL ACQUISITION AND TRACKING SEXTANT	ΔR						Ⓟ	Ⓟ		ΔS				ΔR					Ⓢ	Ⓢ	Ⓢ	Ⓟ	Ⓟ			S	S			
P.2.2.1 RATE DAMPING MINIMUM DEADBAND		R			R										R		R	R												
P.2.2.2 SCS ATTITUDE HOLD (WIDE DEADBAND)	R		R			R	Ⓢ			R				R		R		R			Ⓟ	Ⓢ				S				
P.2.2.3 SCS ATTITUDE HOLD, LIMIT CYCLE	R		R		R									R		R		R		R										
P.2.2.4 PROPORTIONAL RATE FDAI	R	R			R	R	Ⓟ			R				R	R			R		R										
P.2.2.5 MINIMUM IMPULSE CONTROLLER (OPTICS)	R	R	R		R			Ⓟ						R	R	R		R												
P.2.2.6 TRANSLATION PERFORMANCE										R																				
P.2.2.7 DIRECT ULLAGE										R																				
P.2.3.1 CM AND EQUIPMENT TEMPERATURE CONTROL	R	R	R		R	R			R					R	R	R		R		R							S	R	P	R
P.2.3.2 SUIT CIRCUIT HABITABILITY	R		R		R				R					R		R		R								S		S	P	
P.2.3.3 WASTE MANAGEMENT PERFORMANCE																										P	P			
P.2.3.4 WATER SEPARATORS PERFORMANCE	R		R		R				R					R		R										P	P			
P.2.3.5 ECS EVAPORATORS									R																	S				
P.2.3.6 PRESSURE CONTROL CIRCUIT	R		R		R				R					R		R										S	S			R
P.2.4.1 CSM THERMAL CONTROL	R		R		R				R				R	R		R				R						P				
P.2.4.2 SM RCS THERMAL RESPONSE																														
P.2.4.3 CM RCS THERMAL CONTROL																														
P.2.4.4 ECS RADIATOR HEAT REJECTION																										S				
P.2.4.5 EPS RADIATOR HEAT REJECTION																														
P.2.4.6 CABIN CONDENSATION																													P	
P.2.4.7 ECS RADIATOR DEGRADATION							Ⓟ													Ⓟ	Ⓢ	Ⓟ				P	P		P	S
P.2.5.1 AUTO AND MANUAL CRYOGENIC PRESSURE CONTROL																														
P.2.5.2 FUEL CELL WATER SEPARATION AND PURITY																														
P.2.6.1 SPS ΔV	ΔR	Δ		ΔR		Δ			ΔR		P	ΔS	P	ΔR			P		P					P	P	ST	ST			ST
P.2.6.3 REDUNDANT BIPROPELLANT VALUE																														
P.2.6.4 PRIMARY AND AUXILIARY GAUGING DISPLAY																														
P.2.7 SLA PANEL DEPLOY							Ⓢ			ΔR										Ⓟ		Ⓢ		Ⓢ						
P.2.10 BIOMEDICAL INSTRUMENTATION																														
P.3 S-IVB/IU CHECKOUT																														
P.4.1.1 UPDATE AGC				P																										
P.4.2.1 CSM/MSFN S-BAND CAPABILITY				S																										
P.4.2.2 VHF/FM, S-BAND DATA DUMP																														
P.4.2.3 UHF, S-BAND CTE UPDATE																														
P.4.2.4 VHF COMMUNICATIONS				ΔS																										
P.4.3 CONSUMABLES DATA	Δ	Δ	Δ		Δ	Δ			R					Δ	Δ	Δ		Δ		Δ										
S.1 CSM/LV COMPATIBILITY										R																				
S.2.1 FOOD PROVISIONING DATA																												S		
S.2.2 COUCH RESTRAINTS						R												R						R	R					
S.2.3 ACOUSTIC ENVIRONMENT	R	R	R	R	R	R								R	R	R		R												
S.2.4 RESONANT VIBRATION	R	R	R		R	R								R	R	R		R		R				R	R					
S.3.1 ONE MAN LUNAR ORBIT AND TRANS-EARTH COAST OPERATIONS	S	S	S	S	S				S					S	S	S										S	S	S	S	
S.3.3 DISPLAYS AND CONTROLS	R	R	R	R	R	R			R	R	R	R		R	R	R		R		R				R	R	R	R	R	R	R
S.6 EXPERIMENTS																													ΔS	

SUBJECT OBJECTIVE / RELATED OBJECTIVE	P.2.3.6 PRESSURE CONTROL CIRCUIT	P.2.4.1 CSM THERMAL CONTROL	P.2.4.2 SM RCS THERMAL RESPONSE	P.2.4.3 CM RCS THERMAL CONTROL	P.2.4.4 ECS RADIATOR HEAT REJECTION	P.2.4.5 EPS RADIATOR HEAT REJECTION	P.2.4.6 CABIN CONDENSATION	P.2.4.7 ECS RADIATOR DEGRADATION	P.2.5.1 AUTO AND MANUAL CRYO PRESS CONTROL	P.2.5.2 FUEL CELL WATER SEPARATION AND PURITY	P.2.6.1 SPS ΔV	P.2.6.3 REDUNDANT BIPROPELLANT VALVE	P.2.6.4 PRIMARY AND AUXILIARY GAUGING DISPLAY	P.2.7 SLA PANEL DEPLOY	P.2.10 BIOMEDICAL INSTRUMENTATION	P.3 S-IVB/IU CHECKOUT	P.4.1.1 UPDATE AGC	P.4.2.1 CSM/MSFN S-BAND CAPABILITY	P.4.2.2 VHF/FM, S-BAND DATA DUMP	P.4.2.3 UHF, S-BAND CTE UPDATE	P.4.2.4 VHF COMMUNICATIONS	P.4.3 CONSUMABLES DATA	S.1 CSM LV COMPATIBILITY	S.2.1 FOOD PROVISIONING DATA	S.2.2 COUCH RESTRAINTS	S.2.3 ACOUSTIC ENVIRONMENT	S.2.4 RESONANT VIBRATION	S.3.1 1 MAN LUNAR ORBIT & TRANSEARTH COAST OPNS	S.3.3 DISPLAYS AND CONTROLS	S.6 EXPERIMENTS
P.1.1.1 ASTRONAUT ALIGN IMU	S	Ⓢ																				ΔS				S	S	R	P	
P.1.1.2 ASTRONAUT ALIGN VEHICLE USING SCT																						ΔS				S	S	R	P	
P.1.1.3 ASTRONAUT ORBITAL PARAMETER DETERMINATION	S	Ⓢ																				ΔS				S	S	R	P	
P.1.1.4 ASTRONAUT UPDATE AGC																	P		S		S					S		R	P	
P.1.1.6 ASTRONAUT MIDCOURSE STAR SIGHTING	S	Ⓢ																				ΔS				S	S	R	P	
P.1.1.7 ASTRONAUT VISUAL ATTITUDE ORIENTATION																						ΔS			S	S	S		P	
P.1.2.1 ASTRONAUT MAINTAIN PROPORTIONAL RATE FDAI								R						R																
P.1.2.2 ASTRONAUT MINIMUM IMPULSE, OPTICS																														
P.1.2.5 ASTRONAUT PRE ΔV OPERATIONS	S	Ⓢ		P							ΔS						P	S		S	S	S						R	P	
P.1.2.7 ASTRONAUT PERFORM SIMULATED DOCKING														ΔS									ΔR						S	
P.1.3.1 ASTRONAUT MANUAL SPS START											R																		S	
P.2.1.1 G&N AND SCS ATTITUDE REFERENCE COMPARISON											Δ																		P	
P.2.1.2 G&N ATTITUDE ΔV CONTROL AND ENTRY GUIDANCE		Ⓢ									R																			
P.2.1.3 ALIGN IMU	S	Ⓢ																				ΔS				S	S	R	P	
P.2.1.4 ALIGN VEHICLE USING SCT																						ΔS				S	S	R	P	
P.2.1.5 ESTABLISH ORBIT PARAMETERS	S	Ⓢ																				ΔS				S	S	R	P	
P.2.1.6 G&N AND SCS TVC											R																			
P.2.1.7 OPTICAL ACQUISITION AND TRACKING SEXTANT																						ΔS			S	S	S		S	
P.2.2.1 RATE DAMPING MINIMUM DEADBAND											R																			
P.2.2.2 SCS ATTITUDE HOLD (WIDE DEADBAND)		Ⓢ						R						R								ΔS					S		S	
P.2.2.3 SCS ATTITUDE HOLD, LIMIT CYCLE								R																						
P.2.2.4 PROPORTIONAL RATE FDAI								R						R																
P.2.2.5 MINIMUM IMPULSE CONTROLLER (OPTICS)																														
P.2.2.6 TRANSLATION PERFORMANCE											R			R											S		S		S	
P.2.2.7 DIRECT ULLAGE											R														S		S		S	
P.2.3.1 CM AND EQUIPMENT TEMPERATURE CONTROL	R	Ⓟ			Ⓢ			R			ST																	R	S	
P.2.3.2 SUIT CIRCUIT HABITABILITY	P							R			ST																	R	S	
P.2.3.3 WASTE MANAGEMENT PERFORMANCE																								S				R	S	
P.2.3.4 WATER SEPARATORS PERFORMANCE							P	R																				R	S	Δ
P.2.3.5 ECS EVAPORATORS	P							R			ST																		S	
P.2.3.6 PRESSURE CONTROL CIRCUIT																								R				R	S	
P.2.4.1 CSM THERMAL CONTROL			S		S	S		R			ST																	R		
P.2.4.2 SM RCS THERMAL RESPONSE		S			S	S		R			ST																	R	P	
P.2.4.3 CM RCS THERMAL CONTROL																													P	
P.2.4.4 ECS RADIATOR HEAT REJECTION		R	S			S		R			ST																	R	P	
P.2.4.5 EPS RADIATOR HEAT REJECTION		R	S		S			R	ΔR		ST																	R	P	
P.2.4.6 CABIN CONDENSATION								R																				R		
P.2.4.7 ECS RADIATOR DEGRADATION		P	S		P	P	S				ST											ΔS			S	S	S		S	
P.2.5.1 AUTO AND MANUAL CRYOGENIC PRESSURE CONTROL											ST											ΔS						R	P	
P.2.5.2 FUEL CELL WATER SEPARATION AND PURITY									ΔR													ΔS		R				R	P	
P.2.6.1 SPS ΔV		ST	ST		ST	ST		ST	ST			P	P				ΔR					ΔS			S	S	S	R	P	
P.2.6.3 REDUNDANT BIPROPELLANT VALUE											R		S																P	
P.2.6.4 PRIMARY AND AUXILIARY GAUGING DISPLAY											R	S										ΔS							P	
P.2.7 SLA PANEL DEPLOY																														
P.2.10 BIOMEDICAL INSTRUMENTATION																												R		S
P.3 S-IVB/IU CHECKOUT																														
P.4.1.1 UPDATE AGC																		S			S					S		R	P	
P.4.2.1 CSM/MSFN S-BAND CAPABILITY																	S		S	S						S		R	S	
P.4.2.2 VHF/FM, S-BAND DATA DUMP																		S			ΔR					S		R	S	
P.4.2.3 UHF, S-BAND CTE UPDATE																		S			S							R		
P.4.2.4 VHF COMMUNICATIONS																	ΔS		ΔS	ΔS						S			P	
P.4.3 CONSUMABLES DATA								Δ	Δ	Δ	Δ		Δ																	
S.1 CSM/LV COMPATIBILITY																									S	S	S			
S.2.1 FOOD PROVISIONING DATA	S									S																				
S.2.2 COUCH RESTRAINTS								R			R												R							
S.2.3 ACOUSTIC ENVIRONMENT								R			R						R	R	R		R		R				S	R		R
S.2.4 RESONANT VIBRATION								R			R												R			S				
S.3.1 ONE MAN LUNAR ORBIT AND TRANS-EARTH COAST OPERATIONS	S	S	S		S	S	S		S	S	S				S		S	S	S	S						S			P	S
S.3.3 DISPLAYS AND CONTROLS	R		R	R	R	R		R	R	R	R						R	R	R		R							R		
S.6 EXPERIMENTS															S											S		R		

Figure 7-2. Test Objective/Test Objective Matrix