Grumman

CONTRACT REQUIREMENTS EXHIBIT E, PARA. 3.14	CONTRACT ITEM WORK PACKAGE NO. 712	MODEL LM8	CONTRACT NO. NAS9-1100

TYPE II DOCUMENT

LM-8 BPA FACTORY TEST & CHECKOUT PLAN

LTP 561-8

8 November 1968

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REVISIONS

Date	Rev.	Revisions & Added Pages	Remarks

LM-8 FACTORY TEST & CHECKOUT PLAN
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SECTION 1.0 - INTRODUCTION

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1.1 PURPOSE

This document describes the Bethpage factory test program for the LM-8 vehicle from manufacturing buildup to preparation for shipment. It defines in outline form the detailed tests, identified as Operational Checkout Procedures, to be performed to verify that the vehicle satisfies the test requirements and is in condition for acceptance by NASA. Standard Manufacturing Procedure outlines are included to identify their scope within the test program. A matrix which confirms that vehicle tests are in agreement with the governing performance specification is provided, in addition to tabulations of ground support equipment, crew participation, and hazardous operations.

1.2 PRECEDENCE

This Factory Test & Checkout Plan shall satisfy the test requirements of specification LSP 470-2 (Master End Item Detail Specification) and shall have precedence over any other test plan pertaining to LM-8.

1.3 AMENDMENTS

All amendments to this document shall be issued by S/CAT Test Engineering.

1.4 APPLICABLE DOCUMENTS

This Factory Test & Checkout Plan has been prepared in compliance with Contract NAS 9-1100, Exhibit E (Type II Documentation). Reference documents which are applicable are listed below.

LSP470-1	Contract Technical Specification for Lunar Module System
LSP470-2	LM-4 and Subsequent Master End Item Detail Specification, Product Configuration and Acceptance Test Requirements, Part II.
LED360-7	LM-4 and Subsequent Measurement List
LPL561-8	LM-8 BPA Test and Checkout Requirements Document.

1.5 LISTING OF OCP/SMP TITLES AND NUMBERS (SECTION 2.0)

This section lists the numbers and titles of the Bethpage OCP's and SMP's and outline page numbers.

1.6 TEST PROGRAM (SECTION 3.0)

This section describes the test program and contains a vehicle test constraint logic chart, listings of prerequisites and limitations to the test program and test data handling and recording requirements.

1.7 VEHICLE CONFIGURATION (SECTION 4.0)

This section defines the overall vehicle configuration by test phase and contains a listing of applicable level III drawings.

1.8 TEST REQUIREMENTS MATRIX (SECTION 5.0)

The cross reference index supplies a paragraph correlation between the Quality Assurance Provisions (Section #4) of LSP-470-2, Part II, Test and Checkout Requirement Document (TCRD) LPL561-8, and vehicle OCP test sequences where required. The function of this matrix is to confirm that vehicle tests are in agreement with the governing performance specification.

1.9 OCP AND SMP OUTLINES (SECTION 6.0)

In this section arranged in numerical order is an outline of each Operational Checkout Procedure (OCP) and Standard Manufacturing Procedure (SMP) to be performed on the LM-8 vehicle at GAEC, Bethpage. Paragraphs referenced in the outlines refer to LSP470-2, Part II.

1.10 GSE USAGE MATRIX (SECTION 7.0)

This matrix provides a cross reference between GSE end items and applicable OCP's and SMP's.

1.11 CREW PARTICIPATION REQUIREMENTS (SECTION 8.0)

This section lists the OCP's in which crew participation is required.

1.12 HAZARD VS. OCP/SMP MATRIX (SECTION 9.0)

This section lists the OCP's and SMP's associated with (a particular) hazardous test.

1.13 LIST OF ABBREVIATIONS (SECTION 10.0)

This section contains abbreviations used in this document.

SECTION 2.0 - LISTING OF OCP/SMP TITLES AND NUMBERS

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SECTION 3.0 - TEST PROGRAM

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3.1 DESCRIPTION

The LM ascent stage and descent stage flight structures individually go through a manufacturing buildup phase in Plant 2 in which secondary structure and bracketry, complete fluid systems (except for engines) and electrical harnesses are installed. The ascent and descent stages are rotated and cleaned and then transferred to the Cold Flow Facility for high pressure fluid systems testing and orifice sizing.

Upon completion of Cold Flow I testing, both stages are transferred to Plant 5 Final Assembly Area and the engines are installed. The stages are mated and the LM Combined Subsystem Pre-FEAT (62000) tests are performed.

The stages are transferred to the Cold Flow Facility for a series of fluid systems confidence tests (Cold Flow II). They are then returned to the Final Assembly Area, rotated and cleaned, and installation and checkout of the landing gear is performed. The stages are mated in preparation for FEAT (Formal Engineering Acceptance Tests).

Upon completion of FEAT, an ascent stage weight and center of gravity check is performed, and the stage is rotated and cleaned and prepared for shipment. A descent stage weight and center of gravity check is performed and the stage is prepared for shipment.

3.2 LM TEST CONSTRAINT LOGIC CHART

(See figure 1.)

3.3 PREREQUISITES

The following items are prerequisites on the LM-8 test program:

a. Availability of the factory facilities

b. Availability of the vehicle hardware (structure, electrical and fluids lines, functionally verified subsystem assemblies).

c. Availability of GSE, ACE-S/C complex, and manufacturing hardware.

d. Availability of all required software (OCP's, SMP's, ACE-S/C programs, manufacturing procedures).

e. Availability of data acquisition processing and reduction hardware and software.

3.4 LIMITATIONS

The following limitations are imposed on the LM-8 test program:

a. All operations must be capable of being performed under factory ambient conditions of temperature, humidity, pressure and cleanliness (no environmental testing).

b. Pyrotechnic operations are limited to the use of initiator simulators only.

c. Live propellants are not used in any phase of the program.

3.5 TEST DATA HANDLING AND RECORDING

During the running of an OCP or SMP, data will be recorded by ACE-S/C analogue recording equipment, auxiliary recorders located on the mezzanine or factory floor, and Cold Flow checkout equipment. The recording and display equipment provides for receiving and displaying the spacecraft performance parameters and other data necessary for complete checkout of the LM spacecraft.

Data acquired from the ACE-S/C station and the Cold Flow Facility, recorded on both strip-charts and magnetic tapes, yields only the response of the LM spacecraft to commands or stimuli sent to it. The QC annotated OCP/SMP is the only sequentially established record of the test progress, deviation, changes, etc. to the published OCP/SMP document, and constitutes the official test record which must support or refute the recorded data.

When required for the Combined Subsystem Pre-FEAT and FEAT OCP's, a time annotated OCP and the QC annotated OCP must be made available coincident in time with both strip charts and computer reduced data to permit Quasi-Real Time Data Analysis.

Recorded data (magnetic tape, strip charts, QC annotated OCP/SMP's time annotated OCP when required for the Pre-FEAT and FEAT OCP's and the LM Data Reduction Section (LDRS) computer printouts serve as reference material to aid in the trouble shooting of failures during testing, and provide a basis for post-test analysis. All acquired data must be stored for future reference.

Following test completion, a Test Project Engineering Report (TPER) is generated summarizing the test history, test results, conclusion, anomalies, and major hardware changes.

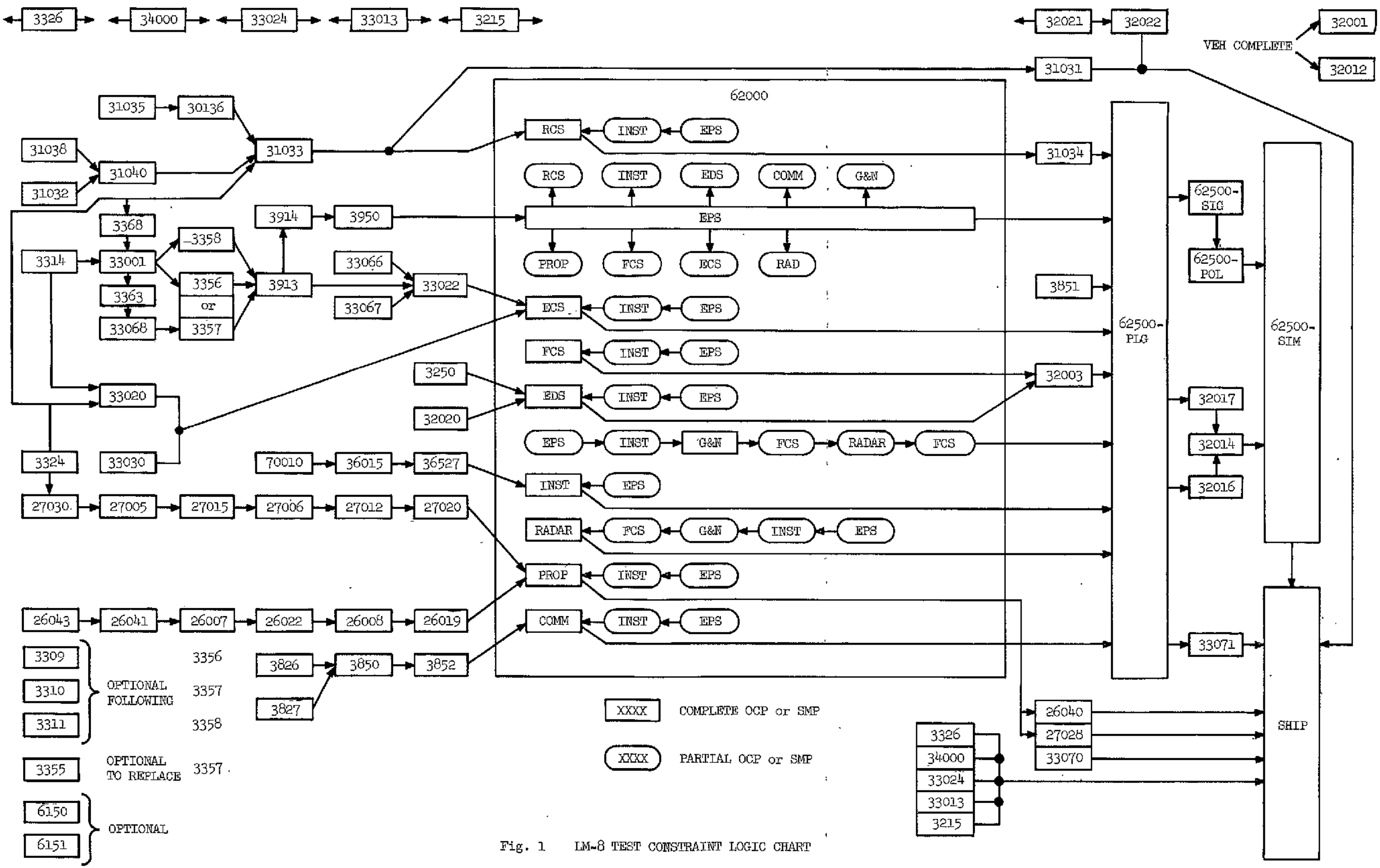

Fig. 1 LM-8 TEST CONSTRAINT LOGIC CHART

SECTION 4.0 - VEHICLE CONFIGURATION

SECTION 4.0 - VEHICLE CONFIGURATION

4.1 VEHICLE CONFIGURATION BY TEST PHASE

The vehicle configuration during various phases of fabrication and test is defined as follows:

A. Manufacturing

Structural build-up of vehicle to include fluid subsystems and most, if not all ERA's and wiring. Vehicle minus rendezvous and landing radars, thermal shielding, panels, A/S and D/S propulsion engines, D/S PQGS, S/band omni and VHF antennas, and batteries.

B. Cold Flow I

A/S and D/S minus equipment listed in paragraph (A).

C. Equipment and Panel Installation & Electrical Tests

Installation of all panels and ERA's and wiring not installed during the manufacturing phase, landing radar antenna, S-band omni and VHF antennas, A/S and D/S propulsion engines, thermal shielding (partial). Vehicle minus landing gear, batteries and thermal shielding (partial).

D. 62000 Preparation and Testing

Vehicle complete except for thermal shielding (partial), landing gear, and batteries.

E. Cold Flow II

Complete stages minus thermal shielding (partial), landing gear, and batteries.

F. C^2F^2.

Landing gear installed, tested, and removed. Stow cabin with cabin equipment and GFE. D/S ALSEP and MESA exercised. Remove equipment installed on a temporary basis for C^2F^2. Vehicle minus landing gear, thermal shielding (partial), and batteries.

G. FEAT

Complete vehicle. Batteries installed, tested and then removed. Vehicle minus thermal shielding (partial), and landing gear.

H. Weight & CG and Shipment

Remaining thermal shielding installed. Weight and center of gravity check of A/S and D/S without landing gear installed. Rendezvous radar antenna removed prior to shipment.

4.2 LEVEL III DRAWINGS

TITLE	DWG. NO.
Propulsion Subsystem	LDW 270-56000
Abort Guidance Section	LDW 300-54002
Control Electronics System	LDW 300-56003
Reaction Control Sybsystem	LDW 310-57000
Mechanical Design Subsystem	LDW 320-54000
Environmental Control Subsystem	LDW 330-55000
Crew Provisions Subsystem	LDW 340-55000
Displays and Controls Subsystem	LDW 350-54000
Operational Instrumentation Power and Control	LDW 360-54000
Radar Section of Guidance, Navigation and Control Subsystem	LDW 370-54000
Primary Guidance, Navigation and Control Subsystem	LDW 370-54001
Communications Subsystem	LDW 380-56000
Electrical Power Subsystem	LDW 390-54000

SECTION 5.0 - TEST REQUIREMENTS MATRIX

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	32001	32003	32012	62000 FCS	62000 EDS				
4.2.2.1		X									
STRUCTURAL SUBSYSTEM TESTS	2.1										
A/S Weight and C.G. Tests	2.1.2										
4.2.2.1.1 (a)	2.1.2 (a)		02								
(b)	2.1.2 (b)		02								
(c)		X									
D/S Weight and C.G. Tests	2.1.3										
4.2.2.1.2 (a)	2.1.3 (a)				02						
(b)	2.1.3 (b)				02						
(c)	2.1.4 (a)	X									
Landing Gear Tests	2.1.1										
4.2.2.1.3 (a) (1)	2.1.1 (a)						18				
(2)	2.1.1 (d)			03-06		14					
(b) (1) a.	2.1.1 (b)			03-06							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	32003	33024	62000 EDS						
4.2.2.1.3 (b) (1) b.	2.1.1 (g)		03-06								
c.	2.1.1 (g)		03-06								
(2) a.	2.1.1 (c)		03-06								
b.	2.1.1 (d)		03-06								
c.	2.1.1 (e)		03-06		18						
(3) a.	2.1.1 (f)		02								
(4)	2.1.1 (a,b,c,d,e,		03-06								
	f,g)										
Thermal Emissivity and Solar Absorptance											
Req. Verification											
4.2.2.1.4	2.1.7 (a,b)	X									
A/S Proof Pressure Test											
4.2.2.1.5 (a)	2.3.6.1 (a)			02							
(b)	2.3.6.1 (a)			02							
(c)	2.3.6.1 (a)			02							

LSP 470-2 PART II	TCRD	OCP SEQUENCES								
		N/A	33024							
A/S Hatch Functional										
4.2.2.1.6	2.3.6.5 (a,b)		02							
Drogue Support Fittings, Functional										
4.2.2.1.7	2.3.6.1 (b)		04,05							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	SMP 3913	SMP 3914	62500 PLG	62500 SIM	62000 EPS				
4.2.2.2	2.2	X									
ELECTRICAL POWER SUBSYSTEM (EPS) TESTS											
Test Equipment Required											
4.2.2.2.1		X									
Power Distribution Test											
4.2.2.2.2 (a)				02							
(1)	2.2.3 (a,b)		02		33-37	09,44 51	08,09 21-25 28-30				
(2)	2.2.3 (a,b,k)				33-37 39,41	20	08,09 21-25 28-30	49,54			
(b)	2.2.3 (b)				33,36	09,44 51	28-30				
(c) (1)	2.2.3 (a)					02					
(2)	2.2.3 (a)				02,41	02					
(3)	2.2.3 (a)					02					
(d)	2.2.7 (a)				03	06,07	35				

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	SMP 3913	62500 PLG	62000 EPS						
4.2.2.2.2 (e)	2.2.6 (c)			04	34						
(f) (1)	2.2.3 (f)										
(2)	2.2.3 (j)				31						
(3)	2.2.3 (h)				39						
(g) (1)	2.2.3 (a,b,l)				31						
(2)	2.2.3 (a,b,l)				31						
(3)	2.2.3 (a,b,l)				17						
(4)	2.2.3 (a,b,l)				17						
(h)	2.2.1 (i)		04								
(i)	2.2.3 (g)				36,37						
ECA Malfunctioning Logic Test											
4.2.2.2.3 (a)		X									
4.2.2.2.3 (b)	2.2.3 (d,e,i)				41-48 55-58						
ECA #1 and ECA #2											
4.2.2.2.3.1(a)	2.2.3 (a,b,l)				41-48 55-58						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A		62500 SIM	62000 EPS						
4.2.2.2.3.1(b)	2.2.3 (e)				41-48						
(c)	2.2.3 (e)				41-48						
(d)	2.2.3 (a,b)				41-48						
(e)	2.2.3 (i)				41-48						
(f)	2.2.3 (a,b)				41-48						
(g)	2.2.3 (d)				55-58						
(h)	2.2.3 (d)				55-58						
(i)	2.2.3 (b)				55-58						
(j)	2.2.3 (d)				55-58						
(k)	2.2.3 (d)				55-58						
(l)	2.2.3 (b)				55-58						
(m) (1)	2.2.3 (a,b,d,e,				41-48 55-58						
	k,i)										
(2)	2.2.3 (a,b,d,e,				41-48 55-58						
	k,i)										
(3)	2.2.3 (a,b,d,e,				41-48 55-58						
	k,i)										

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62500 STM	62000 EPS						
ECA #3 and ECA #4											
4.2.2.2.3.2(a)	2.2.3 (a,b)		33-35 37,39 41,42	44,21	18						
(b)	2.2.3 (a,b,e)			21							
(1)	2.2.3 (a,b,e)			21	10-15						
(2)	2.2.3 (a,b,e)			21	10-15						
(3)	2.2.3 (a,b,e)			21	10-15						
(c)	2.2.3 (a,b,i)			21	10-15						
(1)	2.2.3 (a,b)			21							
(2)	2.2.3 (a,b)			21							
(3)	2.2.3 (a,b)			21							
(d)	2.2.3 (a,b)			21							
(e)	2.2.3 (b,d)			21	10-15						
(1)	2.2.3 (b,d)			21							
(f)	2.2.3 (b)			21	10-15						
(g)	2.2.3 (b,d)		33,34 41	21							
(h)	2.2.3 (a,b)			21							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62500 SIM	62000 EPS						
4.2.2.2.3.2(i)	2.2.3 (b,d)			21							
(j)	2.2.3 (b,d)		34,37	21,51							
(k)	2.2.3 (a,b,d,e,i)		34-35 37,39 41,42	21,44 51	10-15, 18						
Inverter Functional Test											
4.2.2.2.4 (a)	2.2.3 (b,c)		33,34 35,39 41,42	10,21 44,57							
(1)	2.2.3 (b)				05,06						
(2)	2.2.3 (c)		37,39 42		05,06						
(b)	2.2.3 (b,c)		33,39	10,51	05,06						
(c)	2.2.3 (b,c)		34,39 42	21,51	05,06						
Inverter Characteristics											
4.2.2.2.4.1		X									

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62500 SIM	62000 EPS						
Lighting Tests											
4.2.2.2.5 (a)	2.2.4 (c,d,g)		10, 33-37 39,41 42	08,10 11,39 43	33 60-74						
(b) (1)	2.2.4 (a,b,g)		10-42	11	60-74						
(2)	2.2.4 (a,b,h)		10-41 42	10,11	60-74						
(3)	2.2.4 (a,b,g)		10,42	11	60-74						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	33020	62000 ECS	62500 PLG	62500 SIM					
4.2.2.3	2.3	X									
ENVIRONMENTAL CONTROL SUBSYSTEM (ECS)											
TESTS											
Test Equipment Required											
4.2.2.3.1		X									
Carbon Dioxide (CO_2) Partial Pressure											
Sensor											
4.2.2.3.2	2.3.4.3 (d)			04	14	15					
Suit Circuit Assembly											
4.2.2.3.3	2.3.4			04	14	14					
(a)	2.3.4.3 (a)			04	14	14					
(b)	2.3.4.3 (c,i,m)			06	14	14					
(c)	2.3.4.1 (a)		06,08								
	2.3.4.2 (a)										

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	33020	33030	62000 ECS	62500 PLG	62500 SIM				
4.2.2.3.3 (d)	2.3.4.3 (t)				03	14,15	15				
Cabin Recirculation Assembly											
4.2.2.3.4	2.3.4.3 (f)(k)				04						
Oxygen Supply and Cabin Pressure Control											
Section (OCP's) Tests											
4.2.2.3.5	2.3.3	X									
Proof Pressure and Leakage Test	2.3.3.1										
4.2.2.3.5.1(a)	2.3.3.1 (b)		05	02							
(b)	2.3.3.1 (a)		03	16							
Leakage Test											
4.2.2.3.5.1.1(a)	2.3.3.2 (a)		05,12								
(1)	2.3.3.2 (a)		05,12								
(2)	2.3.3.2 (a)		05,12								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	33013	33020	33030	62000 ECS	62500 PLG	62500 SIM			
4.2.2.3.5.1.1(a)(3)	2.3.3.2 (a)			05,12							
a.	2.3.3.2 (a)			05,12							
b.	2.3.3.2 (a)			05,12							
(b)	2.3.3.2 (b)				02 06						
(1)	2.3.3.2 (b)				06						
(2)	2.3.3.2 (b)				06						
(3)	2.3.3.2 (b)				06						
a.	2.3.3.2 (b)				06						
b.	2.3.3.2 (b)				06						
(c)	2.3.3.1 (c)		03								
(1)	2.3.3.2 (c)		03								
(2)	2.3.3.2 (c)		03								
Oxygen Control Module Test											
4.2.2.3.5.2 (a)	2.3.3.7 (b) (c)				08-13	03	14,15	14,15			
(b)	2.3.3.7 (i)			15	08-13	03					

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	33020	33024	33030	62000 ECS	62500 PLG	62500 SIM			
4.2.2.3.5.2(c)	2.3.3.7 (a)		04,10 11		08-13						
Cabin Pressure Relief and Dump Valve											
4.2.2.3.5.3	2.3.5.3 (a)			03,05							
Cabin Pressure Switch											
4.2.2.3.5.4(a)	2.3.3.7 (b,c)					03	14,15	14,15			
	2.3.6.3 (b)										
High Pressure Oxygen Control Assembly											
4.2.2.3.5.5(a)	2.4.3 (a) (b) 2.3.3.7 (j)				02,09 11,13						
(b)	2.3.3.7 (j)				05 14,15						
(c)	2.3.3.7 (j)				02,03 04						
GOX Tanks											
4.2.2.3.5.6	2.3.3.7 (d,e)				07,16	03	18,19	15			

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	33001	33013	33024	33068	33071	62000 ECS	62500 PLG	62500 SIM	
Cabin Leakage and Cabin Pressure Relief											
and Dump Valve Tests											
4.2.2.3.5.7(a)	2.3.5.1 (a)				04		02				
(b)	2.3.5.2 (a)				04		02				
(c)	2.3.5.3 (a)				02						
(d)	2.3.5.5 (b)				03						
(e)	2.3.5.5 (b)				03						
(f)	2.3.5.5 (a)				05						
	2.3.5.3 (a)										
Heat Transport Section (HTS) Tests											
4.2.2.3.6	2.3.1.1 (a,b)		02,07	02		02,03					
	2.3.1.2 (a,b,c,)										
Coolant Recirculation Assembly											
4.2.2.3.6.1	2.3.1.5 (b,c,d, e,							05,06	13	12	
	g,h)										

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	SMP 3356	SMP 3357	SMP 3358	62000 ECS	62500 PLG	62500 SIM	33070		
Coolant Accumulator											
4.2.2.3.6.2	2.3.1.5 (f,g)					05	14	13			
Cabin Temperature Control Valve											
4.2.2.3.6.3(a)	2.3.1.5 (i)					07					
(b)	2.3.1.5 (i)					07					
(c)	2.3.1.5 (i)					07					
Suit Temperature Control Valve											
4.2.2.3.6.4	2.3.4.3 (i)					08					
W/G Fill Verification											
4.2.2.3.6.5(a)			02-07	02-05					08		
(b) (1)	2.3.1.4 (a,b,c,d,				02-07				06		
(2)	e)				02-07				06		

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	33022	33066	33067	62000 ECS	62500 PLG	62500 SIM			
Water Management Section (WMS) Tests											
4.2.2.3.7	2.3.2.1 (a,b)		06 02,03	02,03	02-04	02					
	2.3.2.2 (a,b,c,d)										
	2.3.2.7 (a)										
Water Control Module											
4.2.2.3.7.1	2.3.2.6 (c,d)		03,05				16	12,13			
	2.3.2.7 (d)										
Water Tanks											
4.2.2.3.7.2	2.3.2.6 (a,b,d)					02	16,17	12,13			

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	32014	32022	34000	62000 EPS	62500 PLG	62500 SIM			
4.2.2.4	2.13	X									
CREW PROVISIONS SUBSYSTEM TESTS											
Support and Restraint Tests											
4.2.2.4.1 (a,b,c,d,e)			04	02,03							
Lighting											
4.2.2.4.2	2.2.4 (a,b,c,d,e,					33,36 37	10	10			
	f,g,h,i)					60-74					
Waste Management Section											
4.2.2.4.3 (a) (1)	2.13.1 (b)				03						
(2)	2.13.1 (b)				03						
(3)	2.13.1 (b)				03						
(4)	2.13.1 (b)				03						
(b) (1)	2.13.1 (c)				03						
(2)	2.13.1 (c)				03						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	32014	32016	32017	32021	32022	34000	62500 SIM		
4.2.2.4.3 (b) (3)	2.13.1 (c)							03			
(4)	2.13.1 (c)							03			
(c) (1)	2.13.1 (d)							02			
(2)	2.13.1 (d)							02			
(d) (1)	2.13.2 (a)	X	PER	LCD	3298						
(2)	2.13.2 (a)	X									
(3)	2.13.2 (a)	X									
Scientific Equip. (SEQ.) Fit Check											
4.2.2.4.4 (a)		X									
(b)		X									
Crew Compartment Fit and Functional Tests											
4.2.2.4.5 (a)	2.1.2 (a,b,c,d)				02,03 04	03					
(b)	2.13.4 (a,b)		06,07	04,05			04,05		10		
(c)	2.13.5		06,07	04,05			04,05		10		
	2.13.6										

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62000 RAD	62500 PLG	62500 SIM					
4.2.2.5	2.4,2.5,2.6	X									
PRIMARY GUIDANCE, NAVIGATION AND CONTROLS											
SUBSYSTEM (PGNCS) TESTS											
PGNCS Tests, General											
4.2.2.5.1		X									
Test Equipment for PGNCS Test											
4.2.2.5.2		X									
LGC Interfaces											
4.2.2.5.3 (a)	2.5.4 (a,b,c,f)			11,12 13		61					
(b)	2.6.6 (a,b,c)			24		46					
	2.6.10 (a,b)										
(c)	2.4.18 (b)		19			46					
(d)	2.7.10.6 (f)		20			63					
(e)	2.4.18 (c)		18,26 27		33	66					

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62000 RAD	62000 G&N	62500 PLG	62500 SIM				
4.2.2.5.3 (f)	2.4.18 (g)		16,17								
(g)	2.4.18 (d)		02,03 25			42					
(h)	2.4.18 (a)		18,19 21								
	2.12.1										
(i)	2.5.4 (d,e)			11							
(j)	2.4.18 (d)				06						
(k)	2.4.18 (d)				09						
(l)	2.11.4 (b)						36				
PSA/SCA Interfaces											
4.2.2.5.4 (a)	2.5.4 (e,f)						61				
	2.4.18 (b,d)										
(b)	2.4.18 (d)				22						
(c)	2.4.18 (a,b,c,d,						09				
	e,f,g)										

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62000 RAD	62500 PLG	62500 STM	62000-G&N				
IMU/Gimbal Angle Sequencing Transformation											
Assembly (GASTA) Interface											
4.2.2.5.5	2.4.18 (d)		09								
DSKY Interfaces											
4.2.2.5.6 (a)	2.4.2 (a)						06				
(b)	2.12.3 (b,c)					11					
Rendezvous Radar (RR) Tests											
4.2.2.5.7	2.5	X									
RR Self-Test											
4.2.2.5.7.1(a) (1)				05	22	61					
(2)	2.5.1 (d)			05	22	61					
(3)	2.5.1 (e)			05	22	61					
(b) (1)	2.5.1 (h)			05	22	61					
(2)	2.5.1 (f)			05	22	61					

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 RAD	62500 PLG	62500 SIM						
4.2.2.5.7.1(b) (3)	2.5.1 (f)		05	22	61						
RR Antenna Angular Coverage and Slew Test	2.5.3										
4.2.2.5.7.2	2.5.3 (a,b)		06	33							
RR Angular Tracking Test											
4.2.2.5.7.3	2.5.8 (e)		10								
RR RF Test											
4.2.2.5.7.4	2.5.3 (a,b)		08								
RR Acquisition, Range and Range Rate Tests											
4.2.2.5.7.5	2.5.3 (i)		09,12 13								
	2.5.11 (a)										
	2.5.14 (b,c,d)										

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 RAD	62500 SIM							
Integrated RR/LGC Tests											
4.2.2.5.7.6		X									
RR/LGC Antenna Positioning Test											
4.2.2.5.7.6.1(a)	2.5.4 (e,f)		11	61							
RR/LGC Interface Range Rate Test											
4.2.2.5.7.6.2	2.5.4 (a)		12								
RR/LGC Interface Range Test											
4.2.2.5.7.6.3	2.5.4 (a,b)		13								
Transponder (T) Tests											
4.2.2.5.7.7		X									
Landing Radar (LR) Tests											
4.2.2.5.8		X									

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 RAD	62500 PLG							
LR Self Test	2.6.1 (a)		16,17	22							
4.2.2.5.8.1(a)	2.6.1 (b)		16	22							
(b)	2.6.1 (c,d)		17	22							
(c)			17	22							
LR Transmitter Parameters Test	2.6.8 (a,b)										
4.2.2.5.8.2	2.6.5 (a)		18								
LR Receiver Sensitivities Test											
4.2.2.5.8.3		X									
Acquisition Threshold Test											
4.2.2.5.8.3.1	2.6.8 (a)		20								
Acquisition Time Test											
4.2.2.5.8.3.2	2.6.8 (a)		20								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62000 RAD	62500 PLG						
LR Antenna Tilt Test											
4.2.2.5.8.4	2.6.12 (a,b,c,d)			24	22,33						
LR Altitude and Velocity Measurement Tests											
4.2.2.5.8.5	2.6.14 (a,b)			21,29	34,35						
LR/LGC Interfaces											
4.2.2.5.8.6	2.6.14 (a,b)			29	33						
PGNCS Descent Engine Control Tests											
4.2.2.5.9		X									
PGNCS Descent Engine (DE) ON/OFF Control											
Test											
4.2.2.5.9.1(a)	2.7.12 (a)		19,26		33						
(b)	2.7.10.3 (b)		19,21 22		33						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62500 PLG	62500 SIM						
PGNCS Descent Engine Throttle Control											
4.2.2.5.9.2(a)	2.7.12 (b)		26								
(b)	2.7.12 (b)		23,26	33							
PGNCS Descent Engine Gimbal Trim Control											
4.2.2.5.9.3(a)	2.7.12 (c)		15,26	33	46						
(b)	2.7.10.2 (g)				46						
(c)	2.7.10.2 (g)		26		46						
(d)	2.7.12 (c)		15,26	33	46						
PGNCS Ascent Engine Control Tests											
4.2.2.5.10 (a)	2.7.12 (d)		20,27	42							
(b)	2.7.10.4 (a,b)		20	42							
PGNCS RCS Control Tests											
4.2.2.5.11	2.7.12 (a)		18,26 27	33	66						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS								
Mode and Status Discrete Test											
4.2.2.5.12 (a)	2.4.18 (b,c)		18								
(b)	2.4.18 (e)		19								
(c)	2.4.18 (e)		19								
(d)	2.4.18 (f)		19								
(e)	2.7.10.6 (e)		21								
(f)	2.7.10.6 (d)		21								
(g)			21								
PGNCS Manual Outputs Verification											
4.2.2.5.13	2.4.18 (b,g)		16-17								
PGNCS Displays Test											
4.2.2.5.14 (a)	2.4.18 (b,d)		25								
(b)	2.4.18 (b,d)		02								
(c)	2.4.18 (b,d)		03								
(d)	2.4.18 (b,d)		03								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62500 PLG	62500 SIM						
4.2.2.5.14 (d) (1)	2.4.18 (b,d)		03								
(2)	2.4.18 (b,d)		03								
(e)	2.4.18 (d)			42							
LM Tracking Light (LTL) Test											
4.2.2.5.15	2.2.4 (d)			42	43						
Landing Point Designator (LPD) and											
Docking Window Tests											
4.2.2.5.16		X									

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 POL	62000 FCS							
4.2.2.6	2.7	X									
STABILIZATION & CONTROL (SCS) TESTS											
4.2.2.6 (a)	2.7.10.7 (a,b)		08-10								
SCS Tests General											
4.2.2.6.1		X									
Test Equipment for SCS Tests											
4.2.2.6.2		X									
Attitude Translation Control Assembly											
(ATCA) and Descent Engine Control											
Assembly (DECA) Tests											
4.2.2.6.3		X									
Analog Trim Test											
4.2.2.6.3.1(a)	2.7.10.1 (g)			49							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS								
4.2.2.6.3.1(b)	2.7.10.1 (g)		49								
(c) (1)	2.7.10.1 (g)		49								
(2)	2.7.10.1 (g)		49								
Descent Limiter Test											
4.2.2.6.3.2(a)	2.7.10.1 (a)		50								
(b)	2.7.10.1 (a)		50								
(c)	2.7.10.1 (a)		50								
(d)	2.7.10.1 (a)		50								
(e)	2.7.10.1 (a)		50								
Ascent Limiter Test											
4.2.2.6.3.3(a)	2.7.10.1 (a)		51								
(b)	2.7.10.1 (a)		51								
(c)	2.7.10.1 (a)		51								
(d)	2.7.10.1 (a)		51								
(e)	2.7.10.1 (a)		51								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS								
4.2.2.6.3.3(f)	2.7.10.1		51								
Maximum and Minimum Dead Band Test											
4.2.2.6.3.4(a)	2.7.10.1 (b)		49								
(1)	2.7.10.1 (b)		04,49								
(2)	2.7.10.1 (b)		49								
(b) (1) (a)			49								
(b)			49								
(2) (a)	2.7.10.1 (b)		49								
(b)	2.7.10.1 (b)		49								
Pulse Ratio Modulation (PRM) Test											
4.2.2.6.3.5(a)	2.7.10.1 (e)		11								
(b)	2.7.10.1 (e)		11								
(c)	2.7.10.1 (e)		11								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62500 SIM							
RCS Jet Logic Test											
4.2.2.6.3.6(a) (1)	2.7.10.2 (a)		13								
(2)	2.7.10.2 (a)		13								
(3)	2.7.10.2 (a)		13								
(4)	2.7.10.2 (c)		13								
(b)	2.7.10.2 (a, c)		13								
Attitude Controller Assembly (ACA) Tests											
4.2.2.6.3.7		X									
ACA Pulsed Mode Test											
4.2.2.6.3.7.1(a)	2.7.10.2 (b)		12	30							
(b)	2.7.10.2 (b)		12	30							
(c)	2.7.10.2 (b)		12	30							
ACA Mode Control Test											
4.2.2.6.3.7.2(a)	2.7.10.2 (b)		08								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS								
4.2.2.6.3.7.2(b)	2.7.10.2 (b)		08								
(c)	2.7.10.2 (b)		08								
(d)	2.7.10.2 (b)		08								
ACA Direct Mode Test											
4.2.2.6.3.7.3(a)	2.7.10.2 (b)		07								
(b)	2.7.10.2 (b)		07								
(c)	2.7.10.2 (b)		07								
ACA Hardover Mode Test											
4.2.2.6.3.7.4(a)	2.7.10.2 (h)		07								
(b)	2.7.10.2 (h)		07								
+X Translational Switch Test											
4.2.2.6.3.8(a)	2.8.9 (a)		07								
(b)	2.8.9 (a)		07								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62500 SIM							
Thurst/Translation Control Assembly											
(T/TCA) Tests											
4.2.2.6.3.9		X									
T/TCA Throttle Mode Test											
4.2.2.6.3.9.1(a)	2.4.18 (b,g,f)		23	67							
(b)(1)	2.4.18 (b,g,f)		23	67							
(2)	2.4.18 (b,g,f)		23	67							
(3)	2.4.18 (b,g,f)		23	67							
(c)	2.4.18 (b,g,f)		23	67							
T/TCA Translation Mode Test											
4.2.2.6.3.9.2(a)	2.7.10.2 (c)		10	70							
(b)	2.7.10.2 (c)		10	70							
(c)	2.7.10.2 (c)		10	70							
(d)	2.7.10.2 (c)		10	70							
(e)	2.7.10.2 (c)		10	70							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62500 PLG	62500 SIM						
Rate Gyro Assembly (RGA) Tests											
4.2.2.6.4 (a)	2.7.10 (a)		04	30	27						
(1)	2.7.1.2 (c)		04	30	27						
(2)	2.7.1.2 (c)		57	30	27						
(3)	2.7.1.2 (d)		57		27						
(b)			51		27						
(c)			51		27						
Abort Guidance Section (AGS) Tests											
4.2.2.6.5		X									
AGS Power Turn-on and AGS/CES Interface											
Tests											
4.2.2.6.5.1(a)	2.7.1.1			30	32						
(b)	2.7.1.1 (a)		29		32						
(1)	2.7.1.1 (a)		29		32						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62500 SIM							
4.2.2.6.5.1(c)			29	32							
(1)			29	32							
(d)	2.7.1.1 (b)		29	32							
(1)	2.7.1.1 (b)		29	32							
(2)	2.7.1.1 (b)			32							
(e)	2.7.1.1 (c)		29								
(f)	2.7.1.1 (c)		29								
(g)	2.7.1.1 (d)		29								
(h)		X									
(i)	2.7.10.6		42								
(1)	2.7.10.6 (a,b)		42								
(j)	2.7.10.6 (e)		42,52	69							
(1)	2.7.10.6 (e)		42,52	69							
(k)	2.7.10.6 (d)		42,52	69							
(1)	2.7.10.6 (d)		42,52	69							
(l)	2.7.10.3 (b)		42,52								
(1)	2.7.10.3 (b)		42,52								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS								
4.2.2.6.5.1(m)	2.7.10.4 (b)		42,52								
(1)	2.7.10.4 (b)		42,52								
(n)	2.7.10.6 (g)		42								
(1)	2.7.10.6 (g)		42								
AGS/DEDA Test											
4.2.2.6.5.2(a)	2.7.2		30								
(b)	2.7.2		30								
(c)	2.7.2		30								
(1)	2.7.2		30								
(d)	2.7.2		30								
(1)	2.7.2		30								
(e)	2.7.2		30								
(1)	2.7.2		30								
(f)	2.7.2		30								
(1)	2.7.2		30								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
			62000 FCS	62500 PLG	62500 SIM						
AGS Self-Test											
4.2.2.6.5.3(a)	2.7.1.1		30,31 33	30	32,58						
(b)	2.7.3		30,31 33	30	32,58						
(c) (1)	2.7.3 (a)		30,31 33	30	32,58						
(2)	2.7.3 (b)		30,31 33	30	32,58						
(3)	2.7.3 (a)		30,31 33	30	32,58						
(4)	2.7.3 (a)		30,31 33	30	32,58						
(5)	2.7.3 (d)		30,31 33	30	32,58						
AGS Attitude Hold Mode Test											
4.2.2.6.5.4(a)	2.7.1.1 (e)		53								
(b)	2.7.8 (a)		53								
(c)	2.7.8 (a)		53								
(d)	2.7.4.3		53								
(e)	2.7.4.3		53								
(f)	2.7.8		53								
(1)	2.7.8 (a)		53								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS								
4.2.2.6.5.4(f) (2)	2.7.8 (b)	X									
(3)	2.7.8 (b)		53								
(g)	2.7.8 (a)		53								
(1)	2.7.8 (a)		53								
AGS Display Interface Tests											
4.2.2.6.5.5(a)	2.7.9		34,35 37,38								
(1)	2.7.9 (b)		35,36								
(2)	2.7.9 (a)		34								
(3)	2.7.9 (d)		38								
(4)	2.7.9 (c)		37								
(5)	2.7.9 (c)		37								
(b) (1)	2.7.8 (a)		34								
(2)	2.7.8 (d)		38								
(3)	2.7.8 (c)		37								
(4)	2.7.8 (c)		37								
(5)	2.7.8 (b)		35,36								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62500 SIM							
AGS Gyro Drift and Accelerometer Bias											
Tests	2.7.6										
4.2.2.6.5.6(a)	2.7.6 (a)		39								
(b)	2.7.7 (a,b)		39								
AGS - IMU Electrical Alignment											
4.2.2.6.5.7	2.7.5		44,48	35,37 52							
AGS Performance											
4.2.2.6.5.8		X									
(a)		X									
(b)		X									
(c)		X									
AGS Downlink											
4.2.2.6.5.9	2.7.6 (b,c,e,g,h)		41	74							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	31031	31035	31036						
4.2.2.7	2.8	X									
REACTION CONTROL SUBSYSTEM (RCS) TESTS											
Test Equipment Required											
4.2.2.7.1		X									
Structural Integrity of the RCS Section											
4.2.2.7.2 (a) (1)	2.8.2 (a)		02		03,07						
(2)	2.8.2 (b)			02,03 07,08	04,08						
(3)	2.8.6 (a)		02	02,03 07,08	03,07 04,08						
(b) (1)	2.8.6 (a)			03,08	04,08						
(2)	2.8.2 (b)			03,08	04,08						
(3)	2.8.2 (b)		02	03,05	03,04 05						
(4)	2.8.2 (b)		04,10	03,08	04,08						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	31033	31034	31038		31031	31036	31040		
Thrust Chamber Assembly and Propellant											
Manifold Pressure and Leakage Test											
4.2.2.7.3 (a)	2.8.5 (b)			02							
(b) (1)	2.8.6 (h)			02							
(2)	2.8.6 (g)						04 10		18		
(3)	2.8.6 (h)			02							
(4)	2.8.6 (g)							04			
(5)	2.8.6 (g)								18		
(6)	2.8.6 (g)		02								
(c)	2.8.6 (i)						02	03	18		
(d)	2.8.6 (g,h,i)			02			04 10	04	18		
(e)	2.8.6 (k)			04	04						
(f)	2.8.6 (g,h,i,k)			04							
(g)	2.8.6 (k)				02						
(h)	2.8.8 (d)				02 04						
(i)	2.8.7 (a) 2.8.6 (p)				04						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	31031	31032	31033	31035	31036	62000 RCS	62500 PLG		
Thruster Cluster Heater Functional Test											
4.2.2.7.4 (a)	2.8.4 (b)							16-19	23		
(b)	2.8.4 (b)							16-19			
(c)	2.8.4 (b)							16-19	23		
(d)	2.8.4 (a,b)							16-19	42		
(e)	2.8.4 (a,b)							16-19	42		
(f)	2.8.4 (b)							16-19	42		
(g)	2.8.4 (a)							22			
RCS Cleanliness Maintenance											
4.2.2.7.5	2.8.1 (a,b,c,d)			05	04		02,06				
RCS Component Functional Tests											
4.2.2.7.6 (a)	2.8.6 (n)		02			02,07	03,07				
(b) (1)	2.8.6 (m)		05,11			04,09					
(2)	2.8.6 (m)		05,11			04,09					
(3)	2.8.6 (m)		05,11			03,08					

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	31031	31032	31034	31035	31036				
4.2.2.7.6 (c) (1)	2.8.6 (b)		07,13			06,11					
(2)	2.8.6 (d)		07,13			06,11					
(d) (1)	2.8.6 (d)		09			05,10					
(2)	2.8.6 (d)		03,09			05,10					
(3) (a)	2.8.6 (d)		03,09			05,10					
(b)	2.8.6 (d)		12,06			05,10					
(e)	2.8.6 (e)		10,04				04,08				
(f)	2.8.6 (h)				02	02,07					
(g)	2.8.6 (f)			04,07							
(h)	2.8.6 (h)				02						
(i) (1)	2.8.6 (c)		08,14								
(2)	2.8.6 (c)		08,14								
(j) (1)	2.8.6 (l)			04,07							
(2)	2.8.6 (l)			04,07							
(3)	2.8.6 (l)			04,07							
(4)	2.8.6 (l)			04,07							
(5)	2.8.6 (l)			04,07							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	31032	31033	31035	31036	62500 SIG	31034			
4.2.2.7.6 (j) (6)	2.8.6 (l)		04,07								
RCS Valve Tests											
4.2.2.7.7 (a) (l)	2.8.8 (c)						04				
(2)	2.8.8 (c)						04				
(3)	2.8.3 (a,c)						04				
(a)	2.8.3 (b)						04				
(b)	2.8.8 (c)						04				
(c)	2.8.3 (c)						04				
(4) (a)	2.8.8 (c)						04				
(b)	2.8.3 (b)						04				
(5) (a)	2.8.8 (c)						05				
(b)	2.8.3 (b)						05				
(c)	2.8.8 (c)						05				
(d)	2.8.3 (b)						05				
(b)	2.8.8 (c) 2.8.8 (b)							03			
(c) (l)	2.8.8 (a)			03							

LSP 470-2 PART II	TCRD	OCP SEQUENCES										
		N/A	31033	31038	31032							
4.2.2.7.7 (c) (2)	2.8.8 (a)		03									
(3)	2.8.8 (a)		03									
(4)	2.8.8 (a)		03									
(5)	2.8.8 (a)		03									
(6)	2.8.8 (a)		03									
(7)	2.8.8 (a)		03									
Thrust Chamber Pressure Switches												
4.2.2.7.8	2.8.8 (d)			02								
RCS/APS Backup Test												
4.2.2.7.9 (a)	2.8.6 (g)				02-07							
(b)	2.8.6 (j)				02-07							
Verification of Untested Requirements												
4.2.2.7.10		X										

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	27030								
4.2.2.8	2.9	X									
PROPULSION SUBSYSTEM											
Test Equipment Requirement for Propulsion											
Subsystem Tests (GSE)											
4.2.2.8.1		X									
Ascent Propulsion Subsystem (APS) Tests											
4.2.2.8.2 (a)		X									
(b)		X									
(c)		X									
(d)		X									
APS Proof Pressure Test											
4.2.2.8.2.1(a)		X									
(b) (1)	2.9.8 (a)		02								
(2) (a)	2.9.8 (a)		02								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	27028	27030							
4.2.2.8.2.1(b) (2) (b)	2.9.8 (a)		05	02							
(c) (1)	2.9.8 (a)		05	02							
(2)	2.9.8 (a)		05	02							
(3) (a)		X									
(b)		X									
(c)		X									
(c)				02 03							
APS External Leak Test/Verification											
4.2.2.8.2.2(a)		X									
(b) (1)			09	02							
(2)	2.9.8 (e)			02							
(3)	2.9.14(e)			02							
(4)			05	02							
(5)			05 09	02 03							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	27015	27028	27030						
APS Installed Component Verification Tests											
4.2.2.8.2.3(a) (1)	2.9.8 (d)			09	02						
	2.9.14 (d)										
(2)	2.9.8 (d)			09	02						
	2.9.14 (d)										
(b) (1)	2.9.9 (a)		02	05	02						
(2)	2.9.9 (a)		02	05	02						
(c) (1)	2.9.14 (b)(d)		02	06 04							
	2.9.8 (b)										
(2)		X									
(3)	2.9.14 (b)		02	06 04							
(4)	2.9.8 (b)		03	06 04							
	2.9.14 (d)										
(d) (1)				04							
(2)				04							
(3)	2.9.11 (b)			04							
(4)	2.9.14 (b)			04							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	27015	27028	27030						
4.2.2.8.2.3(d) (5)				04							
(6)				04							
(7)				04							
(8)	2.9.11 (b)			04							
(9)	2.9.14 (b)			04							
(10)				04							
(11)				04							
(12)				04							
(e) (1)	2.9.8 (d)		04	02 07	04						
	2.9.9 (a)										
(2) (a)	2.9.14 (d)		04	02 07	04						
(b)			04	02 07	04						
(f) (1)	2.9.9 (a)			08	02						
(2)	2.9.9 (a)			08	03						
(3)	2.9.8 (c)			08	02						
	2.9.14 (a)										

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
			27005	27012		27028	27030	62000 PROP			
4.2.2.8.2.3(f) (4) (a)	2.9.8 (c)					08	03				
(b)	2.9.14 (a)					08	03				
(c)	2.9.8 (d)					08	03				
(d)	2.9.14 (a)					08	03				
(e)	2.9.14 (a)					08	03				
(g)		X									
(h) (1)	2.9.8 (f)			02 03		09	02 03				
(2)	2.9.8 (f)					05	02				
(3)	2.9.8 (f)			02 03		05 08	02 03				
(i)		X									
(j)	2.9.13 (e)		39					17			
APS Substitute Propellant Cold Flow Test											
4.2.2.8.2.4(a) (1)		X									
(2)		X									
(3)		X									
(b) (1)		X									

LSP 470-2 PART II	TCRD	N/A	OCP SEQUENCES 27005			27012		27028			
4.2.2.8.2.4(b) (2)		X									
(c) (1)	2.9.11 (a)		02 03 09 10	15 16 21 22	27 28 33 34						
(2)	2.9.11 (b)		06 13 19 25	31 37							
(3)	2.9.11 (a)		06 13 19 25	31 37							
APS Low Pressure Leak Testing Verification											
4.2.2.8.2.5(a)		X									
(b)	2.9.18 (a)					02 03					
(c) (1)	2.9.18 (a)					02					
(2)	2.9.18 (a)					03					
(3)	2.9.18 (a)					03					
(4)	2.9.18 (c)					02					
(5)	2.9.18 (c)					03					
(6)	2.9.18 (a)					02 03					
(7)	2.9.18 (b)					02 03		08			
	2.9.14 (e)										

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	27020	27028	27030						
4.2.2.8.2.5(d)	2.9.19 (a) (c)		04 06								
(e)	2.9.19 (a)		04 05								
APS Flight Configuration Test											
4.2.2.8.2.6(a)		X									
(b) (1)	2.9.8 (d)			08	03						
(2)	2.9.14 (d)			08	03						
(c)	2.9.14 (c)		03 06	08							
	2.9.19 (b)										
(d) (1)	2.9.19 (a)		03								
(2)	2.9.19 (a)		03								
(e) (1)	2.9.14 (c)		07	10							
	2.9.19 (a)										
(2)	2.9.14 (c)		07	10							
(3)	2.9.19 (a)		07	08,10							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	26022	26040	26041						
Descent Propulsion Subsystem (DPS) Tests											
4.2.2.8.3 (a)		X									
(b)		X									
(c)		X									
(d)		X									
DPS Proof Pressure Test											
4.2.2.8.3.1(a)		X									
(b) (1)	2.9.1 (c)				06						
	2.9.3 (b)										
(2)	2.9.3 (b)				12						
(3)	2.9.3 (a)(b)			05	06						
(4)	2.9.1 (c)		04								
(5) (a)	2.9.1 (c)		04								
(b)	2.9.1 (c)		04								
(6) (a)			02 03								
(b)			04								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	26022	26040	26041	26043					
4.2.2.8.3.1(b) (6) (c)			04								
(c)	2.9.1 (c)		04		06						
DPS External Leak Check											
4.2.2.8.3.2(a)		X									
(b) (1)	2.9.3 (c)			05	06						
(2)	2.9.3 (c)			05	12						
(3)	2.9.3 (c)			05	06						
(4)		X									
(5)	2.9.3 (c)					02					
(6)	2.9.3 (c)			05 07	06	02					
	2.9.5 (c)(d)										
DPS Installed Component Verification Tests											
4.2.2.8.3.3(a) (1)	2.9.15 (c)			05							
(2)	2.9.15 (c)			05							
(b) (1)	2.9.15 (a)			03	03 04 07 08						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	26022	26040	26041						
4.2.2.8.3.3(b) (2)	2.9.15 (a)			04	09						
(3)	2.9.4 (b)			05							
(4)	2.9.4 (b)				06						
(5)	2.9.5 (c)			05							
(6)	2.9.5 (c)			05							
(7)	2.8.15 (c)			05							
(c) (1)	2.9.4 (b)				06						
(2)	2.9.4 (b)				06						
(3)	2.9.4 (b)				06						
(d) (1)	2.9.4 (a)			05	06						
(2)	2.9.4 (a)			05	06						
(e) (1)			04	06							
(2)			04	06							
(3)	2.9.6 (b)		04	06							
(4)	2.9.15 (d)		04	06							
(5)			04	06							
(6)			04	06							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	26022	26040	26041	26043					
4.2.2.8.3.3(f) (1)	2.9.4 (b)		05	07		05					
	2.9.15 (c)										
(2) (a)	2.9.4 (b)		05	07							
(b)	2.9.15 (c)		05	07		05					
(g) (1)	2.9.4 (b)		04		13	05					
(2)	2.9.4 (b)		04		13	05					
(3)	2.9.15 (c)		04			05					
(4) (a)	2.9.15 (d)			07		05					
(b)	2.9.15 (d)			07							
(c)	2.9.15 (c)										
(h)		X									
(i) (1)	2.9.3 (c)			05							
(2)	2.9.3 (c)			05	06						
(3)	2.9.3 (c)			07		02					
(j) (1)	2.9.4 (c)					05					
(2)	2.9.4 (c)					05					
(k) (1)	2.9.15 (c)					02					

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	26007	26043	62000 PROP	62500 PLG	62500 SIM				
4.2.2.8.3.3(k) (2)	2.9.15 (c)			02							
(l) (1)	2.9.4 (d)										
(2)	2.9.4 (d)										
(m)		X									
(n) (a)	2.9.13 (a)(b)				15	26					
(b)					16						
(b) (1)	2.9.13 (c)				16	26	24				
(2)	2.9.13 (c)				16	26	24				
(3)	2.9.13 (c)				16	26	24				
(c)	2.9.13 (e)				17						
Descent Stage Substitute Propellant Cold											
Flow Test											
4.2.2.8.3.4(a) (1)	2.9.6 (a)	X									
(2)	2.9.6 (a)	X									
(b) (1)	2.9.6 (a)	X									
(2)	2.9.6 (a)		07 11 17 21								

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	26007	26041							
4.2.2.8.3.4(c) (1)	2.9.6 (a)		02 12 22								
(2)	2.9.6 (b)		06 16 19 25								
(3)	2.9.6 (a)		06 09 16 19 25								
(4)	2.9.6 (a)		25								
DPS Mission Duty Cycle											
4.2.2.8.3.5(a) (1)		X									
(2)		X									
(b) (1)		X									
(2)		X									
(c)	2.9.6 (c)			11 12							
(d)	2.9.6 (c)			13							
(e)	2.9.6 (c)	X									
(f) (1)	2.9.6 (c)			10 11							
(2)	2.9.6 (c)			13							
(3)	2.9.6 (c)			13							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	26019	26040	26043	62000 PROP					
DPS Low Pressure Leak Test/Verification											
4.2.2.8.3.6(a)		X									
(b)	2.9.2 (a)		02								
(c)	2.9.2 (a) (b)		02								
	2.9.17 (a)										
(d)	2.9.17 (b)					20					
DPS Flight Configuration Test											
4.2.2.8.3.7(a)		X									
(b) (1)	2.9.15 (c)			07	05						
(2)	2.9.15 (c)			07	05						
(c)	2.9.15 (f)			08		19 20					
	2.9.17 (c)										
(d) (1)	2.9.17 (a)					19					
(2)	2.9.17 (a)					19					
(e) (1)	2.9.15 (e)			08		21					
(2)	2.9.15 (e)			08		21					

LSP 470-2 PART II	TCRD	OCP SEQUENCES										
		N/A	26008	26019	26040	27006	27028					
PROPULSION SUBSYSTEM CLEANLINESS												
4.2.2.8.4	2.9.7 (c)		10-13 15	03	10	11	11					
	2.9.12 (c)											

LSP 470-2 PART II	TCRD	N/A	62000 PROP	62000 ECS	62000 RCS	62000 FCS	62000 EPS	62000 RAD	62000 INST	62500 PLG	62500 SIM
4.2.2.9		X									
DISPLAYS AND CONTROLS SUBSYSTEM (D&C)											
General D&C Tests											
4.2.2.9.1 (a)	2.2.3 (b)				03,05		21-25 28-30			02,03	02,03
	2.2.4 (a,b)						60-74			10	10
	2.5.1 (c,d,e,f)							05			49
	2.5.6 (a)							27			
	2.6.1 (b,c,d)							16,21			46
	2.7.9				29-42						
	2.9.22		02-03 04-06								
	2.12.2 (b)								02		
	2.12.3 (b)								03		
	2.9.13 (d)		02,03 04,06								
(b)			02-21	02-10	02-22	02-57	02-75	03-29	02-04	02-43	02-78

Header note: the columns from N/A through 62500 SIM are grouped under the spanning heading OCP SEQUENCES.

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62000 FCS	62500 PLG	62500 SIM						
Digital Event Timer Test											
4.2.2.9.2 (a) (1,2)	2.12.1 (k)		05	33							
(b) (1,2,3,4)	2.12.1 (k)		05	33							
(c) (1,2,3,4)	2.12.1 (k)		05	33							
(d) (1,2)	2.12.1 (k)		05	33							
(e) (1 to 12)	2.12.1 (k)		05								
Digital Mission Timer											
4.2.2.9.3 (a) (1,2,3)	2.12.1 (b)		06								
(b) (1 to 6)	2.12.1 (k)		06								
(c) (1 to 27)	2.12.1 (k)		06								
(d) (1)	2.12.1 (k)		06								
ORDEAL (GFE) Test											
4.2.2.9.4 (a) to (w)	2.7.11 (a)		45		38						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62500 SIM	62000 EDJ						
4.2.2.10	2.10	X									
EXPLOSIVE DEVICES (ED) SUBSYSTEM											
Test Equipment Requirements for ED Tests											
4.2.2.10.1		X									
ED Circuitry Functional Tests											
4.2.2.10.2 (a)	2.10.9		04	04	09						
(b) (1)	2.10.9 (b)				02, 12 13, 14						
(2)	2.10.9 (b)			42	02, 16						
(3)	2.10.9 (b)				02, 17						
(c) (1)	2.10.9 (c)				08						
(2)	2.10.9 (c)				02, 08						
(3)	2.10.9 (c)				02, 08						
(d)	2.10.9 (c)				16						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	SMP 3250	62500 PLG	62500 STM	62000 EDS					
Circuitry Tests											
4.2.2.10.3	2.10.8		02	04	04,42	02-05 07 11-17					
	2.10.9 (a,b,d)										
Explosive Devices											
4.2.2.10.4 (a)		X									
(b)		X									
(c)		X									
(d)		X									

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62000 IPC							
4.2.2.11	2.11	X									
COMMUNICATIONS SUBSYSTEM (CS)											
CS Tests											
4.2.2.11.1		X									
Test Equipment Requirements											
4.2.2.11.1.1				X							
Subsystem Checkout Requirements											
4.2.2.11.1.1.1 (a) (1)			07	X							
(2)			07	X							
(3)			07	X							
(4)			07	X							
(5)			07	X							
(b) (1)				X							
(2)				X							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62000 COM	62000 IPC						
4.2.2.11.1.1.1 (b) (3)					X						
(4)					X						
(c)				02	X						
(d)					X						
Intercommunication System (ICS)											
4.2.2.11.1.2 (a)	2.11.1 (e)		08	06							
(b)	2.11.1 (g)		08	04,07							
(c)	2.11.1 (e)			06							
(d)	2.11.1 (f)		08	07							
(e)	2.11.1 (d)			07							
(f)	2.11.1 (c)		08	04,05 07,08							
(g)	2.11.1 (c)		08	04,07							
Mike & Bio Power Supplies											
4.2.2.11.1.3 (a)	2.11.1 (a)			03							
(b)	2.11.1 (a)			03							

LSP 470-2 PART II	TCRD	OCP SEQUENCES										
		N/A		62500 PLG		62000 COM	62500 STM					
VHF Performance Tests												
4.2.2.11.1.4		X										
VHF Transmitter Tests												
4.2.2.11.1.4.1 (a)	2.11.2 (f)			06,07 34-37	41,42 08,33	17	17					
(b)	2.11.2 (u)			06,07 33-37	41,42 08							
(c)	2.11.2 (f)			06,33 34-37	41,42 08	16	17					
(d)	2.11.2 (u)			06,34 35-37	41,42 08,33							
VHF Receiver Tests												
4.2.2.11.1.4.2 (a)	2.11.2 (b,g,h)			33 07,34 35-37	39,41 42,08	11,12 14,15	17					
(b)	2.11.2 (f,g,h)			07,37 39,41	42,08 33-36	10,12 13,15	17					

LSP 470-2 PART II	TCRD	N/A	SMP 3826	SMP 3851	62500 PLG		62000 COM				
VHF RF Path Verification											
4.2.2.11.1.4.3 (a)	2.11.2 (j)		02,03	02							
(b)	2.11.2 (j)		02,03	02							
(c)	2.11.2 (j)		02,03								
(d)	2.11.2 (j)		02,03				19				
S-Band Performance Tests											
4.2.2.11.1.5		X									
S-Band Receiver Verification											
4.2.2.11.1.5.1 (a)	2.11.3 (b,p)				07,34 35-37	39,08	22				
(b)	2.11.3 (u)				07,35 36,37	41,42 33					
(c)	2.11.3 (p)				07,37 39		23				
S-Band Transmitter Verification											
4.2.2.11.1.5.2 (a)	2.11.3 (t)				06,07 33-37	39,41 42,08	32,				
(b)	2.11.3 (t)				06,07 37,41	42,08 33-35	32,				

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	SMP 3827	62500 PLG	62000 COM						
4.2.2.11.1.5.2 (c)	2.11.3 (t)			07,08	32						
(d)	2.11.3 (t)			07,08	32						
(e)	2.11.3 (t)			07,08	32						
(f)	2.11.3 (k,t)			07,08	34						
S-Band RF Path Verification											
4.2.2.11.1.5.3 (a)	2.11.3 (m)		02,03 04								
(b)	2.11.3 (m)		02,03 04								
(c)	2.11.3 (m)		02,03 04								
(d)	2.11.3 (m)		02,03 04								
(e)	2.11.3 (m)		02,03 04								
1.25 MHZ Subcarrier Modulation Indices											
Verification											
4.2.2.11.1.5.4	2.11.3 (t)				35						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62000 COM	62000 IPC						
Up Voice BU (DUA) Verification											
4.2.2.11.1.5.5	2.11.4 (e)		08,09	28							
GSE Interface Verification											
4.2.2.11.1.6		X									
S-Band Power Amplifier Current Margin Test											
4.2.2.11.1.6.1 (a)	2.11.3 (i)			24,25							
(b)					X						
VHF Transceiver GSE Interface Verification											
4.2.2.11.1.6.2					X						
Signal Processor Assembly GSE Interface											
Verification											
4.2.2.11.1.6.3					X						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62000 COM	62000 IPC						
Steerable Antenna Tests											
4.2.2.11.1.6.4 (a)					X						
(b)				42 45							
(1)	2.11.3 (j,s)	X									
(2)	2.11.3 (j,s)			42							
(3)	2.11.3 (j,s)			42							
(4)	2.11.3 (j,s)			42							
(5)	2.11.3 (j,s)		33-37 39,41 42	42							
(6)	2.11.3 (j,s)			45							
(7)	2.11.3 (j,s)			45							
(8)	2.11.3 (j,s)			45							
(9)	2.11.3 (j,s)		33,37 39,41 42	45							
S-Band Mode Verification											
4.2.2.11.1.7		X									

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62500 SIM	62000 COM	62000 IPC					
Verification of ST-2 (SR-6) Modes											
4.2.2.11.1.7.1 (a)	2.11.3 (1-1)				29						
(b)	2.11.3 (1-1)				29						
(c)	2.11.3 (1-1)		08								
(d)	2.11.3 (1-1)				36						
Stimuli											
4.2.2.11.1.7.1.1(a)	2.11.3 (1-1)					X					
(b)	2.11.3 (1-1)			18		X					
Success Criteria											
4.2.2.11.1.7.1.2(a)	2.11.3 (1-1)				36						
(b)	2.11.3 (1-1)		08		36						
(c)	2.11.3 (1-1)				36						
(d)	2.11.3 (1-1)				36						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62500 SIM	62000 COM	62000 IPC					
Verification of ST-4 (SR-2) Modes											
4.2.2.11.1.7.2 (a)	2.11.3 (1-2)				27						
(b)	2.11.3 (1-2)			18	27						
Stimuli											
4.2.2.11.1.7.2.1(a)	2.11.3 (1-2)					X					
(b)	2.11.3 (1-2)			54		X					
Success Criteria											
4.2.2.11.1.7.2.2(a)	2.11.3 (1-2)				40						
(b)	2.11.3 (1-2)		08		40						
Verification of ST-6 (SR-2) Modes											
4.2.2.11.1.7.3 (a)	2.11.3 (1-3)				37						
(b)	2.11.3 (1-3)				37						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 STM	62000 COM	62000 IPC						
Stimuli											
4.2.2.11.1.7.3.1(a)	2.11.3 (1-3)			37							
(b)	2.11.3 (1-3)			37							
Success Criteria											
4.2.2.11.1.7.3.2(a)	2.11.3 (1-3)			37							
(b)	2.11.3 (1-3)			37							
Verification of ST-10 (SR-2) Modes											
4.2.2.11.1.7.4 (a)	2.11.3 (1-6)		54	38							
(b)	2.11.3 (1-6)			38							
(c)	2.11.3 (1-6)		54	38							
(d)	2.11.3 (1-6)			38							
(e)	2.11.3 (1-6)			38							
Stimuli											
4.2.2.11.1.7.4.1(a)	2.11.3 (1-6)				X						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62000 COM	62000 IPC						
4.2.2.11.1.7.4.1(b)	2.11.3 (1-6)				X						
(c)	2.11.3 (1-6)				X						
(d)	2.11.3 (1-6)				X						
Success Criteria											
4.2.2.11.1.7.4.2(a)	2.11.3 (1-6)			38							
(b)	2.11.3 (1-6)		08	38							
(c)	2.11.3 (1-6)			38							
(d)	2.11.3 (1-6)			38							
(e)	2.11.3 (1-6)			38							
Verification of ST-8A Mode											
4.2.2.11.1.7.5 (a)	2.11.3 (1-5)			41							
(b)	2.11.3 (1-5)			41							
(c)	2.11.3 (1-5)			41							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62000 COM	62000 IPC						
Stimuli											
4.2.2.11.1.7.5.1(a)	2.11.3 (1-5)				X						
(b)	2.11.3 (1-5)				X						
(c)	2.11.3 (1-5)				X						
Success Criteria											
4.2.2.11.1.7.5.2(a)	2.11.3 (1-5)		08	41							
(b)	2.11.3 (1-5)			41							
(c)	2.11.3 (1-5)			41							
Verification of SR-8 Mode											
4.2.2.11.1.7.6 (a)	2.11.3 (1-4)										
Stimuli											
4.2.2.11.1.7.6.1	2.11.3 (1-4)				X						

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 SIM	62000 COM							
Success Criteria											
4.2.2.11.1.7.6.2	2.11.3 (1-4)										
DSEA Verification											
4.2.2.11.1.8 (a)	2.11.5 (h)			30							
(b)	2.11.5 (b)			30							
VHB "B" PCM Split Phase Data											
4.2.2.11.1.9	2.11.2 (n)		26	39							
TLM Verification											
4.2.2.11.1.10(a)	2.11.6 (a)			20,21							
(b)	2.11.6 (b)			20,21							
(c)	2.11.6 (c)			20,21							
(d)	2.11.6 (d)			20,21							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	27030	36015	36527	62000 INSTR	62000 PROP	62000 RCS	62500 PLG		
PCMTEA High - Bit Rate Mode Test											
4.2.2.12.2.1.1	2.12.1 (b,d,e,g,			04,05 06,09		02			02		
	h)										
PCMTEA Low - Bit - Rate - Mode Test											
4.2.2.12.2.1.2	2.12.1 (b,d,e,g,			07-09	20						
	h)										
Operational Instrumentation Test/											
Verification											
4.2.2.12.3		X									
Transducers and Signal Sensors											
4.2.2.12.3.1 (a)	2.12.3 (b,c,d,e)		02,03				02,08	03	05,26		
(b)	2.12.2 (b,c,d,e)	X									

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	36015	62000 INSTR	62000 PROP	62000 RCS	62500 PLG	62500 SIM			
4.2.2.12	2.12	X									
INSTRUMENTATION SUBSYSTEM (IS)											
Test Equipment Requirements for IS Tests											
4.2.2.12.1		X									
Operational Instrumentation Turn-On											
4.2.2.12.2 (a)	2.12.2 (a)			02							
(b)	2.12.3 (a)			03			11	11			
(c)	2.12.1 (a)		03	02			02,04	03,09			
Test/Verification and Measurements											
4.2.2.12.2.1 (a)	2.12.1 (c)		03								
(b)	2.12.1 (h)				03,04 05,06	04,05 07,08	03,09				
	2.12.2 (b)				07 10-13	09,10 13,14					
					15-18	15					

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	36527	62000 COM	62000 INSTR	62000 PROP	62000 RCS	62500 PLG	62500 SIM		
Caution and Warning (C&W) Test											
4.2.2.12.4	2.12.3 (b,c,d,e,		21-87		04	02,03 04,05	04,16 17-19	13,14 17,19	11,12 15		
	f)										
Data Storage Electronics Assembly (DSEA)											
Tests											
4.2.2.12.5 (a) (1) a.	2.12.1 (a)			02							
b.	2.11.5 (h)			02							
(2) a.				02							
b.				02							
c.				02							
(b) (1)	2.11.5 (a,b,d,e,			30							
	h, i,j)										
(2)	2.11.5 (f,g)			30							
(3)	2.11.5 (c)			30							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A	62500 PLG	62500 SIM							
4.2.2.13		X									
Engineering Acceptance Tests (FEAT)											
FEAT Scope											
4.2.2.13.1		X									
FEAT System Verification Test											
4.2.2.13.1.1		X									
FEAT Mission-Oriented Plugs-In Test											
4.2.2.13.1.2			33-39 41-42								
FEAT Mission-Oriented Plugs-Out Test											
4.2.2.13.1.3				X							

LSP 470-2 PART II	TCRD	OCP SEQUENCES									
		N/A									
FEAT Electromagnetic Compatibility											
Acceptance Test											
4.2.2.13.1.4		X									

SECTION 6.0 - OCP AND SMP OUTLINES

SECTION 9.0 -- HAZARD vs. OCP/SMP MATRIX

SMP OUTLINE

SMP 3215

Test Title:

Inert Explosive Devices Clearance and Fit Check

Subsystem:

Ascent and Descent Explosive Devices

Test Objectives:

a. To verify that no structural and/or plumbing interferences are present to hinder the installation of Explosive Devices and the torquing of Inert Cartridges in the LM Vehicle.

b. To insure proper fit, correct routing and length of the Umbilical and Pyro Electrical Lines.

Vehicle Configuration:

Mated Stages

Location:

LM Final Assembly Area

Hazardous Operations:

Not Applicable

Components Under Test:

All areas in which explosive devices are installed.

Test Description:

Seq. 01: Interstage Umbilical Combing and Wrapping Procedure.

a. Combing and wrapping Umbilical Lines (Electrical and Fluid), so as to allow the Guillotine Cutter Assembly to be fitted.

Seq. 02: Circuit Interrupter Cartridge Installations (inert).

a. Installation of Explosive Cartridges in the deadface connectors and checking proper fit of Pyro Connectors to these Explosive Devices.

Seq. 03: Booster Cartridge Installation (inert).

a. Installation of explosive cartridges in all Helium Valves and checking proper fit of Pyro Connectors to these explosive devices.

Seq. 04: RCS Cartridge Installation (inert)

a. Installation of Explosive Cartridges in the RCS Valve and checking proper fit of Pyro Connectors to these Explosive Devices.

Test Description: (Cont).

Seq. 05: Inert Explosive Nut, Bolt and Cartridge Sub-Assembly Installations.

a. Installation of Explosive Devices in all four (4) interstage fittings and checking proper fit of Pyro Connectors to these devices. Also fitting associated blast covers.

Seq. 06: Pyro Line length check to Explosive Devices relay boxes (Ascent and Descent).

a. Installation of ED Relay Boxes and mating all Pyro Connectors to insure proper fit and length.

SMP OUTLINE

SMP 3250

Test Title:

Explosive Devices Subsystem Resistance Measurement Test

Subsystem:

Explosive Devices

Test Objective:

To measure and establish limits for resistance of System "A" and System "B" Explosive Devices Firing Circuitry.

Vehicle Configuration:

Mated Stages

Location:

Plant #5 Final Assembly Area

Hazardous Operations:

Not Applicable

Components Under Test:

ED Relay Bcxes
Vehicle Wiring (Pyro Lines)

Test Description:

Seq. 01: Call to Station and EPS Activation

Seq. 02: Firing Circuit Resistance Measurements

Test Title:

Flush, Purge, Evacuation, Drain of Primary HTS, A/S

Subsystem:

Environmental Control - HTS

Test Objective:

To flush and drain primary HTS A/S and leave in a clean and dry condition.

Vehicle Configuration:

Ascent Stage.

Location:

Plant 5

Hazardous Operation:

Alcohol flush.

Components Under Test:

Primary HTS complete.

Test Description:

Seq. 001: HTS, GSE Activation

Seq. 002: Water Flush

Seq. 003: Alcohol Flush

Seq. 004: GN_2 Purge and Drain

Seq. 005: Evacuation

Seq. 006: Blanket Pressure in HTS

Seq. 007: Securing After Test

Test Title:

Flush, Purge, Evacuation, Drain of HTS, Primary D/S.

Subsystem:

ECS

Test Objectives:

To drain, flush, purge and maintain cleanliness level of the HTS D/S by a sequential alcohol flush, GN2 purge, evacuation, and application of a blanket pressure to the system.

Vehicle Configuration:

Descent Stage

Location:

Plant #5

Hazardous Operations:

Alcohol flush

Components Under Test:

All lines in HTS

Test Description:

Seq. 001: HTS-GSE Activation

Seq. 002: HTS Descent Coolant Loop Water Flush

Seq. 003: HTS D/S Coolant Loop GN_2 Purge

Seq. 004: HTS D/S Coolant Loop Evacuation

Seq. 005: Primary Coolant Loop HTS Blanket Pressure

Seq. 006: Securing after test

Test Title:

Flush, Purge, Evacuation, Drain of HTS Secondary

Subsystem:

ECS-HTS

Test Objectives:

- To fill, flush, drain, purge, evacuate and apply blanket pressure to secondary HTS system.

Vehicle Configuration:

Ascent Stage

Location:

Plant #5

Hazardous Operations:

Alcohol Flush of HTS Secondary

Components Under Test:

Secondary HTS

Test Description:

Seq. 001: HTS-GSE power activation

Seq. 002: HTS-secondary coolant loop water flush

Seq. 003: FCS-secondary HTS alcohol flush

Seq. 004: HTS-secondary coolant loop GN_2 purge

Seq. 005: HTS-secondary coolant loop evacuation

Seq. 006: Secondary coolant loop HTS blanket pressure

Seq. 007: Securing after test

Test Title:

Proof Pressure and Interface Leak Check of Suit Circuit Assembly and Oxygen Control Module

Subsystem:

ECS

Test Objectives:

a. Verification of the structural integrity of the interface between the LSC 330-190 Suit Circuit Assembly and the LSC 330-390 Oxygen Control Module by applying a proof pressure.

b. Verification that the leakage at the interface between the LSC 330-190 Suit Circuit Assembly and the LSC 330-390 Oxygen Module is within allowable limits.

Vehicle Configuration:

Not Applicable

Location:

Plant #2 - Clean Room

Hazardous Operations:

Proof pressure to 1350 psig.

Components Under Test:

Interfaces between LSC 330-190 Suit Circuit Assembly and LSC 330-390 Oxygen Module.

Test Description:

Seq. 01: Call to station

Seq. 02: LSC 330-390/190 Interface Proof Pressure & Leak Test

a. Pressurize the following interfaces to a proof pressure of 1350 psig. Reduce pressure to operating pressure (950± 25 psig) and perform a leakage test using a Mass Spectrometer Leak detector.

1. Line between the LSC 330-190 and the Asc GOX No. 1 304 valve.

2. Line between the LSC 330-190 and the Asc GOX No. 2 304 valve.

3. Line between the LSC 330-190 and the PLSS 304 valve.

Test Description: (Cont)

b. Pressurize, the LSC 330-306 Sense Lines and the interface between the outlet of the LSC 330-306 Reg and the inlet to the LSC 330-190 SCA; to a proof pressure of 6.4 $\pm$.1 psig. Reduce pressure to operating pressure (4.9 $\pm$.2) psig and perform a leakage test using a Mass Spectrometer Leak detector.

Seq. 03: Securing After Test

Test Title:

Cabin Leak Test and Cabin Safe Pressure Test

Subsystem:

ECS

Test Objectives:

a. Verification that the leakage rate of LM Cabin at operating pressure is within acceptable limits.

b. Verification that the cabin can be pressurized to 5.0 psig for leak checking prior to performing actual proof pressure.

Vehicle Configuration:

Ascent Stage

Location:

Plant #3

Hazardous Operations:

Proof pressure to 5.7 psig

Components Under Test:

LM Cabin

Test Description:

Seq. 01: Cabin Safe Pressure Test

Seq. 02: Secure from Safe Pressure Test

Seq. 03: Relocation of Vehicle and GSE (Plant #3)

Seq. 04: Cabin Leak Test

Seq. 05: Dump Cabin Pressure

Seq. 06: Securing after Test

Test Title:

Cabin Leak Test

Subsystems:

ECS

Test Objectives:

Verification that the leakage rate of LM Cabin at operating pressure is within acceptable limits. Verification that the Cabin can be pressurized to 5.0 psig for leak checking prior to performing actual proof pressure.

Vehicle Configuration:

Ascent Stage

Location:

Plants #2 and #5

Hazardous Operations:

Proof pressure to 5.7 psig.

Components Under Test:

Vehicle Cabin

Test Description:

Seq. 01: Cabin Safe Pressure Test

Seq. 02: Cabin Leak Test

Seq. 03: Dump Cabin Pressure

Seq. 04: Securing After Test

TEST TITLE:

Flush, Purge, Evacuation, Fill and Gas Entrapment Test of HTS Primary D/S Alternate-Service Adapter.

Subsystem:

Environmental Control (Primary HTS-D/S)

Test Objectives:

a. To verify system leak free with a 1 hr. GN_2 pressure decay.

b. To clean the primary D/A HTS with flushing fluids to acceptable cleanliness level.

c. To verify results are within Spec. Limits of LSP14-0020.

d. To dry the HTS with a GN_2 Purge (pressure decay) and a vacuum.

e. To perform vacuum decay verifying system dry.

f. To fill the primary D/S coolant loop with certified water/glycol.

g. To circulate chilled W/G with the trim control unit through HTS-Primary D/S.

h. To determine the amount of entrapped gas in the primary descent stage.

i. To verify the HTS - Primary D/S circulation.

Vehicle Configutation: Descent Stage only-HTS manufacturing complete.

Location: Plant # 5 CEF, integrated workstand.

Hazardous Operation: Alcohol Flush

Components Under Test:

Descent Stage HTS

Test Description:

Seq. 001: HTS - GSE activation.

Seq. 002: HTS Evacuation flush.

Seq. 003: GN_2 purge.

Seq. 004: Evacuation and water glycol fill.

Seq. 005: Securing after test.

SMP OUTLINE

SMP 3356

Test Title:

Flush, Purge, Fill and Gas Entrapment Test of Heat Transport Section, Primary Ascent Stage

Subsystem:

ECS

Test Objectives:

a. To verify system leak free with a 1 hr GN_2 pressure decay.

b. To clean the primary ascent stage HTS with flushing fluids to acceptable cleanliness level.

c. To verify results within Specification limits of LSP14-0020.

d. To dry HTS with a GN2 Purge and Vacuum.

e. To perform vacuum decay verifying system dry.

f. To fill the primary A/S Coolant Loop with certified water/glycol.

g. To determine the amount of entrapped gas in the primary ascent stage.

h. To circulate chilled W/G with the trim control unit through HTS - Primary A/S.

i. To verify the HTS - Primary Ascent Stage Circulation.

Vehicle Configuration:

Ascent Stage

Location:

Plant #5 - Final Assembly

Hazardous Operations:

Alcohol Flush of HTS

Components Under Test:

A/S HTS

Test Description:

Seq. 01: Call to Stations.

Seq. 02: HTS - GSE Power Activation

Seq. 03: HTS Primary Coolant Loop Evacuation and Flush-Ascent Stage only.

Seq. 04: HTS - Primary Coolant Evacuation and W/G Fill.

Test Description: (Cont).

Seq. 05: Gas Entrapment Test (Vehicle Only) (Para. 4.2.2.3.6.5)

Seq. 06: Gas Entrapment Test (Vehicle and GSE)

Seq. 07: Water/Glycol Circulation

Seq. 08: Securing After Test - A/S

Test Title:

Flush, Purge, Evacuation, Fill and Gas Entrapment Test of Heat Transport Section, Primary Descent Stage

Subsystem:

ECS

Test Objectives:

a. To verify system leak free with a 1 hr. GN2 pressure decay.

b. To clean the primary D/S HTS with flushing fluids to acceptable cleanliness level.

c. To verify results are within Spec. Limits of LSP14-0020.

d. To dry the HTS with a GN_2 Purge (pressure decay) and a vacuum.

e. To perform vacuum decay verifying system dry.

f. To fill the primary D/S coolant loop with certified water/glycol.

g. To circulate chilled W/G with the trim control unit through HTS - Primary D/S.

h. To determine the amount of entrapped gas in the primary descent stage.

i. To verify the HTS - Primary D/S circulation.

Vehicle Configuration:

Descent Stage

Location:

Plant #5 - Final Assembly

Hazardous Operations:

Alcohol Flush

Components Under Test:

Primary D/S HTS

Test Description:

Seq. 01: HTS - GSE Power Activation

Seq. 02: Evacuation, Flush and Purge.

Seq. 03: Evacuation and W/G Fill

Test Description: (Cont).

Seq. 04: Water/Glycol Circulation

Seq. 05: Securing After Test

SMP OUTLINE

SMP 3358

Test Title:

Flush, Purge, Evacuation, Fill and Gas Entrapment Test of Heat Transport Section, Secondary

Subsystem:

ECS

Test Objectives:

a. To verify system leak free with a 1 hr GN_2 pressure decay.

b. To clean the secondary HTS with Flushing Fluids to acceptable cleanliness level.

c. To verify results are within Specification limits of LSP14-0020.

d. To dry the HTS with a GN_2 purge and vacuum.

e. To perform vacuum decay verifying system dry.

f. To fill the secondary coolant loop with certified water glycol.

g. To determine the amount of entrapped gas in the secondary coolant loop.

h. To circulate chilled W/G with the trim control unit through HTS Secondary.

i. To verify the HTS - Secondary Circulation.

Vehicle Configuration:

Ascent Stage

Location:

Plant #5 - Final Assembly

Hazardous Operations:

Alcohol Flush

Components Under Test:

Secondary HTS

Test Descriptions:

Seq. 01: Call to Stations

Seq. 02: HTS - GSE Power Activation

Seq. 03: HTS - Secondary Coolant Loop Evacuation and Flush - A/S only

Seq. 04: HTS - Secondary Coolant Evacuation and W/G Fill

Test Description: (Cont).

Seq. 05: Gas Entrapment Test (Vehicle Only) (Para. 4.2.2.3.6.5)

Seq. 06: Gas Entrapment Test (Vehicle and GSE)

Seq. 07: Water/Glycol Circulation

Seq. 08: Securing after test - secondary HTS

SMP OUTLINE

SMP 3363

Test Title:

D/S HTS Leak Check

Subsystem:

Environmental Control (HTS D/S)

Test Objectives:

To verify the structural/mechanical integrity of the primary D/S HTS by an operating pressure decay and leak check and pad pressure to insure cleanliness of system.

Vehicle Configuration:

Primary D/S HTS complete

Location:

Plant #2

Hazardous Operations:

Not Applicable

Components Under Test:

Primary D/S HTS

Test Description:

Seq. 001: Proof pressure and leak check

Seq. 002: Pressure decay

Seq. 003: Pad pressure

Seq. 004: Securing after test

Test Title:

Ascent Stage - Primary HTS Leak Check

Subsystem:

Environmental Control (Primary HTS-A/S)

Test Objectives:

Verify the mechanical integrity of the HTS of the ascent stage of the ECS.

Vehicle Configuration:

Ascent Stage only - HTS Line and component installation is complete.

Location:

Plant #2

Hazardous Operation:

HTS Structural integrity test 52 to 54 psig.

Components Under Test:

Ascent Stage Primary HTS

Test Description:

Seq. 01: HTS Structural integrity test.

Seq. 02: HTS Operational - pressure leak check.

Seq. 03: HTS Inter-coolant - loop leak test.

Seq. 04: HTS Primary pressure decay test.

Seq. 05: Securing after test.

SMP OUTLINE

SMP 3368

Test Title:

Ascent Stage HTS Secondary Pressure Decay, Leak check.

Subsystem:

Environmental Control Subsystem.

Test Objectives:

To verify the structural/mechanical integrity of the secondary HTS by an operating pressure decay and leak check and pad pressure to insure cleanliness of system.

Vehicle Configuration:

Secondary HTS complete in Ascent Stage

Location:

Plant #2

Hazardous Operation:

Not Applicable

Components Under Test:

Secondary mechanical HTS

Test Description:

Seq. 001: Proof pressure test.

Seq. 002: Secure from leak test

Seq. 003: Inter-coolant leak check

Seq. 004: Pressure decay test

Seq. 005: Securing after test

SMP OUTLINE

SMP 3826

Test Title:

Operational VHF Section Insertion Loss and Voltage Standing Wave Ratio Test.

Subsystem:

Communications

Test Objectives:

The Verification of the VHF Communication RF Signal Paths

Vehicle Configuration:

Ascent Stage

Location:

Plant #5 Final Assembly

Hazardous Operations:

Not Applicable

Components Under Test:

RF Signal Paths

a. Coax Lines

b. Coax Connectors

Test Description:

Seq. 01: Call to Stations

Seq. 02: Insertion Loss Measurements

a. Verify operation of GSE

Seq. 03: VSWR Measurements

a. Verify operation of GSE

SMP OUTLINE

SMP 3827

Test Title:

S-Band Section Insertion Loss and Voltage Standing Wave Ratio Test

Subsystem:

Communications

Test Objective:

The Verification of S-Band Communication RF Signal Paths

Vehicle Configuration:

Mated Stages

Location:

Plant #5 Final Assembly

Hazardous Operations:

Not Applicable

Components Under Test:

RF Signal Path

a. Coax Lines

b. Coax Connectors

Test Description:

Seq. 01: Call to Stations

Seq. 02: Insertion Loss Measurements S-Band Ascent Stage

Seq. 03: Insertion Loss Measurements S-Band Descent Stage

Seq. 04: VSWR Measurements

Seq. 05: Securing after Test

Test Title:

Audio Insertion Loss

Subsystem:

Communications

Test Objective:

To establish the insertion loss which will be incurred in the Vehicle and GSE Lines.

Vehicle Configuration:

Ascent

Location:

Plant #5 Final Assembly - Integrated Work Stand

Hazardous Operations:

Not Applicable

Components Under Test:

Microphone and Headset Lines including GSE

Test Description:

Seq. 01: Vehicle and GSE Insertion Loss of Microphone Lines.

Seq. 02: Vehicle and GSE Insertion Loss of Headset Lines.

Seq. 03: GSE Insertion Loss Microphone Lines.

Seq. 04: GSE Insertion Loss Headset Lines.

Seq. 05: Securing after Test.

a. Computation of Sequence 01, 02, 03, and 04 to obtain Vehicle Insertion Loss of both Microphones and Headset Lines.

Test Title:

In-flight Antenna and Coupler Insertion Loss Verification

Subsystem:

Communications

Test Objectives:

a. To establish and record the insertion loss of the In-flight Antennas while mounted in their Antenna Coupler Hats.

b. To establish and record the insertion loss of the GSE Attenuators in their test configuration.

c. To record insertion loss and S/N's of each configuration to be used in OCP 62500-PLG testing.

Vehicle Configuration:

Not Applicable

Location:

Plant No. 5 1st Mezz.

Hazardous Operations:

Not Applicable

Components Under Test:

LSC 380-21002 VHF In-flight Antenna

LSC 380-28004 A-Band In-flight Antenna

Test Description:

Seq. 01: Insertion Loss A-Band

Seq. 02: Insertion Loss VHF

Test Title:

Communications Continuity and Voltage Checks with Associated Anode Stimulus Checks and DUA Verifications

Subsystem:

Communications

Test Objectives:

To provide confidence check on vehicle communications wiring, associated circuit breakers, anode stimulus and DUA Verification.

Vehicle Configuration:

Mated Stages (alternates provided if stages not mated)

Location:

Plant #5 Final Assembly Area

Hazardous Operation:

Not applicable

Components Under Test:

Communications Circuit Breakers
Communications Wiring

Test Description:

Seq. 001: Description, instructions and call to stations

Seq. 002: Continuity Verification

Seq. 003: Voltage Verification

Seq. 004: Anode Stimulus Checks

Seq. 005: Data Uplink Wiring Verification

SMP OUTLINE

SMP 3913

Test Title:

Ascent Stage Power Verification

Subsystems:

Electrical Power

Test Objectives:

Verify the integrity of the Ascent EPS Subsystem Buses

Vehicle Configuration:

Ascent Stage

Location:

Plant #5 Final Assembly

Hazardous Operations:

Not Applicable

Components Under Test:

Panel 11

Panel 14 and 16

Vehicle Wiring

Test Description:

Seq. 01: Call to Stations

Seq. 02: Bus Isolation and Continuity Verification

Seq. 03: Connector Voltage Measurements

Seq. 04: Trans-Lunar Bus Verification

Seq. 05: Securing after Test

SMP OUTLINE

Test Title:

Descent EPS Power Checkout

Subsystems:

Electrical Power

Test Objectives:

Verifies the integrity of the Descent Stage

EPS Main Feeders and Subsystem Buses

Vehicle Configuration:

Mated Stages

Location:

Plant #5 Final Assembly

Hazardous Operations:

Not Applicable

Components Under Test:

Panel 11

Panels 14 and 16

Panel 1

Panel 8

Descent ECA's No. 1 and 2

Vehicle Wiring

Test Description:

Seq. 01: Call to Stations

Seq. 02: Continuity verification of the Vehicle Descent Stage Buses

Seq. 03: Load Connector Voltage Verification

Seq. 04: Comm. TV Voltage Verification

Seq. 05: Securing after Test

SMP OUTLINE

SMP 3950

Test Title:

EPS Lines Installation Resistance check

Subsystem:

Electrical Power

Test Objectives:

a. To verify proper bonding between:

   1. Vehicle structure and LM ground points

   2. Mated stages

b. To verify configuration and installation of each EPS feederline cable by means of resistance measurements with pre-determined tolerances.

Vehicle Configuration:

Ascent Stage, Descent Stage, and mated stages

Location:

Plants 2 and 5

Hazardous Operations:

Not applicable

Components Under Test:

a. LM ground points

b. EPS feederline cables

Test Description:

Seq. 01: A/S and D/S Ground Point Resistance Measurement Checks.

Seq. 02: EPS Lines Installation Resistance Checks.

Test Title:

Bi-Monthly Pad Pressure Check for A/S Propulsion, RCS and D/S Propulsion.

Subsystem:

A/S Propulsion, RCS and D/S Propulsion.

Test Objectives:

To pressurize systems and verify pad pressure.

Vehicle Configuration:

Ascent Stage, Descent Stage or Mated Stages.

Location:

Wherever Vehicle is located.

Hazardous Conditions:

Pneumatic Pressure up to 100 psig.

Components Under Test:

A/S Propulsion, RCS, and D/S Propulsion subsystems in their entirety.

Test Descriptions:

Seq. 01: Verification of Pad Pressures APS, RCS

a. Monitor and record pressure of the He Tank #1, He Tank #2, Oxid Tank, Fuel Tank, RCS Fuel Services "A" and "B", RCS Oxid Services "A" and "B", RCS He Tank Fill Systems "A" and "B", RCS Fuel Tank Fill Systems "A" and "B", RCS Oxid Tank Vent, Fuel Tank Vent, Test S/O Valve, Pre Valve, Test Point. Disconnects amd QD GP9406. Remove and replace DPS Oxid Relief Valve Desicator and RCS He Tankage Module Desicator if pink in color. If any of the pressures recorded above were below 9 or 10 psig as called for in the SMP, perform Sequence 02 or 03.

Seq. 02: Pressurization of APS and DPS.

Seq. 03: Pressurization of RCS Tanks, Fuel and Oxid

SMP OUTLINE

SMP 6151

Test Title:

Ascent and Descent Propellant Tank Dryness Verification.

Subsystem:

RCS, APS, DPS

Test Objectives:

To insure dryness of the Ascent and Descent Propulsion Systems.

Vehicle Configuration:

Ascent and Descent Stages

Location:

Plant #5 - Final Assembly

Hazardous Operation:

Not Applicable

Components Under Test:

All Fluid propulsion components.

Test Description:

Seq. 001: A/S Propulsion Tank Dryness Verification

Seq. 002: D/S Propulsion Tank Dryness Verification

Seq. 003: RCS Manifold Dryness Verification

Test Title:

Descent Stage Substitute Propellant Cold Flow Test

Subsystem:

Descent Propulsion

Test Objectives:

To hydraulically balance the Descent Stage Propellant Feed System. To demonstrate the performance characteristics of the vehicle helium regulators at a pre-determined inlet pressure.

Vehicle Configuration:

Descent Stage.

Location:

Cold Flow Facility

Hazardous Condition:

Pneumatic Pressures up to 1000 psig.

Equipment Under Test:

Pressurization and Propellant Feed Section.

a. Pressure reducers (regulators)

b. Orifice Plates

Test Descriptions: (Para. 4.2.2.8.3.4)

Seq. 01: Call to Stations

Seq. 02: Substitute Propellant Fill

a. Fill of fuel and oxidizer tanks with substitute propellants to provide liquid media for flowing through the feed system for orifice sizing.

Seq. 03: Pre-Run Operation Helium Section

a. Verification of facility gaseous helium status.

b. Verification of a safe start condition prior to pressurization.

Seq. 04: Pre-Run Preparation of Instrumentation Module

a. Assurance of instrumentation module bleed in.

Test Description: (Cont).

Seq. 05: Pre-Run Fluid System Bleed

a. Verification of a proper bleed in from the propellant tanks to the engine simulator.

b. Verification that the oxid and fuel weigh tank catch unit is in a "GO" condition.

c. Obtaining of initial fuel and oxidizer sight glass readings. (Actual level of propellants in respective tanks).

Seq. 06: Test Operations-Flowmeter Calibration

a. Performance of a flowmeter calibration run during which the substitute propellants are flowed from the vehicle tanks into their respective fuel and oxidizer catch tanks and weighed.

b. Indication by TC of his choice of continuing in sequential order through Seq. 09 or to perform Seq. 10. The option is to repeat the run from the partially filled tanks.

Seq. 07: Post Test Operation

a. Unloading of weigh catch tank unit. (Return substitute propellants to storage and transfer carts.)

Seq. 08: Pre-Run Operations

a. Bleed of Fluid System refer to Sequence 05.

Seq. 09: Test Operations

a. Performance of a flowmeter calibration run during which the substitute propellants are flowed from the vehicle tanks into their respective fuel and oxidizer catch tanks and weighed.

Seq. 10: Vent of Pressurization and Propellant Section

a. Vent of propellant tanks to ambient.

b. Vent of upstream of solenoid latch valves to ambient.

c. Obtaining final sight glass readings.

d. Performance of Post Test calibration procedures.

Seq. 11: Post Test Operation

a. Return of substitute propellants to the storage and transfer carts.

Seq. 12: Pre-Run Operations-Ambient Helium Propellant Utilization

a. Load of substitute propellants (ox and fuel).

Test Description: (Cont).

Seq. 13: Pre-Run Operations Helium Section

a. Refer to Seq. 03

Seq. 14: Pre-Run Operation of Preparation of Instrumentation Module

a. Refer to Sequence 04.

Seq. 15: Pre-Run Operations Fluid System Bleed

a. Refer to Sequence 05.

Seq. 16: Test Operations - Flow Meter Calibration.

a. Refer to Sequence 06.

Seq. 17: Post Test Operation

a. Refer to Sequence 07.

Seq. 18: Pre-Run Operation Fluid System Bleed

a. Refer to Sequence 08.

Seq. 19: Test Operations - Flow Meter Calibration

a. Refer to Sequence 09.

Seq. 20 : Vent Pressurization and Propellant Sections

a. Refer to Sequence 10.

Seq. 21: Post Test Operation - Return Substitute Propellants to Storage and Transfer Carts.

a. Refer to Sequence 11.

Seq. 22: Pre-Run Operations Ambient Helium Propellant Utilization

a. Load of substitute propellants (oxid and fuel).

Seq. 23: Pre-Run Operations Helium Section

a. Refer to Sequence 03.

Seq. 24: Pre-Run Operation of Preparation of Instrumentation Module

a. Refer to Sequence 04.

Seq. 25: Test Operations - Propellant Utilization

a. Verification of propellant initial levels in their respective tanks.

Test Description: (Cont).

b. Flow of substitute propellants from their tanks through the engine simulator into the storage and transfer carts at a predetermined flow rate.

Seq. 26: Vent Pressurization and Propellant Sections

a. Vent of propellant tanks to ambient.

b. Final sight glass readings are obtained.

c. Final data recordings.

Seq. 27: Return Freon to Storage and Transfer Carts

a. Application of pad pressure to tank.

b. Secure from test.

OCP OUTLINE

OCP-GF-26008-LM-8

Test Title:

Descent Stage Propellant Feed Section, Dry and Sample

Subsystem:

D/S Propulsion

Test Objective:

Verification of dryness in DPS at the conclusion of Cold Flow Testing

Vehicle Configuration:

Descent Stage

Location:

Cold Flow Facility

Hazardous Operations:

Pneumatic Pressure to 50 psig.

Components Under Test:

Propellant tanks and lines

Test Description:

Seq. 01: Call to Stations

Seq. 02: First Flush Fluid Fill (low level)

a. Filling of fuel tank to about 5 inches with freon TF, to float away any water in the bottom of the fuel tank.

Seq. 03: First Flush Fluid Drain

a. Draining fuel tank of all freon.

Seq. 04: Second Flush Fluid Fill

a. Filling of fuel tank with freon TF to float away any remaining water.

Seq. 05: Second Flush Fluid Drain

a. Draining of fuel tank level to 5-7 inches as freon is returned to the storage cart.

b. Checking of cleanliness by taking samples.

c. Draining and discarding of remaining freon.

Test Description: (Cont).

Seq. 06: First Flush Fluid Fill (low level)

a. Filling of oxidizer tank to about 5 inches with Freon TF, to float away any residual water in the bottom of the oxid. tank.

Seq. 07: First Flush Fluid Drain

a. Draining oxidizer tank of all Freon.

Seq. 08: Second Flush Fluid Fill

a. Filling of oxidizer tank with Freon TF to float away any remaining water.

Seq. 09: Second Flush Fluid Drain

a. Draining of oxidizer tank level to 5-7 inches as Freon is returned to the storage cart.

b. Checking of cleanliness by taking samples.

c. Draining and discarding of remaining Freon.

Seq. 10: GN_2 Warm-up and Purge

a. Drying of the System

1. Purge the oxidizer and fuel tanks with warm GN_2 for 4 hours at 50 psig.

b. Checking for DPS Dryness

1. Samples from the oxidizer and fuel systems will be checked for Freon and moisture content.

Seq. 11: Simultaneous Purge of Fuel and Oxidizer Systems

a. Sequence 11 will be performed only in the event that the samples taken in Sequence 10 fail. This sequence is essentially a duplicate of Sequence 10 pertaining to both the fuel and oxidizer systems.

Seq. 12: Repurge of Oxidizer System

a. This sequence is performed only in the event that the fuel system samples met specifications and one or both oxidizer samples failed. This sequence is essentially a duplicate of Sequence 10 pertaining to the oxidizer system.

Test Description: (Cont).

Seq. 13: Repurge of Fuel System

a. This sequence is performed only in the event that oxidizer system samples met specifications and one or both fuel samples failed. This sequence is essentially a duplicate of Sequence 10 pertaining to the fuel system.

Seq. 14: System Sampling After 8 Hours

a. Verification that the Freon and/or moisture content does not exceed 200 ppm.

1. Allow system to dwell 8 hours; at the end of 8 hours take new Freon and water samples.

b. If the samples exceed 200 ppm then repeat Sequence 11, 12 and 13 as necessary, then repeat Sequence 14.

Seq. 15: Securing After Test

a. Application of GN_2 blanket pressure of 10-20 psig to fuel and oxidizer tanks through GQ 9440 and GQ 9441. (Paragraph 4.2.2.8.4).

OCP OUTLINE

Test Title:

Low Pressure Descent Engine Interface Leakage Check

Subsystems:

D/S Propulsion

Test Objectives:

a. To establish the leakage integrity of the D/S engine interfaces at low pressure.

b. To leak check all mechanical connections and all new brazes not previously leak checked.

Vehicle Configuration:

Descent Stage

Location:

LM Final Assembly Area

Hazardous Operations:

Pneumatic pressures to 50 psig.

Components Under Test:

D/S Propellant Feed Section Vehicle/Engine Interfaces. Propellant line quick disconnects.

Test Description:

Seq. 01: Call to Stations

Seq. 02: Descent Engine Interface Leak Check. (Para. 4.2.2.8.3.6)

a. Pressurization and venting of the D/S propellant tanks with GHe (3 cycles) to ensure a GHe environment throughout the system.

b. Pressurization of the D/S propellant tanks and engine feed lines to 50 psig GHe.

c. Leak check of the D/S engine interfaces and feed lines using a mass spectrometer leak detector.

d. Leak check of the D/S propellant line quick disconnects using a volumetric leak detection meter (LDM).

e. Leak check of the D/S engine solenoid vent valves using a mass spectrometer leak detector.

f. Venting of GHe from propellant tanks.

Test Description: (Cont).

Seq. 03: GN_2 Blanket Pressure Application

a. Pressurization and venting of the D/S propellant tanks with GN_2 (3 cycles) to clear them of GHe.

b. Pressurization of the propellant tanks to 15 psig with GN_2.

Seq. 04: Securing After Test

OCP OUTLINE

OCP-GF-26022-LM-8

Test Title:

Descent Stage Internal Component Leak Checks

Subsystem:

D/S Propulsion.

Test Objectives:

To establish that the leakage integrity of the D/S propulsion subsystem was not degraded during the Cold Flow Tests, and to establish the pressure integrity of the propellant system.

Vehicle Configuration:

Descent Stage.

Location:

Cold Flow Facility

Hazardous Operations:

Pneumatic pressures up to 1000 psig.

Components Under Test:

Helium regulators, burst disc, check valves, low pressure manifolds and propellant tanks.

Test Descriptions:

Seq. 01: Call to Stations

Seq. 02: Substitute Propellant Fill, Fuel (Para. 4.2.2.8.3.1 (b) (6)).

a. Fill tank with substitute propellant to reduce pneumatic pressure energy stored in tank during Sequence 04.

Seq. 03: Substitute Propellant Fill, Oxidizer (Para. 4.2.2.8.3.1 (b) (6)).

a. Typical to Sequence 02.

Seq. 04: Regulator Creep, and Propellant Burst Discs Leak Tests. Proof pressure tests of the low pressure manifolds and propellant tanks.

Seq. 04-027: Regulator Creep Test (Para. 4.2.2.8.3.3., (e))

a. Application of vacuum on reference ports of primary and secondary regulators.

Test Description: (Cont).

b. Pressurization of high pressure manifold to 950 psig GHe through port GQ 9405 with latching valves open.

c. Closing of primary and secondary latching valves after checking that the regulators have locked up and are maintaining a maximum of 255 psig outlet pressure.

d. Venting of the low pressure manifold through GQ 9425 to 212 psig.

e. Opening of primary solenoid valve.

f. Monitoring of primary regulator creep by observing for a specified period of time the pressure rise in the Regulator Creep Verification Unit.

g. Repetition of above steps for secondary regulator. (Sequence 04-038).

Seq.04-047A: Pressurization of the Low Pressure Manifold to Proof Pressure (Para. 4.2.2.8.3.1 (b))

a. Pressurization of low pressure manifold to 358 to 367 psig GN_2 through part GQ 9425 with the primary and secondary solenoid valves closed.

b. Venting of low pressure manifolds to zero psig.

Seq. 04-062: Fuel and Oxidizer Burst Disc Leak Check (Para. 4.2.2.8.3.3 (g))

a. Pressurization of oxidizer and fuel propellant feed system to regulator lock-up pressure (238 psig/253 psig maximum)

b. Leakage check of the fuel and oxidizer burst discs.

Seq. 04-080: Proof Pressure Test of Fuel and Oxidizer Propellant Tanks.

a. Pressurization of the cavities between the relief valves and the burst discs in the fuel and oxidizer systems to 180 to 200 psig.

b. Pressurization of the oxidizer tank to a proof pressure of 358 to 367 psig.

c. Rapid venting of the oxidizer tank to below 270 psig.

d. Pressurization of the fuel tank to a proof pressure of 358 to 367 psig.

e. Rapid venting of the oxidizer tank to below 270 psig.

f. Venting of propellant system to 8 to 10 psig.

Test Description: (Cont).

Seq. 05: Quad Check Valve Leak Check (Para. 4.2.2.8.3.3 (f))

a. Venting of low pressure manifold upstream of check valves through GQ 9425 to atmosphere.

Seq. 05-005: Leak Check Downstream Check Valves

a. Collection of Helium Leaking Past Check Valve Using the LDM.

Seq. 05-021: Leak Check Upstream Check Valves

a. Collection of helium leaking past check valve using the LDM.

Seq. 05-041: Leak Check Whole Check Valves Assemblies

a. Collection of helium leaking past fuel check valve assembly using the LDM.

b. Repetition of prior steps for oxidizer check valve assembly.

Seq. 06: Substitute Propellant Offloading

a. Pressurization of propellant tanks with GHe through GQ 9442 and GQ 9443 to 50 psig.

b. Offloading of propellants

c. Closing of helium supply.

d. Venting of propellant tanks to 15 psig

OCP OUTLINE

OCP-GF-26040-LM-8

Test Title:

D/S Propulsion System Verification

Subsystem:

D/S Propulsion

Test Objectives:

To verify that the descent stage propulsion system is ready for shipment to Kennedy Space Center by performing functional and pressure integrity tests.

Vehicle Configuration:

Descent Stage

Location:

Cold Flow Facility

Hazardous Operations:

Pneumatic pressures up to 2200 psig.

Components Under Test:

a. Supercritical Helium Tank

b. Helium Explosive Valves

c. Latching Helium Solenoid Valve

d. Helium Regulators

e. Quad Check Valves

f. Compatibility Squib Valves

g. Pressure Relief Valves and Burst Discs

h. Engine Pre-Valves

i. Engine Ball Valves

j. New Brazes

k. Mechanical Fittings

Test Description:

Seq. 01: Call to Stations

Seq. 02: SHe Tank Purge and Sample

Test Description: (Cont).

Seq. 03: SHe Tank Cold Gas Flow, LHe Fill and Cold Soak. (Para. 4.2.2.8.3.3)

a. Loading of the SHe tank with liquid helium, cold soak of the system for 6 hrs. minimum, topping off SHe tank with LHe and pressurization to 80 psig.

Seq. 04: SHe Tank Heat Leak Test (Para. 4.2.2.8.3.3 (b))

a. Monitoring and recording of SHe tank pressure for 24 hours.

Seq. 05: SHe Tank Leak Test, Latching Helium Solenoid Valve Leak Check, and High Pressure Manifold Proof and Leak Check. (Para.4.2.2.8.3.3)

Seq. 06: Helium Regulator Functional Check and Creep Test. (Para. 4.2.2.8.3.3)

a. Check of the regulator by recording inlet and outlet temperature and pressure under flow conditions.

Seq. 07: Proof Pressure and Leak Check of Brazed Bypass Caps, Relief Valve Functional Check, Quad Check Valve Functional and Leakage Check, Engine Ball Valve Leak Check, Pre-Valve Leak Check, and Thermo-Relief Check. (Para. 4.2.2.8.3.3 and 4.2.2.8.3.7)

a. Determination of relief valve cracking and reseat pressure.

b. Internal leak check of relief valves

c. Internal leak check of squib valves

d. External leak check of all new brazes and all mechanical joints from downstream of the compatibility squib valve through the engine interface and including the engine lines.

e. External leak check of all components and fittings between the regulator outlets and the compatibility squibs.

f. Internal leak check of quad check valves.

Seq. 08: Engine Ball Valve Leakage Check Using GN_2. (Para. 4.2.2.8.3.7)

a. Leak check of fuel ball valves, oxidizer ball valves and engine pre-valves.

Seq. 09: Quad Check Valve Low Pressure Leakage Test on Factory Floor Only (Para. 4.2.2.8.3.6)

Seq. 10: Pressure Purge D/S Propulsion and SHe Tank Blanket Pressure (GN_2) Reapplication. (Para. 4.2.2.8.4)

Seq. 11: Securing After Test

OCP OUTLINE

OCP-GF-26041-LM-8

Test Title:

D/S Propulsion S/S Proof Pressure H/P Manifold Helium Leak Check, SHe Tank Heat Leak Test, and Mission Simulation Run.

Subsystem:

D/S Propulsion

Test Objectives:

a. Establishment of structural integrity at proof pressure level of the following:

1. He start tank with associated lines.
2. High pressure manifold.
3. SHe tank (at modified proof pressure level)

b. Establishment of leakage integrity at operational pressure level of the following:

1. High pressure manifold.
2. SHe tank.

c. Verification of heat leak characteristics of the SHe tank.

d. Performance of a mission simulation run.

Vehicle Configuration:

Descent Stage

Location:

Cold Flow Facility

Hazardous Operations:

Seq. 06: Pressurization of the high pressure manifold, 2174 to 2274 psig; pressurization of SHe tank, 1880 to 1925 psig.

Seq. 12: Pressurization of ambient He start tank to 2274 psig.

Seq. 13: Pressurization of propellant tanks to 240 psig.

Components Under Test:

Plumbing connections, SHe and He tanks with associated lines.

Test Descriptions:

Seq. 01: Call to Stations

Seq. 02: SHe Tank Purge and Sample

Test Descriptions: (Cont).

Verification that the SHe tank is filled with sufficiently pure helium.

Seq. 03: SHe Tank Cold Gas Flow and LHe Fill

a. Cooling of the SHe tank followed by filling with LHe.

Seq. 04: SHe Tank Stabilization

a. Monitoring of pressure in SHe tank for 2-3 hours.

Seq. 05: Safety Precautions for Emergency SHe Tank Venting (LDG 563-26041-9)

a. Verification of hook-up per Fig. 1-9 with exception of line 05 to GQ9405.

Seq. 06: High Pressure Manifold Proof and Leak Test. SHe Tank Modified Proof and Leak Test, and Latching Valve Leak Test.

a. Pressurization of the line that connects to GQ9405.

b. Proof pressurization of high pressure manifold. (Para. 4.2.2.8.3.1 (b) (2).)

c. Pressurization of SHe. tank to modified proof pressure (Para.4.2.2.8.3.1 (b) (1)).

d. Leak check of secondary (downstream) SHe burst disc, leak check of the burst disc cavity and all brazed joints. (Para.4.2.2.8.3.3 (c) (3)).

e. Leak check of primary (upstream) burst disc. (Para.4.2.2.8.3.3 (b) (4)).

f. Leak check of all brazes and mechanical joints in the SHe tank and high pressure manifold down to the regulator inlets. This is a dry leak test.

g. Leak check of GQ9401 and GQ9407 for 10 minutes after first bubble with caps off, followed by a leak check after one hour with the caps on.

h. Internal leak check of primary and secondary shutoff valves.

Seq. 07: LHe Fill and Cold Soak

a. Filling of the SHe tank with LHe followed by a cold soaking for six (6) hours.

Seq. 08: SHe Tank LHe Refill and SHe Pressurization

a. Filling of the SHe tank (topped off) with LHe and pressurizing it to a supercritical state with additional helium.

Seq. 09: SHe Tank Heat Leak Test

Test Descriptions: (Cont).

a. Monitoring of the SHe tank for the pressure rise due to external heat inputs to the tank.

Seq. 10: Substitute Propellant Fill (fuel side)

a. Filling of fuel tanks with freon.

Seq. 11: Substitute Propellant Fill (Oxidizer Side)

a. Filling of oxid tanks with Freon.

Seq. 12: Ambient He Start Tank Proof and Leak Test

a. Leak check of all brazes and mechanical joints per Figure C-2 of Supplement 2. This is a dry leak check of ambient helium start tank.

Seq. 13: Mission Simulation Profile Run

a. Performance of the SHe Mission Simulation Run duplicating the LM mission duty cycle program. The SHe primary burst disc is then leak checked. Observation of helium quantity leaking past SHe primary burst disc. (Para. 4.2.2.8.3.3 (g) (2)).

Seq. 14: Securing After Test

a. Venting of the SHe tank, the prop. tank ullage and warming the SHe tank to ambient condition.

Seq. 15: Substitute Fuel Propellant Off Loading

a. Draining of the Freon from the fuel tanks to prepare for a re-filling with water for orificing runs.

Seq. 16: SHe Tank Venting (to be done only if required)

a. Venting of the SHe tank until it stabilizes at 60 to 100 psig.

Seq. 17: Securing SHe tank (to be done only if required)

a. Venting of facility pressure to zero.

Seq. 18: Securing After Test

OCP OUTLINE

OCP-GF-26043-LM8

Test Title:

Descent Stage Propulsion Electrical and Fluid Check

Subsystems:

Descent Stage Propulsion.

Test Objectives:

a. Verification of facility compatibility with parts of the descent stage wiring harnesses, at the interstage connectors.

b. Verification of responses of electrically operated fluid control and monitoring devices in the descent stage propulsion subsystem to known stimuli, and identification of sensor output channels at the interstage connectors.

c. Verification that performance of pneumatically operated components located between the helium pressure regulators and the descent stage engine interface is within the limits stipulated in the Master End Item Specification.

d. Establishment of a confidence level for subsequent pressurization of the low pressure lines, tanks, and other components in the descent stage propulsion subsystem.

e. Verification that leak rates of all lines, vessels, and components located between the helium pressure regulators and the descent stage engine interface are within the limits stipulated in the Master End Item Specification.

Vehicle Configuration:

Descent Stage

Location:

Cold Flow Facility

Hazardous Conditions:

a. Helium high pressure manifold up to 875 psig.

b. Helium low pressure manifold up to 350 psig.

c. Propellant tanks up to 275 psig.

Equipment Under Test:

a. Pressure transducers and wiring harness associated with low pressure helium manifold, and the propellant tanks and propellant feed section.

Equipment Under Test: (Cont).

b. Temperature transducers and wiring harness associated with the propellant tanks.

c. Propellant tanks.

d. Propellant feed section.

e. Low pressure helium lines.

f. Lunar dump explosive valves.

g. Lunar dump latching solenoid valves.

h. Helium latching solenoid valves.

i. Burst disc/relief valve assemblies.

Test Description:

Seq. 001: Call to Stations

Seq. 002: Solenoid Latching Valve Channel Identification and Lunar Dump Valve Test Line Proof/Leak Check. (Paragraphs 4.2.2.8.3 and 4.2.2.12.3.)

a. Application of regulated blanket pressure upstream of lunar dump valves. Cycling of the following valves for verification of mechanical actuation and proper electrical response:

1.	Fuel Vent Solenoid Valve Open	GQ3500X
2.	Oxidizer Vent Solenoid Valve Open	GQ4000X
3.	Helium Primary Solenoid Valve Closed	GQ3309X
4.	Helium Secondary Solenoid Valve Open	GQ3310X

b. Pressurization of Lunar Dump Valve test lines to proof pressure of approximately 350 psig.

c. Venting of pressure in Lunar Dump Valve test lines to approximately 240 psig.

d. Performance of Lunar Dump Valve internal leak checks.

e. Venting of pressure in Lunar Dump Valve test lines to approximately 200 psig.

f. External leak checking of Lunar Dump Valve test lines.

g. Internal leak checking of test ports GQ9448 and GQ9449.

h. Venting of pressure in Lunar Dump Valve test lines to zero psig.

Test Description: (Cont).

Seq. 003: Propellant Tank Temperature Transducer Partial Channel Identification. (Paragraph 4.2.2.12.3.1)

a. Comparison of expected indications with electrical outputs of the following transducers (at test cell ambient temperature):

1. Temperature, No. 1 Fuel Tank Bulk GQ3718T

2. Temperature, No. 2 Fuel Tank Bulk GQ3719T

3. Temperature, No. 1 Oxidizer Tank Bulk GQ4218T

4. Temperature, No. 2 Oxidizer Tank Bulk GQ4219T

b. Sequential application of stimulus and verification of increased outputs of above transducers.

Seq. 004: Pressure Transducer Partial Channel Identification (paragraph 4.2.2.12.3.1)

a. Comparison of expected indications with electrical outputs of the following transducers (with pad pressure applied).

1. Pressure, No. 1 Fuel Tank Ullage GQ3501P

2. Pressure, Engine Interface, Fuel GQ3611P

3. Pressure, No. 1 Oxidizer Tank Ullage GQ4001P

4. Pressure, Engine Interface, Oxidizer GQ4111P

5. Pressure, He Reg Outlet Manifold GQ3018P

6. Pressure, He Reg Outlet Manifold, Redundant GQ3025P

b. Sequential removal of power to above pressure transducers and verification of appropriate channel output loss.

Seq. 005: Descent Stage Regulated Pressure/Propellant Tanks/Propellant Feed Section Electrical Validation, Component Structural Integrity Test and Dry Leak Check. (Paragraphs 4.2.2.12.3, 4.2.2.12.3.1, 4.2.2.8.3)

a. Venting of pad pressure from low pressure helium manifold, propellant tanks, and feed sections to ambient pressure.

b. Comparison of expected indications with electrical responses of the following transducers (at ambient pressure).

1. Pressure, He Regulator Outlet Manifold GQ3018P

Test Description: (Cont).

2. Pressure, He Regulator Outlet Manifold, Redundant GQ3025P

3. Pressure, No. 1 Fuel Tank Ullage GQ3501P

4. Pressure, Engine Interface Fuel GQ3611P

5. Pressure, No. 1 Oxidizer Tank Ullage GQ4001P

6. Pressure, Engine Interface Oxidizer GQ4111P

c. Pressurization of the fuel/oxidizer tanks and feed sections to approximately 55 psig through ports GQ9442 and GQ9443; comparison of outputs of transducers in (b) to expected indications.

d. Repeat of (c) at pressures of 125 and 205 psig.

e. Pressurization of the fuel and oxidizer burst disc/relief valve cavities to approximately 100 psig through ports GQ9444 and GQ9445; verification of the proper seating and opening of relief vent valves.

f. Disablement of the helium secondary regulator by closing the helium secondary solenoid valve and opening the helium primary solenoid valve; pressurization of the helium high pressure manifold to approximately 100 psig through port GQ9404; comparison of the following transducer outputs to expected indications:

1. Press He Reg Outlet Manifold GQ3018P

2. Press He Reg Outlet Manifold, Redundant GQ3025P

g. Pressurization of the helium high pressure manifold to approximately 520 psig through port GQ9404 and the low pressure manifold to primary helium regulator lockup pressure; comparison of the following transducer outputs to expected indications:

1. Press He Reg Outlet Manifold GQ3018P

2. Press He Reg Outlet Manifold, Redundant GQ3025P

h. Venting of helium high pressure and low pressure manifolds to approximately 225 psig through port GQ9425.

i. Disablement of the helium primary regulator by closing the helium primary solenoid valve and opening the helium secondary solenoid valve; repressurization of the helium high pressure manifold to approximately 520 psig through port GQ 9404 and the low pressure manifold to secondary helium regulator lockup pressure.

Test Description: (Cont).

j. Prevention of gas back-flow through helium primary regulator in subsequent pressurization by opening the helium primary solenoid valve; pressurization of low pressure manifold to proof pressure of approximately 350 psig through port GQ9425.

k. Venting of pressure in high and low pressure manifolds to approximately 200 psig using ports GQ9440 and GQ9441.

l. Disablement of both helium regulators, by closing helium primary and secondary solenoid valves, to prevent possibility of excessive regulator back flow during leak check; performing of helium external leak check of the low pressure manifold between regulator outlets and compatibility valve inlets.

m. Internal leak checking of flight half quick disconnects listed below, using liquid displacement meter:

1. GQ9440
2. GQ9441
3. GQ9430
4. GQ9431
5. GQ9432
6. GQ9433
7. GQ9425

n. Opening of helium primary solenoid valve and venting of the high and low pressure manifolds to ambient through ports GQ9440 and GQ9441 to permit subsequent leak checking; performing of internal leak checks of fuel and oxidizer quad check valves by back pressurizing to 10 psig and sensing leak rate at an upstream port.

o. With approximately 200 psig in the fuel and oxidizer tanks, proceed with verification of fuel and oxidizer relief valve cracking pressures by pressurizing to above 260 psig and venting to approximately 254 psig through the ports listed below.

1. GQ9444 (oxidizer relief valve).
2. GQ9445 (fuel relief valve).

Test Description: (Cont).

p. Venting of pressure in propellant burst disc/relief valve cavities to approximately 200 psig through ports GQ9444 and GQ9445 and performing of following tests.

1. Internal leakage of ports GQ9444 and GQ9445.

2. External leakage of burst disc/relief valve lines.

q. Pressurizing of propellant burst disc/relief valve cavities to approximately 250 psig through ports GQ9444 and GQ9445; performing of internal leak checks of relief valve poppets.

r. Pressurization of oxidizer tanks to approximately 270 psig through port GQ9442; comparison of expected indications with electrical outputs of the following transducers:

1. Pressure, No. 1 Oxidizer Tank Ullage	GQ4001P
2. Pressure, Engine Interface, Oxidizer	GQ4111P

s. Rapid venting of oxidizer ullage pressure to approximately 235 psig through port GQ9452.

t. Venting of pressure from oxidizer burst disc/relief valve cavity to zero psig through port GQ9444; performing of internal leak checks of the following components:

1. Oxidizer burst disc.

2. Oxidizer lunar dump explosive valve.

u. Venting of pressure between the oxidizer check valve and oxidizer compatibility explosive valve to zero psig through port GQ9440; performance of internal leak check of oxidizer compatibility explosive valve.

v. Pressurization of fuel tanks to approximately 270 psig through port GQ9443; comparison of expected indications with electrical outputs of the following transudcers:

1. Pressure, No. 1 Fuel Tank Ullage	GQ3501P
2. Pressure, Engine Interface, Fuel	GQ3611P

w. Rapid venting of fuel ullage pressure to approximately 235 psig through port GQ9453.

Test Description: (Cont).

x. Venting of pressure from fuel burst disc/relief valve cavity to zero psig through port GQ9445; performing of internal leak checks of the following components:

1. Fuel burst disc.

2. Fuel lunar dump explosive valve.

y. Venting of pressure between the fuel check valve and fuel compatibility explosive valve to zero psig through port GQ9441; performance of internal leak check of fuel compatibility explosive valve.

Seq. 006: Descent Stage Regulated Pressure Component and Propellant Feed Section Dry Leak Check. (Paragraph 4.2.2.8.3)

a. Pressurization of the helium high pressure manifold to approximately 875 psig through port GQ9404; performance of primary/secondary solenoid latching valve internal leak check using port GQ9425.

b. Extablishment of approximately 15 psig pad pressure between helium latching solenoid valve outlets and propellant compatibility explosive valve inlets, using port GQ9425.

c. Establishment of approximately 30 psig pad pressure between supercritical helium explosive valve outlet and helium solenoid latching valve inlets, using port GQ9404.

d. External leak checking of propellant feed section from propellant compatibility explosive valves to engine interface, using helium leak detector at 235 psig.

e. Internal leak checking of primary and secondary seals of the fuel and oxidizer trim orifice flange assemblies, using liquid displacement meter.

f. Internal leak checking of the vehicle ports listed below, using liquid displacement meter:

1. GQ9452

2. GQ9453

3. GQ9456

4. GQ9457

5. GQ9463

6. GQ9464

Test Description: (Cont).

g. g. External leak checking of the propellant tank diffuser covers, using the helium leak detector.

h. Internal leak checking of the vehicle ports listed below, using liquid displacement meter:

1. GQ9442
2. GQ9443

i. Venting of pressure in the propellant feed section to a pad of approximately 15 psig.

Seq. 007: Propulsion Transducer Blanket Pressure Confidence Check (Paragraph 4.2.2.12.3)

a. Comparison of expected indications with electrical outputs of the following pressure transducers:

1.	Pressure, Helium Regulator Outlet Manifold	GQ3018P
2.	Pressure, Helium Regulator Outlet Manifold, Redundant	GQ3025P
3.	Pressure, No. 1 Fuel Tank Ullage	GQ3501P
4.	Pressure, Engine Interface, Fuel	GQ3611P
5.	Pressure, No. 1 Oxidizer Tank Ullage	GQ4001P
6.	Pressure, Engine Interface, Oxidizer	GQ4111P

Seq. 008: Leak Check of Engine Bleed Lines (Para. 4.2.2.8.3)

a. External helium leak checking of the lines listed below at approximately 220 psig, using the helium leak detector:

1. Oxidizer low point drain line
2. Oxidizer high point drain line
3. Fuel low point drain line
4. Fuel high point drain line
5. Pre-valve test shut-off valve line

b. Internal helium leak checking at the ports listed below at approximately 220 psig, using the liquid displacement meter:

1. GQ9457
2. GQ9476
3. GQ9477
4. GQ9478
5. GQ9479

Test Title:

Ascent Stage Substitute Propellant Cold Flow Test.

Subsystem:

Ascent Stage Propulsion.

Test Objectives:

a. To hydraulically balance the ascent stage propellant feed system.

b. To demonstrate the performance characteristics of the pressurization and propellant feed system with the four pressure regulators operating individually and in combination.

c. To demonstrate the performance characteristics of the pressure regulators under decaying inlet pressure and low temperature conditions, and to demonstrate the performance characteristics of the solenoid latching valves at low temperature.

d. To verify that internal leakage across relief valve ass'y burst discs are within acceptable limits.

e. To verify that propellant tank low level sensors are operational.

Vehicle Configuration:

Ascent Stage.

Location:

Cold Flow Facility.

Hazardous Operations:

Pneumatic pressures up to 3500 psig.

Components Under Test:

Set of matched orifices in the fuel and oxidizer feed lines.
Pressure reducers (regulators).
Solenoid latching valves.
Propellant tank relief valve burst disc assy's.
Propellant tank low level sensors.

Test Description:

(Para. 4.2.2.8.2.4.)

Seq. 01: Call to Stations.

Seq. 02: Substitute Propellant Fill, Fuel.

a. Filling of fuel tank with substitute propellant (water) to reduce pneumatic energy stored in tank.

Seq. 03: Substitute Propellant Fill, Oxidizer.

a. Filling of oxidizer tank with substitute propellant (freon) to reduce pneumatic energy stored in tank.

Test Description: (Cont).

Seq. 04: Helium Pressurization Preparation.

a. Seq. 04-002: Check of helium storage to ascertain that it is at 4500 psig minimum.

b. Seq. 04-004: Setting of pneumatic control station into start-safe condition.

c. Seq. 04-005: Setting of ascent stage control station into 'GO' condition.

Seq. 05: Preparation of Instrumentation Module.

a. Seq. 05-002: Application of vacuum to reference port of one helium regulator.

b. Seq. 05-006: Isolation of instrumentation module from vehicle.

c. Seq. 05-012: Purge of instrumentation module of fluid.

d. Seq. 05-015: Recording of ambient and pressurized zero readings of the delta P transducers on instrumentation module.

e. Seq. 05-031: Bleeding of the fluid lines after opening of the instrumentation module to vehicle propellants.

f. Seq. 05-045: Recording of ambient bled-in zeros with instrumentation module in 'isolate mode' and 'test mode'.

g. Seq. 05-047: Recording of fluid level in propellant tanks.

Seq. 06: Test Operation (Flowmeter Calibration).

a. Seq. 06-002: Setting of fuel and oxidizer Weigh-Tank Calibration Units (WTCU) to receive substitute propellants flowing through the propulsion system.

b. Seq. 06-005: Verification of facility valves configuration to route substitute propellants to WTCU's.

c. Seq. 06-011: Pressurization of ullage in propellant tanks.

d. Seq. 06-014: Recording of pre-run pressurized bled-in zeros with instrumentation module in 'test mode' and 'isolate mode'.

e. Seq. 06-026: Flow of substitute propellants through Engine Simulator Unit (ESU) to WTCU's as follows:

1. Turn on of all instrumentation recorders.

2. Start of flow.

Test Description: (Cont).

3. Adjustment of flow to 33 GPM.

4. Set of instrumentation module in 'test mode'.

5. When fuel WTCU collected 2000 lbs of fuel approximately, set of instrumentation module to 'isolate mode' and termination of flow.

f. Seq. 06-028: Recording of post-run pressurized bled-in zeros with instrumentation module in 'test mode' and 'isolate mode'.

Seq. 07: Vent and Pressurization of Propellant Section.

a. Seq. 07-002: Closing of 'He Pri Shutoff' and 'He Sec Shutoff' valves.

b. Seq. 07-003: Venting of cell pressurization system to ambient.

c. Seq. 07-006: Depressurization of propellant tanks to 10-20 psig.

d. Seq. 07-009: Isolation of instrumentation module from vehicle.

e. Seq. 07-013: Purge of instrumentation module of fluid.

f. Seq. 07-018: Recording of ambient zero readings of the delta P transducers on instrumentation module.

g. Seq. 07-028: Recording of fluid level in the propellant tanks.

h. Seq. 07-031: Turn-off of all instrumentation recorders.

Seq. 08: Post Run Operations.

a. Seq. 08-003: Recording of post run weight pressure and fluid level of the WTCU's.

b. Seq. 08-005: Configuration of the WTCU's and facility valves to enable the return of the substitute propellants to the storage carts.

c. Seq. 08-008: Return of the substitute propellants from WTCU's to the fuel and oxidizer storage carts.

Seq. 09: Substitute Propellant Fill, Fuel.

Typical to Sequence 02.

Seq. 10: Substitute Propellant Fill, Oxidizer.

Typical to Sequence 03.

Test Description: (Cont).

Seq. 11: Helium Pressurization Preparation.

Typical to Sequence 04.

Seq. 12: Preparation of Instrumentation Module.

Typical to Sequence 05.

Seq. 13: Test Operations (Propellant Utilization).

a. Seq. 13-002: Configuration of the facility valves to route substitute propellants from vehicle to the fuel and oxidizer storage carts.

b. Seq. 13-007: Pressurization of the ullage of the propellant tanks.

c. Seq. 13-011: Recording of pre-run pressurized bled-in zeros with instrumentation module in 'test mode' and 'isolate mode'.

d. Seq. 13-015: Flowing of substitute propellants from vehicle through ESU to the fuel and oxidizer storage carts as follows:

1. Turn on of all instrumentation recorders.
2. Start of flow.
3. Adjustment of flow to 33 GPM.
4. Setting of instrumentation module in 'test mode'.
5. 120 seconds from initiation of flow, setting of instrumentation module in 'isolate mode' and termination of flow.

e. Seq. 13-016: Recording of post run pressurized bled-in zeros with instrumentation module in 'test mode' and 'isolate mode'.

f. Seq. 13-021: Isolation of vehicle from pressurization system.

g. Seq. 13-023: Partial depressurization of vehicle.

h. Seq. 13-025: Switch of vacuum to the reference port of an alternate helium regulator.

i. Seq. 13-028: Repressurization of ullage of propellant tanks.

j. Repeat of steps (c), (d), and (e).

k. Repeat of steps (f) through (j).

Seq. 14: Vent and Pressurization of Propellant Section.

Typical to Sequence 07.

Seq. 15: Substitute Propellant Fill, Fuel.

Typical to Sequence 02.

Test Description: (Cont).

Seq. 16: Substitute Propellant Fill, Oxidizer.

Typical to Sequence 03.

Seq. 17: Helium Pressurization Preparation.

Typical to Sequence 04.

Seq. 18: Preparation of Instrumentation Module.

Typical to Sequence 05.

Seq. 19: Test Operations (Propellant Utilization).

Typical to Sequence 13.

Seq. 20: Vent and Pressurization of Propellant Section.

Typical to Sequence 07.

Seq. 21: Substitute Propellant Fill, Fuel.

Typical to Sequence 02.

Seq. 22: Substitute Propellant Fill, Oxidizer.

Typical to Sequence 03.

Seq. 23: Helium Pressurization Preparation.

Typical to Sequence 04.

Seq. 24: Preparation of Instrumentation Module.

Typical to Sequence 05.

Seq. 25: Test Operations (Propellant Utilization).

Typical to Sequence 13.

Seq. 26: Vent and Pressurization of Propellant Section.

Typical to Sequence 07.

Seq. 27: Substitute Propellant Fill, Fuel.

Typical to Sequence 02.

Seq. 28: Substitute Propellant Fill, Oxidizer.

Typical to Sequence 03.

Test Description: (Cont).

Seq. 29: Helium Pressurization Preparation.

Typical to Sequence 04.

Seq. 30: Preparation of Instrumentation Module.

Typical to Sequence 05.

Seq. 31: Test Operations (Propellant Utilization).

Typical to Sequence 13.

Seq. 32: Vent and Pressurization of Propellant Section.

Typical to Sequence 07.

Seq. 33: Substitute Propellant Fill, Fuel.

Typical to Sequence 02.

Seq. 34: Substitute Propellant Fill, Oxidizer.

Typical to Sequence 03.

Seq. 35: Helium Pressurization Preparation.

a. Sequence 35-002: Assure helium storage is at 4500 psig minimum.

b. Seq. 35-004: Set of pneumatic control station to start-safe condition.

c. Seq. 35-005: Set of ascent stage control station to 'GO' condition.

d. Seq. 35-006: Interconnection of one helium tank with the high pressure manifold and the pressurization system.

Seq. 36: Preparation of Instrumentation Module.

Typical to Sequence 05.

Seq. 37: Test Operations (Blowdown).

a. Seq. 37-002: Verification that facility valves are configured to route substitute propellants from vehicle to the fuel and oxidizer storage carts.

b. Seq. 37-007: Pressurization of ullage of the propellant tanks and one helium tank to regulator lockup pressure (203 psia maximum).

Test Description: (Cont).

c. Seq. 37-008: Isolation of vehicle from facility pressurization system.

d. Seq. 37-010: Opening of 'He Pri Shutoff' and 'He Sec Shutoff' valves.

e. Seq. 37-014: Recording of pre-run pressurized bled-in zeros with instrumentation module in 'test mode' and 'isolation mode'.

f. Seq. 37-018: Flow of substitute propellants from vehicle through ESU to the fuel and oxidizer storage carts as follows:

1. Turn on of all instrumentation recorders.
2. Start of flow.
3. Adjusting of flow to 34.5 GPM.
4. Set of instrumentation module into 'test mode'.
5. 360 to 390 seconds from initiation of flow set of instrumentation module into 'isolate mode' and termination of flow by closing of 'He Pri Shutoff' and 'He Sec Shutoff' valves, followed by switching of 'Fuel Shutoff' and 'Oxid Shutoff' to 'ALL CLOSED' position.

g. Seq. 37-019: Recording of post-run pressurized bled-in zeros with instrumentalization module in 'test mode' and 'isolate mode'.

Seq. 38: Vent and Pressurization of Propellant Section and Helium Tank.

a. Seq. 38-003: Verification that 'He Pri Shutoff' and 'He Sec Shutoff' valves are closed.

b. Seq. 38-004: Depressurization of helium tank to 10-30 psig.

c. Seq. 38-006: Depressurization of propellant tanks to 10-20 psig.

d. Seq. 38-010: Isolation of instrumentation module from vehicle.

e. Seq. 38-012: Purge of instrumentation module to fluid.

f. Seq. 38-018: Recording of ambient zero readings of the delta P Transducers on instrumentation module.

g. Seq. 38-024: Recording of fluid level in the propellant tanks.

h. Seq. 38-026: Verification that pressurized zero is shifted less than 1% from ambient zero.

i. Seq. 38-031: Turn off of all instrumentation recorders.

Seq. 39: Low Level Sensor Check

Test Title:

Ascent Stage Propellant Feed Section - Dry and Sample

Subsystem:

A/S Propulsion

Test Objective:

Verification of Dryness in the APS at the Conclusion of Cold Flow Testing.

Vehicle Configuration:

Ascent Stage

Location:

Cold Flow Facility

Hazardous Operations:

Hazardous sequence, pneumatic pressure to 50 psig.

Components Under Test:

Propellant tanks and lines

Test Description:

Seq. 01: Call to Stations

Seq. 02: First Flush Fluid Fill (low level)

a. Filling of fuel tank to about 5 inches with Freon TF, to float away any water in the bottom of the fuel tank.

Seq. 03: First Flush Fluid Drain

a. Draining fuel tank of all Freon.

Seq. 04: Second Flush Fluid Fill.

a. Filling of fuel tank with Freon TF to float away any remaining water.

Seq. 05: Second Flush Fluid Drain

a. Draining of fuel tank level to 5-7 inches as Freon is returned to the storage cart.

b. Checking of cleanliness by taking samples.

c. Draining and discarding of remaining Freon.

Test Description: (Cont).

Seq. 06: GN_2 Warm Up and Purge

a. Drying of the system:

1. Purge the oxid and fuel tanks with warm GN_2 for a minimum of 4 hours at 50 psig.

b. Checking for APS Dryness after a 15 minute dwell:

1. Samples from the oxidizer and fuel systems will be checked for Freon and moisture content.

Seq. 07: Simultaneous Purge of Fuel and Oxidizer Systems

a. Sequence 07 will be performed only in the event that the samples taken in Sequence 06 fail. This sequence is essentially a duplicate of Sequence 06 pertaining to both the fuel and oxidizer systems.

Seq. 08: Repurge of Oxidizer System

a. This sequence is performed only in the event that the fuel system samples met specifications and one or both oxidizer samples failed. This sequence is essentially a duplicate of Sequence 06 pertaining to the oxidizer system.

Seq. 09: Repurge of Fuel System

a. This sequence is performed only in the event that oxidizer system samples met specifications and one or both fuel samples failed. This sequence is essentially a duplicate of Sequence 06 pertaining to the fuel system.

Seq. 10: System Sampling After 8 Hours

a. Verification that the Freon and/or moisture content does not exceed 200 ppm.

1. Allow system to dwell 8 hours. At the end of 8 hours take new Freon and water samples.

b. If the samples exceed 200 ppm then repeat Sequence 07, 08, or 09 as necessary, then repeat sequence 10.

Seq. 11: Securing After Test

a. Application of GN_2 blanket pressure of 10-20 psig to fuel and oxidizer tanks through GP9440 and GP9441. (Para. 4.2.2.8.4)

OCP OUTLINE

OCP-GF-27012-LM-8

Test Title:

Low Pressure Ascent Engine Interface Leakage Check.

Subsystem:

Ascent Stage Propulsion.

Test Objectives:

To establish the leakage integrity of the ascent stage engine interfaces at low pressure.

Vehicle Configuration:

Ascent stage.

Location:

LM Final Assembly Area.

Hazardous Operations:

Pneumatic pressures up to 50 psig.

Components Under Test:

A/S propellant feed section vehicle/engine interfaces. Propellant line quick disconnects.

Test Description:

Seq. 01: Call to Stations.

Seq. 02: Ascent Engine Interface Leak Check of Oxidizer Propellant Lines.

a. Pressurization of the oxidizer propellant feed section with GHe to 50 psig.

b. Seq. 02-014: Leak check of all new braze joints and mechanical connections in the oxidizer propellant feed section. (Para. 4.2.2.8.2.5).

Seq. 03: Ascent Engine Interface Leak Check of Fuel Propellant Lines.

a. Pressurization of the fuel propellant feed section with GHe to 50 psig.

b. Seq. 03-017: Leak check of all new braze joints and mechanical connections in the fuel propellant feed section. (Para. 4.2.2.8.2.5).

c. Seq. 03-047: Leak check of all new braze joints and mechanical connections in the overboard vent lines. (Para. 4.2.2.8.2.5).

Seq. 04: Securing After Test.

Test Title:

Ascent Stage Propulsion Internal Component Leak Checks

Subsystem:

Assent Stage Propulsion

Test Objectives:

a. Verification that internal leakage across Solenoid Valves & Check Valves are within allowable limits.

b. Verification that Helium Regulators Lock-up and Creep are within allowable limits.

Vehicle Configuration:

Ascent Stage

Location:

Cold Flow Facility

Hazardous Operations:

Pneumatic Pressures up to 3500 psig.

Components Under Test:

Helium Solenoid Latching Valve.
Helium Regulators
Quad Check Valves

Test Description:

Seq. 01: Call to Stations

Seq. 02: Helium Solenoid Latching Valve Leak Check-

a. Leak Check of Primary and Secondary Solenoid Latching Valves.

1. Seq. 02-006: Pressurization of high pressure manifold with GHe to 3500 $^{+0}_{-100}$ psig.

2. Seq. 02-010: Leak check of primary and secondary solenoid latching valves (Para. 4.2.2.8.2.3 (b))

Seq. 03: Regulator Creep Test (Para. 4.2.2.8.2.3 (b)).

a. Regulator Creep Test, Class 1 Secondary.

Test Description: (Cont).

1. Pressurization of propellant tanks with GHe.

2. Pressurization of high pressure manifold with GHe.

3. GHe flow through regulator, then lock-up.

4. Sequence 03-021: Creep Test of Class I Secondary Regulator.

b. Regulator Creep Test, Class 1 Primary.

1. GHe flow through regulator, then lock up.

2. Sequence 03-031: Creep test of Class I primary regulator.

c. Regulator Creep Test, Class 2 Secondary.

1. GHe flow through regulator, then lock up.

2. Sequence 03-043: Creep test of Class II secondary regulator.

d. Regulator Creep Test, Class 2 Primary.

1. GHe flow through regulator, then lock up.

2. Sequence 03-055: Creep test of Class II primary regulator.

Seq. 04: Quad Check Valve Low Pressure Internal Leak Check (Para. 4.2.2.8.2.3 (e))

a. Leak check of downstream fuel and oxidizer check valves.

1. Venting of low pressure manifold.

2. Leak check of downstream fuel quad check valves.

3. Leak check of downstream oxidizer quad check valves.

b. Leak check of upstream oxidizer and fuel check valves and total oxidizer and fuel check valve assemblies.

1. Pressurization of downstream side of upstream check valves to 8-10 psig.

2. Leak check of upstream oxidizer quad check valves.

3. Leak check of upstream fuel quad check valve.

4. Leak check of total fuel quad check valve assembly.

5. Leak check of total oxidizer quad check valve assembly.

Test Description: (Cont)

c. Securing After Test

1. Removal of He low pressure line (fuel)

2. Removal of He low pressure line (oxid)

3. Shutdown of LDW 430-62180 unit.

OCP OUTLINE

OCP-GF-27020-LM8

Test Title:

Ascent Engine Functional and Gaseous Blowdown Check.

Subsystem:

Ascent Stage Propulsion.

Test Objectives:

Verification of the Functional Operation and Pressure Integrity of the Ascent Stage Engine.

Vehicle Configuration:

Ascent Stage.

Location:

LM Final Assembly Area.

Hazardous Operations:

Pneumatic pressures up to 190 psig.
Gaseous blowdown of the feed section and engine.

Components Under Test:

Engine solenoid valves.
Engine pre-valves.
Engine fuel actuators.
Engine isolation and bi-propellant valves.
Thrust chamber pressure transducer.
Fuel pressure transducer, isolation valve inlet.
Oxidizer pressure transducer, isolation valve inlet.
Isolation/bi-propellant valve mismatch.

Test Description:

Seq. 01: Call to Stations.

Seq. 02: Support System and Vehicle Status Verification.

a. Functional verification of ACE, heat transport section, electrical power section and instrumentation.

Seq. 03: Engine Solenoid Valve Leakage Check and Pre-Valve Thermal Relief Check.

a. Leak check of the four engine solenoid valves.

1. Pressurization of the fuel line between the pre-valves and the engines solenoid valves with GN_2 to 190 psig.

Test Description: (Cont)

2. Seq. 03-010: Leak check of the isolation solenoid valve 'A'. (Paragraph 4.2.2.8.2.6 (d)).

3. Seq. 03-014: Leak check of the bi-propellant solenoid valve 'A'. (Paragraph 4.2.2.8.2.6 (d)).

4. Seq. 03-018: Leak check of the isolation solenoid valve 'B'. (Paragraph 4.2.2.8.2.6 (d)).

5. Seq. 03-021: Leak check of the bi-propellant solenoid valve 'B'. (Paragraph 4.2.2.8.2.6 (d)).

b. Prevalve thermal relief check.

1. Seq. 03-026: Pressurization of the fuel line with GN_2 until the prevalve relieve. (Paragraph 4.2.2.8.2.6 (c)).

Seq. 04: Engine Fuel Actuator Functional Checks.

a. Determination of the start-to-open and full-open pressures required to activate the isolation and propellant valves and verification of the operation of the valve position indication switches. (Paragraph 4.2.2.8.2.5 (e)).

Seq. 05: Engine Prevalve and Engine Solenoid Valves Functional Checkout.

a. Activation of the prevalves and engine solenoid valves from the LM cabin controls.

1. Seq. 05-010: Operation of the valves from the LM cabin controls. (Paragraph 4.2.2.8.2.5 (e)).

Seq. 06: Prevalve Leak Test and Gaseous Blowdown.

a. Leak test of the prevalves.

1. Pressurization of the propellant tanks with GN_2.

2. Seq. 06-008: Leak check of the prevalves. (Paragraph 4.2.2.8.2.6 (d)).

b. Gaseous blowdown through leg 'B' of the propellant feed section.

1. Seq. 06-015: Gaseous blowdown through leg 'B' of the propellant feed system. (Paragraph 4.2.2.8.2.5 (d)).

c. Gaseous blowdown through leg 'A' of the propellant feed section.

1. Pressurization of the propellant tanks with GN_2.

2. Seq. 06-029: Gaseous blowdown through leg 'A' of the propellant feed system. (Paragraph 4.2.2.8.2.5 (d)).

Test Description: (Cont)

Seq. 07: Ascent Engine Ball Valve and Shaft Seal Leakage and Checkout of Thrust Chamber Pressure Transducer.

a. Thrust chamber pressure transducer functional.

1. Pressurization of the propellant tanks with GN_2.

2. Pressurization of the thrust chamber with GN_2.

3. Seq. 07-010: ACE-S/C verification of the thrust chamber pressure transducer indication. (Paragraph 4.2.2.8.2.6).

b. Seq. 07-018: Gross fuel shaft seal leakage check and leakage check of isolation valves A and B actuator. (Paragraph 4.2.2.8.2.6).

c. Seq. 07-020: Leakage check of fuel and oxidizer propellant valves A and B. (Paragraph 4.2.2.8.2.6)

d. Seq. 07-022: Leakage check of oxidizer shaft seal. (Paragraph 4.2.2.8.2.6)

e. Seq. 07-025: Leakage check of oxidizer propellant valves A and B. (Paragraph 4.2.2.8.2.6)

f. Seq. 07-027: Leakage check of fuel propellant valves A and B. (Paragraph 4.2.2.8.2.6)

g. Seq. 07-028: Leakage check of isolation valves A and B actuators. (Paragraph 4.2.2.8.2.6)

h. Seq. 07-031: Leakage check of isolation valve B actuator. (Paragraph 4.2.2.8.2.6).

i. Seq. 07-033: Check of isolation valve A actuator leak rate and gross fuel shaft seal leak rate. (Paragraph 4.2.2.8.2.6)

j. Seq. 07-040: Leakage check of propellant valves A and B actuators and isolation valves A and B. (Paragraph 4.2.2.8.2.6)

k. Seq. 07-042: Leakage check of fuel and oxidizer isolation valves A and B. (Paragraph 4.2.2.8.2.6)

l. Seq. 07-044: Leakage check of isolation valves A and B oxidizer shaft seal. (Paragraph 4.2.2.8.2.6)

m. Seq. 07-046: Leakage check of propellant valves A and B oxidizer shaft seal.

n. Seq. 07-048: Leakage check of isolation valves A and B oxidizer (Paragraph 4.2.2.8.2.6)

o. Seq. 07-050: Leakage rate of isolation valves A and B fuel. (Paragraph 4.2.2.8.2.6)

Test Description: (Cont)

p. Seq. 07-051: Leakage check of propellant valves A and B actuators. (Paragraph 4.2.2.8.2.6)

q. Seq. 07-054: Leakage check of propellant valve B actuator. (Paragraph 4.2.2.8.2.6)

r. Seq. 07-056: Leakage check of propellant valve A actuator. (Paragraph 4.2.2.8.2.6)

s. Seq. 07-059, 07-060: Venting of propellant tanks to 15 psig.

Seq. 08: Securing After Test.

Test Title:

Ascent Stage Propulsion System Verification.

Subsystem:

A/S Propulsion.

Test Objectives:

Verification of component function and system pressure integrity.

Vehicle Configuration:

Ascent Stage.

Location:

Factory Floor & Cold Flow Facility

Hazardous Operations:

Pneumatic pressures up to 4650 psig.

Equipment Under Test:

a. Helium Explosive Valves.

b. Solenoid Latching Valves.

c. Pressure Regulators.

d. Quad Check Valves.

e. Compatibility Explosive Valves.

f. Pressure Relief Valves.

g. Burst Discs

h. Engine Pre-Valves.

i. Engine Ball Valves, Actuators and Seals.

j. All new brazes.

k. All mechanical joints

Test Description:

Seq. 001: Call to Stations (Factory Floor)

Seq. 002: Quad Check Valve Low Pressure Flow Test and Leakage Test (Factory Floor) (Para. 4.2.2.8.2.2. and 4.2.2.8.2.3.)

a. Flow test of each quad check poppet.

b. Internal leak check of each quad check poppet.

c. Gross leak check of each quad check valve assembly

Seq. 003: Call to Stations (Cold Flow Facility)

Seq. 004: Regulator Flow Test (Para. 4.2.2.8.2.3.)

a. Temperature and pressure check upstream and downstream of each regulator under flow conditions of 1.45 lbs/min minimum of He with upstream pressure of 3500 psig.

Seq. 005: Solenoid Latching Valve Leak Test, Low Pressure Manifold Proof and External Leak Check (Para. 4.2.2.8.2.3.)

a. High pressure manifold proof pressure (4650 psig)

b. Internal leak check of the solenoid Latching valves.

c. Low pressure manifold proof pressure (333 psig).

d. External leak check of all new brazes and all mechanical joints between the helium explosive valves and the compatibility explosive valves.

Seq. 006: Regulator Creep Test (Para. 4.2.2.8.2.3.)

a. Internal leak check of each regulator.

Seq. 007: Quad Check Valve Low Pressure Flow Test and Leakage Test (Cold Flow Facility) (Para. 4.2.2.8.2.2. and 4.2.2.8.2.3.)

a. Flow test of each quad check poppet.

b. Internal leak check of each quad check poppet.

c. Gross leak check of each quad check valve assembly.

Seq. 008: Propellant Section Functional and Leak Check (Para. 4.2.2.8.2.3, 4.2.2.8.2.5 and 4.2.2.8.2.6)

a. Gross leak check of engine ball valves and verification of valve actuator movement.

Test Description: (Cont).

b. Determination of relief valve cracking and reseat pressure.

c. Internal leak check of relief valves.

d. External leak check of lines downstream of burst discs.

e. Functional check of relief valve vent valves.

f. Internal leak check of relief valve burst discs.

g. External leak check of all new brazes and all mechanical joints between the compatibility squib valves and engine shutoff valves.

h. Internal leak check of the RCS interconnect valves, pre-valve and compatibility squib valves.

i. Determination of pre-valve cracking pressure.

j. Internal leak check of engine valve actuator seals.

Seq. 009. Leak Check of Helium Tanks and Helium Explosive Valves (Para. 4.2.2.8.2.2. and 4.2.2.8.2.3.)

a. External leak check of all new brazes and all mechanical joints between the helium tanks and the helium explosive valves.

b. Internal leak check of the helium explosive valves.

Seq. 010: Engine Ball Valve Leak Test (Para. 4.2.2.8.2.3. and 4.2.2.8.2.6.)

a. Leak check of ball valves, actuators and shaft seals.

Seq. 011: Apply Pad Pressure (Para. 4.2.2.8.2.)

a. Purge all sections with GN_2.

b. Vent all sections to pad pressure, 15-25 psig.

OCP OUTLINE

OCP-GF-27030-LM8

Test Title:

A/S Pressurization and Propellant Feed Sections - Dry Leak Check and Functional

Subsystem:

A/S Propulsion

Test Objectives:

a. Establishment of structural and leakage integrity of the A/S pressurization and propellant sections.

b. Relief valve functional operation.

c. Harness check of A/S transducers.

Vehicle Configuration:

Ascent Stage

Location:

Cold Flow Facility

Hazardous Operations:

Pneumatic pressures up to 4650 psig.

Components Under Test:

Helium storage tanks
Helium explosive valves
Solenoid latching valves
Pressure reducers (regulators)
Quad check valves
Compatibility explosive valves
Pressure relief valves
Burst discs
Fuel and oxidizer propellant tanks
APS/RCS interconnect valves
Quick disconnects
APS transducer harness check

Test Description:

Seq. 01: Call to Stations

Seq. 02: Proof Pressurization, Leak Check and Harness Check of the Pressurization Section.

a. Harness check of helium tank transducers at ambient pressure, 500 psig and 1000 psig using GHe (Para. 4.2.2.12.3.1).

Test Description: (Cont)

b. Proof pressurization of helium storage tanks and high pressure manifold to 4550 to 4650 psig with GHe. (Para. 4.2.2.8.2.1(b)(1)).

c. Venting of helium storage tanks and high pressure manifold to 3400 to 3500 psig. (Para. 4.2.2.8.2.3(a)(1))

d. Harness check of helium tank transducers at 3400 to 3500 psig. (Para. 4.2.2.12.3.1)

e. Proof pressurization of low pressure manifold (regulators to compatibility explosive valves) at 323 to 333 psig (Para. 4.2.2.8.2.1(b)(2)b).

f. Venting of low pressure manifold to 173 to 188 psig (Para. 4.2.2.8.2(b)(4))

g. Inspection of helium pressurization section for visible signs of damage. (Para. 4.2.2.8.2.1(c))

h. External leak check of pressurization section (He tanks to compatibility explosive valves) utilizing a Mass Spectrometer leak detector (MSLD). (Para. 4.2.2.8.2.2(b)(5))

i. Leak check of QD's GP9401, GP9402, GP9406, GP9425, GP9430, GP9431, GP9432, GP9433, GP9440 and GP9441 using a Volumetric Leak Detector Meter (LDM). (Para. 4.2.2.8.2.3(h))

j. Internal leak check of solenoid latching valves using a LDM. (Para. 4.2.2.8.2.3(b))

k. Internal leak check of helium tank explosive valves using a LDM. (Para. 4.2.2.8.2.3(a))

l. Harness check of low pressure manifold transducers at 180 psig, 140 psig and 70 psig. (Para. 4.2.2.12.3.1)

m. Venting of pressurization section to blanket pressure.

Seq. 03: Pressurization Relief Valve Functional, Leak check and Harness Check of the Propellant Section.

a. Harness check of propellant tank transducers at ambient pressure, 45 psig, 120 psig and 180 psig. (Para. 4.2.2.12.3.1)

b. Verification of relief valve vent valve closing. (Para. 4.2.2.8.2.3(f)(4)d)

c. Fuel and oxidizer relief valve functional test at 245 psig maximum. (Para. 4.2.2.8.2.3)

d. Inspection of propellant section for visible signs of damage. (Para. 4.2.2.8.2.1(c))

Test Description: (Cont)

e. External Leak check of propellant section (compatibility explosive valves to engine interface) utilizing a MSLD. (Para. 4.2.2.8.2.2.(b)5

f. Internal leak check of APS/RCS interconnect valves using a LDM. (Para. 4.2.2.7.6g)

g. Internal leak check of fuel and oxidizer relief valves. (Para. 4.2.2.8.2.3(f)4)

h. Leak check of QD's GP9442, GP9443, GP9444, GP9445, GP9458 and GP9459 using a LDM. (Para. 4.2.2.8.2.3(h)(3))

i. Internal leak check of fuel and oxidizer burst discs using a LDM. (Para. 4.2.2.8.2.3(f)(2))

j. Internal leak check of fuel and oxidizer compatibility explosive valves using a LDM. (Para. 4.2.2.8.2.61)

k. Verification of fuel and oxidizer relief valve vent valve opening. (Para. 4.2.2.8.2.3(f)(4)e)

l. Venting of propellant section to ambient pressure.

Seq. 04: Quad Check Valve Leak Check

a. The propellant section from the compatibility explosive valves to the check valves is pressurized with GHe to 8 to 10 psig. (Para. 4.2.2.8.2.3(e)(1))

b. The Quad check valve leakage is measured with a LDM. (Para. 4.2.2.8.2.3(e)(2)a)

Seq. 05: Securing After Test

Test Title:

RCS Verification

Subsystem: Reaction Control Subsystem (RCS)

Test Objectives:

a. Verification of helium high and low pressure section through confidence pressurization and leak tests of mechanical joints and all braze joints not previously tested.

b. Verification of normal functioning of PQMD, high pressure transducers, reaction control quantity meters and loading xducers (GR1151T & GR1152T)

c. Verification of acceptable internal leakage rates for explosive valves (squib), main shutoff valves, helium couplings, propellant quick disconnects (above main shutoff valves), burst discs and propellant tank bladders.

d. Verification of normal functioning of helium pressure relief valves and regulators.

e. Verification of quad check valves cracking pressure and internal leakage.

Vehicle Configuration: Ascent Stage

Location: Cold Flow Facility, Plant #5.

Hazardous Operations: Pneumatic pressures up to 4000 psig.

Components Under Test: RCS Helium Tanks, PQMD's, Reaction Control Quantity Meter, High Pressure Transducers, Squib Valves, Regulators, Regulator Outlet Transducers, Quad Check Valves, Burst Discs, Relief Valves, Propellant Tanks, Main Shut-Off Valves, Mechanical Joints, Previously Untested Braze Joints, Helium Couplings and Propellant Quick Disconnects.

Test Description:

Seq. 01: Call to Stations

Seq. 02: Helium Module Pressure Tests (Para. 4.2.2.7.2.(a) (3) and 4.2.2.7.6.(a)

a. 4000 psig confidence pressure test of helium tanks and lines upstream of the explosive valves.

b. Leak check of mechanical joints and any braze joints not previously checked upstream of the explosive valves at 3500 psig using gaseous Helium.

Test Description: (Continued)

c. Leak check of explosive valves, and Helium fill and vent quick couplings upstream of explosive valves at 3500 psig using gaseous Helium.

d. Functional test of high pressure transducer, PQMD and R.C. Quantity Meter.

Seq. 03: System 'A' Relief Valve Tests
(Para. 4.2.2.7.6. (d) (1), (d) (2), and (d) (3) (a)

a. Verification of burst disc integrity at low pressure. (Verification of no gas flow through the burst disc port.).

b. Verification of relief valve cracking and reseating pressures.

c. Check of relief valve internal leakage using gaseous helium

d. Verification of bleed valve opening and closing pressures.

Seq. 04: System 'A' Propellant Tank System
(Para.4.2.2.7.2.(b) (2),(b) (4) and 4.2.2.7.6. (e)

a. Pressurization of propellant tanks to operating pressure (195-205 psig) and leak checks of all mechanical joints, helium and propellant flight half Q.D. poppets and main shutoff valves using gaseous helium.

Seq. 05: System 'A' Regulator Tests
(Para.4.2.2.7.6. (b)

a. Check of primary and secondary regulator outlet pressures at high flow (20 SCFM) and low flow (3.6 SCFM) with inlet pressures of 3500 psig and 1000 psig using gaseous helium.

b. Check of primary and secondary regulator internal leakage at 3500 psig inlet pressure using gaseous helium.

Seq. 06: System 'A' Burst Disc Leak Check
(Para.4.2.2.7.6. (d) (3) (b)

a. Check of relief valve burst disc leakage at 180 to 185 psid using gaseous helium

Test Description: (Continued).

Seq. 07: System 'A' Quad Check Valve Tests
(Para.4.2.2.7.6. (c)

a. Verification of primary and secondary check valve cracking pressures.

b. Check of primary and secondary check valve internal leakage at low (0.5 to 0.8 psig) and high (100 psig) reverse pressures using gaseous helium.

Seq. 08: System 'A' Bladder Leak Check
(Para.4.2.2.7.6. (i) and 4.2.2.7.5.)

a. Check of propellant tank bladder leakage at 10 psid using gaseous helium.

b. Re-application of pad pressure between squib valves and main shut-off valves.

Seq. 09: System 'B' Relief Valve Tests
(Para.4.2.2.7.6.(d) (1),(d) (2) and (d) (3) (a)

Same as for seq. 03.

Seq. 10: System 'B' Propellant Tank System
(Para.4.2.2.7.2. (b) (2), (b) (4) and 4.2.2.7.6. (e)

Same as for seq. 04.

Seq. 11: System 'B' Regulator Test
(Para.4.2.2.7.6. (b)

Same as for seq. 05.

Seq. 12: System 'B' Burst Disc Leak Check
(Para.4.2.2.7.6. (d) (3) (b)

Same as for seq. 06.

Seq. 13: System 'B' Quad Check Valve Tests
(Para.4.2.2.7.6. (c)

Same as for seq. 07.

Seq. 14: System 'B' Bladder Leak Check
(Para.4.2.2.7.6. (i) and 4.2.2.7.5)

Same as for seq. 08.

Seq. 15: Re-application for Pad Pressure
(Para.4.2.2.7.5)

a. Application of GN2 pad to systems 'A' and 'B' manifolds.

OCP OUTLINE

OCP-GF-31032-LM8

Test Title:

RCS Ascent Interconnect Valve Assembly - Liquid Flush and Leak Check

Subsystem:

Reaction Control Subsystem (RCS)

Test Objectives:

To verify the cleanliness level of the oxidizer and fuel interconnect valve assemblies by flushing with Freon TF (PCA), and sampling.

To dry the assemblies subsequent to the freon flush.

To check for acceptable leakage and latch-force currents of the solenoid valves in the oxidizer and fuel interconnect valve assemblies.

Vehicle Configuration:

N/A

Location:

Plant 2, C.E.F.

Hazardous Operations:

Leak check of solenoid valves and braze joints with helium at 200 and 80 psig, respectively.

Components Under Test:

RCS Ascent Interconnect Valves - LL27-1, LL27-2
LL29-1, LL29-2
LL28-1, LL28-2
LL30-1, LL30-2

Test Description:

Paragraphs 4.2.2.7.5, 4.2.2.7.6(g) and 4.2.2.7.6(j)

Seq. 01: Call to Stations

Seq. 02: Vibration/Flush - Oxidizer Interconnect Valve Assembly (Paragraph 4.2.2.7.5)

a. Flushing freon thru entire assy and sampling discharge for particulate and NVR content.

Seq. 03: GN_2 Purge and Dry - Oxidizer Interconnect Valve Assembly

a. Application of warm GN_2 at 20 psig to purge and dry assembly of residual freon.

Test Description: (Cont)

Seq. 04: Helium Leak Check and Latch Force Test - Oxidizer Interconnect Valve Assembly. (Paragraph 4.2.2.7.6(g) and (j))

a. Application of 200 psig GHe to assembly and leak checking each solenoid valve.

b. Application of 80 psig GHe to assembly and leak checking braze joints.

c. Testing of Interconn. Valves for latching current.

Seq. 05: Vibration/Flush - Fuel Interconnect Valve Assembly. (Paragraph 4.2.2.7.5)

Same as Sequence 02.

Seq. 06: GN_2 Purge and Dry - Fuel Interconnect Valve Assembly

Same as Sequence 03.

Seq. 07: Helium Leak Check and Latch Force Test - Fuel Interconnect Valve Assembly. (Paragraph 4.2.2.7.6(g) and (j))

Same as Sequence 04.

OCP OUTLINE

OCP-GF-31033-LM8

Test Title:

RCS Propellant Feed Section Leak and Functional Test

Subsystem:

RCS

Test Objectives:

a. Verification of pressure integrity of the fuel and oxidizer injector valve flange interface seals and the chamber omni-seal utilizing a pressure decay test in the engine chamber.

b. Verification of proper engine gas flow using gaseous nitrogen.

Vehicle Configuration:

Ascent Stage

Location:

Factory Floor, Plant 5

Hazardous Operations:

Pneumatic pressures up to 200 psig

Components Under Test:

RCS Engine Thrust Chambers

RCS Fuel and Oxidizer Injector Valves

RCS Service Q.D.'s

Test Description:

Seq. 01: Call to Stations

Seq. 02: Pressure Decay Test of Fuel and Oxidizer Injector Valves Flanged Interface Seals and Chamber Omni-Seal

a. Pressurization of RCS Manifold to 175 ±2 psig. Pressure decay test of individual engine chambers.

Seq. 03: Engine Gas Flow Check of Fuel and Oxidizer Injector Valves Using Gaseous N_2. (Para. 4.2.2.7.7(c))

a. Gas flow check of RCS fuel and oxidizer manifold and injector valves.

Seq. 04: Reapplication of Pad in RCS Tankage Modules. (Para. 4.2.2.7.5)

a. Helium pad pressure put in tankage modules A and B.

OCP OUTLINE

OCP-GF-31034-LM-8

Test Title:

RCS Functional

Subsystem:

Reaction Control Subsystem (RCS)

Test Objectives:

a. Verification that the helium leak rates of all service QD's (uncapped), isolation valves (Systems 'A' and 'B') and the fuel and oxidizer crossfeed valves (both directions) are within specification requirements.

b. Verification that the gas flow distribution in the RCS engine combustion chambers are within allowable limits.

c. Verification of isolation valve crossfeed valve and main shut-off valve channel identification.

d. Verification that the forward leakage rates of the engine injector valves are within allowable limits.

Vehicle Configuration:

Ascent Stage

Location:

CEF, Plant 5

Hazardous Operations:

Pneumatic pressures up to 205 psig.

Components Under Test:

Isolation and crossfeed valves.

Engine orifices and injector valves.

Service QD's.

Test Description:

Seq. 01: Call to Stations

Seq. 02: Leak Check of Isolation Valves, Crossfeed Valves and Service Q.D.'s.
(Paragraphs 4.2.2.7.3.(b)5, 4.2.2.7.6(f) and (h)

a. Pressurization of propellant manifolds to 195 to 205 psig GHe.

b. Determination of external leakage of the engine dyna-tube mechanical joints, and the manifold service Q.D.'s.

Test Description: (Cont)

c. Determination of isolation valve forward leakage by opening the engine injector valves and collecting leakage using a volumetric leak detector.

d. Determination of crossfeed valve internal leakage (both directions) by first pressurizing the 'A' system to 195 to 205 psig GHe, and collecting leakage at system 'B' service port. System 'B' is then pressurized with leakage collected at system 'A' service port.

e. Determination of crossfeed valve channel identification by operating the valves and verifying gas flow through service ports.

f. Determination of isolation valve channel identification by operating the valves and verifying gas flow from downstream engines.

Seq. 03: RCS Engine Injector Orifice Flow Test and Isolation Valve Channel I.D.

a. Pressurization of the fuel manifold to 98 to 102 psig GHe, and oxidizer manifold to 3 to 5 psig GN_2. Opening of the fuel and oxidizer injector valves, actuation of the flow sensor unit and recording of pressure signals for fuel distribution.

b. Pressurization of the oxidizer manifold to 98 to 102 psig GN_2 and fuel manifold to 8 to 12 psig GN_2. Opening of the fuel and oxidizer injector valves, actuation of the flow sensor unit and recording of pressure signals for oxidizer flow distribution.

Seq. 04: Injector Valve Forward Leakage, Main Shutoff Valve Channel I.D. and Reapplication of Pad Pressure in Feed Manifolds. (Paragraph 4.2.2.7.3.(1))

a. Leak check of engine injector valves using throat plugs and volumetric leak detectors. Four engines are done simultaneously. The four throat plugs and volumetric leak detectors are first configured to the quad 1 engines. The fuel and oxidizer manifolds are pressurized to 95 to 105 psig nitrogen and the leakage from the fuel and oxidizer injector valves in Quad I, is collected for fifteen (15) minutes.

b. Repeat (a) for Quads II, III, and IV.

c. Verification of main shutoff valve vehicle wiring by cycling the valves from the cabin, and observing nitrogen gas flow.

Seq. 05: Application of Pad Pressure in RCS Tankage Module, System A.

a. Pressurization of System 'A' fuel and oxidizer propellant tank bladders to 5 to 15 psig GN_2 and pressurization of helium section with approximately 5 psi.

Seq. 06: Application of Pad Pressure in RCS Tankage Module, System B.

a. Same as seq. 05 except for System B.

Test Title:

RCS Helium Pressure Module - Proof, Leakage and Functional Tests.

Subsystem:

RCS

Test Objectives:

a. Verification of structural integrity of RCS pressurization module downstream of explosive valves at proof pressures.

b. Verification of acceptable leak rates at operational pressures of lines, fittings and components.

c. Functional verification of the relief valves, regulators and quad check valves.

Vehicle Configuration:

Ascent Stage Sub-assembly

Location:

Plant #2, C.E.F.

Hazardous Operations:

Pneumatic pressures up to 4655 psig

Equipment Under Test:

Squib valves
Regulators
Relief valve assemblies
Quad check valves
Helium couplings
Lines
Fittings

Test Description:

Seq. 01: Call to Stations

Seq. 02: Leakage test of He tank supply line and squib valves and forward leakage of squib valves - System A (Para. 4.2.2.7.2(a),4.2.2.7.6)

Seq. 03: Proof pressure test of RCS regulator inlet and outlet sections and leak check of all joints between squib valves and pressurization lines to propellant tanks - System A (Para. 4.2.2.7.2(b),4.2.2.7.6)

Seq. 04: SLAM start of He pressurization regulators and functional test of primary and secondary regulators at high flow, low flow and lock up conditions - System A Para. 4.2.2.7.2(a),4.2.2.7.6)

Test Description: (Cont)

Seq. 05: Verification of cracking and reseat pressures and forward leakage of relief valves. Leakage test of relief valve burst discs at operating pressure - System A (Para. 4.2.2.7.2(b), 4.2.2.7.6)

Seq. 06: Verification of cracking pressure and internal leak check at 0.5 and 35 psig of individual quad check valve elements - System A (Para. 4.2.2.7.2(b), 4.2.2.7.6)

Seq. 07: Same as 02 - System B

Seq. 08: Same as 03 - System B

Seq. 09: Same as 04 - System B

Seq. 10: Same as 05 - System B

Seq. 11: Same as 06 - System B

OCP OUTLINE

Test Title:

RCS Helium and Propellant Tank Proof, Leakage and Functional Test

Subsystems:

RCS

Test Objectives:

a. Verification of the structural integrity of the RCS tankage modules at proof pressure after assembly.

b. Verification of acceptable leak rates of tank fittings, gamah fittings, propellant Q.D.'s, braze joints and internal leakage of main SOV's and tank bladders previously untested.

c. Verification of PQMD's and high pressure helium transducers.

Vehicle Configuration:

RCS Tankage Modules.

Location:

Plant #2.

Hazardous Operations:

Pneumatic Pressures up to 4655 psig.

Components under Test:

Propellant Tanks
Main Shutoff Valves
Helium Tanks
Propellant Tank Bladders
PQMD's
High Pressure Helium Transducers
Propellant Q.D.'s

Test Description:

Seq. 01: Call to Stations

Seq. 02: Freon Flush of RCS Fuel and Oxidizer Tank Bladders, Followed by Purging and Drying with Warm GN_2, System A. (Para. 4.2.2.7.5 and 4.2.2.7.6.(j)

a. Bladders of System A flushed with freon, then purged and dryed with warm GN_2. System A main shutoff valves are latch force tested.

Seq. 03: Proof Pressure Test of Helium Tank and Leakage Test of all Joints Between Helium Tank and Squib Valves, Verification of PQMD's and High Pressure Helium Transducers, System A. (Para. 4.2.2.7.2.(a) (1) and 4.2.2.7.2.(a) (3))

a. A helium proof pressure check of the helium tank at 4560 to 4655 psig. External leak checks made of all joints and fittings between the helium tank and the explosive valves at 3450 to 3550 psig. Vehicle helium supply pressure transducers and P.Q.M.D. are verified.

Test Description: (Cont)

Seq. 04: Proof Pressure Test of RCS Propellant Tanks, Leak Check of Joints Made During Assembly of Tankage Module, Forward Leakage Test of Main Shut-Off Valves, Propellant QD Leakage and Propellant Tank Flange Leakage, System A. (Para.4.2.7.2.2.7.2 (b), (1) (2) (4) and Para. 4.2.2.7.6. (e).

a. Propellant tanks are proof pressurized at 333 to 340 psig. External leak checks, forward leakage of main shut-off valves and propellant QD leakage at 190 to 200 psig.

Seq. 05: Verification Test of Fuel and Oxidizer Tank Bladder Leakage Rates, System A. (Para. 4.2.2.7.6.(i) (1) and (2))

a. The leakage rate of propellant tank baldders at 9 to 10 psig.

Seq. 06: Same as Sequence 02 for System B.

Seq. 07: Same as Sequence 03 for System B.

Seq. 08: Same as Sequence 04 for System B.

Seq. 09: Same as Sequence 05 for System B.

OCP OUTLINE

OCP-GF-31038-LM8

Test Title:

RCS Engine Functional and Leakage Tests.

Subsystem:

Reaction Control Subsystem (RCS)

Test Objectives:

a. Verification of proper operation of the chamber pressure switches.

b. Verification of leakage integrity of the chamber pressure switches.

c. Verification of the pressure integrity of the engine combustion chamber by conducting a pressure decay check.

d. Verification that forward leakage of the injector valves is within allowable limits.

Vehicle Configuration:

RCS Engine prior to vehicle installation.

Hazardous Operations:

Pneumatic pressures up to 200 psig.

Components Under Test:

RCS Engine

Test Description:

Seq. 01: Call to Stations

Seq. 02: Engine Thrust Chamber Switch Leak Check and Functional Test

a. Leak check of the thrust chamber switch using GHe at 175 psig with FM INERT solution.

b. Actuation of the pressure switch by evacuation of the thrust chamber to 2 psia and 10 psia respectively and monitoring of switch opening and closing on a volt-ohmmeter. (Para. 4.2.2.7.8)

Seq. 03: Combustion Chamber Pressure Decay and Leakage Test using GN_2

a. Performance of pressure decay of the engine combustion chamber for 6 minutes utilizing a controlled internal leakage volume of 200 cc.

Seq. 04: Injector Valve Forward Leakage Check

a. Pressurization of the injector valves to 100 psig with GN_2 and performance of a forward leak check utilizing a volumetric leak detector. (Para. 4.2.2.7.3)

OCP-GF-31040-LM8

Test Title:

RCS Manifold Flush, Dry, Latch Force Test, Solenoid Leak Check, Proof Pressure Check, Transducer Accuracy and External Leak Check.

Subsystem:

RCS

Test Objectives:

a. To verify the cleanliness level of RCS propellant manifolds with freon TF (PCA)

b. To dry the manifolds subsequent to the freon final flush.

c. To hydrostatically proof test the manifold system.

d. To verify the dryness of the RCS propellant tank bladders after flushing the feed manifolds.

e. To internal leak check the solenoid valves in the RCS manifold system.

f. To proof pressure test the braze joints and dyna-tube nuts in the RCS manifold system.

g. To check the RCS propellant manifold transducer for accuracy.

h. To leak test the RCS braze weld fittings, service Q.D.'s and mechanical fittings (dyna-tube nuts only).

Vehicle Configuration:

Different Stages of RCS build-up.

Location:

Plant 2 CEF

Hazardous Operation

Pneumatic pressure up to 340 psig.

Components Under Test:

RCS Solenoid Parker Valves

Test Description:

Seq. 001: Call to Stations.

Seq. 002: First Flush and Sample - Oxidizer System

Seq. 003: First Purge and Dry - Oxidizer System

Seq. 004: First Flush and Sample - Fuel System

Seq. 005: First Purge and Dry - Fuel System

Seq. 006: Proof Pressure - Oxidizer System

Seq. 007: Final Flush and Sample - Oxidizer System

Seq. 008: Final Purge and Dry - Oxidizer System.

Seq. 009: Proof Pressure - Fuel System

Seq. 010: Final Flush and Sample - Fuel System

Seq. 011: Final Purge and Dry - Fuel System

Seq. 012: RCS Fuel and Oxidizer Tank Dryness Verification System "A".

Seq. 013: RCS Fuel and Oxidizer Tank Dryness Verification System "B".

Seq. 014: Solenoid Leak Check System "A".

Seq. 015: Solenoid Leak Check System "B".

Seq. 016: Electrical Latch Force Test.

Seq. 017: Call to Stations.

Seq. 018: Proof Pressure and External Leak Check of RCS Propellant Manifolds and RCS Manifold Pressure Transducers Verification.

OCP OUTLINE

OCP-GF-32001-LM8

Test Title:

A/S Weight and Center of Gravity Test

Subsystem:

Structure

Test Objective:

To determine the dry weight and the horizontal (Y-Z) center of gravity of the Ascent Stage

Vehicle Configuration:

Ascent Stage

Location:

Plant 5, Weight and Balance Fixture

Hazardous Operation:

Not Applicable

Equipment Under Test:

Ascent Stage

Test Description:

Seq. 01: Call to Stations

Seq. 02: A/S Weight and Center of Gravity Test

a. Positioning and leveling of Ascent Stage.

b. Adjustment of load cell digital readout unit.

c. Zeroing of load cells.

d. Preloading of load cells.

e. Transfer of total load to load cells.

f. Verification that Ascent Stage has remained level.

g. First Weighing

h. Repeat of above for second and third weighings.

i. The data from this OCP will be used as the basis for a weight report giving actual weight and horizontal center of gravity. (Paragraph 4.2.2.1.1)

OCP OUTLINE

OCP-GF-32003-LM8

Test Title:

Landing Gear Functional Test

Subsystem:

Mechanical

Test Objective:

To verify the overall functional ability of the landing gear system with regard to the deployment and downlock mechanisms.

Vehicle Configuration:

Descent

Location:

Plant 5, Landing Gear Test Fixture

Hazardous Operation:

Not Applicable

Equipment Under Test:

Landing Gear Mechanism

Test Description:

Seq. 01: Call to Stations

Seq. 02: Continuity Check of Lunar Surface Sensing Probe Switches

Seq. 03 to Seq. 06: Landing Gear Functional Test

a. Continuity check of landing gear deploy switches in deployed and stowed positions.

b. Measurement of gear travel (distance between bolt centers of uplock mechanism) at probe release during deployment.

c. Measurement of time to fully extend and lock gear down.

d. Above procedures are performed individually for each gear. (Paragraph 4.2.2.1.3)

OCP OUTLINE

OCP-GF-32012-LM8

Test Title:

D/S Weight and Center of Gravity Test

Subsystem:

Structure

Test Objectives:

To determine the dry weight and the horizontal (Y-Z) center of gravity of the descent stage.

Vehicle Configuration:

Descent Stage

Location:

Plant 5, Weight and Balance Fixture

Hazardous Operation:

Not Applicable

Equipment Under Test:

Descent Stage

Test Description:

Seq. 01: Call to Stations

Seq. 02: D/S Weight, and Center of Gravity Test

a. Position and level of descent stage.

b. Adjustment of Load Cell Digital Readout Unit.

c. Zeroing of load cells.

d. Preloading of load cells.

e. Transfer of total load to load cells.

f. Verification that descent stage had remained level.

g. First weighing of.

h. Repeat of above for second and third weighings.

i. The data from this OCP will be used as the basis for a weight report giving actual weight and horizontal center of gravity. (Paragraph 4.2.2.1.2)

Test Title:

Crew Compartment Fit and Functional Test

Subsystem:

Crew Provisions

Test Objective:

To demonstrate that each crew equipment item is functionally and physically compatible with the spacecraft, the mission sequence and crew flight requirements, by simulating the LM8 mission.

Vehicle Configuration:

Mated Stages

Location:

Integrated Work Stand Plant 5

Hazardous Operation:

Not Applicable

Equipment Under Test:

Crew equipment within the crew compartment listed on official LM8 stowage list.

Test Description:

Seq. 01: Call to Stations

Seq. 02: Support System Status Verification

a. Power-up and verification of EPS.

b. Power-up and verification of Veh. Comm.

Seq. 03: Lunar Television Transmission

Seq. 04: Flight Crew Readiness

a. Verification of Crew Suiting and Cabin Ingress per OCP-GF-32016-LM8.

b. Evaluation of reach capability and mobility utilizing transfer umbilical.

Seq. 05: Ingress and Checkout

a. Demonstration of change-over, transfer umbilical to LM ECS.

b. Preparation of Cabin for habitation.

Test Description: (Cont)

c. Verification of communications capability.

d. Demonstration of Equipment Transfer.

e. Demonstration of Post Ingress Operation.

f. Demonstration of waste management capability.

g. Alignment of IMU.

h. Utilization of food packs.

Seq. 06: EVA

a. Demonstration of EVA preparation.

b. Demonstration of PLSS/OPS Preparation for Checkout.

c. Demonstration of Post EVA Configuration.

d. Verification of PLSS recharge fit check.

e. Evaluation of Sequence Camera Operation.

f. Demonstration of EVA Equipment Stowage

g. Evaluation of Hard Suit Operations in Cabin.

Seq. 07: Rendezvous Egress

a. Demonstration of LiOH cartridge replacement.

b. Demonstration of preparation for docking.

c. Installation of COAS in Forward and Docking Windows and changing of COAS light bulb.

d. Demonstration of Rendezvous Radar Antenna Deployment.

e. Preparation of Equipment for Transfer.

f. Stowage of Drogue and Probe.

g. Verification of cabin egress per OCP-GF-32016-LM8. (Paragraph 4.2.2.4.5(b))

Seq. 08: Egress/Ingress Procedure for Lunch Break

Seq. 09: Drogue Installation & Removal Fit Check

Seq. 10: Securing After Test

OCP OUTLINE

OCP-GF-32016-LM8

Test Title:

Crew Suiting, Vehicle Ingress/Egress and Suit - Vehicle Checkout.

Subsystem:

Crew Provisions

Test Objective:

To control the crew suiting and their ingress and egress of the LM spacecraft.

Vehicle Configuration:

Ascent Stage

Location:

Final Assembly Area, Integrated Work Stand

Hazardous Operation:

Not Applicable.

Equipment Under Test:

Spacesuits and associated support equipment

Test Description:

Seq. 01: Call to Stations

Seq. 02: PGA Preparation to Donning

Preparation of the pressure garment assembly for donning. Verification of the liquid cooling garment and urine collection transfer assembly acceptability.

Seq. 03: PGA Donning

Suiting of the crew, and donning of associated equipment.

Seq. 04: Crew LM Ingress

Ingress of the LM Crew to the Vehicle.

Seq. 05: Crew LM Egress and PGA Doffing

Egress of the LM Crew from the Vehicle.

OCP OUTLINE

OCP-GF-32017-LM8

Test Title:

Crew Compartment Stowable Equipment Installation and Removal.

Subsystem:

Crew Provisions

Test Objectives:

To control packaging, installation and removal of all stowable equipment.

Vehicle Configuration:

Mated Stages

Location:

Final Assembly Area, Integrated Work Stand

Hazardous Operations:

None

Equipment Under Test:

All equipment listed in LM8 Stowage List, List B & C, applicable to ascent stage.

Test Description:

Seq. 01: Call to Stations

Seq. 02: Stowage in Crew Compartment

a. Transferral of packages to vehicle from the bond and packaging area.

b. Removal of each item from its package and stowage in the vehicle as stated in Stowable Item Verification Checkout Data Sheet.

Seq. 03: Re-stowage of Vehicle after Run I of OCP-32014

a. Verification and/or restowing of all stowable equipment as stated in Stowable Item Verification Checkout Data Sheet.

Seq. 04: Removal from Vehicle

a. Removal of each stowable item from vehicle, and placement in their respective package containers.

Seq. 05: Return to Bond and Packaging Area

a. Transferral of all packages from vehicle to bond and packaging area.

OCP OUTLINE

OCP-GF-32020-LM8

Test Title:

Electrical Circuit Interrupter Operational Test

Subsystem:

Explosive Devices

Test Objective:

Verification of the cycling operation of the electrical circuit interrupters.

Vehicle Configuration:

Ascent and Descent Stages, electrically mated.

Location:

Integrated Workstand, Plant 5

Hazardous Operations:

Pressurization and X-Ray of Electrical Circuit Interrupters

Components Under Test:

Electrical Circuit Interrupters

Test Description:

Seq. 01: Call to Stations

Seq. 02: Electrical Circuit Interrupter Operation. (NASA TWX EP4/13-6-BG 54-67-T321 Dated 23 Mar 67, and LTE 10-38 Dated 4 March 1967)

a. P/J173 ECI Cycling

b. P/J174 ECI Cycling

c. X-RAY of ECI Connectors

d. P/J173 ECI Reset

e. P/J174 ECI Reset

f. X-RAY of ECI Connectors for verification of resetting

OCP OUTLINE

OCP-GF-32021-LM8

Test Title:

Descent Stage, Crew Compartment Fit and Functional Test

Subsystem:

Crew Provisions

Test Objectives:

To verify that each crew equipment item, stowed in the Descent Stage, is functionally and physically compatible with the spacecraft and crew requirements for lunar space operations

Vehicle Configuration:

Descent Stage

Location:

Descent Stage 'Dolly' - Plant 5

Hazardous Operation:

Not Applicable

Equipment Under Test:

Crew Equipment, stowed in Descent Stage, listed on official LM8 Stowage List.

Test Description:

Seq. 01: Call to Stations

Seq. 02: MESA Deployment and Stowage (Quad IV)

Seq. 03: LMP Suited Operations (Para. 4.2.2.4.5).

a. Verification LMP Suited per OCP-GF-32022-LM8.

b. Evaluation of S-Band antenna (Quad I).

c. Evaluation of MESA Stowage Provisions (Quad IV).

d. Operation of Scientific Equipment Bay (Quad II).

e. Deployment of ALSEP Pallets (Quad II).

f. Simulation of RTG/HOT Fuel Element Removal (Quad II).

g. Evaluation of SRC No. 2 in MESA (Quad IV).

h. Weighing of SRC No. 2 (Quad IV).

i. Return of LMP to control of OCP-GF-32022-LM8.

Seq. 04: Removal of all stowed items and return to bond area.

OCP OUTLINE

OCP-GF-32022-LM8

Test Title:

Crew Suiting

Subsystem:

Crew Provisions

Test Objectives:

To Control The Crew Suiting And Their Ingress And Egress To The LM Spacecraft

Vehicle Configuration:

Descent Stage

Location:

Final Assembly Area, Integrated Work Stand

Hazardous Operations:

Not Applicable

Equipment Under Test:

Spacesuits and associated support equipment.

Test Description:

Seq. 01: Call to Stations

Seq. 02: PGA Preparation to Donning (Para. 4.2.2.4.1)

Preparation of the pressure garment assembly for donning.

Seq. 03: PGA Donning (Para. 4.2.2.4.3)

Suiting of the LMP, and donning of associated equipment.

Seq. 04: Crew LM Ingress (Para. 4.2.2.4.4)

Ingress of the LMP to the Descent Stage.

Seq. 05: Crew LM Egress (Para. 4.2.2.4.4)

Egress of the LMP from the Descent Stage.

OCP OUTLINE

OCP-GF-33001-LM8

Test Title:

Ascent Stage Environmental Control Subsystem, Proof Pressure and Leakage Checks

Subsystem:

Environmental Control System, HTS A/S

Test Objectives:

To verify the structural integrity of the HTS A/S with a proof pressure and leakage test.

Vehicle Configuration:

Ascent Stage

Location:

Integrated Workstand, Plant 5

Hazardous Operations:

Pneumatic pressures up to 60 psig

Components Under Test:

Coolant Recirculation Assembly
Secondary Filter
ATS H/X
Suit Temperature Control Valve
Coolant Regenerative H/X
Cabin Air Recirculation Assembly
Cabin Temperature Control Valve
DSE Cold Plate
PSA Cold Plate
CDU Cold Plate
LGC Cold Plate
LGA Cold Plate
GASTA Cold Plate
Coolant Accumulators
AFT Equipment Bay Cold Plates 1 through 11
TLE Cold Plate
ASA Cold Plate
PTA Cold Plate
RGA Cold Plate
Interstage Disconnects

Test Description:

Seq. 01: Call to Stations

Test Description: (Cont)

Seq. 02: HTS Proof Pressure and Pressure Decay Test

a. Proof Pressure Test of the Primary and Secondary HTS A/S at 60 psig with Helium. (Para. 4.2.2.3.6)

b. Pressure decay test of the Primary and Secondary A/S at 45 psig with helium.(Para. 4.2.2.3.6)

Seq. 03: Leakage Test of the Primary and Secondary HTS A/S with a Mass Spectrometer Using Helium at 45 psig (Para. 4.2.2.3.6)

Seq. 04: HTS Inter-coolant Loop Leak Test (Para. 4.2.2.3.6)

a. Purge of the secondary loop for 15 minutes with GN_2.

b. Probe of the HTS secondary effluent gas continuously for 4 minutes.

Seq. 05: Secondary HTS Pressure Decay Test (Para. 4.2.2.3.6)

a. Pressurization of the secondary HTS to 45 psig with GN_2.

b. Performance of a 4.5 hour pressure decay test of the Secondary HTS A/S with the accumulator LSC 330-210 disconnected from the system.

c. Performance of a volumetric leak test of the accumulator LSC 330-210 in accordance with the following:

1. Accumulator LSC 330-210 connected to the Secondary HTS A/S.

2. Displacement Leak Meter connected to port JF9137 of the accumulator.

3. The Secondary HTS A/S pressurized with GN_2 at 45 psig.

d. Performance of a 1 hour pressure decay test of the Secondary HTS A/S with GN_2 at 45 psig, with the accumulator LSC 330-210 connected to the system.

Seq. 06: Primary HTS A/S Pressure Decay Test (Para. 4.2.2.3.6)

a. Pressurization of the Primary HTS A/S to 45 psig with GN_2.

b. Performance of a 4.6 hour pressure decay test of the Primary HTS A/S with the accumulator LSC 330-210 disconnected from the system.

Test Description: (Cont)

c. Performance of a volumetric leakage test of the accumulator LSC 330-210 in accordance with the following:

1. Accumulator LSC 330-210 connected to the Primary HTS A/S.

2. Displacement Leak Meter connected to port JF9137 of the Accumulator.

3. The Primary HTS A/S pressurized with GN_2 at 45 psig.

d. Performance of a 1 hour Pressure Decay Test of the Primary HTS A/S with GN_2 at 45 psig, with the accumulator LSC 330-210 connected to the system.

Seq. 07: Securing After Test

a. Venting of the Primary HTS A/S to ambient pressure.

OCP OUTLINE

OCP-GF-33013-LM8

Test Title:

ECS Interstage Disconnects Proof Pressure and Leakage Test

Subsystem:

ECS HTS and OCPS

Test Objectives:

To verify the mechanical integrity of the HTS and OCPS Interstage Disconnects and flex lines with a proof pressure and leakage test.

Vehicle Configuration:

Ascent and Descent Stage mated

Location:

Integrated workstand, Plant 5

Hazardous Operations:

Pneumatic pressures up to 1340 psig

Equipment Under Test:

HTS and OCPS Interstage Disconnects and flex lines

Test Description:

Seq. 01: Call to Station

Seq. 02: HTS Interstage Disconnects Proof Pressure and Leak Check.

a. Pressure Decay Test of the HTS Interstage Disconnects with helium at 29 psig for 5 minutes.

b. Proof Pressure Test of the HTS Interstage Disconnects mated and demated with helium at 60 psig for 1 minute, (paragraph 4.2.2.3.6).

c. Leakage test of the HTS Interstage Disconnects mated and demated A/S QD with a Mass Spectrometer using helium at 45 psig, (paragraph 4.2.2.3.6.).

Seq. 03: GOX Interstage Disconnect Proof Pressure and Leak Check

a. Proof Pressure Test of the GOX Interstage Disconnect (mated & demated) with helium at 1340 psig for 1 minute, (paragraph 4.2.2.3.5.1(b)).

b. Leakage Test of the GOX Interstage Disconnect (mated & demated) with a Mass Spectrometer using helium at 950 psig (paragraph 4.2.2.3.5.1(c)(2)).

Seq. 04: Securing After Test

OCP OUTLINE

OCP-GF-33020-LM8

Test Title:

A/S Oxygen Cabin Pressure Section Proof Pressure, External Leak and Flow Checks

Subsystem:

A/S Environmental Control

Test Objectives:

a. Perform a proof pressure test and helium leak test to verify the mechanical and pressure integrity of the Oxygen Cabin Pressure Section (OCPS), and Atmosphere Revitalization Section (ARS).

b. To verify mechanical operation and control of regulators and valves at operating pressure and flow conditions.

Vehicle Configuration:

Ascent Stage

Location:

Cold Flow Facility

Hazardous Operation:

a. Application of gaseous helium pressures up to 1350 psig.

b. Application of gaseous oxygen pressures up to 980 psig.

c. Application of gaseous nitrogen pressures up to 980 psig.

Components Under Test:

a. A/S GOX Tanks

b. A/S Interstage QD

c. Oxygen Control Module

d. Suit Circuit Assembly

e. PLSS O_2 Fill QD

Test Description:

Seq. 01: Call to Stations

Seq. 02: OCPS Low Pressure Leak Test

a. Fill A/S OCPS with gaseous Helium through JF9555 to 300 psig.

b. Probe each possible source of leakage with a Helium Leak Detector.

Test Description: (Cont)

Seq. 03: OCPS Proof Pressure Test

a. Increase pressure of OCPS through JF9555 to Proof Pressure of 1340 psig GHe.

b. Hold Proof Pressure for 1 minute max. (paragraph 4.2.2.3.5.1(B)).

c. Reduce pressure of OCPS through JF9555 to 980 psig GHe.

Seq. 04: OCPS Gross Leak Test

a. Disconnect GSE QD from JF9555.

b. Perform fifteen minute Pressure Decay Test of OCPS.

Seq. 05: OCPS Helium Leakage Test

a. Probe each possible source of leakage with a Helium Leak Detector. (Para. 4.2.2.3.5.1.1(a))

b. Connect GSE QD to JF9555.

c. Reduce OCPS pressure to ambient through JF9555.

Seq. 06: ARS and ARS/WMS Proof Pressure Test

a. Isolate ARS from Cabin and OCPS.

b. Isolate Oxygen Control Module from Cabin and GOX Tanks.

c. Pressurize ARS through JF9112 and GF9114 and Oxygen Control Module through JF9555 to 6.4 psig GHe.

d. Hold Proof Pressure for 1 minute max. (paragraph 4.2.2.3.3(c)).

e. Vent ARS through JF9112 and GF9114 and Oxygen Control Module through JF9555 to 4.1 psig GHe.

Seq. 07: ARS and ARS/WMS Interface Helium Leak Test

a. Probe each possible source of leakage with a Helium Leak Detector.

b. Vent ARS through JF9112 and GF9114 and Oxygen Control Module through JF9555 to ambient pressure.

Seq. 08: ARS and ARS/WMS Interface External Leakage Test

a. Pressure purge ARS and OCPS to 3.9 psig with GOX through JF9112, GF9114 and JF9555 to expel Helium.

Test Description: (Cont)

b. With the Oxygen Demand Regulators closed and the CO_2 Canister Select Valve in the Mid-Position, measure the oxygen make-up flow through GF9114 and JF9112 required to compensate for ARS oxygen external leakages. (Para. 4.2.2.3.3(c))

c. With the Oxygen Demand Regulators closed, the CO_2 Canister Select Valve in Primary and the secondary CO_2 Canister Cover removed, measure the oxygen make-up flow through GF9114 and JF9112 required to compensate for ARS oxygen external leakage.

d. With the Oxygen Demand Regulators closed, the CO_2 Canister Select Valve in Secondary and the Primary CO_2 Canister Cover removed, measure the oxygen make-up flow through GF9114 and JF9112 required to compensate for ARS oxygen external leakage.

e. Vent ARS through JF9112 and GF9114 and Oxygen Control Module through JF9555 to ambient pressures.

Seq. 09: Cabin Repressurization Valve Functional Test

a. Pressurize OCPS through JF9555 to 935 psig with GOX.

b. Electrically open the LSC-330-309 Cabin Repressurization Valve for two seconds. Allow valve to slam reseat at high pressure.

c. Pressurize the OCPS through JF9555 to 935 psig.

d. Electrically open the LSC-330-309 Cabin Repressurization Valve for ten seconds. Record pressure and temperature decay of OCPS GOX tanks.

e. Pressurize OCPS through JF9555 to 935 psig with GOX.

Seq. 10: Oxygen Demand Regulator Functional Test - Cabin Mode

a. Evacuate ARS through JF9112 and GF9114 to 4.8 psia.

b. With Oxygen Demand Regulator "A" in "Cabin" and Oxygen Demand Regulator "B" in "Closed", withdraw oxygen through JF9111 and GF9113 to simulate metabolic demand. (Para. 4.2.2.3.5.2(c))

c. With Oxygen Demand Regulator "A" in "Closed" and Oxygen Demand Regulator "B" in "Cabin", withdraw oxygen through JF9111 and GF9113 to simulate metabolic demand. (Para. 4.2.2.3.5.2(c))

Seq. 11: Oxygen Demand Regulator Functional Test-Egress Mode

a. Evacuate ARS through JF9112 and GF9114 to 3.8 psia.

b. With Oxygen Demand Regulator "A" in "Egress" and Oxygen Demand Regulator "B" in "Closed", withdraw oxygen through JF9111 and GF9113 to simulate metabolic demand. (Para. 4.2.2.3.5.2(c))

Test Description: (Cont)

c. With Oxygen Demand Regulator "A" in "Closed" and Oxygen Demand Regulator "B" in "Egress", withdraw oxygen through JF9111 and GF9113 to simulate metabolic demand. (Para. 4.2.2.3.5.2(c))

d. Vent the ARS to ambient through GF9113 and JF9111.

Seq. 12: OCPS External Leakage Test

a. With both "Ref A" and "Reg B" closed measure the make-up leakage flow through JF9555 required to maintain 935 psig GOX in the OCPS. (Para. 4.2.2.3.5.1.1(A))

b. With "Reg A" closed and "Reg B" closed, measure internal leakage of the LSC-330-306 regulators with a VLD.

c. With "Reg A" set to Cabin and "Reg B" closed, measure internal leakage of the LSC-330-306 regulators with a VLD.

d. With "Reg A" set to Egress and "Reg B" closed, measure internal leakage of the LSC-330-306 regulators with a VLD.

e. With "Reg A" closed and "Reg B" set to Cabin, measure internal leakage of the LSC-330-306 regulators with a VLD.

f. With "Reg A" closed and "Reg B" set to Egress, measure internal leakage of the LSC-330-306 regulators with a VLD.

Seq. 13: Oxygen Shut-off Valve Internal Leakage Test

a. Descent O_2 Valve Positive Direction Leakage Test.

1. Pressurize upstream side of Descent O_2 Valve through GF9117 to 940 psig GN_2.

2. Measure leakage at JF9555 with a VLD.

b. PLSS O_2 Fill Valve Test

1. Pressurize upstream side of PLSS Fill Valve through GF9117 to 940 psig with GN_2.

2. Measure leakage at JF9555 with a VLD.

c. No. 1 Ascent O_2 Valve Test

1. Pressurize GOX Tank #1 through GF9117 to 940 psig GN_2.

2. With No. 1 ASC O_2 Valve closed vent Oxygen Control Module to ambient through GF9117.

3. With the Descent O_2 Valve closed measure leakage at JF9555 with a VLD.

4. Vent GOX Tank #1 to ambient through GF9117.

Test Description: (Cont)

d. No. 2 Ascent O_2 Valve Test

1. Pressurize GOX Tank #2 through GF9117 to 940 psig with GN_2.

2. With No. 2 ASC O_2 Valve closed, vent Oxygen Control Module to ambient through GF9117.

3. With Descent O_2 Valve closed measure leakage at JF9555.

e. Descent O_2 Valve - Negative Direction Test.

1. With PLSS Valve closed, pressurize Descent O_2 Valve at 940 psig with GN_2 from GOX Tank #2.

2. Measure leakage at GF9117.

Seq. 14: Emergency Ventilation Mode Test

a. Press. Reg. A Test

1. With Press. Reg. A in "Direct O_2" measure pressure decay of GOX Tank #2 for 5 minutes.

2. During pressure decay, perform a Tactile Flow Test from suit circuit diverter valve and cabin gas return valve.

3. Repressurize GOX Tank #2 and Oxygen Control Module through GF9117 to 940 psig with GN_2.

b. Press Reg B Test

1. With Press Reg B in "Direct O_2" measure pressure decay of GOX Tank #2 for five minutes.

2. During decay perform a Tactile Flow Test from Suit Circuit Diverter Valve and Cabin Gas Return.

Seq. 15: Securing After Test

a. Attach Alnor Dew Point Indicator to GSE downstream to GF9117, take two Dew Point readings from GOX Tank #2 through GF9117.

b. Vent GOX Tank #2 to ambient through GF9117.

c. Verify the mechanical interlock operational. With D/S O_2 valve open, either A/S valve will not open. (Para. 4.2.2.3.5.2(b))

d. Remove and stow GSE.

e. Configure vehicle for storage.

OCP OUTLINE

OCP-GF-33022-LM8

Test Title:

Water Management Section Leak and Functional Test

Subsystem:

Environmental Control

Test Objectives:

a. Verification of the structural and leakage integrity of the WMS.

b. Verification that the WMS exhibits satisfactory flow characteristics.

c. Functional check of the delta P transducer and water regulators.

d. Flush of the water tanks and WCM and verification of a cleanliness level in accordance with the requirements of LSP-14-0020, table II.

Vehicle Configuration:

Mated Stages

Location:

Integrated Workstand, Plant 5

Hazardous Operations:

Not Applicable

Equipment Under Test:

A/S and D/S water tanks, Water Control Module valves and regulators and low pressure network including -107 water boiler.

Test Description:

Seq. 01: Call to Station

Seq. 02: WMS Low Pressure Network Proof Pressure and Helium Leak Test

a. Proof pressurization of the low pressure network (excluding 209 & 224 W/B's) with helium at 12 psig.

b. Helium leak check of low pressure network at 9 psig.

c. Proof pressurization of suit circuit (107) W/B with helium at 10.6 psig and helium leak check of all fittings and connections. (Para. 4.2.2.3.7)

Test Description: (Cont)

Seq. 03: Leak Check of Water Tank Bladders

a. Measurement of leakages of the water tank bladders from the water side to gas side (bladders inflated) and from the gas side to the water side (bladders deflated) at 5 psig GN_2.

Seq. 04: Water Tank Pressure Decay Test - Water Side

a. Pressurization of gas side of water tanks with nitrogen to 6.5 psig. Pressurization of water tank bladders with nitrogen to 50 psig.

b. Pressurization of low pressure network (excluding water boilers) with nitrogen to 9 psig.

c. Five hour pressure decay test of water side of A/S and D/S water tanks.

Seq. 05: Water Tank Pressure Decay Test - Gas Side and WMS Flow Checkout with Water.

a. Pressurization of gas side of WMS with nitrogen to 5 psig and pressurization of the water side of the WMS with water to 50 psig.

b. Five hour pressure decay test on gas side of the A/S and D/S water tanks.

c. Cycling of WCM water regulators and measurement of water outlet pressure and flow rates at inlets to the water boilers. (Para. 4.2.2.3.7.1)

Seq. 06: WMS Flush and WCM Internal Leak Check

a. Flush of WMS with water to cleanliness level specified in LSP-14-0200.

b. Pressurization of WMS with nitrogen to 50 psig for internal leak check of all WCM valves and regulators. (Para. 4.2.2.3.7)

Seq. 07: WMS Purge, Evacuation and Blanket Pressure

a. Purge of WMS with hot nitrogen and evacuation to 500 microns.

b. Nitrogen fill and dew point measurement followed by application of GN_2 blanket pressure.

Seq. 08: Securing After Test

Test Title:

Cabin Proof Pressure Test, Cabin Leak Test, and Cabin Dump/Relief Valve Functional Test

Subsystem:

Environmental Control

Test Objectives:

Verification of structural integrity of the LM cabin and its pressure regulating characteristics.

Vehicle Configuration:

Ascent Stage

Location:

Cold Flow Facility

Hazardous Operation:

Cabin proof pressure to 7.7 psig

Components Under Test:

Cabin Structure, cabin dump/relief valves.

Test Description:

Seq. 01: Call to Stations

Seq. 02: Cabin and Docking Tunnel Proof Pressure Test (para. 4.2.2.1.5).

a. Proof pressure cabin with nitrogen to 7.7 psig.

b. Determine cracking pressure of upper hatch.

c. Locking torque test of upper and FWD hatch locking mechanisms. (Para. 4.2.2.1.6)

Seq. 03: Cabin and Docking Tunnel Leak Test and Cabin Relief/Dump Valve Functional Test (FWD) (Para. 4.2.2.3.5.7)

a. Pressurize cabin and docking tunnel to 5.0 psig with GN_2.

b. Determine cabin and docking tunnel leakage rate.

c. Perform functional test of FWD hatch dump/relief valve.

d. Determine leakage rate of ARS steam duct.

Test Description: (Cont)

e. Vent cabin and docking tunnel to ambient pressure.

f. Prepare vehicle for upper hatch dump/relief valve functional test.

Seq. 04: Cabin Leak Test and N.A.A. Drogue Fit Test at 5 psid. (Para. 4.2.2.1.7)

a. Pressurize cabin to 5 psig with GN_2.

b. Determine cabin leakage rate.

c. Conduct N.A.A. drogue fit test at 5 psig.

d. Verify drogue locking torque is less than 50 in # with the cabin at 5 psid.

Seq. 05: Cabin Relief/Dump Valve Functional Test (Para. 4.2.2.3.5.7) (Upper) and Drogue Fit Test at Ambient Pressure.

a. Increase Cabin pressure to perform Functional Test of Upper Hatch Dump Relief Valve.

b. Vent cabin to Ambient Pressure.

c. Conduct N.A.A. Drogue Fit Test at Ambient Pressure.

d. Verify drogue locking torque is less than 50 in #.

Seq. 06: Securing After Test

OCP OUTLINE

OCP-GF-33030-LM8

Test Title:

Descent Stage Oxygen Cabin Pressure Section Proof Pressure, External Leakage and Flow Check

Subsystem:

Descent stage ECS OCPS

Test Objectives:

a. To verify the mechanical integrity of the D/S ECS OCPS.

b. To verify the proper functional operation of the regulators and relief valves of the high pressure oxygen control module, part number LSC-330-392.

Vehicle Configuration:

Descent Stage

Location:

Cold Flow Facility

Hazardous Operations:

a. Pneumatic pressures up to 4000 psig.

b. Oxygen flow at 2800 psig.

Components Under Test:

D/S GOX Tank
D/S High Pressure Oxygen Control Assembly
D/S Oxygen Interstage Disconnect

Test Description:

Seq. 01: Call to Stations

Seq. 02: D/S OCPS Proof Pressure (Para. 4.2.2.3.5.1)

a. Pressurize the D/S GOX tank to 4000 psig with helium and maintain pressure for 1 minute. Performance x-ducer check at 600, 1200, 1800, and 2400 psig.

Seq. 02-011: Bypass Relief Valve Series Functional Test (Para. 4.2.2.3.5.5)

a. At approximately 2875 psig during the above pressurization cycle, observe change in discharge pressure being emitted through GF9118, which is indicative to either relief valve cracking.

Test Description: (Cont)

b. Depressurize system through GF9150 to 3100 psig. Then permit normal venting to continue through overboard relief valve port while observing for indication of valve reseating at approximately 2850 psig. Reseat determined by observing change in discharge pressure being emitted through GF9118.

Seq. 03: Primary Bypass Valve Cracking and Reseating Test (Para. 4.2.2.3.5.5)

a. With secondary relief valve overridden, repressurize the D/S GOX tank to 3100 psig with helium through GF9150 while observing for indication of primary relief valve cracking at approximately 2875 psig. Cracking is determined by noting change in discharge pressure being emitted through GF9118.

b. Permit normal relief valve action to vent through overboard relief valve port until reseating occurs at approximately 2850 psig. Reseat is determined by observing change in discharge pressure being emitted through GF9118.

Seq. 04: Secondary Bypass Relief Valve Cracking and Reseating Test (Para. 4.2.2.3.5.5)

a. With primary relief valve overridden, repressurize the descent stage GOX tank to 3100 psig with helium through GF9150 while observing for indication of secondary relief valve cracking at approximately 2875 psig. Cracking is determined by observing change in discharge pressure being emitted through GF9118.

b. Permit normal relief valve action to vent through overboard relief valve port until reseating occurs at approximately 2850 psig. Reseat is determined by observing change in discharge pressure being emitted through GF9118.

Seq. 05: Downstream Proof Pressure and Series Overboard Vent Relief Valve Functional Test (Para. 4.2.2.3.5.5)

a. Pressure downstream of regulators is increased using GN_2 and pressurizing through port GF9118 to 1090 psig while observing for indication of either relief valve cracking at approximately 1020 psig.

b. Downstream Proof Pressure (1090 psig) is held for one (1) minute.

Test Description: (Cont)

Seq. 06: OCPS D/S GOX System Helium Leak Check (Para. 4.2.2.3.5.1.1)

a. Pressurize D/S GOX Tank to 2800 psig with helium through GF9150.

b. Disengage GOX Tank fill disconnect and install flight cap. Close downstream isolation valve and disconnect line.

c. Probe all joints with helium leak detector.

d. After a two hour period elapses, for a pressure decay check, reconnect fill disconnect and downstream line.

e. Vent system through GF9150 to 1200 psig.

f. Vent system through GF9118 to atmosphere.

Seq. 07: OCPS Simulated GOX Tank Fill (Para. 4.2.2.3.5.1(b))

a. System is pressurized with GOX through GF9150 to 2800 psig.

Seq. 08: Cabin Repressurization Simulation (Series Regs.) (Para. 4.2.2.3.5.2)

GOX flow through GF9118 is established and maintained for twenty (20) seconds.

Seq. 09: Simulated Metabolic O_2 Consumption (Series Regs) (Para. 4.2.2.3.5.2)

The simulated metabolic flow rates are introduced and the resultant effects on discharge pressure are observed.

Seq. 10: Cabin Repressurization Simulation (Secondary Reg. Operating) (Para. 4.2.2.3.5.2)

GOX flow through GF9118 is established and maintained for twenty (20) seconds.

Seq. 11: Simulated Metabolic O_2 Consumption Secondary Regulator Operating (Para. 4.2.2.3.5.2)

Simulated metabolic flowrates are introduced and resultant effects on discharge pressure are observed.

Seq. 12: Simulated Cabin Repressurization - Primary Reg. Operating (Para. 4.2.2.3.5.2)

After tank pressure is re-established at 2700 psia (GOX), flow through GF9118 is established and maintained for twenty (20) seconds.

Seq. 13: Simulated Metabolic O_2 Consumption - Primary Reg. Operating (Para. 4.2.2.3.5.2)

Simulated metabolic flowrates are introduced and resultant effects on discharge pressure are observed.

Test Description: (Cont)

Seq. 14: Secondary Overboard Vent Relief Valve Test (Para. 4.2.2.3.5.5)

a. With primary relief valve overridden, the GOX tank pressure level is reestablished through GF9150 to approximately 2400 psig.

b. Pressure downstream of regulators is increased to 1090 psig through port GF9118 while observing for indication of secondary relief valve cracking at approximately 1020 psig.

c. Permit normal relief valve action to vent while observing for valve reseat to occur.

Seq. 15: Primary Overboard Vent Relief Valve Test (Para. 4.2.2.3.5.5)

a. With secondary relief valve overridden, the pressure downstream of regulators is increased through port GF9118 to 1090 psig while observing for indication of primary relief valve cracking at approximately 1020 psig.

b. Permit normal relief valve action to vent while observing for valve reseat to occur.

Seq. 16: D/S OCPS GN_2 Pressure Purge (Para. 4.2.2.3.5.1)

a. Vent system through GF9118 to ambient.

b. Pressurize Descent Stage GOX Tank to 700 psig with GN_2 through GF9150.

c. Vent system through GF9118 to ambient.

d. Pressurize Descent Stage GOX Tank to 700 psig with GN_2 through GF9150.

e. Vent system through GF9118 to ambient.

Seq. 17: Securing After Test

Test Title:

D/S Water Management Section Proof and Leak Check.

Subsystem:

Environmental Control - WMS

Test Objectives:

a. Verification of the structural integrity of the D/S water tank and associated lines.

b. Verification of maximum indicated leak rate at any single point of 2X10-7 SCC/SEC.

Vehicle Configuration:

Descent Stage

Location:

Cold Flow Test Facility

Hazardous Operation:

Large Tank Volume at 65 psig - GHe

Components Under Test:

D/S Water Tank
WQMD Instrumentation Port
QD's Water GF9108, and Gas (GF9109)
Lines and Fittings

Test Description:

Seq. 01: Call to Station

Seq. 02: Proof Pressure and Pressure Decay Test

a. Pressurization of inside and outside of tank bladder simultaneously to 63-65 psig, with helium for one minute.

b. Reduction of pressure to 49 to 51 psig for a two (2) minute decay check with a maximum allowable pressure decay of 1 psig.

Seq. 03: D/S WMS GHe Leak Test

a. External leak check of all components, lines, and fittings.

b. Repair or replacement of any item where leak rate exceeds $2X10^{-7}$ SCC/SEC, indicated.

Seq. 04: Venting

a. Venting system to a pad pressure of 6 psig.

Seq. 05: Securing After Test

OCP OUTLINE

OCP-GF-33067-LM8

Test Title:

A/S Water Management Section Proof and Leak Check

Subsystem:

Environmental Control - WMS

Test Objectives:

a. Verification of the structural integrity of the A/S water tanks and the valves, lines, and fittings in the high pressure network, including the PLSS hose.

b. Verification of maximum indicated leak rate at any single point from the tanks to the primary and secondary regulators of $4X10^{-8}$ SCC/SEC.

Vehicle Configuration:

Ascent Stage

Location:

Cold Flow Test Facility

Hazardous Operation:

Large Tank Volume at 65 psi - GHe

Components Under Test:

A/S Water Tank (2)
WQMD Instrumentation Ports
Water Control Module
PLSS Hose & QD
QD's - Water & Gas GF9106, GF9107, GF9105, GF9104
Lines and Fittings

Test Description:

Seq. 01: Call to Stations

Seq. 02: A/S WMS Proof Pressure Test (Para. 4.2.2.3.7)

a. Pressurization of inside and outside of tank bladders simultaneously to 63-65 psig, with helium for 1 minute.

Seq. 03: Pressure Decay Check (Para. 4.2.2.3.7)

a. Pressurization of system from 49 to 51 psig for a two (2) minute decay check with a maximum allowable pressure decay of 1 psi.

Seq. 04: A/S WMS GHe Leak Test (Para. 4.2.2.3.7)

a. External leak check of all components, lines, and fittings in the high pressure system.

Test Description: (Cont)

b. Repair or replacement of any item where leak rate exceeds $4X10^{-8}$ SCC/SEC indicated.

Seq. 05: Venting

a. Venting of the system to a pressure of 5 psig.

Seq. 06: Securing After Test

OCP OUTLINE

OCP-GF-33068-LM8

Test Title:

D/S HTS Proof and Leak Check

Subsystem:

ECS - D/S HTS

Test Objectives:

To verify the structural integrity of the D/S. HTS

Vehicle Configuration:

Descent Stage

Location:

Integrated workstand, Plant 5

Hazardous Operations:

Pneumatic Pressures up to 60 psig

Components Under Test:

D/S W/G Supply and Return Interstage Disconnects
D/S W/G Supply and Return Flex Lines
D/S HTS Gamah TEE's, Unions, and Bulkhead fittings
D/S HTS Cold Plate Assemblies

Test Description:

Seq. 01: Call to Stations

Seq. 02: D/S HTS Proof Pressure and Leak Check

a. Pressurization of D/S HTS with helium at 60 psig for 1 minute. (Proof Pressure Test) (Para. 4.2.2.3.6).

b. Pressure decay test of the D/S HTS with helium at 45 psig for 15 minutes.

c. Leakage test of the D/S HTS W/G Supply and return interstage disconnects (Para. 4.2.2.3.6).

d. Leakage test of the D/S HTS W/G supply and return flex lines. (Para. 4.2.2.3.6).

e. Leakage test of the D/S HTS Gamah unions, TEE's and bulkhead fittings (Para. 4.2.2.3.6).

f. Leakage test of the D/S HTS cold plate assemblies (Para. 4.2.2.3.6).

Test Description: (Cont)

Seq. 03: D/S Primary HTS Pressure Decay Test

a. Pressure Decay Test of the D/S HTS with nitrogen at 45 psig for 4 hours (Para. 4.2.2.3.6).

Seq. 04: Securing After Test

OCP OUTLINE

OCP-GF-33070-LM8

Test Title:

Installation of Water Boilers and Verification Test of Water Glycol Fill

Subsystem:

Heat Transport Section - ECS

Test Objectives:

Verification of the W/G Fill of the Heat Transport Section and installation Water Boilers for safe shipment of LM vehicle.

Vehicle Configuration:

Ascent and Descent Stages

Location:

Integrated Work Stand Plant 5

Hazardous Operations:

Water-Glycol Mixture - Possibility of Spillage

Components Under Test:

W/G Fluid Lines and Accessories

Coolant Accumulator

W/G Pump Discharge Pressure Transducer

Water Boiler Outlet Temperature Transducer

W/G Quick Disconnects

Primary Water Boiler

Secondary Water Boiler

Test Description:

Seq. 01: Call to Stations

Seq. 02: and Seq. 03: Installation of Primary Water Boiler

Seq. 04: and Seq. 05: Installation of Secondary Water Boiler

Test Description: (Cont).

Seq. 06: GSE Power Activation and W/G Circulation Secondary Loop (Para. 4.2.2.3.6.5(b))

a. Activation of GSE for functional check

b. Circulation of rated amount of W/G through the secondary loop

c. Heating of W/G in the secondary loop to an average temperature of 120°F.

d. De-Activation of GSE at rated pressure and temperature. Disconnection of vehicle secondary loop lines from GSE.

e. Monitoring of W/G pressure and temperature.

Seq. 07: Activation of Vehicle Power and W/G Level Adjustment - Primary Loop

a. Activation of W/G transducers for functional check

b. Adjustment and setting of accumulator level with reference to W/G temperature

c. Disconnection of vehicle primary loop lines from GSE.

Seq. 08: Gas Entrapment Test - Primary Loop (Para. 4.2.2.3.6.5(a))

Seq. 09: Connection of A/S and D/S Interstage Supply and Return Lines

Seq. 10: Securing After Test

OCP OUTLINE

OCP-GF-33071-LM8

Test Title:

Cabin Leak Test

Subsystem:

Environmental Control

Test Objectives:

Verification of structural integrity of the LM cabin prior to shipment to KSC.

Vehicle Configuration:

Ascent Stage

Location:

Cold Flow Facility

Hazardous Operation:

Pressurization of the cabin to 5.0 psig

Components Under Test:

Cabin structure

Test Description:

Seq. 01: Call to Stations

Seq. 02: Cabin Leak Test (Para. 4.2.2.3.5.7(a) and (b))

a. Pressurization of the cabin to 5.0 psig with GN_2.

b. Determination of the Cabin Leakage Rate.

c. Venting of the Cabin to Ambient Pressure.

Seq. 03: Securing After Test

OCP OUTLINE

OCP-GF-36015-LM8

Test Title:

Pulse Code Modulation and Timing Electronics Assembly (PCMTEA) Turn-On and Verification.

Subsystem:

Instrumentation

Test Objectives:

a. Verification of the functional operation of the PCMTEA.

b. Verification of the PCMTEA timing signals in the high bit rate at the GSE connector.

c. Verification of split phase voltage in the low bit rate at the GSE connector.

d. Verification of the synchronization of the acceptance checkout equipment-spacecraft (ACE-S/C) with the airborne PCMTEA.

e. Verification of pulse code modulation and transmission, in all assigned time slots of high and low bit rates, via hardline to the ACE-S/C, of the following PCMTEA parameters:

   1. 15 and 85 percent levels of the calibration voltage.

   2. SYNC code and prime frame ID words.

   3. Mission elapsed time.

   4. Data rate format ID words.

   5. Oscillator failure detection circuits.

Vehicle Configuration:

Ascent stage

Location:

Integrated work stand, Plant 5 CEF

Hazardous Operation:

Not applicable.

Component Under Test:

LSC360-2-5-8 PCMTEA

OCP OUTLINE

OCP-GF-34000-LM8

Test Title:

Waste Management Section - External Leakage Test

Subsystems:

Crew Provisions

Test Objectives:

Establishment of Leakage Integrity of the Waste Management Section

Vehicle Configuration:

Ascent Stage or Mated Vehicle

Location:

Integrated Workstand, Plant 5

Hazardous Operations:

Not Applicable

Components Under Test:

PLSS Condensate Hose Assy.
PLSS Condensate Collector Assy.
Quick Disconnect

Test Description:

Seq. 01: Call to Stations

Seq. 02: Condensate Collector Assembly Relief Valve Operating Pressure Test (Para. 4.2.2.4.3)

a. Record cracking and seating pressure of relief valve. (Para. 4.2.2.4.3(c))

Seq. 03: Condensate Transfer Assembly External Leakage Test Set-Up (Para. 4.2.2.4.3(b))

a. Pressurization of Condensate Transfer Assembly to 1.3 psig. (Para. 4.2.2.4.3(b))

b. Leakage test of the Condensate Transfer Assembly with a Helium Leak Detector. (Para. 4.2.2.4.3(b))

Seq. 04: Securing After Test

OCP OUTLINE

OCP-GF-36527-LM8

Test Title:

Data Channel Verification

Subsystem:

Instrumentation

Test Objectives:

a. Verification of the operational instrumentation data channels which go through either of the two signal conditioner electronics assemblies (SCEA) by simulating transducer and signal sensors at the SCEA input connectors.

b. Verification of measurements are monitored at their normal points of readouts as applicable.

   1. Cabin display only

   2. ACE-S/C only

   3. Cabin displays and ACE-S/C

c. Verification of CWEA data logic channels by simulated signals at the SCEA input connectors.

Vehicle Configuration:

Ascent stage

Location:

Integrated work stand, Plant 5, CEF

Hazardous Operation:

Not Applicable

Components Under Test:

LSC 360-5-1010-1 SCEA #1
LSC 360-5-1020-1 SCEA #2
LSC 360-8-9 CWEA
LSC 360-2-5-8 PCMTEA

Test Description:

Seq. 01: Call to Stations

Seq. 02: Verification of support system status

Seq. 03: Verification of displays turn-on

Seq. 04: Verification of 0-5 VDC analog channel

Test Description:

Seq: 01-000	Call to stations
Seq: 02-000	Support system status verification
Seq: 02-001	DC power application to the vehicle busses
Seq: 03-000	PCMTEA turn-on and signal verification
Seq: 03-004	Verification of the split phase voltage in the low bit rate at the GSE connector
Seq: 03-006	Verification of the PCMTEA timing signals in the high bit rate at the GSE connector
Seq: 04-000	PCMTEA/GSE umbilical interface verification (HI-BIT RATE)
Seq: 04-003	Verification of the 15 percent and 85 percent levels of the calibration voltage.
Seq: 04-004	Verification of PCMTEA mission elapsed time updating at one second intervals
Seq: 04-005	Verification of the data rate format ID word, 00011011 (High Bit Rate)
Seq: 05-000	PCMTEA mission elapsed time reset verification
Seq: 05-005	Verification that mission elapsed time is updating from zero at one second intervals after reset.
Seq: 06-000	PCMTEA HI-BIT to LO-BIT rate verification
Seq: 06-006	Verification of PCMTEA HI-BIT to LO-BIT rate switchover by actuating the COMM-TLM PCM switch in the vehicle from HI to LO.
Seq: 07-000	PCMTEA umbilical interface verification (LO-BIT RATE)
Seq: 07-002	Verification of the 15 percent and 85 percent levels of the calibration voltage.
Seq: 07-003	Verification of PCMTEA mission elapsed time updating at one second intervals.
Seq: 07-004	Verification of data rate format ID word, 11100100 (Low Bit Rate).
Seq: 08-000	PCMTEA LO-BIT to HI-BIT RATE Verification
Seq: 08-006	Verification of PCMTEA LO-BIT to HI-BIT rate switchover by actuating the COMM-TLM PCM switch in the vehicle from LO to HI.
Seq: 09-000	2048 KHZ crystal oscillator failure detection circuit verification.
Seq: 09-009	Verification of oscillator failure detector #1 (Discrete) - High Bit Rate
Seq: 09-012	Verification of oscillator failure detectors #2 & #3 (Analog) - High Bit Rate.
Seq: 09-022	Verification of oscillator failure detector #1 (Discrete) - Low Bit Rate.
Seq: 09-025	Verification of oscillator failure detectors #2 & #3 (Analog) - Low Bit Rate
Seq: 10-000	Securing After Test

Test Description: (Cont)

Seq. 31: Verification of Sel. coolant pump fail Channel (Para. 4.2.2.12.4)

Seq. 32: Verification of emer 02 vlv elec/VPI open Channel (Para. 4.2.2.12.4)

Seq. 33: Verification of LGC Warning Channel (Para. 4.2.2.12.4)

Seq. 34: Verification of ISS Warning Channel (Para. 4.2.2.12.4)

Seq. 35: Verification of pitch trim fail Channel (Para. 4.2.2.12.4)

Seq. 36: Verification of roll trim fail Channel (Para. 4.2.2.12.4)

Seq. 37: Verification of L/R data vel/rng NG Channel (Para. 4.2.2.12.4)

Seq. 38: Verification of R/R no track ind Channel (Para. 4.2.2.12.4)

Seq. 39: Verification of Prop tank lvl low Channel (Para. 4.2.2.12.4)

Seq. 40: Verification of fuel tank level low Channel (Para. 4.2.2.12.4)

Seq. 41: Verification of O_2 tank level low Channel (Para. 4.2.2.12.4)

Seq. 42: Verification of AEA test cond fail Channel (Para. 4.2.2.12.4)

Seq. 43: Verification of jet drivers Channel (Para. 4.2.2.12.4)

Seq. 44: Verification of ED system "A" relay transfer Channel (Para. 4.2.2.12.4)

Seq. 45: Verification of ED system "B" relay transfer Channel (Para. 4.2.2.12.4)

Seq. 46: Verification of volt select S-band receiver AGC Channel (Para. 4.2.2.12.4)

Seq. 47: Verification of commanders bus voltage Channel (Para. 4.2.2.12.4)

Seq. 48: Verification of system eng'r bus voltage Channel (Para. 4.2.2.12.4)

Seq. 49: Verification of suit outlet press Channel (Para. 4.2.2.12.4)

Seq. 50: Verification of CO_2 part pressure Channel (Para. 4.2.2.12.4)

Seq. 51: Verification of H_2O sep rate Channel (Para. 4.2.2.12.4)

Seq. 52: Verification of manifold pres reg. Channel (Para. 4.2.2.12.4)

Seq. 53: Verification of pres. He tank No. 1 Channel (Para. 4.2.2.12.4)

Seq. 54: Verification of pres. He tank No. 2 Channel (Para. 4.2.2.12.4)

Seq. 55: Verification of pres fuel/isol valve Channel (Para. 4.2.2.12.4)

Seq. 56: Verification of pres O_2/isol valve Channel (Para. 4.2.2.12.4)

Test Description: (Cont)

Seq. 05: Verification of 0-40 VDC analog channel

Seq. 06: Verification of 0-12 VDC analog channel

Seq. 07: Verification of 0-14.6 VDC analog channel

Seq. 08: Verification of -10 VDC to +10 VDC analog channel

Seq. 09: Verification of -13 to +13 VDC analog channel

Seq. 10: Verification of +/-3.5 VRMS 800 HZ analog channel

Seq. 11: Verification of 15 VRMS 400 HZ channel

Seq. 12: Verification of 115 VRMS 400 HZ analog channel

Seq. 13: Verification of resistance channel 1364 Ohms-1671 Ohms

Seq. 14: Verification of resistance channel 1364 Ohms-1793 Ohms

Seq. 15: Verification of resistance channel 1363 Ohms-1913 Ohms

Seq. 16: Verification of resistance channel 665 Ohms-2795 Ohms

Seq. 17: Verification of resistance channel 665 Ohms-1913 Ohms

Seq. 18: Verification of discrete channel contact closures

Seq. 19: Verification of discrete channel solid state closures

Seq. 20: Verification of high bit rate/low bit rate dump (Para. 4.2.2.2.2.1.2)

Seq. 21: ISG CWEA test preparation (Para. 4.2.2.12.3 & 4.2.2.12.4)

Seq. 22: Verification of Bat. 1, ECA 1 Channel (Para. 4.2.2.12.4)

Seq. 23: Verification of Bat. 2, ECA 1 Channel (Para. 4.2.2.12.4)

Seq. 24: Verification of Bat. 3, ECA 2 Channel (Para. 4.2.2.12.4)

Seq. 25: Verification of Bat. 4, ECA 2 Channel (Para. 4.2.2.12.4)

Seq. 26: Verification of Bat. 5, ECA 3 Channel (Para. 4.2.2.12.4)

Seq. 27: Verification of Bat. 6, ECA 4 Channel (Para. 4.2.2.12.4)

Seq. 28: Verification of Prim. Suit comp fail Channel (Para. 4.2.2.12.4)

Seq. 29: Verification of spare suit comp fail Channel (Para. 4.2.2.12.4

Seq. 30: Verification of coolant accum. Channel (Para. 4.2.2.12.4)

Test Description: (Cont)

Seq. 57: Verification of des eng arm press He reg. Channel (Para. 4.2.2.12.4)

Seq. 58: Verification of +28VDC ASA Channel (Para. 4.2.2.12.4)

Seq. 59: Verification of +12VDC ASA Channel (Para. 4.2.2.12.4)

Seq. 60: Verification of press He tank A Channel (Para. 4.2.2.12.4)

Seq. 61: Verification of press He tank B Channel (Para. 4.2.2.12.4)

Seq. 62: Verification of press He reg A Channel (Para. 4.2.2.12.4)

Seq. 63: Verification of press He reg B Channel (Para. 4.2.2.12.4)

Seq. 64: Verification of Des O_2 Press Channel (Para. 4.2.2.12.4)

Seq. 65: Verification of ASC O_2 Press 1 and 2 Channel (Para. 4.2.2.12.4)

Seq. 66: Verification of Des H_2O qty Channel (Para. 4.2.2.12.4)

Seq. 67: Verification of Asc H_2O qty 1 and 2 Channel (Para. 4.2.2.12.4)

Seq. 68: Verification of +15VDC supply Channel (Para. 4.2.2.12.4)

Seq. 69: Verification of +4.3VDC supply Channel (Para. 4.2.2.12.4)

Seq. 70: Verification of +6VDC supply Channel (Para. 4.2.2.12.4)

Seq. 71: Verification of -15VDC supply Channel (Para. 4.2.2.12.4)

Seq. 72: Verification of -6BDC supply Channel (Para. 4.2.2.12.4)

Seq. 73: Verification of -4.7VDC supply Channel (Para. 4.2.2.12.4)

Seq. 74: Verification of -4.7VDC back up supply Channel (Para. 4.2.2.12.4)

Seq. 75: Verification of freq. ASA, 29V, 400 HZ Channel (Para. 4.2.2.12.4)

Seq. 76: Verification of RGA IPH pickoff, 0.8 KHZ Channel (Para. 4.2.2.12.4)

Seq. 77: Verification of inv. bus bolt and freq Channel (Para. 4.2.2.12.4)

Seq. 78: Verification of phase A, B, C, RGA spinmotor Channel (Para. 4.2.2.12.4)

Seq. 79: Verification of temp, upstream of crit elec Channel (Para. 4.2.2.12.4)

Seq. 80: Verification of temp, quad cluster No. 4 Channel (Para. 4.2.2.12.4)

Seq. 81: Verification of temp, quad cluster No. 3 Channel (Para. 4.2.2.12.4)

Seq. 82: Verification of temp, quad cluster No. 2 Channel (Para. 4.2.2.12.4)

Seq. 83: Verification of temp, quad cluster No. 1 Channel (Para. 4.2.2.12.4)

Test Description: (Cont)

Seq. 84: Verification of R/R ant. loop Channel (Para. 4.2.2.12.4)

Seq. 85: Verification of temp S-band ster. ant. Channel (Para. 4.2.2.12.4)

Seq. 86: Verification of master alarm relay driver redundancy (Para. 4.2.2.12.4)

Seq. 87: Verification of CWEA Pwr Caution (Para. 4.2.2.12.4)

Seq. 88: Securing after test

Test Title:

LM Combined Subsystem Pre-FEAT Test - Control

Subsystem:

All LM Spacecraft Subsystems

Test Objective:

a. Provide a controlling document which will demonstrate the functional performance and integration of multiple subsystems of the LM Spacecraft Vehicle.

b. A Bar Chart will control the test flow serially or in parallel for:

OCP-GF-62000-ECS
OCP-GF-62000-INSTR
OCP-GF-62000-EPS
OCP-GF-62000-EDS
OCP-GF-62000-G&N
OCP-GF-62000-PROP
OCP-GF-62000-RCS
OCP-GF-62000-COMM
OCP-GF-62000-RAD
OCP-GF-62000-FCS

c. A Constraint Chart will provide alternate test flow if desired flow cannot be maintained as a result of troubleshooting or other conditions.

d. Insure control of GSE support equipment by means of OCP-GF-62000-IPC.

e. Insure initial LM Spacecraft Cabin Configuration.

f. Furnish the listings of applicable drawings, measurements monitored, non-standard abbreviations and symbols, personnel requirements, safety requirements, standard and special instructions, limited life equipment and communication channel assignments.

Vehicle Configuration:

Ascent and Descent Stages mechanically and electrically mated.

Location:

Integrated Workstand, Plant 5

Hazardous Operations:

Hazardous working conditions as outlined in the referenced Satellites.

Equipment Under Test:

EPS - Electrical Power Subsystem

LTG - Lighting Subsystems

PGNS - Primary Guidance and Navigation Subsystem

LR - Landing Radar Subsystem

RR - Rendezvous Radar Subsystem

AGS - Abort Guidance Subsystem

CES - Control Electronics Section

RCS - Reaction Control System

PROP - Propulsion Subsystem

EDS - Explosive Devices Subsystem

COMM - Communications Subsystem

Inst - Instrumentation Subsystem (including Caution and Warning)

D&C - Display and Controls

ECS - Environmental Control Subsystem

Test Description:

1. Authorizes the performance of all testing after ensuring that cooling support has been made available via SMP 3356.

2. The STE directs S/S TC's (EPS, RCS, INST & EDS) in the serial execution of discrete sequences within each of the satellites.

3. Parallel testing is initiated once the ECA's within the EPS S/S have been functionality verified. Upon completion of portions of EPS, RCS, COMM and EDS tests, parallel testing of the G&N and PROP S/S is begun.

4. Vehicle activities are constrained during AOT and Fine Alignment Sequences of the G&N satellite after which G&N is then used to support FCS for several sequences.

5. ECS and RAD testing commences in parallel. G&N support is directed for several sequences within the RAD and COMM satellites.

6. FCS testing is performed serially upon completion of RAD testing with G&N and RAD support directed as required.

7. ECS heat load tests are performed upon completion of FCS followed by parallel operation of the final sequences to verify performance of ECS, PROP, COMM and EPS.

Test Description: (Cont)

8. The document provides the procedure for shutdown of Instrumentation, followed by a verification of bus isolation per EPS satellite. Removal of electric power and shutdown of cooling support are performed upon completion of all tests.

9. The control document authorizes sequences of satellites to be performed out of numerical order. This design permits maximum flexibility in performance of tests.

Test Title:

LM Combined Subsystem Pre-FEAT Test - Environmental Control

Subsystem:

Environmental Control Subsystem (ECS)

Test Objectives:

a. To verify pump parameters and the response of the Heat Transport Section (HTS) to the cabin temperature control valve settings.

b. To verify the performance of the Atmosphere Revitalization Section (ARS).

c. To verify the operation of the ECS Operational Instrumentation.

d. To verify the operation of applicable ECS portions of the Caution and Warning Subsystems.

e. To verify the integrated performance of the HTS and ARS.

f. To verify the capability of the Emergency Cabin and Suit Repressurization sections to function properly in all of their operating modes while functionally interfaced with EPS and Instrumentation.

g. To verify the various electrical interlocks between the oxygen demand regulators and the cabin pressure switch for the operation of the cabin repress valve, the suit diverter valve, and the cabin fans.

h. To verify that WMS exhibits satisfactory flow characteristics with GN_2 and to functionally check the WQMD's.

Vehicle Configuration:

Mated

Location:

Integrated or Ascent Workstand, Plant 5

Hazardous Operation:

Pneumatic pressure to 250 psig

Equipment Under Test:

Water Control Module (All Valves & Regs)

Suit Circuit Assembly

Oxygen Control Module (All Valves)

Equipment Under Test: (Cont)

Cabin Air Recirculation Assy (H/X & Fans)

ECS Relay Box

Water Glycol Pumps (Both Prim. & Sec.)

Water Glycol Accumulators

WQMD's

Cabin Pressure Switch

ECS Circuit Breakers

CO_2 Sensor

LiOH Cartridges and Canisters

ECS Transducers (All but GF3591 & GF3592)

ECS Display Meters and Advisory Lites

ECS Parts of Vehicle Harness

Test Description:

Seq. 01: Call to Station

Seq. 02: Water Management Section

a. WQMD Calibration

1. The WQMD is calibrated for a 0.75 fill ratio for the Descent and Ascent H_2O tanks. A zero setting is obtained at a pressure of 12.0 psia nominal, and a 100% setting at 48.2 psia nominal.

b. Water Tanks

1. The water tanks are pressurized with GN_2 to check the Caution and Warning System at the following three points: (Para 4.2.2.3.7.2)

(a) Low level (10 PCT) of D/S water tank

(b) Non-full condition (95 pct) of either or both A/S water tanks

(c) Unequal level (15 pct difference) between the two A/S water tanks.

Test Description: (Cont)

c. WMS GN_2 Flow Tests

1. Correlation of the H_2O flow (in another OCP) with GN_2 flow is accomplished with the primary, and redundant H_2O regulators biased at 3.8 and 4.8 psig.

Seq. 03: OCPS Verification and Descent and Ascent O_2 Tank Checkout

a. OCPS Verification

1. Operation of the suit isolation and cabin repress valves are checked by simulating loss of cabin pressure and suit pressure. (Para. 4.2.2.3.5.2 a & 4.2.2.3.3 d)

2. The cabin repress valve, diverter valve and cabin pressure switch are checked out with the O_2 pressure regulators in all logic configurations. (Para. 4.2.2.3.5.4)

3. Verify the operation of the mechanical interlock & manual override between GOX tank selector valves. (Para. 4.2.2.3.5.2 b)

b. O_2 Tanks - C&WEA Verification (Para. 4.2.2.3.5.6)

1. Descent O_2 Tank - 'low level' caution light is activated at 135 ± 85 psia.

2. Ascent O_2 Tank #1 - 'low level' caution verification of caution light at 100 ± 30 psia.

Seq. 04: Atmosphere Revitalization Section (ARS)

a. Suit Fan 1 Test and Checkout of Suit Flow Valves in Suit Disconnect Position (Normal Mode). (Para. 4.2.2.3.3 a)

1. Verify that the valve position indicators (Event lights) at ACE operate for: (Para. 4.2.2.3.3)

   (a) Cabin gas return valve

   (b) O_2 pressure regulators A & B

   (c) Suit isolation valves

   (d) Suit circuit relief valve

2. Verify the operating parameters of Suit Fan 1. (Para. 4.2.2.3.3. a)

3. Verify the flow division characteristic of either the CDR's or SE's Suit Isol. valve in the suit disconnect position. (Para. 4.2.2.3.3)

Test Description: (Cont)

b. CO_2 Sensor Verification. (Para. 4.2.2.3.2)

1. Inst. Interface

(a) CWEA

(b) PCM

(c) ACE S/C

(d) Cabin Displays

2. EPS Interface

3. At various stimuli points.

c. C/O of Suit Fan 1 Flow Through LiOH Cartridges in Normal and Egress Mode. (Para. 4.2.2.3.3)

1. Verify that with the LiOH cartridges installed and simulated suit pressure drops, Suit Fan 1 can supply the minimum specified flow in the normal and egress mode (4.8 and 3.8 psia respectively). (Para. 4.2.2.3.3 a)

2. Verify speed of water separators 1 & 2.

3. Vary suit differential pressure and record corresponding suit supply flow. (Para. 4.2.2.3.3)

d. Pump Failure C/W Test. (Para. 4.2.2.3.6.1)

1. Verify the primary glycol pump failure input to the ECS caution light of the Caution and Warning Subsystem.

e. Suit Fan 1 and Water Separator C/W Test. (Para. 4.2.2.3.3)

1. Verify suit fan 1 failure and water separator failure inputs to the ECS caution light of the Caution and Warning Subsystem.

f. Suit Fan 2 Test (Normal and Egress Mode). (Para. 4.2.2.3.3)

1. Verify the operating parameters of Suit Fan 2. (Para. 4.2.2.3.3 a)

2. Vary suit differential pressure and record corresponding suit supply flow. (Para. 4.2.2.3.3)

g. Suit/Fan 2 C/W Test. (Para. 4.2.2.3.3)

1. Verify Suit Fan 2 failure input to the Suit/Fan warning light of the Caution and Warning Subsystem.

Test Description: (Cont)

h. Removal of LiOH Cartridge

1. With suit loop at atmospheric pressure, remove primary and PLSS LiOH cartridges.

Seq. 05: Heat Transport Section (HTS) - Coolant Pump Checkout

a. Primary Glycol Pump Tests (Para. 4.2.2.3.6.1)

1. Activate pump No. 2 and record its operating parameters and then deactivate.

2. Activate pump No. 1 and record its operating parameter and deactivate.

3. With TCU verify W/G flow is over 225 PPH Min. for the measured pump Delta Pressure.

b. Primary Glycol Pump Auto-Switchover (S/O) (Para. 4.2.2.3.6.1)

1. Verification of the automatic S/O to glycol pump No. 2 in the event glycol pump No. 1 fails. Pump No. 1 CB is pulled simulating failure and S/O is verified by observing the ACE event and component caution light are on and the maintenance of pump pressure.

c. Secondary Glycol Pump Test (Para. 4.2.2.3.6.1)

1. Activate secondary glycol pump and record its operating parameters and deactivate.

2. With TCU verify W/G flow is over 225 PPH Min. for the measured pump discharge pressure.

d. Glycol Overtemp. and Glycol Accumulator Low Level Test (Para. 4.2.2.3.6.2)

1. Verifies the High Glycol Temp Input - greater than 50 deg. F, (nominal) to the glycol caution light. Dry ice is used to lower the temp at the transducer inhibiting the caution light which is activated once more at the end of this sequence upon rise of temp due to removal of the dry ice. The temperature at which the glycol caution light is reactivated is recorded.

2. Verifies the primary and secondary low glycol accumulator level inputs at ten percent (10%) nominal to the glycol caution light.

3. Verification of proper accumulator level at glycol caution light activation is accomplished by draining the accumulator into the portable fill reservoir.

Test Description: (Cont)

4. Verify springload of primary and secondary accumulators at 5 to 15 percent by observing that the pump outlet pressure (static) is within specification limits.

5. Restore normal accumulator configuration.

Seq. 06: ECS HTS System Head Curves

a. Vary glycol flow and temperature through primary glycol loop and record delta P across the pumps and pump discharge pressure at each flow.

b. Vary glycol flow and temperature through secondary glycol loop and record pump discharge pressure at each flow.

Seq. 07: H/X and Cabin Temperature Control Functional Test (Para. 4.2.2.3.6.3)

a. Verify the ability of the glycol loop to respond to hot and cold cabin temperature control valve settings by establishing and recording relationships of temperatures at various points in the primary glycol loop for the maximum cool, normal, and maximum heat positions of the cabin temperature control valve.

Seq. 08: Suit Circuit Assembly - Heat Transport Section Interface Functional Test (Egress Mode, 3.8 Psia Nominal) (Para. 4.2.2.3.3 b and 4.2.2.3.6.4)

a. Verify the ability of the suit loop and the HTS to function together to control the suit loop temperature and to remove simulated metabolic water which is introduced into the suit loop as steam.

b. Suit Circuit Assembly - Heat Transport Section Interface Functional Test (Normal Mode, 4.8 Psia Nominal) (Para. 4.2.2.3.3 b & 4.2.2.3.6.4)

1. Verify the ability of the suit loop and the HTS to function together to control the suit loop temperature and to remove a simulated metabolic load which is introduced into the suit loop as water and heat.

Seq. 09: ECS Shutdown and Water Collection

a. Shutdown ECS and GSE which were operational in previous sequences.

b. Drain accumulated water in suit loop and GSE.

1. Record volume in GSE water reservoir

2. Record volume of H_2O from lines to reservoir

Test Description: (Cont)

3. Drain H_2O accumulated in 'canned-man' (LSC 430-91033-11) from H_2O drain, cabin port and suit port and record.

4. Reconfigure to all fittings and valves to OCP initial configuration.

Seq. 10: Drying Suit Loop and Canned Man

a. Dry the SGTS and the SCA

1. Remove the hoses from the SCA to SGTS.

2. Establish heated purge of SCA, and SGTS using GN_2 conditioning cart.

3. After drying is accomplished the original equipment configuration is established to allow the performance of FEAT.

Seq. 11: Securing After Test

a. Reverification of the leakage integrity of the ARS/WMS interface.

b. Reverification of the leakage integrity of the ARS/CO_2 Sensor interface.

c. Configuration of spacecraft ECS and ECS GSE controls to safe storage configuration.

OCP OUTLINE

OCP-GF-62000-INSTR-LM-8

Test Title:

LM Combined Subsystem Pre-FEAT Test - Instr

Subsystem:

Instrumentation

Test Objectives:

To turn on the LM Instrumentation Subsystem and to provide minimal verification of the adequate operation of the PCMTEA.

To test the logic of those CWEA data channels available at the SCEA GSE Connectors.

Vehicle Configuration:

a. Planned - Electrically connected stages (Ascent and Descent)

b. Minimum - Ascent Stage with staging interconnections shorted to simulate attached Descent Stage.

Location:

Integrated Test Standard

Hazardous Conditions:

Not Applicable

Equipment Under Test:

PCM/TEA

SCEA #1

SCEA #2

CWEA

Selected Transducers

Test Description:

Seq. 001: Call to Stations

Seq. 002: Instrumentation Turn-on and Verification (Para. 4.2.2.12.2 a)

a. PCMTEA/GSE umbilical interface verification (Hi-bit rate)

b. PCMTEA mission elapsed time reset verification

Test Description: (Cont)

c. EPS AC and DC CRT bus readout check

d. PCMTEA and SCEA remote turn-on verification

e. PCMTEA oscillator failure detection circuit (hi-bit rate)

Seq. 003: CWEA Displays Turn-on and Self-Test (Para. 4.2.2.12.2 (b))

a. CWEA Displays Turn-on

b. CWEA Displays Self-Test

Seq. 004: CWEA Stimuli Generator Test (Para. 4.2.2.12.4)

a. CES AC Warning

b. CES DC Warning

c. AGS Warning

d. PRE AMPS Caution

e. Heater Caution

f. O_2 QTY Caution

g. INVERTER Caution

h. ASC HI REG Caution

i. RCS Caution

j. ASC PRESS Warning

k. WATER QTY Caution

l. BATTERY Caution

m. ASC QTY Caution

n. DES QTY Caution

OCP OUTLINE

OCP-GF-62000-EPS-LM-8

Test Title:

LM Combined Subsystem Pre-FEAT Test - EPS,

Subsystem:

Electrical Power Subsystem (EPS)

Test Objective:

a. Demonstration of proper functional operation of Ascent Stage EPS and related controls and displays.

b. Demonstration of proper functional operation of Descent Stage EPS and related Ascent Stage EPS controls, displays and interfaces.

c. Verification of accuracy of EPS cabin meters and ACE-S/C voltage and current readouts.

d. Measurement of resistance of EPS main power paths.

e. Verification of isolation of translunar busses.

f. Verification of external LM power interfaces.

g. Demonstration of proper functional operation of interior and exterior lights operated by cabin panel controls.

Vehicle Configuration:

Mated Stages

Location:

Integrated Workstand, Plant 5 CEF

Hazardous Operations:

Tracking light operation (eye protection needed)

Equipment Under Test:

Ascent Stage Electrical Control Assemblies (2)

Inverters (2)

Deadface Relay

Relay Junction Box

Descent Stage Electrical Control Assemblies (2)

Light Control Assembly (LCA)

Equipment Under Test: (Cont)

Tracking Lights

Docking Lights

Flood Lights

Panel Lights

Portable Utility Lights

Test Description:

Seq. 01: Call to Stations

a. Verification that required personnel are at their respective stations.

Seq. 02: EPS Activation Bus Power on, via J167

a. Verification that the GSE and the vehicle are in the proper configuration for application of power, and the applying of GSE power to the vehicle busses. (Para. 4.2.2.2.2C2)

Seq. 03: AC Isolation Power Transformer Turn-on

a. Utilization of ground AC power is required for preliminary instrumentation checkout.

Seq. 04: Lighting Test Set Set-Up

a. Verification that the Lighting Test Set is properly configured to support lighting requirements.

Seq. 05 & 06: Inverter Functional Test

a. Verification, for each inverter, of output voltage and frequency, on ACE-S/C. (Para. 4.2.2.2.4 a2)

b. Verification, for each inverter, of output voltage on the cabin voltmeter. (Para. 4.2.2.2.4 a1)

c. Verification of inverter selection by means of cabin controls. (Para. 4.2.2.2.4 b)

d. Measurement of each AC bus voltage under load (utilizing GSE load bank)

e. Response of Caution and Warning

Test Description: (Cont)

Seq. 07: Ascent ECA Power on Procedure

a. Verification that the GSE and the vehicle are in the proper configuration for ascent vehicle power, and the actual turn-on of ascent vehicle power.

Seq. 08 & 09: Ascent Battery Cabin Displays, ACE-S/C Displays, and Feeder Line Verification

a. Verification for each ascent stage ECA, of: (Para. 4.2.2.2.2 a2)

1. Normal main feeder contractor operation

2. Alternate main feeder contactor operation

3. Associated cabin battery status flags and controls

b. Comparison of precision voltmeter readings with LM cabin voltmeter and ACE-S/C readouts of voltage for each of the following vehicle measurements points: (Para. 4.2.2.2.2 a1)

1. Commander's DC bus

2. System Engineer's DC bus

3. Each of the ascent battery feeders

c. Utilizing GSE load bank, comparison of precision ammeter readings with LM cabin ammeter and ACE-S/C readouts of current for each of the ascent battery feeder current monitors. (Para. 4.2.2.2.2b)

Seq. 10, 11, 12, 13, 14, 15: Ascent ECA Malfunction Logic

a. Verification, for each ascent stage ECA, of:

1. Response to simulated reverse current condition. (Para. 4.2.2.2.3.2 a, e, f, g, i, e & k)

2. Response to simulated over-current condition. (Para. 4.2.2.2.3.2, a, b, c & d)

3. Response to simulated over-temperature condition.

4. Response of caution and warning to simulated over-current and reverse current. (Para. 4.2.2.2.3 b)

Seq. 16: Verification of Display Circuit Operation

a. Verification of control over EPS displays by operating the display circuit breaker.

Test Description: (Cont)

Seq. 17: Independency of ECA Controls

a. Verification of Commander's and System Engineer's redundant control circuitry as follows:

1. ASC ECA (Para. 4.2.2.2.2 g3)

2. ASC ECA Control (Para. 4.2.2.2.2 g4)

Seq. 18: Check of Battery Isolation From The Busses

a. Verification that the ascent batteries feed the proper bus both in the normal and back-up modes of operation.

Seq. 19: Verification of LMP and CDR Independency

a. Verification of Isolation between Commander's DC bus and System Engineer's DC bus.

Seq. 20: Descent ECA Power-On Procedure

a. Verification that the GSE and the vehicle are properly configured for application of descent vehicle power, and the actual application of descent vehicle power.

Seq. 21, 22, 23, 24, 25: Descent Battery Cabin Displays, ACE-S/C Displays, and Feeder Line Verification

a. Verification, for each descent stage ECA electrical control subassembly, of: (Para. 4.2.2.2.2 a2)

1. Battery high voltage main feeder contactor operation

2. Battery low voltage main feeder contactor operation

3. Associated cabin battery status flags and controls

b. Comparison of precision voltmeter readings with LM cabin voltmeter and ACE-S/C readouts of voltage for each of the following vehicle measurement points: (Para. 4.2.2.2.2 a1)

1. Commander's DC bus

2. System Engineer's DC bus

3. Each of the Descent Battery feeders

c. Utilizing GSE load bank, comparison of precision ammeter readings with LM cabin ammeter and ACE-S/C readouts of current for each of the descent feeder current monitors. (Para. 4.2.2.2.2 b)

Test Description: (Cont)

Seq. 26: Cross Tie Balance Load Feeder Line Check

a. Measurement of voltage drop of Cross Tie Balance Load Feeder Lines.

Seq. 27: LUT Feeder Line Verification (Para. 4.2.2.2.2 P/O d)

a. Verification of LUT power transfer interface

1. Relay junction box LUT power contactor operation

b. Measurement of voltage drop of LUT feeder line.

Seq. 28, 29, 30: Descent Battery Cabin Displays, ACE-S/C Displays, and Feeder Line Verification

a. Verification, for each descent stage ECA electrical control subassembly of: (Para. 4.2.2.2.2 a2)

1. Battery high voltage main feeder contactor operation

2. Battery low voltage main feeder contactor operation

3. Associated cabin battery status flags and controls

b. Comparison of precision voltmeter readings with LM cabin voltmeter and ACE-S/C readouts of voltage for each of the following vehicle measurement points: (Para. 4.2.2.2.2 a1)

1. CDR's DC bus

2. LMP DC bus

3. Each of the descent battery feeders

c. Utilizing GSE load bank, comparison of precision ammeter readings with LM cabin ammeter and ACE-S/C readouts of current for each of the descent feeder current monitors. (Para. 4.2.2.2.2 b)

Seq. 31: Redundant EPS CB Verification

a. Verification of Commander's and System Engineer's redundant control circuitry as follows:

1. DES ECA (Para. 4.2.2.2.2 g1)

2. DES ECA Control (Para. 4.2.2.2.2 g2)

b. Verification of battery deadface relay contactor operation (relay junction box and deadface relay box) (Para. 4.2.2.2.2 f2)

Test Description: (Cont)

Seq. 32: DC Bus Isolation

a. Verification of isolation between Commander's DC bus and System Engineer's DC bus.

Seq. 33: Docking Lights Checkout with Simulated Components

a. Verification of docking light operation. (Para. 4.2.2.2.5 P/O a)

Seq. 34: LM/CSM Interface Verification (Para. 4.2.2.2.2 e)

a. Verification of CSM power transfer interface.

1. Operation of power contactors connecting CSM power to LM Commander's DC bus.

2. CSM control of descent stage contactors.

Seq. 35: LUT/Descent ECA Switchover (Para. 4.2.2.2.2 d)

a. Verification of LUT control of descent stage ECA power contactors.

Seq. 36 & 37: DC/Bus Fault Light Verification (Para. 4.2.2.2.2 P/O i)

a. Verification of DC Bus Fault Light by:

1. Energizing Commander's bus with deenergized System Engineer's bus shorted to ground (bus tie circuit breakers open)

2. Energizing System Engineer's bus with deenergized Commander's bus shorted to ground (bus tie circuit breakers open)

Seq. 38: X-Lunar Bus Isolation Check (1st Run)

a. Verification of isolation of translunar busses from vehicle ground with translunar loads disconnected.

Seq. 39: Automatic Power Switchover with Abort Stage Switch. (Para. 4.2.2.2.2 P/O f3)

a. Verification of Abort Stage Switch - commanded automatic power switchover between Descent Stage and Ascent Stage power sources without power interruption under worst case conditions of:

1. Minimum voltage

2. Removing of redundant paths of ECA control from the CDR's DC bus, then the LMP's DC bus.

Test Description: (Cont)

Seq. 40: Window Heater Check and Isolation Power Transformer Turn-On

a. Verification of AC window heater operation

b. Verification of DC window heater operation

c. Utilization of Ground AC power is required to support other subsystems.

Seq. 41, 42, 43, 44, 45, 46, 47, 48: Descent ECA Malfunction Logic

a. Verification, for each battery malfunction circuitry in descent stage ECA's of:

1. Response to simulated battery over temperature

2. Response to simulated HV overcurrent condition (Para. 4.2.2.2.3.1 - a, b, c, d, e, f and P/O m)

3. Response of Caution and Warning to simulated over-current. (Para. 4.2.2.2.3 P/O b)

Seq. 49: Descent ECA Low Voltage Taps on

a. Preparation of descent battery taps for following sequences. (Para. 4.2.2.2.2 P/O a)

Seq. 50, 51, 52, 53: Descent ECA's Low Voltage Overcurrent Test

a. Verification, for each battery malfunction circuitry in descent stage ECA's of:

1. Response to simulated LV overcurrent condition

2. Response of Caution and Warning

Seq. 54: Descent ECA High Voltage Taps On

a. Preparation of descent battery taps for following reverse current sequences. (Para. 4.2.2.2.2 P/O a)

Seq. 55, 56, 57, 58: Descent ECA's Reverse Current Test

a. Verification, for each battery malfunction circuitry in descent stage ECA's, of:

1. Response to simulated reverse current condition (Para. 4.2.2.2.3.1 - a, g, h, i, j, k, l & m).

2. Response of Caution and Warning to simulated reverse current. (Para. 4.2.2.2.3 P/O b).

Test Description: (Cont)

Seq. 59: Configuration for EPS Support

a. Verification that EPS Subsystem is secured and prepared to support other subsystem testing.

Seq. 60 thru 74: Lighting Tests (Para. 4.2.2.2.5a)

a. Verification of power failure indicator (PFI) Lights using Lighting Test Set (LTS).

b. Verification of integral lighting and override control using LTS.

c. Verification of crewman's optical alignment sight interface using COAS Test Set.

d. Verification of tracking light wiring using the tracking light simulator.

e. Verification of flood lighting and dimmer control response using the LTS. (Para. 4.2.2.2.5 b1)

f. Verification of numeric lights interface

1. Checks utilizing G&E LTS to preclude damage to Light Control Assembly (LCA).

g. Verification of Sequence Camera interface using Sequence Camera Test Set.

h. Verification of Portable Utility Light interface using Sequence Camera Test Set.

i. Verification of actual vehicle tracking light.

j. Provision for utilizing the lighting test set for extended periods in order to support other sub-systems.

k. Verification of numeric lighting outputs from LCA.

l. Provision for demating Lighting Test Set.

m. Verification of numerics lighting outputs from LCA.

1. Check of dimmer control response. (Para. 4.2.2.2.5 b2)

2. Check of dimmer override. (Para. 4.2.2.2.5 b2)

n. Verification of integral lighting outputs from LCA.

1. Check of dimmer control response. (Para. 4.2.2.2.5 b3)

2. Check of dimmer override. (Para. 4.2.2.2.5 b3)

Test Description: (Cont)

o. Verification of annunciator lighting output from LCA

1. Check of dimmer control response (Para. 4.2.2.2.5 b2)

2. Check of dimmer override. (Para. 4.2.2.2.5 b2)

Seq. 75: X-Lunar Bus Isolation Check (Final Run)

a. Verification of isolation translunar busses from vehicle ground with translunar loads connected. (Para. 4.2.2.2.2 h)

OCP OUTLINE

Test Title:

LM Combined Subsystem Pre-FEAT Test - EDS

Subsystem:

Explosive Devices Subsystem (EDS)

Test Objectives:

a. Demonstration of proper functional operation of Explosive Devices Circuitry.

b. Verification of proper circuit isolation and firing circuit resistance.

Vehicle Configuration:

Mated Stages

Location:

Integrated Workstand, Plant 5 CEF

Hazardous Operations:

Not Applicable

Equipment Under Test:

ED Relay Boxes

Delay Timer

Pyrotechnic Batteries

Test Description:

Seq. 01: Call to Station

Seq. 02: EDTS Resistance Measurements

a. Establish RRA and RTS resistance measurements for System A and B.

b. Verification of correct panel and relay configuration and operation.

Seq. 03: Megohmmeter Measurement Checks

a. Verification of 100 megohms minimum isolation between: (Para. 4.2.2.10.3)

1. Active Conductors

2. Active Conductors and Ground

Test Description: (Cont)

Seq. 04: Firing Line Resistance Measurement of System A (Para. 4.2.2.10.3)

a. Verification, by precision measurements, that firing circuit resistances are within specified critical range.

b. Verification of circuit integrity.

Seq. 05: Firing Line Resistance Measurement of System B (Para. 4.2.2.10.3)

a. Verification by precision measurements, that firing circuit resistances are within specified critical range.

b. Verification of circuit integrity

Seq. 06: ED Battery Check

a. Verification of ED Battery Polarity

b. Check of ED Battery Voltage

Seq. 07: Staging Timing Sequence Set-Up

a. Installation and resistance verification of the staging timing circuitry initiator eight (8) simulators for System A and System B. (Para. 4.2.2.10.2 a)

Seq. 08: Staging Timing Sequence Check

a. Application of ACE Stimuli.

b. Verification of correct staging timing operation for System A and System B. (Para. 4.2.2.10.2 c)

Seq. 09: Firing Line Verification Check

a. Installation and check of remainder of firing circuit initiator simulators for System A and System B. (Para. 4.2.2.10.2 a)

Seq. 10: ED Functional Test Set-Up

a. Insertion of proper ACE R-Start Stimuli.

Test Description: (Cont)

Seq. 11: System A and System B Battery Functional Check

a. Verification of ED battery circuit and panel controls and displays.

b. Mating of ED battery with ED subsystem and verification of circuitry, panel controls and displays and ED battery is within specified limits.

Seq. 12: System A Functional Check

a. Firing of related initiator simulators and closing of associated relays during activation of manual cabin ED controls. (Para. 4.2.2.10.3)

b. Monitoring of the above via the ACE-S/C. (Para. 4.2.2.10.2 g)

c. Monitoring of transient responses throughout the functional check. (Para. 4.2.2.10.3)

Seq. 13: System B Functional Check

a. Firing of related initiator simulators and closing of associated relays during activation of manual cabin ED controls. (Para. 4.2.2.10.3)

b. Monitoring of the above via the ACE-S/C. (Para. 4.2.2.10.2 bl)

c. Monitoring of transient responses throughout the functional check. (Para. 4.2.2.10.3)

Seq. 14: System A and System B Functional Check

a. Firing of related initiator simulators and closing of associated relays during activation of manual cabin ED controls. (Para. 4.2.2.10.3)

b. Monitoring of the above via the ACE-S/C. (Para. 4.2.2.10.2 bl)

c. Monitoring of transient responses throughout the functional check. (Para. 4.2.2.10.3)

Seq. 15: Abort Stage ASC Press Check

a. Check of Ascent Engine Pressurization of both System A and System B separately and together using the Abort Stage switch. (Para. 4.2.2.10.3)

b. Monitoring of transient responses throughout the functional check. (Para. 4.2.2.10.3)

Test Description: (Cont)

Seq. 16: Descent Engine (He) Pressurization Check

a. Check of Descent Engine Pressurization utilizing DECA engine on command. (Para. 4.2.2.10.3)

b. Monitoring of Descent Engine (DE) pressurization function check via the ACE-S/C (Para. 4.2.2.10.2.G.2)

c. Monitoring of transient responses throughout the functional check. (Para. 4.2.2.10.3)

Seq. 17: Stage Command Verification

a. Verification of stage command to System A and System B separately via AELD engine start command. (Para. 4.2.2.10.3)

b. Monitoring of stage command verification by the ACE-S/C. (Para. 4.2.2.10.2.G.3)

c. Monitoring of transient responses throughout the function check. (Para. 4.2.2.10.3)

Seq. 18: Landing Gear Deploy Switches Check

a. Check of Landing Gear Deploy switches circuitry. (Para. 4.2.2.12.2.1.A)

Seq. 19: Temperature Transducer Simulation Check

a. Check of temperature transducer circuitry. (Para. 4.2.2.12.3.1.a)

OCP OUTLINE

OCP-GF-62000-G&N-LM-8

Test Title:

LM Combined Subsystem Pre-Feat Test - G&N

Subsystem:

Guidance and Navigation

Test Objectives:

To verify normal operation of the Guidance and Navigation power supplies and IMU temperature control circuitry.

To operationally check the LM Guidance Computer and DSKY.

To verify accuracy of the LGC clock.

To verify operation of the computer control and reticle dimmer assembly.

To verify dynamic operation of each Gimbal stabilization loop.

To verify operation of each Gimbal torquing loop.

To verify proper operation of turn-on and shutdown procedures.

To verify that the G and N subsystem is operationally ready to support further vehicle integrated testing.

To verify all stimuli and response between ACE-S/C and G and N subsystem.

To verify proper operation of the LGC at high and low operating levels of the LGC +4 and +14 VDC power supplies.

To verify PIPA and IRIG operation during IMU operational test.

To verify IMU CDU moding, CDU repeating accuracy, CDU command accuracy, CDU command rate, and FDAI linearity test.

To verify signal conditioning assembly/PCM interface.

To obtain and verify IRIG scale factor error for each IRIG.

To obtain and verify PIPA bias and scale factor error for each PIPA.

To obtain and verify stable member normal bias drifts about the input axes of the IRIG's (NBDX, NBDY, NBDZ).

To obtain and verify stable member acceleration sensitive drifts about the input axes of the IRIG's due to acceleration along the spin reference axes (ADSRAX, ADSRAY, ADSRAZ).

Test Objectives: (Cont)

To obtain and verify stable member acceleration sensitive drifts about the input axes of the IRIG's due to acceleration along the input axes (ADIAX, ADIAY, ADIAZ).

To determine, azimuth and elevation measurement of the AOT three LOS's by means of optical targets. Calculation of the angles between the LOS's and verification by LGC computation using AOT optical sighting data.

To determine the ability of the G&N system to align the stable member to a pre-determined orientation with respect to an earth reference coordinate frame, based on optical sightings.

Vehicle Configuration:

Ascent Stage

Location:

Integrated Workstand, Plant 5

Hazardous Operation:

Not applicable.

Equipment Under Test:

Inertial Measurement Unit (IMU)

LM Guidance Computer (LGC)

Coupling Data Unit (CDU)

Power and SERVO Assembly (PSA)

Computer Control Reticle Dimmer Assy (CCRDA)

Pulse Torque Assembly (PTA)

Displays and Keyboard (DSKY)

Signal Conditioner Assembly (SCA)

Alignment Optical Telescope (AOT)

Navigation Base (Nav Base)

"A" Harness

"B" Harness

Test Description:

Seq. 01: Call to Stations

Seq. 02: Support Systems Status Verification

Seq. 03: Preliminary AOT Mechanical Check, AOT Heater Current Test, and Reticle Dimmer Check.

a. AOT mechanical operation check

b. AOT heater current checks

Seq. 04: IMU Standby Power Turn-On

a. Application of IMU Standby Power.

b. Verification of Portable temperature controller. (PTC) transfer of IMU Heater Power to vehicle power.

Seq. 05: LGC/DSKY Power Turn-On

a. Application of LGC/DSKY power.

b. Verification of LGC Power Supply.

Seq. 06: LGC Operational Test

a. DSKY Check

1. Verification of DSKY capability for Data Entry.

2. Operational check of DSKY Status Lights and Electroluminescent Numeric Elements.

b. LGC Check

1. LGC Self Test

2. Verification of alarms and interrupt programs

3. Verification of LGC arithmetic operations, and timing operations.

Seq. 07: LGC Voltage Margin Test

a. Insertion of known voltages into +4VDC and +14VDC power supply feedback loops.

b. Verification of proper LGC operation at the following combinations of voltage levels.

1. High +14VDC High +4VDC

2. High +14VDC Low +4VDC

Test Description: (Cont)

3. Low +14VDC Low +4VDC

4. Low +14VDC High +4VDC

Seq. 08: LM Guidance Computer Clock Test

a. Operational Check of Computer Clock by averaged computed readings.

b. LGC Clock Test in the LGC Standby Mode.

Seq. 09: Computer Control and Reticle Dimmer Assembly Check

a. Verification of CCRD Capability for LGC Data Entry.

b. Check of AOT Reticle Dimming Control.

Seq. 10: IMU Operate Turn-On

a. Application of IMU Operate Power.

b. Verification of G&N ACE-S/C Measurements.

Seq. 11: Temperature Control Verification Test

Verification of PIPA's temperature and stabilization. During G&N standby and operate modes.

Seq. 12: G&N Parameter Test

a. Verification at ACE-S/C of G&N measurements.

b. Functional checkout of PIPA pattern selection using PSAAM and ACE-S/C Controls.

c. Verification of G&N High Rate Measurements.

Seq. 13: IMU Operation Test

Verification of proper IMU operation by performance of test program which computes values of local 'g" and horizontal earth rate.

Seq. 14: PGNS Operational Test

Verifies the IMU, CDU repeating accuracy, CDU command accuracy, CDU command rate, FDAI and Gasta commands.

Seq. 15, 16, 17: IMU Gimbal Friction Test

Determination of IMU Gimbal friction levels of the outer, inner and middle gimbal by means of gimbal torquing through positive and negative angles.

Test Description: (Cont)

Seq. 18, 19, 20, 21: IMU Gimbal Step Response Test

Verification of stabilization loop response of inner, outer and middle gimbal by means of step voltage inputs to each servo amplifier.

Seq. 22: IMU Cage Test

Verification of IMU Cage Switch operation by means of monitoring platform response.

Seq. 23: IRIG Scale Factor Test

a. Torquing of platform through predetermined angles.

b. Computation by LGC of each IRIG scale factor error.

   1. Display of scale factor errors on DSKY and at ACE-S/C.

c. Determination of $\pm X$, $\pm Y$, $\pm Z$, IRIG scale factor errors by averaging of Data from all three test runs.

Seq. 24: IMU Performance Test

a. Positioning of platform in various preselected orientations.

b. Display of individual test results on DSKY and at ACE-S/C.

c. Calculations on Data resulting from IMU performance test program to obtain and verify the following IMU parameters:

   1. PIPA bias parameters.

   2. PIPA Scale Factor Parameters.

   3. Normal Bias drift parameters (NBDX, NBDY, NBDZ).

   4. Acceleration sensitive drift parameters, due to acceleration along spin reference axes (ADSRAX, ADSRAY, ADSRAZ).

   5. Acceleration sensitive drift parameters, due to acceleration along input axes, (ADIAX, ADIAY, ADIAZ).

d. Comparison of results with last three sets of lab determined parameters.

Seq. 25, 26: Provision in OCP for performance of two additional runs of IMU Performance Test if out of tolerance conditions are shown by the comparison.

Test Description: (Cont)

Seq. 27: Preliminary Positioning and Adjustment of Optical Targets

a. Calibration Data is inserted into computer for all six detent positions.

b. Position all three theodolites for max AOT field of view.

1. With dioptometer mount adjusted for max focus.

2. Azimuth scales set to zero.

Seq. 28: AOT Function Accuracy

a. Sighting of optical targets (theodolites) by AOT in three detent positions.

b. Measurement of LOS Azimuth and Elevation angles by optical targets.

c. Measurements of LOS shaft and trunnion angles by AOT.

d. Calculation of AOT line of sight angles (X and XZ).

e. LGC computation of AOT line of sight angles. (X1 and X2) using AOT shaft and trunnion angle measurements and manufacturers calibration data.

f. Comparison of LGC computed LOS (X1, and X2) with same angle calculated from optical target data.

Seq. 29: G&N Fine Alignment

a. Verification of accuracy of command IMU orientation, based on optical sighting data.

1. Determination of IMU present and desired orientation at start of alignment test.

(a) Sighting of optical targets by AOT.

(b) Measurement of optical target shaft and trunnion angles by AOT.

(c) Measurement of true azimuth and elevation of optical targets.

(d) Entry of LGC of:

(1) IMU stable member azimuth

(2) Site Latitude

(3) True azimuth and elevation of optical targets

(4) AOT detent code and star code

(5) AOT sighting measurements

Test Description: (Cont)

2. Fine Alignment

   a. IMU stable member alignment to desired orientation.

   b. Monitoring of gravitational components of horizontal PIPA outputs to determine accuracy of alignment.

   c. Repeat of alignment procedures using another orientation in which different PIPA's are in the horizontal plane.

Seq. 30: PGNS Shutdown

a. Verification of gimbal parking procedure.

b. Removal of IMU operate, LGC/DSKY, and IMU standby power.

c. Verification of transfer of IMU Heater power to PTC.

Seq. 31: G&N Abbreviated Turn-On

a. Abbreviated secondary turn-on of the G&N subsystems with only necessary verification made of the following:

   1. IMU standby power turn-on.

   2. LGC/DSKY power turn-on.

   3. IMU operate power turn-on.

   4. Coarse align to zero.

Seq. 32: Downmode to G&N Standby

The transfer of G&N system from the operate to standby mode, for support of related OCP.

Seq. 33: G&N Standby Mode to G&N Operate Mode

Enables the G&N system to transfer from standby back to an operate mode to support related OCP.

Test Title:

LM Combined Subsystem Pre-FEAT Test - Propulsion

Subsystem:

Propulsion (PROP)

Test Objectives:

Test No. 1

To provide an end-to-end check or channel identification of electrical paths associated with pressure transducers, temperature transducers, and valve position indicators of the Descent and Ascent Propulsion Subsystems.

Test No. 2

To verify performance of the Descent Propellant Quantity Gaging System Control Unit.

To verify D/S PQGS Control Unit Telemetry Outputs and cabling interfaces with ACE-S/C.

To verify D/S PQGS Sensor Circuitry.

To verify operation of the D/S PQGS (Quantity Indicator) cabin display.

To verify operation of the Ascent and Descent Engine Propellant low level sensors under empty tank conditions via ACE-S/C Telemetry Downlink.

Test No. 3

To verify the Functional Operation and internal leakage integrity of the Descent Engine at low pressure.

To ascertain that the propellant feed section and descent engine propellant passages do not have any restrictions.

To verify the proper operation of the thermal relief capability of the engine pre-valves and check internal leakage of the valves.

To provide an end-to-end check or Channel I.D. of electrical paths associated with the Descent Engine Instrumentation.

Vehicle Configuration:

Ascent and Descent Mated

Location:

Integrated Workstand, Plant 5

Hazardous Operation:

Pneumatic Pressures up to 200 PSIG

Equipment Under Test:

Ascent Fuel Propellant Section

Ascent Oxid Propellant Section

Descent Fuel Propellant Section

Descent Oxid Propellant Section

Ascent Helium Supply Section

Descent Helium Supply Section

PQGS Control Unit

Sensing Probes (4 D/S and 2 A/S)

Display Meter

Propellant Shut-Off Valves A, B, C & D

Solenoid Valves A, B, C & D

Fuel Pre-Valves (2)

Test Description:

Seq. 01: Call to Station

Seq. 02: Ascent Propulsion Transducer Ambient Check and Valve Position Indicator Channel I.D.

a. Verification of the functional operation and Channel I.D. of the individual Ascent He Reg 1 and Ascent He Reg. 2 solenoid latching valves during cycling by:

1. Actuating solenoids by Ascent He Reg. switches. (Para. 4.2.2.9.1 (b))

2. Verification of proper cabin flag displays. (Para. 4.2.2.9.1 (a) and (b))

3. Verification of proper ACE displays. (Para. 4.2.2.12.2.1 (b))

Test Description: (Cont)

b. Recording of all APS pressure and temp. transducers at their associated ACE displays.

   1. Verification that transducers ambient readouts are within the end-to-end ACE tolerances. (Para. 4.2.2.12.3.1 (a))

c. Recording of all APS pressure and temp. transducers at their associated cabin displays.

   1. Verification that transducers ambient readouts are within the end-to-end cabin display tolerances. (Para. 4.2.2.12.3.1 (a))

Seq. 03: APS Helium Tank No. 1 Transducer Channel ID at 215 Psia

a. Recording of ambient readouts of Helium Tank No. 1 Temperature Transducers by:

   1. Verification of proper ACE end-to-end display tolerances. (Para. 4.2.2.12.2.1 (b))

   2. Operation of 'Helium Mon' select switch and verification of proper cabin display end-to-end tolerances. (Para. 4.2.2.9.1 (a) and (b))

b. Verification of Helium Tank No. 1 Pressure Transducers Channel I.D. by:

   1. Application of known gaseous nitrogen stimuli (215 psia) to Helium Tank No. 1 Pressure Transducer only.

   2. Verification of known He Tank No. 1 Press Transducer output on the proper ACE displays. (Para. 4.2.2.12.2.1 (b))

   3. Operation of the 'Helium Mon' select switch and verification of the known He Tank No. 1 Press. Transducer press on the proper cabin displays. (Para. 4.2.2.9.1 (a) & (b))

c. Venting of 'He Tank No. 1' to blanket pressure and Channel ID of Tank No. 1 Temp. Transducer by:

   1. Recording of temp. transducer decrease on proper ACE display. (Para. 4.2.2.12.2.1 (b))

   2. Operation of 'Helium Mon' selector switch and recording of temp. decrease on proper cabin display. (Para. 4.2.2.9.1 (a) & (b))

Seq. 04: APS Helium Tank No. 2 Transducer Channel I.D. at 215 Psia

a. Recording of ambient readouts of Helium Tank No. 2 Temperature Transducer by:

   1. Verification of proper ACE end-to-end display tolerances. (Para. 4.2.2.12.2.1 (b))

Test Description: (Cont)

2. Operation of 'Helium Mon' select switch and verification of proper cabin display end-to-end tolerances. (Para. 4.2.2.9.1 (a) and (b))

b. Verification of Helium Tank No. 2 Press. Transducers Channel I.D. by:

1. Application of known gaseous nitrogen stimuli (215 psia) to Helium Tank No. 2 Press. Transducer only.

2. Verification of known 'He Tank No. 2 Press. Transducer' output on the proper ACE displays. (Para. 4.2.2.12.2.1 (b))

3. Operation of the 'Helium Mon' select switch and verification of the known 'He Tank No. 2 Press. Transducer' press on the proper cabin displays. (Para. 4.2.2.9.1 (a) & (b))

c. Venting of 'He Tank No. 2' to blanket pressure and channel ID of tank No. 2 Temp Transducers by:

1. Recording of Temp. Transducer decrease on proper ACE display. (Para. 4.2.2.12.2.1 (b))

2. Operation of 'Helium Mon' selector switch and recording of temp. decrease on proper cabin display. (Para. 4.2.2.9.1 (a) & (b))

Seq. 05: APS He Reg Outlet Manifold Transducer End-to-End Check at 65 Psia

a. Verification of APS He Reg Outlet Manifold Transducers End-to-End by:

1. Application of known gaseous nitrogen stimuli (65 psia) to He Outlet Manifold transducers only.

2. Verification of He Reg Outlet Manifold transducers outputs on the proper ACE displays. (Para. 4.2.2.12.2.1 (b))

Seq. 06: APS Fuel Section Transducer End-to-End Check at 65 Psia

a. Verification of APS Fuel Tank Bulk Temp Transducer Ambient readout by:

1. Recording of proper ACE End-to-End display tolerances. (Para. 4.2.2.12.2.1 (b))

2. Operation of Prop Temp/Press Man Sw. and verification of proper cabin displays end-to-end tolerances. (Para. 4.2.2.9.1 (a) and (b))

b. Verification of APS Fuel Tank Ullage Press and Fuel Isol Valve Inlet Press Transducers and Fuel Tank Transducer end-to-end checks by:

Test Description: (Cont)

1. Application of known gaseous nitrogen stimuli (65 psia) to Fuel Section transducers only.

2. Verification of a temp. increase on tank temp transducers output at:

   (a) ACE Display (Para. 4.2.2.12.2.1 (b))

   (b) Cabin Meter (Para. 4.2.2.9.1 (a))

3. Verification of known fuel isol valve inlet press. transducer output in proper ACE displays. (Para. 4.2.2.12.2.1 (b))

4. Verification of the known Fuel Tank Ullage Press Transducer output on the proper cabin meter displays. (Para. 4.2.2.9.1 (a))

c. Venting of Fuel Section to blanket press.

Seq. 07: APS Oxid Section Transducer End-to-End Check at 65 Psia

a. Verification of APS Oxid Tank Bulk Temp Transducer readout by:

1. Recording of proper ACE end-to-end display tolerances. (Para. 4.2.2.12.2.1 (b))

2. Operation of Prop Temp/Press. Man Switch and verification of proper cabin display end-to-end tolerances. (Para. 4.2.2.9.1 (a) and (b))

b. Verification of APS Oxid Tank Ullage press and Oxid Isol Valve Inlet Pressure Transducers and Oxid Tank Transducer end-to-end checks by:

1. Application of known gaseous nitrogen stimuli (65 psia) to Oxid section transducers only.

2. Verification of a temperature increase on tank temperature transducer output at:

   (a) ACE Display (Para. 4.2.2.12.2.1 (b))

   (b) Cabin Meter (Para. 4.2.2.9.1 (a))

3. Verification of known Oxid Isolation Valve Inlet Pressure Transducer Output in proper ACE displays Para. 4.2.2.12.2.1 (b)

Test Description: (Cont)

4. Verification of the known Oxid Tank Ullage Press Transducer outpu on the proper cabin meter displays (Para. 4.2.2.9.1 (a))

c. Venting of Oxid Section to blanket pressure

Seq. 08: Descent Propulsion Transducer Ambient Check and Valve Position Indicator Channel ID

a. Verification of the functional operations and channel ID of individua Descent Propulsion Solenoid Latching Valves during cycling by:

1. Actuation of solenoids by Des. He Reg. 1 and 2 switches and Des. Propul - Fuel Vent and Oxid vent Switches Para. 4.2.2.9.1 (b)

2. Verification of proper cabin flag displays (Para. 4.2.2.9.1 (a))

b. Recording of all Des. press and temp transducers at their associated ACE displays.

1. Verification that transducer ambient readouts are within the end-to-end ACE tolerances. (Para. 4.2.2.12.3.1 (a))

c. Operation of Helium Mon. Select and Propellant Temp/Press Mon Switches and recording of all Des. Press and temperature transducers at their associated cabin displays (Para. 4.2.2.9.1 (a) and (b))

1. Verification that transducer ambient readouts are within the end-to-end cabin display tolerances (Para. 4.2.2.12.3.1 (a))

Seq. 09: Supercritical Helium Tank Transducer Check at 115 Psia

a. Verification of the Functional Operation of the Helium Tank Transducer by:

1. Application of known gaseous nitrogen stimuli (115 psia) to the Supercritical tank transducers only.

2. Recording of known SHe Supply Tank Press Transducer output on the proper ACE displays Para. 4.2.2.12.2.1 (b)

3. Operation of 'Helium Mon' select switch and recording of the known Supercritical Press Transducer Output on the proper cabin display (Para. 4.2.2.9.1 (a) & (b))

b. Venting of Supercritical He Tank to blanket pressure

Seq. 10: Ambient Helium Storage Tank Transducer Channel ID at 115 Psia

a. Verification of the functional operation and channel ID of the ambient Helium Storage Tank Transducers only:

Test Description: (Cont)

1. Application of known gaseous nitrogen stimuli (115 psia) to the Ambient He Storage Press. transducer only.

2. Recording of the Amb. He Storage Tank Press transducer output on the proper ACE display (Para. 4.2.2.12.2.1 (b))

3. Operation of the 'Helium Mon' select switch and recording of the known Amb. He Storage Tank Press Transducer output on the proper cabin displays (Para. 4.2.2.9.1 (a) and (b))

b. Venting of Ambient He Storage Tank to Blanket Pressure.

Seq. 11: DPS Helium Regulator Output Manifold Transducer End-to-End check at 65 Psia

a. Verification of the functional operation and end-to-end check of the Helium Reg. Outlet Manifold Pressure Transducer individually by:

1. Application of a known gaseous nitrogen stimuli (65 psia) to the two (2) He Reg. Outlet Manifold Pressure Transducers only.

2. Recording of the two (2) known He Reg. Outlet Pressure Manifold Transducer outputs on their proper ACE displays (Para. 4.2.2.12.2.1 (b)

b. Venting of the entire He Manifold to blanket pressure.

Seq. 12: DPS Fuel Section Transducers End-to-End check or channel ID at 65 Psia

a. Verification of functional operation and channel ID of the Fuel Tank Bulk Temperature Transducers only by:

1. Recording of the Fuel tank 1 and 2 temperature transducers ambient outputs on their proper ACE display (Para. 4.2.2.12.2.1 (b))

2. Operation of the 'Propellant Temp/Press Mon' switch in Des. 1 and Des 2 positions and recording of temperature transducers ambient outputs on the proper cabin meter display (Para. 4.2.2.9.1 (a) & (b))

3. Application of Heat to Fuel Tank #1 Temp transducer only.

4. Verification of temp increase at Tank #1 transducer only at proper ACE displays (Para. 4.2.2.12.2.1 (b))

5. Operation of Temp/Press Mon Switch and verification of temp increase at tank #1 Cabin meter display only (Para. 4.2.2.9.1 (a) & (b))

6. Application of Heat to Fuel Tank #2 transducer only.

Test Description: (Cont)

7. Verification of temp increase at Tank #2 transducer only at proper ACE display (Para. 4.2.2.12.2.1 (b))

8. Operation of Temp/Press Mon Switch and verification of temp increase at Tank #2 cabin meter display only (Para. 4.2.2.9.1 (a) & (b))

b. Verification of the functional operation and end-to-end check of the Eng Fuel Interface Press Transducer and Fuel Tank Ullage Pressure Transducer at 65 Psia by:

1. Application of a known gaseous nitrogen stimuli (65 psia) to the Fuel Tank #3 Ullage and Engine Fuel Interface press. transducers.

2. Recording of the known Engine Fuel Interface Pressure Transducer output on the proper ACE display (Para. 4.2.2.12.2.1 (b))

3. Operation of the Temp/Press Mon Switch in the Des 1 and Des 2 positions and recording of the known fuel tank ullage pressure transducer output on the proper cabin display (Para. 4.2.2.9.1 (a and b))

c. Venting of DPS fuel manifold to blanket pressure.

Seq. 13: DPS Oxidizer Section Transducer End to End or Channel ID Transducer Check at 65 Psia

a. Verification of the 'functional operation and channel ID of the Oxid Tank Bulk Temp Transducers only by:

1. Recording of the Oxid Tank #1 and #2 temperature transducers ambient outputs on their proper ACE displays (Para. 4.2.2.12.2.1(b)

2. Operation of the 'Propellant Temp/Press Mon' switch in Des 1 and Des 2 positions and recording of Oxid Temp Transducers ambient outputs on the proper cabin meter displays (Para. 4.2.2.9.1 (a) and (b))

3. Application of heat to Oxid tank #1 temp transducer only.

4. Verification of temp increase at tank #1 transducer only at proper ACE display (Para. 4.2.2.12.2.1 (b))

5. Operation of 'Temp/Press monitor' switch and verification of temp increase at tank #1 cabin meter display only. (Para. 4.2.2.9.1 (a) & (b))

6. Application of heat to oxid tank #2 transducer only.

Test Description: (Cont)

7. Verification of temp increase at Tank #2 transducer only at proper ACE display (Para. 4.2.2.12.2.1 (b))

8. Operation of Temp/Press Mon switch and verification of temperature increase at tank #2 cabin meter display only (Para. 4.2.2.9.1 (a) & (b))

b. Verification of the functional operation and end-to-end check of the Engine Oxid Interface Press Transducer and Oxid Tank #1 Ullage Pressure Transducer at 65 Psia by:

1. Application of a known gaseous nitrogen stimuli (65 Psia) to the Oxid Tank Ullage and Oxid Interface pressure transducers.

2. Recording of the known Engine Oxid Interface Pressure Transducer output on the proper ACE display (Para. 4.2.2.12.2.1 (b))

3. Operation of the Temp/Press Mon switch in the Des 1 and Des 2 positions and recording of the oxid tank ullage pressure transducer output on the proper cabin display (Para. 4.2.2.9.1 (a) and (b))

c. Venting of the DPS Oxid manifolds to blanket pressure.

Seq. 14: Securing After Test No. 1

Seq. 15: Propellant Quantity Gaging System/Level Verification

a. Verification of the performance of the PQGS Control Unit by:

1. Application of known values of voltage stimuli (0-5 VDC) to individual sensor channels of the Fuel Tanks No. 1 and No. 2 and Oxid Tanks No. 1 and No. 2. (Note - the resultant measurements are converted within the PQGS into percent values of quantity from zero (0%) to maximum (97%). (Para. 4.2.2.8.3.3 n (Sub. a))

2. Recording of the known measurement outputs for each set of stimuli voltage level on the proper ACE displays. (Para. 4.2.2.12.2.1 (b))

3. Operation of the "PRPLNT QTY MON" switch in the Des. 1 and Des. 2 positions individually and verification of known proper Ox and Fuel Qty Cabin displays. (Para. 4.2.2.9.1 (a) & (b))

Seq. 16: PQGS Sensor Test Dry

a. Verification of the PQGS Dry Sensor Test by:

1. Application of a known voltage stimuli (contact closure) to the control unit (PQGS) (Para. 4.2.2.8.3.3 (n) (bl)

Test Description: (Cont)

2. Recording of the outputs of the Ox and Fuel quantity sensors on the proper ACE Displays. (Para. 4.2.2.12.2.1 (b))

3. Operation of the 'PRLNT QTY MON' switch in the Des. 2 and Des. 1 positions and recording of the Ox and Fuel sensor outputs on cabin displays. (Para. 4.2.2.9.1 (a) & (b))

4. Comparison of the recorded dry sensor measurements to the data supplied by the vendor. (Para. 4.2.2.8.3.3 n, b 2 & 3)

Seq. 17: D/S and A/S Propellant Liquid Level Low

a. Verification of the DPS Prop Liquid Low Level sensor under empty tank conditions by: (Para. 4.2.2.8.3.3 n (c))

1. Recording of the Prop Lqd Level Low sensor warning indications at the proper ACE display. (Para. 4.2.2.12.2.1 (b))

2. Removal of vehicle power by opening CB Propul-PQGS and recording the removal of the Low Level warning indications at ACE displays. (Para. 4.2.2.12.2.1 (b))

b. Verification of the APS Fuel and Ox Tank Low Level sensors under empty tank conditions by: (Para. 4.2.2.8.2.3 (j))

1. Recording of the APS Fuel and Ox tank low level warning indications on the proper ACE displays. (Para. 4.2.2.12.2.1 (b))

2. Removal of conditioning power to the APS low level sensors by operation of the 'Inst-Sig Sensor' CB and recording the removal of the low level warning indications at ACE displays. (Para. 4.2.2.12.2.1 (b))

Seq. 18: PQGS Fuel/Oxid Quantity Tank

a. Re-verification of the DPS PQGS Fuel/Oxid Tank Quantity Sensors by:

1. Application of a known value (1 volt) of voltage stimuli to individual sensor channels of the fuel tanks No. 1 and No. 2 and Oxid tanks No. 1 and No. 2. (Para. 4.2.2.8.3.3 (n) (a))

2. Recording of the known liquid level sensor outputs on the proper ACE displays. (Para. 4.2.2.12.2.1 (b))

3. Operation of the 'PRPLNT QTY MON' Sw in the Des. 1 and Des. 2 positions and recording of known Fuel and Oxid sensor outputs on cabin displays. (Para. 4.2.2.9.1 (a) & (b))

b. Channel ID of the No. 1 Tank Fuel and Oxid sensors versus the No. 2 sensors by:

Test Description: (Cont)

1. Application of known stimuli to No. 2 Tank sensor probes only.

2. Recording of the known No. 2 Tank Qty Sensor outputs on the proper ACE displays and recording of No. 1 Tank Fuel and Oxid Qty Sensor remaining unchanged from item 1 above. (Para. 4.2.2.12.2.1 (b))

3. Operation of "Prplnt Qty Mon" switch and recording of Tank No. 1 Oxid and Fuel sensor outputs on the proper cabin displays. (Para. 4.2.29.1 (a) & (b)

4. Reversal of the known voltage stimuli to Tanks No. 1 & 2.

5. Recording of the complete known reversal of the sensor outputs between Tanks No. 1 & 2 on the proper ACE displays. (Para. 4.2.2.12.2.1 (b))

6. Operation of the "Prplnt Qty Mon" switch in Des. 1 & Des. 2 and recording of the individual known sensor outputs on the proper cabin displays. (Para. 4.2.2.9.1 b)

c. Removal of vehicle power and GSE stimuli from the DPS PQGS Control Unit.

Seq. 19: Engine Solenoid Valve Leakage Check and Engine Pre-Valve Thermal Relief Check

a. Leakage rate thru each of the 4 DPS Pilot Solenoid Valves are checked by: (Para. 4.2.2.8.3.7 (d))

1. Application of 200 PSIG gaseous N_2 pressure upstream of the valves.

2. Verification of pressure in DPS upstream of Propellant Shut-Off valves via ACE displays.

3. Measurement of GN_2 leakage rate of each individual solenoid at each solenoid drain using volumetric leak detector.

b. Pre-Valve Thermal Relief Pressure checked by: (Para. 4.2.2.8.3.7(c))

1. Venting of upstream side of Fuel Pre-Valves to 0-5 psig.

2. Application of GN_2 pressure in 10 psig increments to downstream side of both Pre-valves and closing off source pressure after each increment to check for Pre-valve cracking as indicated by decrease in GSE gage reading.

Test Description: (Cont)

3. Venting and removal of all GSE pressure sources from DPS.

Seq. 20: Propellant Feed Section/Engine Gaseous Blowdown and Engine Solenoid Pre-Valve Leak Check

a. Verification of internal leakage rates of the DPS Pre-Valves at 50 psig by: (Para. 4.2.2.8.3.7 (c))

   1. Application of a known gaseous N_2 pressure (50 psig) to the DPS Fuel and Oxid sections resulting in 50 psig upstream of the pre-valves.

   2. Recording of known Fuel and Oxid Engine Interface Pressure transducer outputs at ACE displays.

   3. Application of a GSE Leak Displacement meter at the Pre-Valve Test Port and measurement of internal leakage thru pre-valves.

b. Verification of Propellant Shut-Off Valves A and B actuation and engine blowdown by: (Para. 4.2.2.8.3.6 (d))

   1. Application of a gaseous N_2 pressure stimulti to the "B" actuators of the "series" shutoff valves actuators for full open position.

   2. Verification of "B" shutoff valves actuation by increase in pressure of GSE water gage attached to vents of shutoff valves actuators.

   3. Application of GN_2 pressure to the "A" actuator of the "series" shutoff valve actuators.

   4. Verification of A and B shut-off valves full open by "Blow-down" GN_2 flow thru the descent engine and by increase in pressure of GSE water gage.

   5. Cessation of "Blowdown" at a predetermined Prop Tank Pressure (as displayed at ACE) by venting the SOV 'A' actuator.

   6. Venting of A and B shutoff valves actuators.

c. Verification of propellant shutoff valves C and D actuation and engine blowdown by:

   1. Reapplication of a known GN_2 pressure (50 psig) to the DPS Fuel and Oxid sections.

   2. Recording of the known Fuel and Oxid Engine Interface Pressure transducer outputs at ACE displays.

Test Description: (Cont)

3. Repeat of same procedural steps of item 2a thru 2f, except substitute valve C for B operations, and valve D for A operations.

Seq. 21: Propellant Ball Valve Internal Leak Check (50 Psig) and Chamber Pressure Transducer Check

a. Measurement of total leakage rate of B and C fuel and oxid valves.

1. Application of 50 psig GN_2 pressure upstream of the oxid and fuel ball valves.

2. Verification of the fuel and oxid engine interface pressures via ACE displays.

3. Application of 200 psig GN_2 at the A and D shutoff valve actuators; opening ball valves A and D actuators.

4. Measurement of gross leakage rate of oxid and fuel valves B and C at the throat plug leakage port with the GSE Leak Displacement Meter.

b. Determination of leakage rate of B and C oxid valves and B and C fuel valves. This step will only by performed if excess leakage occurred in a.4.

1. Venting of fuel tanks to ambient pressure.

2. Measurement of leakage rate of oxid valves B and C at the throat plug leakage port with the GSE Leak Displacement Meter.

3. Subtract leakage rate determined in b.2. from that obtained in a.4. to determine B and C fuel valves gross leakage rate.

4. Repressurization of fuel tanks to 50 psig GN_2.

c. Measurement of total leakage rate of A and D fuel and oxid valves.

1. Venting of GN_2 pressure at A and D shutoff valve actuators, closing A and D ball valves.

2. Application of 200 psig GN_2 at the B and C shutoff valve actuators; opening ball valves B and C actuators.

3. Measurement of gross leakage rate of oxid and fuel valves A and D at the throat plug leakage port with the GSE Leak Displacement Meter.

4. Venting of oxid tanks to ambient pressure.

Test Description: (Cont)

d. Determination of leakage rate of A and D oxid valves and A and D fuel valves. This step will only be performed if excess leakage occurred in c.3.

1. Measurement of leakage rate of fuel valves A and D at the throat plug leakage port with the GSE Leak Displacement Meter.

2. Subtract leakage rate determined in d.1 from that obtained in c.3 to determine A and D oxid valves gross leakage rate.

3. Venting of GN_2 pressure at B and C shutoff valve actuators, closing B and C ball valves.

4. Venting of fuel tanks to pad pressure.

5. Pressurization of oxid tanks to pad pressure.

e. Verification of the functional operation of the Engine Chamber Pressure Transducer by:

1, Application of 25 psig GN_2 pressure in the engine chamber.

2. Verification of the engine chamber pressure in psia via ACE displays.

3. Operation of cabin CB 'FLT DISP-THRUST'.

4. Recording of chamber thrust on proper cabin displays.

5. Verification of the redundant engine chamber pressure in psia via ACE displays.

Seq. 22: Securing After Test No. 3

Test Title:

LM Combined Subsystem Pre-FEAT Test - COMM

Subsystem:

Communications

Test Objective:

Verification of basic S-Band and VHF Communication modes of operation.

Verification of voice performance.

Min. Vehicle Config:

Mated Stages

Location:

Integrated Workstand, Plant 5 - CEF

Hazardous Operation:

S-Band Steerable Antenna radiation.

Equipment Under Test:

a. Signal Processor Assy

b. VHF Transceiver

c. S-Band Transceivers

d. S-Band Power Amplifiers

e. S-Band Steerable Ant. (SBSA)

f. Data Storage Electronic Assy (DSEA)

g. Digital Uplink Assembly (DUA)

Test Description:

Seq. 01: Call to Stations

Seq. 02: Communications Turn-On

a. Specific circuit breaker activation

Test Description: (Cont)

Seq. 03: MIC and BIO Voltage Test

a. Verification of mike and BIO power supplies to CDR position

1. When BU and normal positions of switch are used on both LMP and CDR Panels. (Para. 4.2.2.11.1.3 a & b)

Seq. 04: ICS Test - CDR to LMP

a. Verification of no output at the CDR when CDR ICS T/R switch is off. (Para. 4.2.2.11.1.2 b)

b. 1. Verification of audio level into CDR 600 ohm headset for any position of mode switch.

2. Verification of signal to noise ratio.

3. Verification of ICS volume control attenuation.

4. Verification of master volume control attenuation (Para. 4.2.2.11.1.2 f)

c. Verification of audio levels and signal to noise measurements as in part b, for both CDR and LMP normal /BU switches in BU position. (Para. 4.2.2.11.1.2 g)

Seq. 05: LMP ICS and Master Volume Control Attenuation Test

a. 1. Verification of audio level LMP 600 ohm headset for any position of mode switch.

2. Verification of signal to noise ratio.

3. Verification of ICS volume control attenuation.

4. Verification of master volume control attenuation. (Para. 4.2.2.11.1.2 f)

Seq. 06: VOX Sensitivity Test CDR

a. Verification of ICS sensitivity for max setting of VOX sensitivity control. (Para. 4.2.2.11.1.2 a)

b. Verification of ICS sensitivity for min setting of VOX sensitivity control. (Para. 4.2.2.11.1.2 c)

Seq. 07: ICS Test - LMP to CDR

a. Verification of CDR headset for input at LMP mike. (Para. 4.2.2.11.1.2 f)

Test Description: (Cont)

b. Measurement of signal to noise for CDR ICS channel. (Para. 4.2.2.11.1.2 f)

c. Verification of signal loss in CDR headset when ICS T/R switch is in off position. (Para. 4.2.2.11.1.2 b)

d. Verification of signal in CDR headset when VOX switch is in ICS position. (Para. 4.2.2.11.1.2 d)

e. Verification of BU control of LMP PIT function. (Para. 4.2.2.11.1.2 g)

Seq. 08: CDR ICS and Master Volume Control Attenuation Test.

a. 1. Verification of audio level at CDR 600 ohm headset for any position of mode switch.

2. Verification of signal to noise ratio.

3. Verification of ICS volume control attenuation.

4. Verification of master volume control attenuation. (Para. 4.2.2.11.1.2 f)

Seq. 09: VOX Sensitivity Test LMP

a. As in Seq. 06 using LMP panel switch path.

Seq. 10: Sensitivity Test VHF B/LMP HDST

a. Verification of VHF B signal producing signal to noise ratio at LMP headset. (Para. 4.2.2.11.1.4.2 b)

b. VHF AGC voltage vs. input level determined.

Seq. 11: Squelch Test - VHF B RCVR/LMP HDST

a. Verification of VHF B signal producing a maximum squelchable signal. (Para. 4.2.2.11.1.4.2 a)

Seq. 12: Volume Control Test VHF B

a. Verification CDR and LMP dynamic volume control range. (Para. 4.2.2.11.1.4.2 a)

b. Also verification of VHF B turn-off when receiver power is turned off. (Para. 4.2.2.11.1.4.2 b)

Test Description: (Cont)

Seq. 13: Sensitivity Test VHF A/CDR HDST

a. Same as Sequence 10 using CDR position and VHF A carrier path. (Para. 4.2.2.11.1.4.2 b)

b. VHF A AGC voltage vs input level determined.

Seq. 14: Squelch Test VHF A RCVR/CDR HDST

a. Same as Seq. 11 using CDR position and VHF A carrier path. (Para. 4.2.2.11.1.4.2 b)

Seq. 15: Volume Control Test VHF A

a. Same as Seq. 12 a and 12 b using VHF A carrier path, and same reference para.

Seq. 16: Transmitted S+N/N VHF B XMTR/LMP Mike

a. Verification of downlink VHF B signal to noise ratio over LMP mike paths. Also verification of LMP VHF B T/R switch controlling VHF B carrier. (Para. 4.2.2.11.1.4.1 c)

b. Same as in a, except for CDR (mike 2). (Para. 4.2.2.11.1.4.1 c)

Seq. 17: Transmitted S+N/N VHF A XMTR/CDR Mike

a. Same as in Seq. 16 a, except for VHF A signal carrier used. (Para. 4.2.2.11.1.4.1 a)

b. Same as in a above, using CDR (mike 2). (Para. 4.2.2.11.1.4.1 a)

c. Also R-Start 128 actuated and verified.

Seq. 18: VHF Ranging Test (RTTA)

Test to be determined

Seq. 19: PLSS Insertion Loss Test

a. Determination of insertion loss of VHF B XMTR to pre-egress connector. (Para. 4.2.2.11.1.4.3 d)

b. R-Start 128 actuated and verified

Seq. 20: Freq. Test/Pri. RCVR (PM)

a. Verification of ACE Station TLM AGC measurement of NLT 0.5 V Also, verified signal strength meter in cabin. (Para. 4.2.2.11.1.10 a)

Test Description: (Cont)

b. Verification of ACE TLM static phase error (Para. 4.2.2.11.1.10 b)

c. Verification of Pri S-Band power (Para. 4.2.2.11.1.10 c)

d. Verification that PA does no recycle when S-Band XCVR is off.

Seq. 21: Freq. Test/Sec RCVR (PM)

a. Verification of ACE Station TLM AGC measurement of NLT 0.5 volt. Also, verified signal strength on cabin meter. (Para. 4.2.2.11.1.10 a)

b. Verification of ACE TLM Static Phase error. (Para. 4.2.2.11.1.10 b)

Seq. 22: Quieting Sensitivity - Pri XCVR CDR HDST

a. Verification of S+N/N output at CDR HDST for a carrier signal at S-Band Diplexer. Verification also, of dynamic range of S-Band volume control at CDR HDST. (Para. 4.2.2.11.1.5.1 a)

Seq. 23: S-Band Vol. Control - SEC XCVR LMP HDST

a. Verification of S+N/N output at LMP HDST for a carrier signal at S-Band Diplexer. Verification also, of dynamic range of S-Band volume control at LMP HDST. (Para. 4.2.2.11.1.5.1 c)

b. Verification of Uplink Squelch Control

Seq. 24: S-Band Power Ampl. Margin Test PRI XMTR/RCVR, PRI Pwr Ampl

a. Verification of maintenance of amp. lock within a ±10 percent power variation around the nominal primary PA current variation. (Para. 4.2.2.11.1.6.1)

Seq. 25: S-Band Power Ampl. Margin Test SEC XMTR/RCVR, SEC Pwr Ampl

a. Verification of maintenance of amp lock within a ±10 percent power variation around the nominal secondary PA current variation. (Para. 4.2.2.11.1.6.1)

Seq. 26: DUA Calibration Test

a. Tie-in of Digital Command Test Assy Test set and calibration via up-link S-Band of vehicle Digital Uplink Assy. (DUA)

Test Description: (Cont)

Seq. 27: Decoding, Capability Test

a. Verification of a 'Valid' uplink message producing a "Transfer" and a 'Invalid' uplink message producing a "No Transfer." This is accomplished via S-Band PCM mode. (Para. 4.2.2.11.1.7.2 a)

b. Verification of a downlink Bit Error Rate (BER) of NMT 10 bits in 10 million bits. (Para. 4.2.2.11.7.2 b)

Seq. 28: DUA 70 KHZ Uplink Back-Up Voice Test and Level

a. Verification of CDR HDST on a 70 KHZ subcarrier via S-Band uplink. Verification of DUA/Voice - Data switch operation via signal loss in off position. Verification of RCVR total power. (Para. 4.2.2.11.1.5.5)

Seq. 29: DUA/LGC Interface Checkout

a. Verification of an uplink and return downlink message via S-Band with ACE CRT validation. (Para. 4.2.2.11.1.7.1 a,b)

Seq. 30: Data Storage Electronics Assembly Checkout

a. Verification of proper DSEA operation by use of cabin indicator. Recording of approx two minutes of tone. Verification of DSEA off with DSEA on-off switch in OFF position. (Para. 4.2.2.11.1.8)

Seq. 31: PM Linear RCVR and PM Test XMTR Verification

a. Verification adjustment PM RCVR and XMTR to 1 Radian per volt in the COMM test station.

Seq. 32: S-Band D/L Deviation Test (PM)

a. Verification of signal to noise ratios of voice, 1.25 MHZ and 1.024 MHZ for PM Hi power mode. Also, deviations for above signals are verified for same conditions. Verification of S-Band modulation disappearance for off position of voice/on voice BU switch. Verification of no modulation on 1.25 MHZ for CDR S-Band T/R switch in off position. (Para. 4.2.2.11.1.5.2 a & b)

b. Verification of signal to noise ratios and deviation ratio for Emergency Key at PM Lo power with PMP prime power removed. (Para. 4.2.2.11.5.2.c)

c. For Lo power mode, verification is made for deviation ratios and signal to noise measurements of voice, 1.024 MHZ and 1.25 MHZ subcarriers. In addition, the CDR S-Band T/R switch is verified for proper operation, with Bio-Med in active position and Voice/DN Voice BU in DN Voice BU position. (Para. 4.2.2.11.5.2 d and e)

Test Description: (Cont)

Seq. 33: FM Calibration

a. Internal calibration adjustments of (S-Band) Communication Test Station.

Seq. 34: S-Band D/L Deviation Test (FM)

a. Verification of TV mode at 500 kc using Hi power mode and FM modulation. Measurements of signal to noise and deviations are verified for 500 KHZ, 1.25 MHZ and 1.024 MHZ in this set of conditions. (Para. 4.2.2.11.5.2 f)

Seq. 35: 1.25 MHZ Subcarrier Modulation Indices Verification

a. Deviation and signal to noise measurements of the 1.25 MHZ subcarrier are verified for the 8 sub-subcarriers using each relay switch. (CDR/LMP) (Para. 4.2.2.11.1.5.4)

Seq. 36: ST2 (SR-6)

a. Verification of Transfer for a Valid message and a No Transfer for an Invalid message via PCM (S-Band up and down link) (Para. 4.2.2.11.1.7.1.2 a)

b. Verification of a good BER (NMT 10 bits in 10 million) (Para. 4.2.2.11.1.7.1.2 b)

c. Measurement of ranging delay time, verification of ranging correlation and ranging disable when Off/Reset and TV/CWEA Enable switch positions are selected. (Para. 4.2.2.11.1.7.1.2 c)

d. Voice conference (using VHF and S-Band) involving CDR, LMP, CM, and MSFN. (Para. 4.2.2.11.1.7.1.2 b)

Seq. 37: ST-6 (SR-2)

a. Verification of Lo Power downlink 512 KHZ emergency key PMP prime power off. Verification of Lo Power uplink voice via 30 KHZ SC PMP prime power off. (Para. 4.2.2.11.1.7.3)

Seq. 38: ST-10 (SR-2)

a. Verification of the following:

1. Satisfactory TV reproduction (D/L)

2. NMT 10 bit errors in 10 million (Hi Bit)

3. Duplex VHF and S-Band voice communication (involving EVA, Crewman and MSFN)

4. Satisfactory EMU transmission from EVA to MSFN.

Test Description: (Cont)

b. Validation of proper switch operation preventing S-Band from functioning normally when 30 KHZ SC is not present due to S-Band Squelch switch in on position. (Para. 4.2.2.11.1.7.4.2)

Seq. 39: VHF PCM Bit Error Test

a. Verification of a minimum BEC via downlink VHF B at Lo Bit Rate (1.6 KBS) in a 10 million total bits. (Para. 4.2.2.11.1.9)

Seq. 40: ST-4 (SR-2)

a. Verification of duplex voice communication between LM+ MSFN via S-Band in back-up mode (No SPA power) (Para. 4.2.2.11.1.7.2.2 a)

b. Validation of minimum bit error count in 10 million at Lo Bit Rate on 1.024 MHZ SC downlink (Para. 4.2.2.11.1.7.2.2 b)

Seq. 41: Mode St-8A

a. Calibration of Pen recorders.

b. Verification of satisfactory voice transmission between EVA and MSFN via LM.

c. Validation of presence of Bio-med channels D/L on MSFN sonic analyzer.

e. Lo Bit D/L PCM data verification. (Para. 4.2.2.11.1.7.5.2)

Seq. 42: S-Band Steerable Antenna Manual Tracking Capability Test

a. Verification of pitch and yaw synchro controls, and angle readouts.

Seq. 43: S-Band Steerable Antenna Test GSE Set-Up

Seq. 44: S-Band Steerable Antenna Path Verification

a. Validation of RF free space and hardlink signal path providing a locked U/L & D/L S-Band signal.

b. Verification of S-Band heater operation.

Seq. 45: Automatic Acquisition Test - Pri XCVR

a. Verification of proper automatic lock-on of SBSA to a remote 2101.8 MHz signal when signal source is offset from nominal center line of LOS in both yaw and pitch planes. (Para. 4.2.2.11.1.6.4)

Seq. 46: Communications Shutdown

a. Normal procedure for placing vehicle equipment ERA's into dormant state.

b. CTS and support test equipment power-down.

OCP OUTLINE

OCP-GF-62000-RAD-LM-8

Test Title:

LM Combined Subsystem Pre-FEAT Test - Radar

Subsystem:

Guidance and Navigation

Test Objectives:

Verification of performance characteristics for the Rendezvous and Landing Radars and to support subsequent FCS Tests.

Vehicle Configuration:

Mated Stages

Location:

Integrated Workstand Plant 5

Hazardous Operation:

This is a hazardous OCP whenever either Radar is free to radiate without a suitable Hat.

Equipment Under Test:

RR Electronics Assembly

RR Antenna Assembly

LR Electronics Assembly

LR Antenna Assembly

Test Description:

Seq. 01: Call to Stations

Seq. 02: RR GSE turn-on

Seq. 03: Activation of LM Cabin Controls and Displays

Seq. 04: RR Turn-on

a. Verification of internal power supply voltages, DC.

b. Verification of presence of 800 Hz.

c. Monitoring of RR Antenna temperature (all Seq.)

Test Description: (Cont)

Seq. 05: RR Self Test

a. Verification, in self test, of signal strength meter readings for:

1. Xmtr output power

2. AGC voltage

3. Shaft error

4. Trunnion error (Para. 4.2.2.5.7.1)

b. Verification of Range and Range Rate self test values. (Para. 4.2.2.5.7.1)

c. Verification of Shaft and Trunnion motion during self test. (Para. 4.2.2.5.7.1)

d. Verification of proper operation of No-Track Light.

Seq. 06: Angular Coverage, Slew and Drift Rate Tests

a. Verification of Shaft and Trunnion axes angular capability. (Para. 4.2.2.5.7.2)

b. Verification of Shaft and Trunnion axes slew rates. (Para. 4.2.2.5.7.2)

c. Verification of Shaft and Trunnion axes drift rates. (Para. 4.2.2.5.7.2)

d. Check of proper X-Pointer operation.

Seq. 07: RR Gyro Torquing Test

a. Check of Compensated-Gyro-Error saturation voltage for both primary and redundant paths.

Seq. 08: RR RF Test (Para. 4.2.2.5.7.4)

a. Verification of transmitter output power.

b. Verification of transmitter output frequency.

c. Check spectral purity of transmitted output.

d. Check modulation indices.

Seq. 09: RR Acquisition Test

a. Verification of acquisition time. (Para. 4.2.2.5.7.5)

Test Description: (Cont)

b. Verification of acquisition capability at a simulated range of 400 NM. (Para. 4.2.2.5.7.5)

c. Determination of AGC voltage vs range.

Seq. 10: RR Trunnion and Shaft Angle Tracking

a. Verification of Shaft and Trunnion, angle tracking errors at ranges of 400 NM, 100 NM and minimum GSE - range. (Para. 4.2.2.5.7.3)

Seq. 11: Antenna Designation

a. Verification of the capability of the LGC to position the RR Shaft and Trunnion axes to several selected angles. (Para. 4.2.2.5.7.6.1)

b. Check of the dynamic nulling characteristics.

c. Verification of POWER ON/LGC MODE Discrete.

Seq. 12: RR Range Rate Test (Para. 4.2.2.5.7.5 and 4.2.2.5.7.6.2)

a. Verification of Range Rate accuracy at several range rate values.

b. Verification of LGC Range Rate readout capability. (Para. 4.2.2.5.7.6.2)

Seq. 13: RR Range Verification

a. Verification of Range accuracy at several static values of Range. (Para. 4.2.2.5.7.5)

b. Verification of LGC Range-Readout capability. (Para. 4.2.2.5.7.6.3)

c. Check Dynamic-Range capability at ranges of 350, 150 and 60 NM.

Seq. 14: Securing After RR Tests

Seq. 15: LR GSE Turn-On

Seq. 16: LR Power Turn-On

a. Check of LR antenna temperature.

b. Check of Internal Power Supply Voltages.

c. Check of Altitude Transmitter and Velocity Transmitter output power on Cabin Signal Strength Meter. (Para. 4.2.2.5.8.1 a)

Seq. 17: LR Self-Test Verification

a. Initiation of In-Flight Self-Test by means of cabin switch.

Test Description: (Cont)

b. Verification, in response to internally generated signals, of altitude, altitude rate, forward and lateral velocity indications on cabin display meters. (Para. 4.2.2.5.8.1 b,c)

c. Verification of self-test frequencies.

Seq. 18: LR Transmitter Verification

a. Verification by means of Antenna Hat and GSE.

1. Verification of frequency and power output of both the Altimeter and Velocity Transmitters. (Para. 4.2.2.5.8.2)

2. Check of Altimeter Transmitter for Linearity, Modulation Rate and Frequency Deviation in the two modes of range operation.

Seq. 19: Gain State Switching Verification

a. Measurement of input R.F. power level at which gain state switching occurs for each of the four receiver channels.

Seq. 20: Acquisition Threshold and Acquisition Time Verification

a. Verification of acquisition threshold; the minimum RF power level at which lock-on (tracker lock) is achieved for each of the four receiver channels (Para. 4.2.2.5.8.3.1)

b. Verification of tracker acquisition probability - i.e. number of times lock-on is achieved out of number of times lock-on is attempted within specified allowable acquisition time for each of the four receiver channels. (Para. 4.2.2.5.8.3.2)

Seq. 21: LR Display Accuracy Check

a. Simulation by GSE of specific altitude and velocity Standard Test Condition (STC) signals that are fed into the four receiver channels.

b. Verification of predetermined responses as indicated by cabin display readouts. The STC signal selected will determine the magnitude and direction of display readout. (Para. 4.2.2.5.8.5)

Seq. 22: LR CWEA Checkout and Tracker Lock Chan ID

a. Verification of the LR Caution and Warning Interface. This is accomplished by attentuating the stimuli to each of the three trackers, affecting C & W one at a time, and check for the initiation of the Caution and Warning Displays.

b. Verification of the LR Meter Display Warning circuitry. Altitude and Altitude Rate Signals are removed from meter displays initiating the Rng/Rng Rt - Alt/Alt Rt warning light.

Test Description: (Cont)

c. Verification of the LR Caution and Warning Displays during LR power turn-off.

Seq. 23: Forced Tracker Search Verification

a. The verification of the LR to unlock from simulated signals generated by GSE when the radar test switch is momentarily placed in the LDG and then OFF position.

Seq. 24: LR Antenna Tilt Verification

a. Verification of antenna travel and time for position change. (Para. 4.2.2.5.8.4)

1. Descent to Hover

2. Hover to Descent

Seq. 25: Dynamic Test, High and Low Range

a. Verification of maximum Doppler frequency change rates through which tracker lock is required to be maintained. Both the high and low range modes are verified.

Seq. 26: Tracking To Zero Doppler (Low Range)

a. Measurement of frequency at which loss of lock occurs while tracking to zero Doppler in a simulated low altitude condition.

Seq. 27: Preamp Scan

a. Measurement of noise amplitude at pre-amp outputs with no input signal.

Seq. 28: Channel Cross-Talk Verification

a. Measurement of signal leakage between channels measured at pre-amp outputs.

Seq. 29: LDG Radar and LGC Interface Test

a. Verification of altitude and velocity accuracies using standard test conditions (STC) generated from GSE and measured at ACE-S/C via LGC Downlink. (Para. 4.2.2.5.8.5 & 4.2.2.5.8.6)

b. LR output discretes verified at ACE-S/C via LGC Downlink. (Para. 4.2.2.5.8.5)

c. Verification of the LGC Ant Auto function in positioning the LR antenna from Descent to Hover.

Test Description: (Cont)

Seq. 30: Securing After Test

a. LR Shutdown

Seq. 31: LR/GSE Power Turn-On

a. FCS Support

Seq. 32: LR/GSE Power Turn-Off

a. FCS Support

Seq. 33: RR/GSE Power Turn-On

a. FCS Support

Seq. 34: RR/GSE Power Turn-Off

a. FCS Support

Test Title:

LM Combined Subsystem Pre-FEAT Test - Reaction Control.

Subsystem:

Reaction Control (RCS).

Test Objectives:

Determine end-to-end check or channel identification of electrical paths associated with:

a. Valve Position Indicators.

b. C & W Indicators (associated with (a))

c. Pressure Transducers.

d. Temperature Transducers.

Demonstration of functional operation of the A/B-1 and A/B-2 thruster cluster heater assemblies; and lower limit levels of associated C&WEA circuitry.

Establishment of a 'Heater Current' measurement on a per Quad per System basis.

Vehicle Configuration:

Ascent Stage.

Location:

Integrated Workstand, Plant 5 CEF.

Hazardous Operations:

Pressurization of tanks and lines above blanket pressure valves.

Equipment Under Test:

RCS Propellant Section Components.

RCS Helium Pressurization Section.

RCS System A/B-1 and A/B-2 Thruster Heaters.

Main Shutoff Valves.

ASC/RCS Int. Valves.

Isolation Valves.

Equipment Under Test: (Cont)

Crossfeed valves.

Reg Out. Transducer.

Manifold Transducers.

Helium Tank Transducer.

Tank Temperature Transducers.

Thruster Heater Bands.

Regulator A and B, CWEA Indicators.

Heater CWEA Indicators.

NOTE: Seq. 01 and 21 are "Call to Stations"

Seq. 20 is "Securing After Test"

Seq. 02: RCS Power On and Pressure Venting

a. All RCS Solenoid Latching Valve CB's energized.

b. RCS Flags, Meter Display and Heater Display CB's energized.

c. Verification and setting of RCS Latching Valve flags as an initial condition for later testing.

d. Venting of Ascent Propellant Tanks to ambient pressure.

e. Venting of entire RCS, i.e., lines and tanks, to ambient pressure.

Seq. 03: RCS Transducer Check Under Ambient Conditions.

a. Recording of all RCS pressure and temperature transducers at their associated ACE displays.

   1. Verification that transducer ambient readouts are within the end-to-end ACE tolerances (Para. 4.2.2.12.3.1(a)).

b. Verification of all Thrust Chamber Pressure switches 'CLOSED' via ACE displays.

c. Recording of all RCS pressure and temperature transducers at their associated cabin displays (Para. 4.2.2.9.1 (a) and (b).

   1. Verification that transducer ambient readouts are within the end-to-end cabin display tolerances (Para. 4.2.2.12.3.1(a)).

Test Description: (Cont)

Seq. 04: RCS - Solenoid Latching Valve Channel ID and CWEA Check.

a. Verification of the functional operation and channel ID of each individual RCS/ASC Interconnect Solenoid Latching Valve during cycling by:

1. Physically feeling for solenoid movement by hand.

2. Verification of proper cabin flag displays (Para. 4.2.2.9.1 (a) and (b)).

3. Verification of proper ACE displays (Para. 4.2.2.12.2.1(b)).

b. Verification of the functional operation and channel ID of the RCS Crossfeed Solenoid Latching Valves during cycling by:

1. Physically feeling for solenoid movement by hand.

2. Verification of proper cabin flag displays (Para. 4.2.2.9.1 (a) and (b)).

3. Verification of proper ACE displays (Para. 4.2.2.12.2.1(b)).

c. Verification of the functional operation and channel ID of the RCS Main Shutoff Solenoid Latching Valves and 'Reg A and B' warning light functions during cycling by:

1. Physically feeling for solenoid movement by hand.

2. Verification of proper cabin flag displays (Para. 4.2.2.9.1 (a) and (b)).

3. Verification of proper ACE displays (Para. 4.2.2.12.2.1(b)).

4. Verification of 'Master Alarms' and individual 'RCS Reg A or B' warning activation during "OPEN" cycles (Para. 4.2.2.12.4).

5. Verification of 'Master Alarm' resets and 'Reg A and B' warning inhibits during "CLOSE" cycles (Para. 4.2.2.12.4).

d. Verification of the functional operation and channel ID of the RCS Isolation Solenoid Latching Valves during cycling by:

1. Physically feeling for solenoid movement by hand.

2. Verification of proper cabin flag displays 4.2.2.9.1 (a) and (b)).

3. Verification of proper ACE displays (Para. 4.2.2.12.2.1(b)).

Test Description: (Cont)

e. De-activation of all power for RCS Solenoid Latching Valves by opening of valve circuit breakers.

Seq. 05: RCS System A Helium Regulator Outlet Transducer Channel ID at 65 Psia.

a. Pressurization of Reaction Control System A Helium Section to 65 psia utilizing gaseous nitrogen.

   1. Manifolding of gas and liquid sides of propellant tank bladders with the 'He Test Port' gas supply to maintain zero (0) ΔP throughout section.

b. Verification of the known 'He Reg Outlet' pressure on the proper ACE displays (Para. 4.2.2.12.2.1(b)).

c. Operation of 'Temp/Press Mon' select switch and verification of the known 'He Reg Outlet' transducer pressure on the proper cabin meter display (Para. 4.2.2.9.1 (a) and (b)).

d. Venting and sequential removal of GHQD's from Sys A propellant tanks and helium test port for maintenance of proper blanket pressure in helium section.

Seq. 06: RCS System B Helium Regulator Outlet Transducer Channel ID at 65 Psia.

a. Pressurization of Reaction Control System B Helium Section to 65 psia utilizing gaseous nitrogen.

   1. Manifolding of gas and liquid sides of propellant tank bladders with the 'He Test Port' gas supply to maintain zero (0) ΔP throughout section.

b. Verification of the known 'He Reg Outlet' pressure on the proper ACE displays (Para. 4.2.2.12.2.1(b)).

c. Operation of 'Temp/Press Mon' select switch and verification of the known 'He Reg Outlet' transducer pressure on the proper cabin meter display (Para. 4.2.2.9.1 (a) and (b)).

d. Venting and sequential removal of GHQD's from System B propellant tanks and 'He Test Port' for maintenance of proper blanket pressure in helium section.

Seq. 07: RCS System A Fuel Manifold Transducer Channel ID at 65 Psia.

a. Pressurization of Reaction Control System A Fuel Manifold to 65 psia utilizing gaseous nitrogen.

Test Description: (Cont)

b. Verification of the known A and B System 'Fuel Manifold Pressure Transducer' outputs on the proper ACE displays (Para. 4.2.2.12.2.1(b)).

c. Operation of 'Temp/Press Mon' select switch and verification of the known 'Fuel Manifold' transducers pressure on the proper cabin meter displays (Para. 4.2.2.9.1 (a) and (b)).

d. Venting of System A Fuel Manifold to blanket pressure.

Seq. 08: RCS System A Oxid Manifold Transducer Channel ID at 65 Psia.

a. Pressurization of Reaction Control System A Oxidizer Manifold to 65 psia utilizing gaseous nitrogen.

b. Verification of the known A and B System 'Oxid Manifold Pressure Transducer' outputs on the proper ACE displays (Para. 4.2.2.12.2.1(b)).

c. Operation of 'Temp/Press Mon' select switch and verification of the known 'Oxid Manifold' transducers pressures on the proper cabin meter displays (Para. 4.2.2.9.1 (a) and (b)).

d. Venting of System A Oxidizer Manifold to blanket pressure.

Seq. 09: RCS System B Fuel Manifold Transducer Channel ID at 65 Psia.

a. Pressurization of Reaction Control System B Fuel Manifold to 65 psia utilizing gaseous nitrogen.

b. Verification of the known 'Fuel Manifold Press' transducer output on the proper ACE displays (Para. 4.2.2.12.2.1 (b)).

c. Operation of 'Temp/Press Mon' select switch and verification of the known Fuel Manifold Press Transducer pressure on the proper cabin meter display (Para. 4.2.2.9.1 (a) and (b)).

d. Venting of System B Fuel Manifold to blanket pressure.

Seq. 10: RCS System B Oxid Manifold Transducer Channel ID at 65 Psia.

a. Pressurization of Reaction Control System B Oxid Manifold to 65 psia utilizing gaseous nitrogen.

b. Verification of the known 'Oxid Manifold Press' transducer output on the proper ACE displays (Para. 4.2.2.12.2.1(b)).

c. Operation of 'Temp/Press Mon' select switch and verification of the known Oxid Manifold Press Transducer pressure on the proper cabin meter display (Para. 4.2.2.9.1 (a) and (b)).

Test Description: (Cont)

d. Venting of System B Oxid Manifold to blanket pressure.

Seq. 11: APS Oxid Section Blanket Pressure Reapplication.

a. Pressurization of the APS Oxid Section with GN_2 to blanket pressure through the Oxidizer Fill-Vent Coupling.

b. Closure of the GHQD and removal from the Oxid Fill-Vent Coupling.

Seq. 12: APS Fuel Section Blanket Pressure Reapplication.

a. Pressurization of the APS Fuel Section with GN_2 to blanket pressure through the Fuel Fill-Vent Coupling.

b. Closure of the GHQD and removal from the Fuel Fill-Vent Coupling.

Seq. 13: RCS Helium Tank A Transducer Channel ID at 215 Psia.

a. Pressurization of RCS Helium Tank A to 215 psia utilizing gaseous nitrogen.

b. Verification of the known 'He Tank Press' transducer output on the proper ACE display (Para. 4.2.2.12.2.1(b)).

c. Operation of 'Temp/Press Mon' select switch and verification of the known 'He Tank' Press Transducer pressure on the proper cabin meter display (Para. 4.2.2.9.1 (a) and (b)).

d. Venting of 'RCS Helium Tank A' to blanket pressure.

Seq. 14: RCS Helium Tank B Transducer Channel ID at 215 Psia.

a. Pressurization of RCS Helium Tank B to 215 psia utilizing gaseous nitrogen.

b. Verification of the known 'He Tank Press' transducer output on the proper ACE display (Para. 4.2.2.12.2.1(b)).

c. Operation of 'Temp/Press Mon' select switch and verification of the known 'He Tank' press transducer pressure on the proper cabin meter display (Para. 4.2.2.9.1 (a) and (b)).

d. Venting of 'RCS Helium Tank B' Blanket pressure.

Seq. 15: RCS Fuel Tank Temperature Transducer Channel ID.

a. Verification of Fuel Tank A Temperature Transducer ambient temperature readout on proper ACE display.

b. Application of heat to Fuel A Temperature Transducer only.

Test Description: (Cont)

c. Verification of temperature increase at Fuel Tank A Temperature Transducer on proper ACE display (Para. 4.2.2.12.2.1(b)).

d. Operation of 'Temp/Press Mon' select switch and verification of a 'Fuel Tank A' temperature greater than ambient and the 'Fuel Tank B' temperature still ambient on the proper cabin meter display (Para. 4.2.2.9.1 (a) and (b)).

e. Application of heat to Fuel B Temperature Transducer only.

f. Verification of temperature increase at Fuel Tank B Temperature Transducer on proper ACE display (Para. 4.2.2.12.2.1(b)).

g. Operation of 'Temp/Press Mon' select switch and verification of the temperature increase of Fuel Tank B Temperature Transducer on the proper cabin meter display (Para. 4.2.2.9.1 (a) and (b)).

Seq. 16: Quad I A/B-1 and A/B-2 Heater Functional Test and C & W Verification (Para. 4.2.2.7.4 (a), (b), (c), (d), (e) and (f)).

a. Setting of all 'Htr Cont - RCS Sys A/B-2 Quad' switches to "AUTO".

b. Operation of 'Temp Mon' select switch and verification of Quad I ambient temperature indication on cabin display meter.

c. Verification of ambient temperature indication at Quad I ACE display.

d. Verification of all RCS Quad I GSE thermocouples at ambient temperature.

e. Application of power in automatic mode to Sys A/B-2 Quad I heaters.

f. Verification of temperature rise of the Quad I A/B-2 heater bands via GSE thermocouples.

g. De-activation of the A/B-2 Quad I 'Htr Con' switch.

h. Verification of temperature decrease at each A/B-2 heater band via the GSE Quad I thermocouples.

i. Application of power in auto mode to Sys A/B-1 Quad I heaters.

j. Verification of Quad I A/B-1 heater band operation via GSE thermocouples.

k. Application of power in "AUTO" mode to Quad I A/B-2 heaters.

l. Verification of maximum and minimum Quad temperatures via GSE thermocouples, cabin and ACE displays.

Test Description: (Cont)

m. Application of power in 'Man' mode to Quad I A/B-2 heaters.

n. Determination of time to reach temperature stabilization of Quad I heaters via GSE thermocouples and ACE.

o. Application of power in "AUTO" mode to Quad I A/B-2 heaters.

p. Determination of time to reach temperature stabilization of Quad I heaters via ACE display.

q. De-energization of Quad I heaters and verification of 'Heater' caution light activation at less than 120°F.

r. Verification of caution temperature level via cabin display and ACE.

s. Verification of caution reset circuitry.

Seq. 17: Quad II A/B-1 and A/B-2 Heater Functional Test and C & W Verification (Para. 4.2.2.7.4 (a), (b), (c), (d), (e) and (f)).

a. Operation of 'Temp Mon' select switch and verification of Quad II ambient temperature indication on cabin display meter.

b. Verification of ambient temperature indication at Quad II ACE display.

c. Verification of all RCS Quad II GSE thermocouples at ambient temperature.

d. Application of power in automatic mode to System A/B-2 Quad II heaters.

e. Verification of temperature rise of the Quad II A/B-2 heater bands via GSE thermocouples.

f. De-activation of the A/B-2 Quad II 'Heater Con' switch.

g. Verification of temperature decrease at each A/B-2 heater band via the GSE Quad II thermocouples.

h. Application of power in auto mode to System A/B-1 Quad II heaters.

i. Verification of Quad II A/B-1 heater band operation via GSE thermocouples.

j. Application of power in "AUTO" mode to Quad II A/B-2 heaters.

k. Verification of maximum and minimum Quad temperatures via GSE thermocouples, cabin and ACE displays.

Test Description: (Cont)

l. Application of power in "Man" mode to Quad II A/B-2 heaters.

m. Determination of time to reach temperature stabilization of Quad II heaters via GSE thermocouples and ACE.

n. Application of power in "AUTO" mode to Quad II A/B-2 heaters.

o. Determination of time to reach temperature stabilization of Quad II heaters via ACE display.

p. De-energization of Quad II heaters and verification of 'Heater' caution light activation at less than 120°F.

q. Verification of caution temperature level via cabin display and ACE.

r. Verification of caution reset circuitry.

Seq. 18: Quad III A/B-1 and A/B-2 Heater Functional Test and C & W Verification (Para. 4.2.2.7.4 (a), (b), (c), (d), (e) and (f)).

a. Operation of 'Temp Mon' select switch and verification of Quad III ambient temperature indication on cabin display meter.

b. Verification of ambient temperature indication at Quad III ACE display.

c. Verification of all RCS Quad III GSE thermocouples at ambient temperature.

d. Application of power in automatic mode to Sys A/B-2 Quad III heaters.

e. Verification of temperature rise of the Quad III A/B-2 heater bands via GSE thermocouples.

f. De-activation of the A/B-2 Quad III 'Htr Con' switch.

g. Verification of temperature decrease at each A/B-2 heater band via the GSE Quad III thermocouples.

h. Application of power in auto mode to Sys A/B-1 Quad III heaters.

i. Verification of Quad III A/B-1 heater band operation via GSE thermocouples.

j. Application of power in "AUTO" mode to Quad III A/B-2 heaters.

k. Verification of maximum and minimum Quad temperatures via GSE thermocouples, cabin and ACE displays.

Test Description: (Cont)

l. Application of power in 'Man' mode to Quad III A/B-2 heaters.

m. Determination of time to reach temperature stabilization of Quad III heaters via GSE thermocouples and ACE.

n. Application of power in "AUTO" mode to Quad III A/B-2 heaters.

o. Determination of time to reach temperature stabilization of Quad III heaters via ACE display.

p. De-energization of Quad III heaters and verification of 'Heater' caution light activation at less than 120°F.

q. Verification of caution temperature level via cabin display and ACE.

r. Verification of caution reset circuitry.

Seq. 19: Quad IV A/B-1 and A/B-2 Heater Functional Test and C & W Verification (Para. 4.2.2.7.4(a), (b), (c), (d), (e) and (f)).

a. Operation of 'Temp Mon' select switch and verification of Quad IV ambient temperature indication on cabin display meter.

b. Verification of ambient temperature indication at Quad IV ACE display.

c. Verification of all RCS Quad IV GSE thermocouples at ambient temperature.

d. Application of power in automatic mode to Sys A/B-2 Quad IV heaters.

e. Verification of temperature rise of the Quad IV A/B-2 heater bands via GSE thermocouples.

f. De-activation of the A/B-2 Quad IV 'Htr Con' switch.

g. Verification of temperature decrease at each A/B-2 heater band via the GSE Quad IV thermocouples.

h. Application of power in auto mode to Sys A/B-1 Quad IV heaters.

i. Verification of Quad IV A/B-1 heater band operation via GSE thermocouples.

j. Application of power in "AUTO" mode to Quad IV A/B-2 heaters.

k. Verification of maximum and minimum Quad temperatures via GSE thermocouples, cabin and ACE displays.

Test Description: (Cont)

l. Application of power in 'Man' mode to Quad IV A/B-2 heaters.

m. Determination of time to reach temperature stabilization of Quad IV heaters via GSE thermocouples and ACE.

n. Application of power in "AUTO" mode to Quad IV A/B-2 heaters.

o. Determination of time to reach temperature stabilization of Quad IV heaters via ACE display.

p. De-energization of Quad IV heaters and verification of 'Heater' caution light activation at less than 120°F.

q. Verification of caution temperature level via cabin display and ACE.

r. Verification of caution reset circuitry.

Seq. 22: RCS Heater Current Measurement (Para. 4.2.2.7.4(g)).

a. Verification of vehicle "No Load Residual" bus current (less than 2.5 amps DC).

b. Application of power to Quad I A/B-1 heaters.

c. Recording of A/B-1, Quad I total current draw, via GSE ammeter.

d. Deactivation of Quad I A/B-1 heaters.

e. Application of power to Quad I A/B-2 heaters in the auto mode, and recording of total current draw on GSE ammeter.

f. Application of power to Quad I A/B-2 heaters in the 'Man' mode and recording of total current draw on GSE ammeter.

g. Deactivation of Quad I A/B-2 heaters and recording of residual current.

h. Repeat of preceding checks for each of the other three RCS Quads.

OCP OUTLINE

OCP-GF-62000-FCS-LM8

Test Title:

LM Combined Subsystem Pre-FEAT Test - FCS

Subsystem:

Flight Control Subsystem (FCS)

Test Objectives:

a. To verify the functional performance of the Control Electronics Section (CES)

b. To verify the functional performance of the Abort Guidance Section (AGS)

c. To verify the functional performance of the Integrated Flight Control Subsystem (FCS), consisting of CES, AGS and PGNS integrated in the LM.

Vehicle Configuration:

Ascent and Descent Stages electrically mated.

Location:

Integrated Workstand, Plant 5

Hazardous Operations:

Not applicable

Equipment Under Test:

CES	AGS	G&N
ATCA	AEA	IMU
RGA	ASA	CDU
DECA	DEDA	DSKY
Control Assy No. 1, No. 2, No. 3		LGC
GDA (Pitch and Roll)		
16 RCS Jets (Primary & Secondary)		
Descent Engine		
Ascent Engine		
ACA (CDR and LMP)		
TTCA (CDR and LMP)		

Equipment Under Test: (Cont)

FCS

FCS Displays & Controls

FCS Caution & Warning

FDAI (CDR and LMP)

ORDEAL

Event Timer

Mission Timer

Test Description:

Seq. 01: Call to Station

Seq. 02: PGNS Steering Error Checkout. (Para. 4.2.2.5.14(b))

a. Verification of FDAI's steering error indicators for roll, pitch, and yaw in response to LGC test profiles.

Seq. 03: PGNS X-Pointers and Alt/Alt Rate Meter Checkout. (Para. 4.2.2.5.14(c), (d))

a. Verification of X-Pointer indicators (forward and lateral velocity)

b. Verification of Alt/Alt Rate displays.

Seq. 04: CES Turn-On and Caution/Warning Checkout. (Para. 4.2.2.6.4(a)(1))

a. Verification of RGA run-up time

b. Verification of RGA run-down time

c. Verification of CES power Caution/Warning operation.

d. Determination of 'minimum' and 'stall' positions of the TVA, to prevent TVA overstress conditions in the subsequent tests.

Seq. 05: Event Timer Checkout. (Para. 4.2.2.9.2)

a. Verification of Slew

b. Verification of Count up/down

c. Start/Stop/ Reset

Test Description: (Cont)

Seq. 06: Mission Timer Checkout. (Para. 4.2.2.9.3(a), (b), (c))

a. Verification of Slew

b. Verification of Start/Stop/Reset

c. Verification of Count Up

Seq. 07: ACA Direct, Hardover and + X-Translation Override Checkout. (Para. 4.2.2.6.3.7.3, 4.2.2.6.3.8)

a. Verification of operation of the secondary RCS jets with ACA in hardover control.

b. Verification of operation of Enable/Disable functions of ACA/4 Jet Enable switches.

c. Verification of operation of the secondary RCS Jets in plus X-Translation Override control.

d. Verification of operation of the secondary RCS Jets Direct Mode.

Seq. 08: ACA Proportional Mode Checkout. (Para. 4.2.2.6.3.7.2)

a. Verification of operation of the primary RCS Jets, with ACA proportional rate signals, in AGS Mode, and Mode Control selection.

b. Verification of LMP ACA shorting plug.

c. Operation of Enable/Disable functions of ACA Prop Enable switches in AGS Mode.

d. Verification of ATT/TRANSL switch for 4 Jets Pitch and Roll operation.

Seq. 09: ACA/RGA Gimbal Trim Checkout.

a. Verification of operation of Pitch and Roll GDA's in AGS Mode, controlled by RGA pitch and roll signals.

b. Verification of operation of Pitch and Roll GDA's in AGS Mode, controlled with a ACA in proportional rate mode.

c. Verification of operation of ENG GMBL caution light for ± Pitch and ± Roll GDA's malfunctions.

d. Verification of ENG GMBL Enable/OFF switch.

e. Verification of Gimbal Fail reset via R-Start and ENG GMBL switch.

f. Verification of gimballing inhibit by the Pulse Mode.

Test Desctiption: (Cont)

Seq. 10: TTCA Checkout, (Para. 4.2.2.6.3.9.2)

a. Verification of the operation of primary RCS jets in AGS Mode, controlled by TTCA's.

b. Verification of ON/OFF functions of BAL CPL switch.

c. Verification of Enable/Disable functions of TTCA/Transl Enable switches, in AGS Mode.

d. Verification of ATT/TRANSL switch in 2 and 4 Jets X-translation.

Seq. 11: PRM Checkout. (Para. 4.2.2.6.3.5)

a. Verification of duration of PRM time-on pulses.

b. Verification of pulse ratio frequency of PRM.

Seq. 12: Attitude Controller Assembly Pulse Mode Checkout. (Para. 4.2.2.6.3.7.1)

a. Verification of RCS primary jets in Pulse Mode, controlled by ACA's.

Seq. 13: Jet Logic Checkout. (Para. 4.2.2.6.3.6)

a. Verification of Horizontal/Vertical Jet Logic. (LMP TTCA in THROTTLE, Operating horizontal jets)

b. Verification of LMP & TTCA in throttle, operating Horizontal Jets.

Seq. 14: Lunar Probe Interface Checkout (Para. 4.2.2.1.3(a))

a. Verification of operation of Lunar Contact lights controlled by each of the four landing probes.

b. Verification of LAMP TEST TONE switch to test LUNAR CONTACT lights.

c. Verification of operation of Lunar Contact lights via each redundant circuit, ATCA, and ENG CONT.

d. Verification of manual reset of Lunar Contact Lights.

e. Verification of the redundant functions of Engine Thrust and Descent Engine Override Cmnds in the above circuits.

Seq. 15: PGNS Gimbal Trim Checkout. (Para. 4.2.2.5.9.3(a), (d))

a. Verification of Pitch and Roll GDA's in PGNS Mode including drive rate determination.

Test Description: (Cont)

Seq. 16: PGNS ACA Checkout. (Para. 4.2.2.5.3(f), 4.2.2.5.13)

a. Verification of DES Rate switch for +1 FPS and -1 FPS command inputs to LGC.

b. Verification of ACA's in PGNS Mode, for out-of-detent signal inputs to LGC.

c. Verification of ACA's in PGNS Mode, for proportional rate command inputs to LGC.

d. Verification of Enable/Disable functions of ACA Prop Enable switches.

Seq. 17: PGNS TTCA Checkout. (Para. 4.2.2.5.3(f), 4.2.2.5.1.3)

a. Verification of TTCA's in PGNS Mode for translation command inputs to LGC.

b. Verification of Enable/Disable functions of TTCA/Transl Enable switches.

Seq. 18: PGNS RCS Checkout (Para. 4.2.2.5.11)

a. Verification of operation of the primary RCS jets in PGNS Mode.

Seq. 19: PGNS Descent Engine Checkout. (Para. 4.2.2.5.9.1(a), (b))

a. Verification of On/Off Control of the Descent Engine in PGNS Mode.

b. Manual On/Off Control of the Descent Engine by means of one START push-button and the two STOP push-buttons. Determination of the time delay between the DECA Engine-On command and the Descent Engine Helium pressurization functions.

c. Checkout of DECA logic.

Seq. 20: PGNS Ascent Engine Checkout. (Para. 4.2.2.5.10(a), (b))

a. Verification of On/Off Control of the Ascent Engine in PGNS Mode, utilizing a Pressurization Cart.

b. Verification of Ascent Quantity caution light.

c. Verification of manual On/Off control of the Ascent Engine in PGNS Mode, by means of one START push-button and the two STOP pushbuttons.

d. Ascent Engine Control Assembly Logic Checkout. (Auto Engine On/Off)

Test Description: (Cont)

Seq. 21: PGNS Abort/Abort Stage Checkout. (Para. 4.2.2.5.12(e), (f), (g), 4.2.2.5.9.1(b))

a. Verification of Abort and Abort Stage push-buttons function in PGNS Mode.

b. Verification that with ENG ARM switch in 'OFF' and ABORT or ABORT STAGE push-buttons exercised, the Manual START is ineffective, and 'Auto Engine ON' is effective.

c. Verification of time delay interval between the initiation of the Abort Stage and the On command to the Descent Engine.

Seq. 22: Descent Engine Override Checkout. (Para. 4.2.2.5.9.1(b))

a. Verification of Manual On/Off control of the Descent Engine, with START/STOP push-buttons.

b. Verification of On/Off operation of the Descent Engine pre-valves A & B (primary and secondary).

c. Verification of On/Off operation of the Descent Engine solenoid valves A, B, C and D (primary and secondary), utilizing a Pressure Cart.

d. Verification of Caution/Warning logic for the Descent Regulator.

e. Verification of 'DES REG' warning upper and lower limits.

f. Verification of On/Off functions of DES ENG CMD OVRD switch.

Seq. 23: Auto/Manual Throttle Checkout. (Para. 4.2.2.6.3.9.1(a), (b), (c), 4.2.2.5.9.2(b))

a. Verification of Descent Engine throttling with TTCA's, in Manual Throttle Mode.

b. Verification of Descent Engine throttling in Automatic Throttle Mode, controlled by LGC test program.

c. Verification of manual override of 'Auto Throttle Cmd'.

Seq. 24: DECA Power Supply Redundancy Checkout

a. Verification of DECA operation (manual and auto throttle engine on/off) with both primary and auxiliary DECA power supplies on.

b. Verification of DECA operation with the auxiliary power off.

Test Description: (Cont)

c. Verification of DECA operation with ATCA power supply turned off.

d. Verification of Descent Engine off, controlled by LGC.

Seq. 25: PGNS FDAI Total Attitude Checkout (Para. 4.2.2.5.14 (a))

a. Verification of FDAI's total attitude displays initiated by LGC Profile.

Seq. 26: PGNS Automatic Descent/RCS No-Fail Test. (Para. 4.2.2.5.9.1(a), 4.2.2.5.9.2, 4.2.2.5.9.3(a), (c), (d), 4.2.2.5.11)

a. Verification of FCS functions in a simulated run of the descent phase of LM mission. The following functions are performed with PGNS in control using an LGC test profile:

1. On/Off control of the Descent Engine.
2. Automatic throttling of the Descent Engine.
3. Gimballing of the Descent Engine.
4. On/Off operation of 16 primary RCS jets.
5. LR information processed during profile run.

b. Verification of RCS failure logic under the No-Fail conditions.

Seq. 27: PGNS Automatic Ascent. (Para. 4.2.2.5.10(a), 4.2.2.5.11)

a. Verification of the FCS functions in a simulated run of the ascent phase of LM mission. The following functions are performed with PGNS in control using an LGC test profile:

1. On/Off control of the Ascent Engine.
2. On/Off operation of 16 primary RCS jets.
3. RR information processed during profile run.

Seq. 28: RCS TCA Malfunction Mode Checkout (Para. 4.2.2.12.4)

a. Verification of RCS Caution/Warning logic via TCA malfunction tables for the following conditions:

1. Long fail malfunctions.
2. Short fail malfunctions.
3. Opposing jets malfunctions.

Test Description: (Cont)

Seq. 29: AGS Turn-On. (Para. 4.2.2.6.5.1(b), (c), (d), (g), (f))

a. Verification of switchover of ASA Heater power source from PTMU to LM power.

b. ASA temperature operating point.

c. ASA gyros run-up and run-down time, via SMRD monitoring.

d. Flight program previously inserted at the BTME via AEA self-test.

e. AEA internal power supply votages.

f. AGS timing pulses.

Seq. 30: Data Entry and Display Assembly (DEDA) Verification (Para. 4.2.2.6.5.2, 4.2.2.6.5.3)

a. Verification of DEDA status lights and electro-luminescent numeric elements.

b. Verification of DEDA entry and display alarm logic.

c. Verification of DEDA for AEA data entry.

Seq. 31: AEA Self Test. (Para. 4.2.2.6.5.3)

a. Verification of AEA Arithmetic operations and memory content.

b. AGS warning light.

c. DEDA in and out shifting pulses.

Seq. 32: AEA Load and Verify Routine.

a. Verification of AEA capability to accept and process the load and verify program. (Executive program)

b. Verification of operation of ACE-S/C uplink, carry-on, and downlink equipment associated with the AGS.

Seq. 33: AEA Self Test Addendum Verification. (Para. 4.2.2.6.5.3)

a. Verification of operation of data entry and readout in memory.

b. Cross-talk check, verifying that the newly entered data does not affect the previous entries.

c. Verification of DEDA binary to decimal, conversion capability, and display of all readout positions.

Test Description: (Cont)

Seq. 34: AGS/FDAI Total Attitude Checkout. (Para. 4.2.2.6.5.5(a)(2), (b)(1))

a. Verification of AEA capability to drive FDAI total attitude displays in response to AEA test program.

Seq. 35: AGS/FDAI Attitude Error Checkout, at Maximum Deadband. (Para. 4.2.2.6.5.5(a)(1), (b)(5))

a. Verification of AEA capability to drive FDAI attitude error displays at maximum deadband, in response to AEA test program.

Seq. 36: AGS/FDAI Attitude Error Checkout, at Minimum Deadband.

a. Verification of AEA capability to drive FDAI's attitude error displays at minimum deadband, in response to AEA test program.

Seq. 37: AGS Alt/Alt Rate Checkout. (Para. 4.2.2.6.5.5(a)(4), (b)(4), (a)(5), (b)(3))

a. Verification of AEA capability to drive Altitude and Altitude Rate Indicators in response to AEA test program.

Seq. 38: AGS Cross-Pointer Checkout. (Para. 4.2.2.6.5.5(a)(3), (b)(2))

a. Verification of AEA capability to drive Cross-Pointer Indicators in response to lateral velocity signals of the AEA test profile.

Seq. 39: AGS Gyro and Accelerometer Scale Factors and Polarity Verification. (Para. 4.2.2.6.5.6)

a. Verification of accumulation of AEA processed accelerometer and gyro outputs for five minutes of time, utilizing AEA test program.

b. Verification of output of accumulated data to ACE-S/C via downlink telemetry.

c. Verification of ACE-S/C recording and reduction of data for determination of polarity and scale factors of gyros and accelerometers.

d. Verification of orientation of ASA axes relative to the local vertical, by means of ASA accelerometers.

Seq. 40: AGS Pre-Launch Gyro Calibration. (Para. 4.2.2.6.5.8(b))

a. Optical determination of the vehicle azimuth.

b. Insertion of compensation factors for AEA accelerometers and gyros, and of the site latitude.

Test Description: (Cont)

c. AEA computation of Euler angles.

d. Determination of Non-G drift factors for X, Y and Z gyros.

Seq. 41: AGS Flight Program Insertion. (Para. 4.2.2.6.5.9)

a. Flight program load into AEA via ACE-S/C uplink.

b. Verification of flight program by AEA Self-Test and operation in the Orbit Align Mode.

Seq. 42: AGS Inertial Reference and Polarity Verification. (Para. 4.2.2.6.5.1(h), (i), (j), (k), (l), (m), (n))

a. Verification of AEA output discretes, required for the inertial reference operational modes.

b. Determination of accelerometer polarity by means of AEA flight program.

Seq. 43: PGNS/AGS State Vector Transfer.

a. Verification of PGNS CDU zero

b. Verification of AGS IMU align

c. Verification of AGS initialization

d. Verification of readout of state vector on DEDA

Seq. 44: PGNS/AGS Attitude Alignment. (Para. 4.2.2.6.5.7)

a. Verification of PGNS attitude alignment transfer.

b. Verification of AGS orbit align

c. Verification of AGS IMU align

d. Verification of AGS/PGNS alignment, utilizing readouts of FDAI's total attitude.

Seq. 45: ORDEAL Checkout (Orbital Rate Drive Electronics for Apollo & LM). (Para. 4.2.2.9.4)

a. Verification of operation of ORDEAL control, driving CDR and LMP FDAI's total attitude displays.

Test Description: (Cont)

b. Verification of operation of ORDEAL in Lunar Orbit Mode at 100 NM and 80 NM, with determination of drive rates for CDR and LMP FDAI's.

c. Verification of operation of ORDEAL in Earth Orbit Mode at 40 NM and 310 NM, with determination of drive rates for CDR and LMP FDAI's.

d. Verification of operation of ORDEAL lighting in Bright and Dim Modes.

Seq. 46: PGNS Gyro Compassing.

a. Determination of the orientation of the LM navigation base with respect to earth coordinates.

Seq. 47: AGS Lunar Align.

a. Nulling out of earth rate effects on ASA gyros.

b. Alignment of ASA inertial reference to the local vertical by Y and Z accelerometers.

c. Verification of vertical alignment by the directional cosines matrix.

d. Comparison of AGS directional cosine angles with the respective PGNS CDU angles (PGNS in gyro-compassing mode).

Seq. 48: PGNS/AGS Alignment Verification. (Para. 4.2.2.6.5.7)

a. Accumulation of ASA accelerometer and gyro pulses over an extended sampling period.

b. Verification of PGNS/AGS alignment by comparison of data obtained from PGNS and AGS accelerometers.

Seq. 49: Deadband and DECA Gimbal Threshold Checkout. (Para. 4.2.2.6.3.1, 4.2.2.6.3.4(a)(1), (a)(2), (b)(1)(a), (b)(1)(b))

a. Verification (via AGS Program) of minimum and maximum deadband of ATCA attitude control loops. (yaw, pitch, and roll)

b. Verification of DECA gimballing threshold via AGS program.

Seq. 50: Descent Limiter and RGA Checkout. (Para. 4.2.2.6.3.2)

a. Verification (via AGS Program) of ATCA descent limiters in yaw, pitch, and roll control loops. AEA test program is utilized to generate attitude error signals.

Test Description: (Cont)

b. Verification of FDAI's Rate Indicators in response to RGA gyro test outputs.

Seq. 51: Ascent Limiter Checkout. (Para. 4.2.2.6.3.3)

a. Verification (via AGS Program) of ATCA ascent limiter in yaw, pitch, and roll control loops. AEA test program is utilized to generate attitude error signals.

b. Verification of Algebraic summation of RGA outputs and AEA attitude error signals in yaw, pitch, and roll control loops.

c. Verification of FDAI's Rate Indicators in response to RGA gyro test outputs.

Seq. 52: AGS Abort/Abort Stage. (Para. 4.2.2.6.5.1(j), (l), (k), (m))

a. Verification of FCS functions during the Abort and Abort Stage operation in AGS guidance mode. By means of AGS test profile, the following functions are exercised and verified in the Abort, and Abort Stage operation:

Abort:

1. Initialization of AGS Abort Test Profile, accomplished by pressing the Abort push-button.
2. Arming of the Descent Engine.
3. Turn-on of the Descent Engine.
4. Gimballing of the Descent Engine in positive and negative pitch and roll.
5. On/Off operation of the primary RCS jets in positive and negative yaw, pitch and roll.

Abort Stage:

1. Initialization of AGS Abort Stage Test Profile, accomplished by pressing the Abort Stage push-button.
2. Simulation of staging by ACE-S/C R-Start command.
3. Turn-off of the Descent Engine.
4. Arming of the Ascent Engine.
5. Turn-on of the Ascent Engine.

Test Description: (Cont)

6. On/Off operation of the primary RCS jets in positive and negative yaw, pitch and roll.

7. Manual resetting of the Abort and Abort Stage push-buttons.

Seq. 53: AGS Attitude Hold Checkout. (Para. 4.2.2.6.5.4(f))

a. Verification of AGS Attitude Hold capability by monitoring the AEA steering error outputs, resulting from the yaw, pitch, and roll components of the earth rate vector.

Seq. 54: AGS Turn-Off.

a. AGS power turn-off.

b. Transfer of ASA heaters operation to external control (PTMU)

Seq. 55: RCS Shutdown.

a. De-activation of RCS Subsystem.

b. Determination of the final status of RCS valves by LM cockpit displays.

c. De-activation of RCS displays.

Seq. 56: Descent Engine Throttle Current Check.

a. Verification of the current values at the inputs to the descent engine including TVA, pre-valves and Diode redundancy. The throttle is exercised in manual mode, by the CDR TTCA.

Seq. 57: ATCA Free Run, Mission Timer, and RGA Run-down Check. (Para. 4.2.2.6.4(a)(2), (a)(3))

a. Verification of Mission Timer, operating by its own internal synchronization.

b. Ability of ATCA 800 cps power supply to operate in a free running mode.

800 cps frequency of ATCA power supply is evaluated by comparison of RGA motor speeds obtained with and without the synchronization signal from the PCM/TE clock.

c. Run-down time of RGA gyros.

d. Operation of Caution/Warning for CES power.

Test Title:

LM Combined Subsystem Pre-FEAT Test - Initialization and Pre-Checkout

Subsystem:

GSE for all LM Spacecraft Subsystems, ACE-S/C and ACE - Carry-on

Test Objective:

a. Provide initialization (test set-ups) and pre-checkout procedures (Pre-Checkout Preparation Checklist) required to support LM Combined Subsystem Pre-FEAT Test.

b. Provide a detailed test equipment matrix containing group (S/S and ACE/Carry-on/Spacecraft) usage and quantity available vs. quantity required.

c. A vehicle connector list will verify proper vehicle connector configuration as required to support the start of the Pre-FEAT Test.

d. Vehicle equipment installation will be verified utilizing the flight hardware lists.

e. Provide the initial cabin configuration to support start of the Pre-FEAT Test.

Vehicle Configuration:

Ascent and Descent Stages mechanically and electrically mated.

Location:

Integrated Workstand, Plant 5

Hazardous Operations:

Not Applicable

Equipment Under Test:

GSE and support equipment for the following groups:

ACE-S/C

ACE-Carry-on

Spacecraft

Instrumentation Subsystem

Equipment Under Test: (Cont)

Communications Subsystem

Electrical Power Subsystem

Environmental Control Subsystem

Propulsion Subsystem

Abort Guidance Subsystem

Control Electronics Section

Displays and Controls Subsystem

Primary Guidance, Navigation and Control Subsystem

Landing Radar Subsystem

Rendezvous Radar Subsystem

Reaction Control Subsystem

Explosive Devices Subsystem

Test Description:

Seq. 01: Preparation of workstand and vehicle for Pre-FEAT Test by configuring GSE and support equipment for groups listed in "Equipment Under Test" section.

Seq. 02: Performance of checkout procedures and initial settings for GSE and support equipment listed in "Equipment Under Test" section.

Seq. 03: Performance, as specified by the control document, of set-ups and pre-checkout preparation checklist during the running of the Pre-FEAT Test portions of the test.

Test Title:

LM combined FEAT Test-Control

(to be supplied)

OCP OUTLINE

OCP-GF-62500-SIG-LM8

Test Title:

LM Combined FEAT Test-RCS Valve Signature

Subsystem:

Stabilization and Control (S&C)
Reaction Control (RCS)

Test Objectives:

Verification of proper timing of RCS thruster valve responses.

Verification of proper geometric position and proper primary to secondary coil identification.

Verification of vehicle wiring to the RCS engines by observing the gas flow from the RCS engines.

Vehicle Configuration:

Ascent stage

Location:

Integrated workstand, Plant 5 CEF

Hazardous Operations:

Not applicable

Components Under Test:

Attitude and Translation Control Assembly (ATCA)
RCS Thrusters
Attitude Controller Assembly (ACA)
Thrust Translation Controller Assembly (T/TCA)
LM Guidance Computer (LGC)

Test Description:

Seq. 01: Call to Stations

Seq. 02: Support System Status Verification

a. Verification of power application to vehicle bus at 26.5 VDC.

b. Set and verification of vehicle cabin circuit breaker and switch configuration.

Test Description: (Cont)

Seq. 03: RCS Jet Wiring/Gas Flow and Channel Verification

a. Verification of GN_2 at 15 to 25 psig.

b. Energize TCA CB for a particular quad and RCS system. Activate T/TCA for single axis translation and observe specified thruster gas bag inflation. The T/TCA is returned to detent and the CB's and switches are opened and turned off respectively.

c. Item b above is repeated 15 times to cover all RCS thrusters and systems individually.

d. The data is checked for correct channel assignment.

Seq. 04: AGS Mode (Para. 4.2.2.7.7)

a. Valve signatures recorded

1. T/TCA positioned to obtain single Axis responses from RCS thrusters for all Axis.

2. Transient responses across secondary coil fuel and oxid solenoids due to primary coil fuel and oxid solenoid energization are recorded.

b. Verification of data appearing on correct Instrumentation Recorder System channels.

Seq. 05: Hardover Mode (Para. 4.2.2.7.7(a)(5))

a. Valve signatures recorded

1. ACA positioned to obtain "Hardover" responses from RCS thrusters.

2. Transient responses to hardover commands are recorded.

b. Verification of data appearing on correct Instrumentation Recorder System channels.

Seq. 06: G&N Turn-On

a. Verification of nominal +28 VDC power application to Commander's Bus and LM Pilots bus.

b. G&N Ace-S/C File load

1. Verification of power applied to the PGNS-LGC/DSKY.

2. Set cabin CB and switch configuration.

c. LGC Self Check

Test Description: (Cont)

Seq. 07: Valve Signature - Primary (DAP) Mode

a. Insert RCS firing data into the LGC memory via tape.

b. LGC mode jet firings.

c. Verification of data appearing on Instrumentation Recorder System.

Seq. 08: Securing After Test

OCP OUTLINE

Test Title:

LM Combined FEAT Test-Extended Polarity Tests

Subsystem:

Stabilization and Control Subsystem

Test Objectives:

a. Verification of the 'end to end' polarity of the attitude control loops for yaw, pitch and roll, from vehicle rate to RCS jets; exercised by rotation of the vehicle to verify polarity of RGA gyros in response to the physical rotation about X, Y and Z axes.

b. An 'end to end' polarity test from Abort Sensor Assembly to the RCS jets. Verification of the polarity of ASA gyros including the X, Y, Z linear accelerometer components in response to the physical rotation about X, Y and Z axes.

Vehicle Configuration:

Mated Stages

Location:

Integrated Workstand, Plant 5

Hazardous Operation:

Suspension of vehicle

Equipment Under Test:

a. Rate Gyro Assembly (RGA)

b. Attitude and Translation Control Assembly (ATCA)

c. Abort Sensor Assembly (ASA)

d. Abort Electronics Assembly (AEA)

Test Description: (Para. 4.2.2.6)

Seq. 01: Call to Station

Seq. 02: Support System Status Verification

Seq. 03: Configuration and CES Turn-On and RGA Run-Up

Seq. 04: Pitch Rotation

a. Verification of GSE guide and drive equipment for pitch rotation.

b. Activation of Control Switch Box.

Test Description: (Cont)

c. Rotation of the vehicle in positive and negative pitch to verify polarity of the RGA pitch gyro attitude control loop. Record demod output, RCS jets on event lights and verify on light beam recorder. Observe RGA outputs monitored on FDAI'S.

Seq. 05: Roll Rotation

a. Verification of GSE guide and drive equipment for roll rotation.

b. Activation of Control Switch Box.

c. Activation of RGA.

d. Rotation of the vehicle in positive and negative roll to verify polarity of the RGA roll gyro attitude control loop.

Seq. 06: Yaw Rotation

a. Verification of GSE guide and drive equipment for yaw rotation.

b. Activation of Control Switch Box.

c. Activation of RGA.

d. Rotation of the vehicle in positive and negative yaw to verify polarity of the RGA yaw gyro attitude control loop.

e. RGA run down time.

Seq. 07: Instrumentation, Caution and Warning Activation, and AGS Turn-On.

a. C&W Turn-on

b. AGS Turn-on

c. ASA temperature

d. ASA GTRD run-up

e. AEA self-test

f. Body axis align.

g. Earth rate compensation X, Y, Z axis.

Seq. 08: Yaw Rotation

a. Verification of GSE guide and drive equipment for yaw rotation.

b. Selection of AGS attitude hold mode.

c. Activation of Control Switch Box.

Test Description: (Cont)

d. Rotation of the vehicle in positive and negative yaw to verify polarity of the AGS attitude hold loop.

e. Observe jets on event lights and verify on light beam recorder. Reload FDAI yaw rate, yaw attitude error and attitude. Verify components of accel. X, Y, Z.

Seq. 09: Roll Rotation

a. Verification of GSE guide and drive equipment for roll rotation.

b. AEA self test.

c. Body axis align.

d. Selection of AGS attitude hold mode.

e. Activation of Control Switch Box.

f. Rotation of the vehicle in positive and negative roll to verify polarity of AGS attitude hold loop. Observe jets on event lights and verify on light beam recorder.

g. Record FDAI roll rate, roll attitude error and attitude. Verify components of accel. X, Y, Z.

Seq. 10: Pitch Rotation

a. Verification of GSE guide and drive equipment for pitch rotation.

b. AEA self test.

c. Body axis align.

d. Selection of AGS attitude hold mode.

e. Activation of Control Switch Box.

f. Rotation of the vehicle in positive and negative pitch to verify polarity of the AGS attitude hold loop.

g. Observe jets on event lights and verify on light beam recorder.

h. Record FDAI pitch rate, pitch attitude error and attitude. Verify components of accel. X, Y, Z.

i. Removal of earth rate compensation in X, Y, and Z axes.

Test Description: (Cont)

Seq. 11: Recording Gyro Rundown Time and AGS Shut-down

a. AEA turn-off and record ASA gyros run-down time.

b. Turn-off of RGA and ATCA.

c. Verification of CES C&W.

d. Transfer of ASA heater control from AGS to PTMU.

e. Turn-off of the support subsystems.

Test Title:

LM Combined Feat Test-Systems Verification (Plugs-In)

Subsystem:

All Subsystems - Integrated Vehicle

Test Objectives:

To verify the total LM System EMC performance in typical mission modes.

Vehicle Configuration:

a. Ascent and Descent stages electrically and mechanically mated for Descent, Abort and Abort Stage phases of mission.

b. Ascent stage de-mated electrically for Ascent phase of mission.

Location:

Integrated Test Stand

Hazardous Conditions:

Not Applicable

Equipment Under Test:

All flight equipment except for:

a. Test units substituted for RCS Quads.

b. GSE Power Supplies in place of LM batteries.

Test Description:

Seq. 001: Call to Stations

a. Verification of the intercom voice communication between the test conductor and all test personnel.

b. Verification of decoms setting.

c. Annotation of all recorders.

d. Load basic ACE file structure.

e. Activation of voltage monitoring recorder.

Seq. 002: Activation of EPS and Instrumentation

a. Verification of GSE water-glycol cooling of the LM vehicle (Para. 4.2.2.3.6.5)

Test Description: (Cont)

b. GSE DC power to CDR BUS, via MSS (J167) (Para. 4.2.2.2.2(C2))

c. MSS DC power to LMP BUS, via BUS cross-ties (Para. 4.2.2.2.2(C2))

d. RCS SYS (A&B) TCA Quad CB Turn-on

e. INSTR. PCM Telemetry Turn-On, Hi Rate, controlled externally via LUT umbilical path. (Para. 4.2.2.2.2(D2))

Seq. 003: EPS, DC Power Switchover.

a. Preparation for LUT-ON, MSS-OFF switchover. (Para. 4.2.2.2.2(D))

b. LUT power-On Para. 4.2.2.2.2(D))

c. MSS power-off

d. Preparation for LUT-On.

e. Descent batteries LVT power-On.

f. LUT power-Off.

g. Separation of CDR and LMP Buses.

h. Monitoring of EPS status.

Seq. 004: LM/CSM Interface checkout (Pre Launch Set-Up)

a. S-Band and radar heaters turn-on.

b. IMU switchover to LM power.

c. ASA temp switchover to LM power.

d. DC power switchover from the descent batteries LVT to CSM power.

e. DC power switchover from CSM power to the descent batteries LVT.

f. ASA power switchover to PTMU.

g. PCM telemetry turn-on via vehicle CB'S.

h. Inverter simulator turn-on.

i. Window heater C/O

1. SE window heater

2. CDR window heater

Test Description: (Cont)

j. Reseting of pyro simulator.

k. ED transient check SYS (A AND B).

Seq. 005: Verification of Ambient Readouts of Temperature, Pressures, and Quantity of Expendables Throughout the LM Subsystems.

Seq. 006: COMM, VHF XMTR Power Verification and S-Band Power Measurements

a. Activation & C/O of PRI & SEC S-Band (Para. 4.2.2.11.1.5.2)

b. Activation & C/O of VHF (Para. 4.2.2.11.1.4.1)

Seq. 007: COMM, Voice Link Checkout

a. Turn-on of CDR audio communication (Para. 4.2.2.11.1.1.1)

b. Turn-on of LMP audio communication (Para. 4.2.2.11.1.1.1)

c. Turn-on of PM S-Band primary transceiver and primary power amplifier (Para. 4.2.2.11.1.5.2)

d. Checkout of S-Band uplink. (Para. 4.2.2.11.1.5.1)

e. Turn-on of VHF-A, and downlink checkout. (Para. 4.2.2.11.1.4)

f. Turn-on of CTS VHF-A, and uplink checkout. (Para. 4.2.2.11.1.7.4.1(c))

Seq. 008: S-Band Ranging Test (continuous) and BEC Test

a. Preparation for ranging test.

b. S-BD ranging test.

c. Bit error comparison check (continuous).

d. Determination of ranging delay.

e. Flight headset C/O CDR and LMP.

f. DUA 70KC S-Band backup voice check.

g. VHF A voice check.

h. VHF A/Intercom intelligibility test.

i. VHF B voice check.

j. VFH B/Intercom intelligibility test.

k. S-Band voice check.

l. S-Band/Intercom voice intelligibility test.

est Description: (Cont)

m. VHF ranging C/O

Seq. 009: Activation of DUA

a. Verification of DUA off.

b. Turn-on of DUA.

c. Clearing CRT DUA counts. (and continuous monitoring)

Seq. 010: Lighting Checkout

a. Verification of flood lights. (Para. 4.2.2.2.5(B)(1))

b. Verification of integral lights. (Para. 4.2.2.2.5(B)(3))

c. Verification of numeric lights. (Para.4.2.2.2.5(B)(2))

d. Mission timer ON/RESET and verification of mission timer lighting. (Para.4.2.2.9.3)

e. Event timer ON/STOP/RESET and verification of event timer lighting. (Para. 4.2.2.9.2)

f. Propulsion alphanumeric lights C/O

g. CDR X-PNTR numeric lights C/O

h. Range/ALT numeric lights C/O

i. RCS numeric lights C/O

j. SE X-PNTR numeric lights C/O

k. Numeric lights dimmer C/O

l. Verification of docking lights via cabin controls. (Para. 4.2.2.2.5(A))

m. Verification of docking lights via LM/SLA SW. (Para. 4.2.2.2.5(A))

n. Verification of tracking lights. (Para. 4.2.2.2.5(A))

Seq. 011: C&WEA Displays Turn-On, and Self-Test.

a. Turn-on of C&WEA displays. (Para. (4.2.2.12.2)

b. C&WEA self-test.

c. Master alarm C/O.

Seq. 012: AC/DC BUS C/W Trip Level Checkout

a. DC BUS trip level check.

Test Description: (Cont)

b. AC BUS trip level check.

Seq. 013: ECS, Heat Transport Section (HTS) Caution and Warning Checkout (Para. 4.2.2.3.6)

a. Verification of caution and warning of the primary glycol loop.

b. Glycol pump Auto switchover check

c. Verification of caution and warning of the secondary glycol loop.

Seq. 014: ECS, Atmosphere Revitalization Section (ARS) Caution and Warning Checkout

a. The caution and warning is verified as operated by the following ARS components.

1. Suit fans.

2. Water separators.

3. Glycol low delta pressure.

4. CO_2 sensor test (Para. 4.2.2.3.2)

5. Torn suit protection tests.

6. Cabin repress C/O.

Seq. 015: ECS, Cabin Repressurization Checkout. (Para. 4.2.2.3.5.2)

Functional operation of cabin repressurization system is verified in the normal and backup modes as follows:

a. Operation under the decompressed cabin condition (simulated) in the following configurations:

1. Oxygen regulators A and B in cabin mode.

2. Manual override of repress valve.

3. Oxygen regulator A failed.

4. Oxygen regulator B failed.

5. Oxygen regulators A and B failed.

b. Operation under the decompressed cabin condition (simulated) in the egress mode, in the following configuration:

1. Oxygen regulator A in egress, and regulator B failed.

2. Oxygen regulator B in egress, and regulator A failed.

Test Description: (Cont)

3. Oxygen regulators A and B in egress.

c. Operation under the pressurized cabin condition in the following configurations:

1. Oxygen regulators A and B failed.

2. Oxygen regulator A in egress, and regulator B failed.

3. Oxygen regulator B in egress, and regulator A failed.

d. Operation of manual override of oxygen regulators A and B under the decompressed cabin condition (simulated).

Seq. 016: ECS, Descent Water Tank Checkout and ASC Tank(s) Zero Point Checkout (Para. 4.2.2.3.7.2)

a. Pressurization of descent water tank by GSE.

b. Descent water tank low level C/O.

c. Verification of Caution and Warning ASC Tank zero point C/O(simulated).

Seq. 017: ECS, Ascent Water Tank Checkout

a. Pressurization of ascent water tank by GSE.

b. Verification of caution and warning at the following water levels (simulated).

1. Tank 2 less than full.

2. Tank 2 less than tank 1.

3. Tank 1 less than full.

4. Tank 1 less than tank 2.

Seq. 018: ECS, Oxygen Tanks Functional Checkout (Para. 4.2.2.3.5.6)

a. Pressurization of the descent and ascent oxygen tanks.

Seq. 019: ECS, Oxygen Tank C/W Checkout

a. Verification of caution and warning at ascent and descent tank low levels (simulated).

Seq. 020: Activation of CES.

a. FCS displays turn-on.

b. CES turn-on.

c. Setting ACE-S/C control room recorders.

Test Description: (Cont)

d. RGA SMRD verification.

e. Verification of start stop buttons are off.

f. Activation of engine control circuits.

g. Monitoring of critical parameter via PCM.

Seq. 021: Descent Engine Override

a. Arming of Des Eng

b. Verification start and stop buttons are off.

c. Des. Eng Gimballing

d. ACE Counter set-up

Seq. 022: Activation of radars

a. Activate LR Coolant unit.

b. Cabin control set-up for LR Activation.

c. Landing radar activation.

d. Gain states and BTC Signal C/O.

e. Landing radar self-tests (Para. 4.2.2.5.8.1)

f. LRAA To hover,

g. LRAA To descent.

h. RNDZ Radar activation.

i. RNDZ Self-test (Para. 4.2.2.5.7.1).

Seq. 023: RCS Heater Activation (Para. 4.2.2.7.4)

a. Ambient Quad cluster temperature C/O.

b. Activation of RCS Quad heaters and monitor temperature.

Seq. 024: RCS Functional Test

a. RCS activation.

b. RCS fuel tanks temp and press displays check.

c. RCS displays check.

d. RCS main sov and ascent feed valves display check.

Test Description: (Cont)

e. RCS thruster pair displays check.

f. RCS SYS A, main sov check.

g. RCS SYS B, main sov check.

h. RCS fuel manifolds, pressure display check.

i. RCS oxid manifolds, pressure display check.

j. RCS pressurization check, simulated.

k. RCS pressurization reset.

l. RCS system A, main sov close.

m. RCS system B, main sov close.

Seq. 025: ED Checkout

a. LDG Gear functional check.

b. DES pressure vent Valves C/O

Seq. 026: Propulsion S/S Functional Test

a. Descent He Regulators and flags C/O.

b. Propulsion displays and controls C/O.

c. PQGS sensor test dry.

d. PQGS control unit checkout.

e. Propulsion transducers ambient C/O. **(Para. 4.2.2.12.3.1)**

1. Ascent transducers.
2. Descent 1 Transducers.
3. Descent 2 Transducers.
4. Descent supercritical press transducers.
5. Ascent temp 1 transducers
6. Ascent press 1 transducers.
7. Ascent temp 2 transducers.
8. Ascent press 2 transducers.
9. Descent ambient press transducers.

Test Description: (Cont)

10. Descent engine thrust transducers.

Seq. 027: Propulsion Ascent He Regulators Selection, and Pressurization C/O.

a. Ascent He reg 1, open, He reg 2 close.

b. Ascent He reg 1, close.

c. Ascent He reg 2, open.

d. Ascent He reg 1, open.

e. Ascent He tanks ED arm.

f. Ascent He tanks ED reset.

g. Ascent He tank 1, ED actuation.

h. Ascent He tank 1, ED reset.

i. Ascent He tank 2, ED actuation.

j. Ascent He tank 2, ED reset.

k. Ascent He both tanks, ED actuation.

l. Ascent He both tanks, ED reset.

Seq. 028: Descent Engine Manual start/stop Functional Checkout

a. DES ENG Controls Activation

b. ED Master Arm Activation and verification.

c. ED DES Press reset

d. ED DES Prop ISOL VLVS C/O

e. DESC Press reset

f. ED DES Start He Press C/O

g. ARM DES ENG

h. Manual DES ENG START

i. Deactivation of DES ENG and ED Controls

Seq. 029: Ascent Engine Manual START/STOP

a. ASC ENG Controls deactivation

b. ED LOGIC Power deactivation

Test Description: (Cont)

c. ASC ENG Simulate staging command and Verification.

d. ARM ASC Engine

e. Manual ASC ENG START/STOP

f. Prop Ox And Fuel QTY C/O

g. De-arm ASC ENG

h. ASC ENG Control activation

i. ED Reset

Seq. 030: Activation of PGNS And AGS

a. IMU STANDBY Power turn-on

b. LGC/DSKY Power turn-on

c. LGC Error Reset program

d. LGC Self-check

e. AGS Turn-on

f. ACG Counters activation for SMRD Monitoring and event light verification.

g. Gyro SMRD Run-up and run-down time verification

h. DEDA Voltage monitoring

i. DEDA EL Checkout

j. AEA Self-test

k. AEA Error volt verification

l. IMU operate Power turn-on

m. Application of IMU Operate Power

n. Coarse align IMU To Zero

o. IMU Operational test.

Seq. 031: Load AEA Memory Noise Test

a. Guidance cont to PGNS and Record CDU Angles

b. Initiate overlay

Test Description: (Cont)

c. Interrupt PGNS Interface to AEA

d. Counter-activation for monitoring GSE-5 and Event light verification

e. Load the load and verify routine

f. Load memory noise test program

g. Memory noise test load verification

Seq. 032: Initiation of AEA Memory Noise Test

a. Initiate Program

b. Stop AEA Memory noise test

c. Re-initiate memory noise test

d. Single word memory dump routine

e. Verification of intentional failure

f. Initiate AEA Memory noise test

g. Resumption of PGNS Interface to AEA

h. Record CDU Angles.

Seq. 033: Major Mode Two - Test One - PGNS Auto Descent Profile

a. Static Test - LM Subsystem check for normal performance, set proper Configuration and confidence check for individual subsystem.

1. Inverter simulator shutdown
2. Flight Inverter number one turn-on
3. Verify DES BATT Low taps on high taps off
4. Adjust power supplies 4 and 3 feeding low taps to 0.2 volts DC below trip level (C&W).
5. Adjust power supplies 1 and 2 feeding low taps to 0.2 volts DC below trip level (C&W).
6. BATT 5 and 6 normal feed to bus on and low taps off.
7. Adjust power supplies 5 and 6 feeding ascent normals to 32.3 volts.
8. DES BATT hi taps on and BATT 5 and 6 normal feed off.
9. Adjust Christy Supply feeding power to high taps to 28.75 VDC.

Test Description: (Cont)

10. Verify AC/DC Voltage and current.

11. DES BATT Low taps on and high taps off.

11A. Activate voltage monitoring recorder.

11B. Unstow RR Antenna- Remove GSE coupler/RF silencer - Verify not obstructed - Manually position to zero/zero and release.

11C. Activate ATCA

12. Activate Rendezvous Radar

13. Rendezvous radar shaft/trunnion resolver readout assembly adjustment.

14. Slew RR ANT to zero pitch/zero YAW.

14A. Slew RR ANT left then right while brush recorder is adjusted.

15. Set up countdown recorder.

15A. Verify/unlock S-Band ANT stow pins.

16. Slew S-Band steerable ant to -75 deg pitch/-75 deg yaw and set-up for slew to +75 deg pitch/+75 deg yaw.

17. Activate COMM primary amplifier and diplexer.

18. Activate landing radar.

19. Set up Landing Radar for standard test condition Number 8A.

20. Initiation of strobe program for landing Radar altitude & velocity verification.

20A. Obtain forward and lateral velocity and altitude data via cabin meters.

21. Obtain LR DVM readings via int power switch.

22. LM cabin control configuration.

23. S/C status verification via ACE.

24. Jet counter activation.

24A. Activate gimbal trim malfunction inhibit.

25. K-Start tape load and verification.

25A. Adjust DES BATT power supplies to trip level if CDR and LMP bus are below 26.0 VDC.

26. Dynamic Test Instructions.

Test Description: (Cont)

27. IMU Fine align and record CDU angles.
28. CES, ED and PQGS cabin control configuration.
29. Turn-on secondary trim control unit.
30. Turn-off primary trim control unit.
31. Activate Glycol Pump 1.
32. ARM Descent Engine.

b. Dynamic Test - LM Integrated System Check (Para. 4.2.2.13.1.2)

1. Initiate and verify mission timer counting.
2. Slew Rendezvous Radar in trunnion to counter clockwise limit.
3. Slew RR in trun to CW limit.
4. Slew RR in trun to zero position yaw.
5. CDR deactivate AUDIO VHF A.
6. CDR activate AUDIO VHF B.
7. CDR deactivate AUDIO S-Band T/R.
8. Slew RR in shaft to lower limit.
9. Slew RR in shaft to upper limit.
10. Slew RR in shaft to zero position pitch.
11. De-arm Descent Engine.
12. Enable COMM VOX tape recorder.
13. Initiate and verify event timer counting.
14. Activate/deactivate docking lights.
15. DES BATT low voltage to high voltage tap switchover.
16. Initiate S-Band antenna slew to +75 deg pitch/+75 deg yaw.
17. LMP deactivate AUDIO VHF A.
18. LMP Activate AUDIO VHF B.
19. LMP deactivate AUDIO S-Band T/R.
20. BATT 5 and 6 normal feed to bus on.

Test Description: (Cont)

21. DES BATT high taps off bus via deadface.

22. Disable COMM VOX tape recorder.

23. Initiate PGNS auto descent profile from LGC computer (G03-L001-K10511-01) obtaining Descent Engine ON/OFF, Gimballing, Throttling and RCS jet ON/OFF.

24. Observe FDAI pitch and yaw error needles and X-Pointers during RR.slew.

25. Obtain and record ALT reading via ALT/ALT RT meter.

26. Obtain and record PQGS fuel and oxid readings initiated via R-andC-Start.

27. Activate/deactivate speed controls of ACE recorders.

27A. Strobe Landing Radar.

28. Move LR to hover position automatically via LGC.

29. Obtain and record LR altitude and velocity X, Y and Z.

30. Obtain and record CDU angles.

31. Monitor DES BATT low/high tap switchover.

32. Monitor ASC BATT to bus.

33. Monitor Glycol Pump pressure

34. Monitor DES Engine gimballing

35. Monitor RCS Jet firings

36. Monitor DES Engine throttling

37. Monitor bus voltage

38. Monitor LR ANT position

39. Monitor DES ENG ON/OFF

40. Monitor docking light operation

41. Monitor RR ANT slew.

42. Obtain and record RR shaft/trun angles

43. Activate/deactivate RR brush recorder

44. Scan LR preamps (DI zero angle then D1 90 angle).

Test Description: (Cont)

45. Activate/deactivate LR brush recorder

46. Activate/deactivate HP printer and record Max and Min dynamic test voltages.

47. Verify pressure increase on engine solenoid checkout unit when DE is turned off.

47A. Activate/deactivate voltage monitoring recorder

48. Observe S-Band ANT slew.

49. Glycol Pump 1 activation

c. Securing After Dynamic Test

1. Deactivate RR

2. Deactivate ATCA

3. Glycol Pump 1 deactivation

4. Turn-on primary trim control unit

5. Turn-off secondary trim control unit

6. Deactivate DECA

7. Deactivate COMM S-Band PWR amplifier

8. IMU coarse align to zero and record CDU angles

9. Stop and reset event timer

10. Stop and reset mission timer

11. Rewind K-Start tape

12. Move LR to Descent via cabin switch

12A. Deactivate Landing Radar

13. DES BATT high taps on bus via deadface

14. BATT 5 and 6 normal feed to bus off

15. Deactivate Inverter 1

16. Verification of dynamic test

Seq. 034. Major Mode Two - Test Two - PGNS Auto Descent Profile

a. Static test - LM Subsystem check for normal performance, set proper configuration and confidence check for individual subsystems.

Test Description: (Cont)

1. BATT 5 normal and backup feed to bus on
2. DES BATT high taps off bus via deadface
3. Adjust Power Supplies 5 and 6 feeding ascent normals to 32.3 volts.
4. DES BATT High taps on bus via deadface
5. BATT 5 normal and backup feed to bus off
6. Adjust Christy Supply feeding power to high taps to 28.75
7. DES BATT high voltage to low voltage tap switchover
8. Adjust power supplies 4 and 3 feeding low taps to 0.2 volts DC below trip level (C&W)
9. Adjust power supplies 1 and 2 feeding low taps to 0.2 volts DC below trip level (C&W)
10. Flight inverter number one turn on
11. Activate ATCA
12. Activate Rendezvous Radar
13. Rendezvous Radar Shaft/Trunnion resolver readout assembly adjustment
14. Slew RR ANT to zero pitch/zero yaw
15. Activate COMM primary amplifier and diplexer
16. Slew S-Band steerable ant to -75 deg pitch/-75 deg yaw and set up for slew to +75 deg pitch/+75 deg yaw
17. LMP activate AUDIO S-Band T/R
18. LMP activate AUDIO VHF A, deactivate AUDIO VHF B
19. CDR deactivate AUDIO VHF B
20. LMP activate PIT-lock VHF test RECVR
21. LMP deactivate VHF A AUDIO, activate AUDIO VHF B T/R and adjust COMM VHF squelch
22. CDR activate AUDIO VHF B and deactivate AUDIO VHF A
23. Activate Landing Radar
24. Set UP Landing Radar for standard Test Condition Seven

Test Description: (Cont)

25. Strobe Landing Radar

26. Obtain and record forward and lateral velocity via X-PTR and ALT/ALT RT via cabin meter.

27. Obtain LR DVM readings via int power switch

28. LM cabin control configuration

29. S/C status verification via ACE

30. Jet counter verification

31. Activate gimbal trim malfunction inhibit

32. K-Start tape load and verification

33. Dynamic test instructions

34. IMU fine align

35. CES, LTNG cabin control configuration

36. Turn-on secondary trim control unit

37. Turn-off primary trim control unit

38. Activate Glycol Pump 1

39. Arm Descent Engine

D. Dynamic Test - LM Integrated System Check (Para. 4.2.2.13.1.2)

1. Initiate and verify mission timer counting

2. Initiate and verify event timer counting

3. Slew RR in trunnion to CCW limit

4. Deactivate RR power supply

5. Inflight inverter one to two switchover

5A. Activate RR power supply

6. Slew RR in trunnion to CW limit

7. Slew RR in Trun to zero position yaw

8. CDR deactivate AUDIO VHF B

9. CDR activate AUDIO VHF A

10. CDR deactivate AUDIO S-Band

Test Description: (Cont)

11. Slew RR in shaft to lower limit
12. Slew RR in shaft to upper limit
13. Slew RR in shaft to zero position pitch
14. De-arm Descent Engine
15. Enable COMM VOX tape recorder
16. Activate/deactivate docking lights
17. DES BATT low voltage to high voltage tap switchover
18. Initiate S-Band antenna slew to +75 deg pitch/+75 deg yaw
19. LMP deactivate AUDIO VHF B
20. LMP activate AUDIO VHF A
21. LMP deactivate AUDIO S-Band T/R
22. BATT 5 normal and backup feed to bus on
23. Glycol Pump 1 to 2 switchover
24. DES BATT high taps off bus via deadface
25. Activate/deactivate tracking lights
26. Disable COMM VOX tape recorder
27. Initiate PGNS auto descent profile from LGC computer (G03-L001-K10511-01) obtaining Descent Engine ON/OFF, Gimballing, Throttling and RCS jet ON/OFF
28. Observe FDAI pitch and yaw error needles and X-Pointers during RR slew
29. Strobe Landing Radar
30. Move LR to hover position automatically
31. Obtain and record CDU angles
32. Observe S-Band antenna slew
33. Obtain and record ALT reading via ALT/ALT RT meter
34. Obtain and record PQGS fuel and oxid readings initiated via R-and C-Starts
35. Activate/deactivate speed controls of ACE recorders

Test Description: (Cont)

36. Monitor DES BATT low/high tap switchover
37. Monitor ASC BATT to bus
38. Monitor Descent Engine gimballing
39. Monitor LR ANT position
40. Obtain and record LR altitude and velocity X, Y and Z
41. Monitor RCS jet firings.
42. Monitor Descent Engine throttling
43. Monitor Glycol Pump switchover and pressure
44. Monitor inflight inverter switchover
45. Monitor DES Engine ON/OFF
46. Monitor docking light operation
47. Monitor RR ANT slew and ant during loss of power
48. Activate/deactivate RR brush recorder
49. Scan LR preamps (D2 Zero angle then D2 90 angle)
50. Activate/deactivate LR brush recorder
51. Activate/deactivate HP printer and record Max and Min dynamic test voltages
52. Verify pressure increase on engine solenoid checkout unit when DE is turned off
53. Activate/deactivate voltage monitoring recorder

c. Securing After Dynamic Test

1. Deactivate RR
2. Deactivate ATCA
3. Deactivate DECA
4. Deactivate COMM S-Band PWR amplifier
5. Glycol Pump 2 deactivation
6. Turn-on primary trim control unit
7. Turn-off secondary trim control unit

Test Description: (Cont)

8. IMU coarse align to zero and record CDU angles

9. Stop and reset event timer

10. Stop and reset mission timer

11. Rewind K-Start Tape

12. Move LR to Descent via cabin switch

12A. Deactivate Landing Radar

13. DES BATT high taps on bus via deadface

14. BATT 5 normal and backup feed to bus off

15. Deactivate flight Inverter 2

16. Verification of dynamic test

Seq. 035: Major Mode Two - Test Three - PGNS Auto Descent Profile

a. Static Test - LM Subsystem Check for Normal Performance, Set Proper Configuration and Confidence Check for Individual Subsystems

1. BATT 6 normal and backup feed to bus on

2. DES BATT high taps off bus via deadface

3. Adjust power supplies 5 and 6 feeding ascent normals to 32.3 volts

4. DES BATT high taps on bus via deadface

5. BATT 6 normal and backup feed to bus off

6. Adjust Christy Supply feeding power to high taps to 28.75

7. DES BATT high voltage to low voltage tap switchover

8. Adjust power supplies 4 and 3 feeding low taps to 0.2 volts DC Below trip level (C&W)

9. Adjust power supplies 1 and 2 feeding low taps to 0.2 volts DC below trip level (C&W)

.0. Flight Inverter Number One turn-on

.1. Activate ATCA

.2. Activate Rendezvous Radar

3. Rendezvous Radar Shaft/Trunnion resolver readout assembly adjustment

Test Description: (Cont)

14. Slew RR ANT to zero pitch/zero yaw
15. Activate COMM primary amplifier and diplexer
16. Slew S-Band steerable ANT to -75 deg pitch/-75 deg yaw and set up for slew to +75 deg pitch/+75 deg yaw
17. CDR activate AUDIO S-Band T/R

17A. LMP Activate AUDIO S-Band T/R

18. LMP activate AUDIO VHF B, deactivate AUDIO VHF A
19. Adjust COMM VHF squelch
20. COMM-PATCH GSE-activate LMP PTT-Lock VHF test receiver
21. LMP activate AUDIO VHF A, deactivate VHF B
22. Activate Landing Radar
23. Set up Landing Radar for standard Test Condition Seven
24. Strobe Landing Radar
25. Obtain and record LR ALT and vel X, Y and Z via strobe at ACE
26. Obtain and Record LR FWD and Lateral vel, ALT AND ALT RT via cabin meter
27. Obtain LR DVM readings via int power switch
28. LM cabin control configuration
29. S/C status verification via ACE
30. Jet counter verification
31. Activate gimbal trim malfunction inhibit
32. K-Start tape load and verification
33. Dynamic test instructions
34. IMU fine align
35. Activate DECA
36. Turn-on secondary trim control unit
37. Turn-off primary trim control unit
38. Activate Glycol Pump 1

Test Description: (Cont)

39. Arm Descent Engine

b. Dynamic Test - LM Integrated System Check (4.2.2.13.1.2)

1. Initiate and verify mission timer counting

2. Initiate and verify event timer counting

3. Glycol Pump 1 to 2 switchover

4. Slew RR in trunnion to CCW limit

4A. Window Heaters on (LMP & CDR)

5. Slew RR in trunnion to CW limit

6. Slew RR in trun to zero position yaw

6A. Suit Fan #1 on.

7. Move LR to hover position automatically

8. CDR deactivate AUDIO VHF A

9. CDR activate AUDIO VHF B

10. CDR Deactivate Audio S-Band

10A. Suit Fan #2 on.

11. Slew RR in shaft to lower limit

12. Deactivate RR power supply

13. Inflight Inverter One to Two switchover

14. Activate RR power supply

15. Slew RR in shaft to upper limit

15A. Window Heaters off

15B. Suit Fan off.

16. Slew RR in shaft to zero position pitch

17. De-arm Descent Engine

18. Enable COMM VOX tape recorder

19. Activate/deactivate docking and tracking lights

20. DES BATT low voltage to high voltage tap switchover

Test Description: (Cont)

21. Initiate S-Band Antenna slew to +75 deg pitch/+75 deg yaw
22. LMP deactivate AUDIO VHF A
23. LMP activate AUDIO VHF B
24. LMP deactivate AUDIO S-Band
25. BATT 6 normal and backup feed to bus on
26. Cycle DES He Reg valves 1 and 2
27. DES BATT high taps off bus via deadface
28. Disable COMM VOX tape recorder
29. Initiate PGNS auto descent profile from LGC computer (G03-L001-K10511-01) obtaining Descent Engine ON/OFF, Gimballing, Throttling and RCS jet ON/OFF
30. Observe Glycol Pump S/O via cabin meter
31. Observe FDAI pitch and yaw error needles and X-Pointers during RR slew
32. Strobe Landing Radar
33. Observe S-Band antenna slew
34. Observe and record ALT via cabin meter
35. Obtain and record PQGS fuel and oxid readings initiated via R and C-Starts
36. Activate/deactivate speed controls of ACE recorders
37. Monitor DES BATT low/high tap switchover
38. Monitor ASC BATT to bus
39. Monitor Descent Engine gimballing
40. Monitor LR ANT position
41. Obtain and record CDU angles
42. Obtain and record LR altitude and velocity X, Y and Z
43. Monitor RCS Jet firings
44. Monitor Descent Engine throttling
45. Obtain and record PQGS fuel and oxid readings initiated via R-and C-Starts

Test Description: (Cont)

46. Monitor inflight inverter switchover

47. Monitor DES engine ON/OFF

48. Monitor docking and tracking light operation

49. Monitor RR ANT slew and ANT during loss of power

50. Activate/deactivate RR brush recorder

51. Scan LR preamps (D3 zero angle then D3 90 angle)

52. Activate/deactivate LR brush recorder

53. Activate/deactivate HP printer and record Max and Min dynamic test voltages

54. Verify pressure increase on engine solenoid checkout unit when DE is turned off

55. Activate/deactivate voltage monitoring recorder

c. Securing After Dynamic Test

1. Deactivate RR

2. Deactivate ATCA

3. Deactivate DECA

4. Deactivate COMM S-Band PWR amplifier

5. Glycol Pump 2 deactivation

6. Turn-on primary trim control unit

7. Turn-off secondary trim control unit

8. IMU coarse align to zero and record CDR Angles

9. Stop and reset event timer

10. Stop and reset mission timer

11. Rewind K-Start tape

12. Move LR to Descent via cabin switch

12A. Deactivate Landing Radar

13. DES BATT high taps on bus via deadface

14. BATT 6 normal and backup feed to bus off
15. Verification of dynamic test

Test Description: (Cont)

Seq. 036: Major Mode Two - Test Four - PGNS Auto Descent Profile

a. Static Test - LM Subsystem check for normal performance, set proper configuration and confidence check for individual subsystems.

1. BATT 5 backup and 6 backup feed to bus on.

2. DES BATT high taps Off bus via deadface.

3. Adjust power supplies 5 and 6 feeding ascent normals to 32.3 volts.

4. DES BATT high taps on bus via deadface.

5. BATT 5 backup and 6 backup feed to bus off.

6. Adjust Christy Supply feeding power to high taps to 28.75.

7. DES BATT high voltage to low voltage tap switchover.

8. Adjust power supplies 4 and 3 feeding low taps to 0.2 volts DC below trip level (C&W).

9. Adjust power supplies 1 and 2 feeding low taps to 0.2 volts DC below trip level (C&W).

10. Flight Inverter Number Two turn-off.

10A. GSE Inverter Simulator activation.

11. Activate ATCA

12. Activate Rendezvous Radar

13. Rendezvous Radar Shaft/Trunnion Resolver Readout Assembly Adjustment.

14. Slew RR ANT to Zero Pitch/Zero Yaw.

15. Activate COMM Primary amplifier and diplexer.

16. Slew S-Band steerable ant to -45 DEG pitch/-60 DEG yaw and set up for slew to zero DEG pitch/-45 DEG yaw.

17. CDR activate AUDIO S-Band T/R.

18. LMP activate AUDIO S-Band T/R.

19. LMP activate AUDIO VHF A, GSE Patching, LMP deactivate VHF B.

Test Description: (Cont)

20. GSE - Set VHF BIOMED/AUDIO simulator off.

21. CDR deactivate AUDIO VHF B, activate AUDIO VHF A.

22. Activate Landing Radar.

23. Set up Landing Radar for Standard Test Condition Seven.

24. Strobe Landing Radar.

25. Obtain and record LR Altitude, Vel X, Y and Z via Strobe at ACE.

26. Obtain and record Forward and Lateral Velocity via X-PTR and ALT/ALT RT via cabin meter.

27. Obtain LR DVM readings via Int Power Switch.

28. LM cabin control configuration.

29. S/C Status verification via ACE.

30. Jet counter verification.

31. Activate Gimbal trim malfunction inhibit.

32. K-Start tape load and verification.

33. Dynamic test instructions.

34. IMU fine align.

35. CES and DES He Reg control configuration.

36. Turn-on Secondary trim control unit.

37. Turn-off Primary trim control unit.

38. Activate Glycol Pump 1.

39. Arm Descent Engine.

b. Dynamic Test - LM Integrated System Check. (Para. 4.2.2.13.1.2)

1. Initiate and verify mission timer counting.

2. Initiate and verify event timer counting.

3. Disable/Enable Engine gimballing.

Test Description: (Cont)

4. Slew RR in Trunnion to CCW-limit.
5. Slew RR in TRUN to CW limit.
6. Slew RR in TRUN to Zero position yaw.
7. Move LR to hover position automatically.
8. CDR deactivate AUDIO VHF A.
9. Glycol Pump 1 to 2 switchover.
10. CDR activate AUDIO VHF B.
11. CDR deactivate AUDIO S-BAND.
12. Activate manual throttle control - Utilize TTCA - Activate Auto throttle control.
13. Slew RR in shaft to lower limit.
14. Slew RR in shaft to upper limit.
15. Slew RR in shaft to Zero position pitch.
16. De-Arm Descent Engine.
17. Enable COMM VOX tape recorder.
18. Activate/Deactivate docking lights.
19. DES BATT low voltage to high voltage tap switchover.
20. Activate/Deactivate tracking lights.
21. Initiate S-Band Antenna slew to zero DEG pitch/-45 DEG yaw.
22. Cycle DES Helium Reg valves.
23. LMP deactivate AUDIO VHF A.
24. LMP activate AUDIO VHF B.
25. LMP deactivate AUDIO S-BAND T/R.
26. BATT 5 backup and 6 backup feed to bus on.
27. DES BATT high taps off bus via deadface.
28. Activate manual override of Descent Engine STOP via cabin control.

Test Description: (Cont)

29. Activate PGNS ATT HOLD function via cabin control.

30. Activate AGS AUTO function via cabin control.

31. Disable COMM VOX tape recorder.

32. Initiate PGNS Auto Descent profile from LGC Computer (G03-L001-K10511-01) obtaining Descent Engine ON/OFF, Gimballing, Throttling and RCS JET ON/OFF.

33. Observe FDAI pitch and yaw error needles and X-Pointers during RR slew.

34. Strobe Landing Radar.

35. Monitor Glycol Pump switchover and pressure.

36. Obtain and record ALT reading via cabin meter.

37. Obtain and record PQGS fuel and oxid readings initiated via R-and C-Starts.

38. Activate/Deactivate speed controls of ACE recorders.

39. Monitor DES BATT Low/High tap switchover.

40. Monitor ASC BATT to bus.

41. Monitor Descent Engine Gimballing.

42. Obtain and record CDU angles.

43. Obtain and record LR Altitude, Vel X, Y and Z via strobe at ACE.

44. Monitor RCS Jet firings.

45. Monitor Descent Engine Throttling.

46. Monitor AC and DC bus voltage via ACE.

47. Monitor LR Auto slew via ACE.

48. Monitor DES ENG ON/OFF via ACE.

49. Monitor Docking/Track Light operation.

50. Adjust AC voltage slowly from approximately 113 VRMS TO 118 VRMS at 3 minutes into profile.

Test Description: (Cont)

51. Monitor RR Antenna positioning and Shaft/Trun angles on readout assembly.

52. Activate/Deactivate RR brush recorder.

53. Scan LR Preamps (R Zero angle then R 90 angle).

54. Activate/Deactivate LR brush recorder.

55. Activate/Deactivate HP Printer and record Max and Min dynami test voltages.

56. Verify pressure increase on engine solenoid checkout unit when DE is turned off and vent gages.

57. Monitor S-Band Antenna slew.

58. Activate/Deactivate voltage and RCS monitoring recorder.

c. Securing After Dynamic Test.

1. Deactivate RR.

2. Deactivate ATCA.

3. Deactivate DECA.

4. Deactivate COMM S-Band PWR Amplifier.

5. Glycol Pump 2 deactivation.

6. Turn-ON Primary trim control unit.

7. Turn-OFF Secondary trim control unit.

8. IMU coarse align to Zero and record CDU angles.

9. Stop and reset event timer.

10. Stop and reset mission timer.

11. Rewind K-Start tape.

12. Move LR to Descent via cabin switch.

12A. Deactivate Landing Radar.

13. DES BATT high taps on bus via deadface.

14. BATT 5 backup and 6 backup feed to bus off.

Test Description: (Cont)

15. Adjust GSE Inverter simulator voltage to 115 VRMS.

16. Verification of dynamic test.

Seq. 037: Major Mode Two - Test Five - PGNS Auto Descent Profile.

a. Static Test - LM Subsystem check for normal performance, set proper configuration and confidence check for individual subsystem.

1. BATT 5 and 6 normal feed to bus on and high taps off.

2. Adjust power supplies 5 and 6 feeding ascent normals to 32.3 volts.

3. DES BATT hi taps on and batt 5 and 6 normal feed off.

4. Adjust Christy Supply feeding power to high taps to 28.75 VDC.

5. Set DES BATT low taps on/high taps off.

6. Adjust power supplies 4 and 3 feeding low taps to 0.2 volts DC below trip level (C&W).

7. Adjust power supplies 1 and 2 feeding low taps to .2 volts DC below trip level (C&W).

8. Adjust GSE Inverter simulator to 398 Hz.

9. Activate ATCA.

10. Activate Rendezvous Radar.

11. Rendezvous Radar Shaft/Trunnion resolver readout assembly adjustment.

12. Slew RR ANT to Zero Pitch/Zero Yaw.

13. Activate COMM Primary Amplifier and Diplexer.

14. Slew S-Band steerable Ant to -45 DEG pitch/-60 DEG yaw and set up for slew to zero DEG pitch/-45 DEG yaw.

15. CDR Activate AUDIO S-Band and LMP activate AUDIO S-Band.

16. LMP activate AUDIO VHF A - GSE Patch - LMP Deactivate AUDIO VHF B.

17. Deactivate VHF BIOMED/AUDIO simulator.

18. CDR deactivate AUDIO VHF B - Activate AUDIO VHF A.

Test Description: (Cont)

19. Activate Landing Radar.
20. Set-up Landing Radar for Standard Test Condition Number Seven.
21. Strobe Landing Radar.
22. Obtain and record LR Altitude, Vel X, Y and Z via strobe at ACE.
23. Obtain and record Forward and Lateral Velocity via X-PTR and ALT/ALT RT via cabin meter.
24. Obtain LR DVM readings via INT power switch.
25. S/C status verification via ACE.
26. Reset JET counters.
27. Activate Gimbal trim malfunction reset.
28. K-Start tape load and verification.
29. Dynamic test instructions.
30. IMU fine align.
31. Activate DECA.
32. Configure DES He Reg valves via cabin control.
33. Turn-on Secondary trim control unit.
34. Turn-off Primary trim control unit.
35. Activate Glycol Pump 1.
36. Arm Descent Engine.

b. Dynamic Test - LM Integrated system check. (Para 4.2.2.13.1.2)

1. Initiate and verify mission and event timer counting.
2. Activate/Deactivate manual DE Gimballing override function.
3. Slew Rendezvous Radar in Trunnion to Counterclockwise limit.
4. Slew RR in TRUN to CW limit.
5. Slew RR in TRUN to Zero position yaw.
6. Move LR to hover position automatically.

Test Description: (Cont)

7. CDR deactivate AUDIO VHF A.

8. Glycol Pump 1 to 2 switchover.

9. CDR activate AUDIO VHF B.

10. CDR deactivate AUDIO S-Band.

11. Activate manual throttle control - Utilize TTCA - Activate auto throttle control.

12. Slew RR in shaft to lower limit.

13. Slew RR in shaft to upper limit.

14. Slew RR in shaft to Zero position pitch.

15. De-arm Descent Engine.

16. Enable COMM VOX tape recorder.

17. Activate/Deactivate docking lights.

18. DES BATT low voltage to high voltage tap switchover.

19. Activate/Deactivate tracking lights.

20. Initiate S-Band antenna slew to zero DEG pitch/-45 DEG yaw.

21. Cycle Descent He Regulator valves via cabin control.

22. LMP deactivate AUDIO VHF A.

23. LMP activate AUDIO VHF B.

24. LMP deactivate AUDIO S-Band T/R.

25. BATT 5 and 6 normal feed to bus on.

26. DES BATT high taps off bus via deadface.

27. Activate manual override of Descent Engine stop via cabin control.

28. Activate PGNS ATT HOLD function via cabin control.

29. Activate AGS Auto function via cabin control.

30. Disable COMM VOX tape recorder.

Test Description: (Cont)

31. Monitor Glycol Pump pressure and switchover.

32. Initiate PGNS Auto Descent profile from LGC Computer (G03-L001-K10511-01) obtaining Descent Engine ON/OFF, Gimballing, Throttling and RCS Jet ON/OFF.

33. Observe FDAI pitch and yaw error needles and X-Pointers during RR slew.

34. Obtain and record ALT reading via ALT/ALT RT meter.

35. Obtain and record PQGS fuel and oxid reading initiated via R-and C-Start.

36. Activate/Deactivate speed controls of ACE recorders.

37. Monitor DES BATT Low/High tap switchover.

38. Monitor ASC BATT to bus.

39. Monitor DES Engine Gimballing.

40. Strobe Landing Radar.

41. Obtain and record LR altitude, Vel X, Y and Z.

42. Monitor RCS Jet firings.

43. Monitor DES Engine Throttling.

44. Monitor DC and AC bus voltage and AC Frequency.

45. Monitor LR position via ACE.

46. Monitor S and C status via ACE.

47. Monitor DES ENG ON/OFF.

48. Monitor docking and tracking light operation.

49. Adjust GSE Inverter simulator from 398 Hz to 402 Hz at three and one-half minutes into profile.

50. Monitor RR ANT slew.

51. Obtain and record RR Shaft/Trun angles.

52. Activate/Deactivate RR brush recorder.

53. Scan LR Preamps (R Zero angle then R 90 angle).

Test Description: (Cont)

54. Activate/Deactivate LR brush recorder.

55. Activate/Deactivate HP printer and record Max and Min dynamic test voltages.

56. Verify pressure increase on engine solenoid checkout unit when DE is turned off.

57. Activate/Deactivate voltage monitoring recorder.

58. Observe S-Band ANT slew.

c. Securing after dynamic test.

1. Deactivate RR.

2. Deactivate ATCA.

3. Deactivate DECA.

4. Deactivate COMM S-Band PWR Amplifier.

5. Glycol Pump 2 deactivation.

6. Turn-on Primary trim control unit.

7. Turn-off Secondary trim control unit.

8. IMU coarse align to Zero and record CDU angles.

9. Stop and reset event timer.

10. Stop and reset mission timer.

11. Rewind K-Start tape and remove from reader.

12. Move LR to Descent via cabin switch.

12A. Deactivate Landing Radar.

13. DES BATT high taps on bus via deadface.

14. BATT 5 and 6 normal feed to bus off.

15. Adjust Inverter simulator to 400 Hz.

16. Verification of dynamic test.

Test Description: (Cont)

Seq. 038: Major Mode Three (FCS), AGS Aborts.

Stop AEA memory noise test.

Interrupt PGNS/AGS interface.

Dump AEA memory.

Load AEA Abort/Abort stage program.

Close PGNS/AGS interface.

Seq. 039: Major Mode Three - Test 1 - AGS ABORT/ABORT Stage.

a. Static Test - LM Subsystem check for normal performance, set proper configuration and confidence check for individual subsystems.

1. Load LGC memory test via K-Start tape (G03-L001-K10506-1).
2. Activate ATCA - Activate DECA.
3. Center Descent Engine if required utilizing ENG ARM and gyro test switches.
4. Deactivate ATCA - Deactivate DECA.
5. BATT 5 normal and 6 normal feed to bus on.
6. DES BATT high taps off bus via deadface.
7. Adjust power supplies 5 and 6 feeding ascent normals to 32.3 volts.
8. DES BATT high taps on bus via deadface.
9. BATT 5 normal and 6 normal feed to bus off.
10. DES BATT high voltage to low voltage tap switchover.
11. Adjust power supplies 4 and 3 feeding low taps to 0.2 volts DC below trip level (C&W).
12. Adjust power supplies 1 and 2 feeding low taps to 0.2 volts DC below trip level (C&W).
13. GSE inverter simulator turn-off.
14. Flight Inverter Number One turn-on.
15. Activate ATCA.

Test Description: (Cont)

16. Activate Rendezvous Radar.

17. Rendezvous Radar Shaft/Trunnion resolver readout assembly adjustment.

18. Slew RR ANT to Zero Pitch/Zero Yaw.

19. Lock RR Auto track.

20. Activate COMM Primary amplifier and diplexer.

21. Slew S-Band steerable Ant to -75 DEG pitch/-75 DEG yaw and set up for slew to +75 DEG pitch/+75 DEG yaw.

22. CDR Activate AUDIO S-Band T/R.

23. LMP activate AUDIO S-Band T/R.

24. GSE Patch and deactivate VHF BIOMED/AUDIO simulator.

25. CDR deactivate AUDIO VHF B and activate AUDIO VHF A.

26. Activate Landing Radar.

27. Set-up Landing Radar for Standard Test Condition Seven.

28. Obtain and record Forward and Lateral Velocity via X-PTR and ALT/ALT RT via cabin meter.

29. Obtain LR DVM readings via INT-power switch.

30. LM cabin control configuration.

31. S/C status verification via ACE.

32. Configure RCS and PROP valves.

33. Reset ED System A and B Stage relays (K2) and verify Daisy chain via ACE.

34. Activate Stage and DES Press reset stimuli via R-Start.

35. Dynamic test instructions.

36. Activate and verify event timer.

37. Activate LGC self-check.

38. Reset event timer and verify event and mission timer reading zero.

Test Description: (Cont)

39. Turn-on Secondary trim control unit.
40. Turn-off Primary trim control unit.
41. Activate Glycol Pump 1.
42. Activate DECA and Engine ARM power.

b. Dynamic Test - LM Integrated system check. (Para. 4.2.2.13.1.2)

1. Initiate and verify mission timer counting.
2. Initiate and verify event timer counting.
3. Initiate S-Band Antenna slew to +75 DEG pitch/+75 DEG yaw.
4. Enable COMM Vox tape recorder.
5. Activate AGS Guidance control.
6. Activate RCS 5 Second ullage burn via LMP TTCA cabin control.
7. Activate manual throttle control via cabin control.
8. Activate AEA Abort program via cabin control resulting in steering errors and Engine ON/OFF from AEA.
9. Throttle DE via TTCA cabin control (CDR) and verify via cabin meter.
10. Activate AEA Abort Stage Program via cabin control resulting in steering errors and Engine ON/OFF from AEA.
11. Glycol Pump 1 to 2 switchover.
12. Activate/Deactivate dock and track lights.
13. Deactivate RR and DECA.
14. Inflight Inverter One to Two switchover.
15. Disable COMM VOX tape recorder.
16. Verify DES BATTS off line after Abort Stage via cabin flags.
17. Verify steering errors from AEA via cabin meter.
18. Verify ASC BATTS to bus and DES BATTS Off bus after Abort Stage via ACE.
19. Activate/Deactivate speed controls of ACE recorders.
20. Verify ED Staging function via ACE.

Test Description: (Cont)

21. Monitor Descent Engine throttling.

22. Verify S and C execution via ACE.

23. Monitor AEA steering errors via ACE.

24. Verify bus voltage and frequency during Abort Stage and inverter switchover via ACE.

25. Verify ASC and DES Engine ON/OFF via ACE.

26. Verify RCS Jet firing via ACE.

27. Monitor Descent Engine Gimballing via ACE.

28. Monitor RR during loss of AC and place at left limit Trun/Upper limit shaft.

29. Activate/Deactivate RR brush recorder.

30. Scan LR Preamps (D1 Zero angle).

31. Activate/Deactivate LR brush recorder.

32. Activate/Deactivate HP Printer and record Max and Min dynamic test voltages.

33. Verify pressure increase on engine solenoid checkout unit when DE is turned off and momentarily vent all four gages.

34. Monitor S-Band ANT slew.

35. Verify Track/Dock light Activation/Deactivation.

36. Activate/Deactivate RCS and EPS GSE monitoring recorders.

c. Securing After Dynamic Test.

1. Glycol Pump 2 deactivation.

2. Turn-on primary trim control unit.

3. Turn-off secondary trim control unit.

4. Deactivate COMM S-Band PWR amplifier.

5. Reset CES and ED cabin controls.

6. Deactivate ATCA.

7. Reset event and mission timer.

8. Verify S and C status via ACE.

Test Description: (Cont)

9. Terminate LGC self-check.
10. IMU coarse align to zero.
11. Deactivate Landing Radar.
12. Dump LGC memory.
13. Rewind K-Start tape.
14. Activate DES BATT high volt taps to bus.
15. Deactivate ASC BATT 5 and 6 normal feed to bus.
16. Deactivate Inflight Inverter 2.
17. Verification of dynamic test.

Seq. 040: PGNS Shutdown

Seq. 041: Major Mode Three - Test Two - AGS Abort/Abort Stage

a. Static Test - LM Subsystem check for normal performance, set proper configuration and confidence check for individual subsystem.

1. BATT 5 and 6 normal feed to bus on and high taps off.
2. Adjust power supplies 5 and 6 feeding ascent normals to 32.3 volts.
3. DES BATT hi taps on and BATT 5 and 6 normal feed off.
4. DES Batt low taps on and high taps off.
5. Adjust power supplies 4 and 3 feeding low taps to 0.2 volts DC below trip level (C&W).
6. Adjust power supplies 1 and 2 feeding low taps to 0.2 volts DC below trip level (C&W).
7. Activate Flight Inverter 2.
8. Activate ATCA and DECA then deactivate.
9. Activate ATCA.
10. Activate Rendezvous Radar.
11. RR Shaft/Trun resolver readout assembly adjustment.
12. Slew RR ANT to Zero Pitch/Zero Yaw.
13. Lock RR in Auto Track.
14. Activate COMM Primary amplifier and diplexer.

Test Description: (Cont)

15. Slew S-Band steerable Ant to -75 deg pitch/-75 deg yaw and set up for slew to +75 deg pitch/+75 deg yaw.

16. Activate Landing Radar.

17. Set up Landing Radar for Standard Test Conditin Number Seven.

18. Obtain and record Forward and Lateral Velocity via X-PTR and ALT/ALT RT via cabin meter.

19. Obtain LR DVM readings via INT power switch.

20. LM cabin control configuration.

21. S/C status verification via ACE.

22. Reset ED System A and B stage relays (K2) and verify Daisy Chain via ACE.

23. Activate Stage and DES PRESS reset stimuli via R-Start.

24. Obtain and record BATT A and B voltage via cabin meter.

25. Dynamic test instructions.

26. Activate DECA and Engine ARM.

b. Dynamic Test - LM integrated system check (Para. 4.2.2.13.1.2)

1. Activate Ascent Engine ARM.

2. Initiate and verify mission timer counting.

3. Initiate and verify event timer counting.

4. Enable COMM VOX tape recorder.

5. Initiate S-Band Antenna slew to +75 deg pitch/+75 deg yaw.

6. Activate AGS guidance control.

7. Activate RCS 5-Second ullage burn via LMP TTCA cabin control.

8. Activate manual throttle control via cabin control.

9. Activate AEA Abort program via Cabin control resulting in steering errors and Engine ON/OFF from AEA.

10. Throttle DE via TTCA cabin control (CDR) and verify via cabin meter.

Test Description: (Cont)

11. CDR activate audio control backup.

12. Activate AEA Abort Stage program via cabin control resulting in steering errors and Engine ON/OFF from AEA.

13. Deactivate BATT feed ties.

14. Activate/Deactivate dock lights.

15. Deactivate DECA.

16. Disable COM VOX tape recorder.

17. Verify DES BATTS off line after Abort Stage via cabin flag.

18. Verify steering errors from AEA via cabin meter.

19. Verify ASC BATTS to bus and DES BATTS off bus after Abort Stage via ACE.

20. Activate/Deactivate speed controls of ACE recorders.

21. Verify ED staging function via ACE.

22. Monitor Descent Engine Throttling.

23. Verify S and C execution via ACE.

24. Monitor AEA steering errors via ACE.

25. Verify bus voltage during Abort Stage.

26. Verify ASC and DES Engine ON/OFF via ACE.

27. Verify RCS Jet firing via ACE.

28. Monitor Descent Engine Gimballing via ACE.

29. Monitor RR during loss of power and place at left limit Trun/upper limit shaft.

30. Activate/Deactivate RR brush recorder.

31. Scan LR Preamps (D1 Zero angle).

32. Activate/Deactivate LR brush recorder.

33. Activate/Deactivate HP Printer and record Max and Min dynamic test voltages.

Test Description: (Cont)

34. Verify pressure increase on engine solenoid checkout unit when DE is turned off and momentarily vent all four gages.

35. Monitor S-Band ANT Slew.

36. Verify docking light Activation/Deactivation.

37. Activate/Deactivate RCS and EPS GSE monitoring recorders.

c. Securing After Dynamic Test.

1. Deactivate COMM S-Band PWR amplifier.

2. Reset CES and ED cabin controls.

3. Activate BATT feed ties.

4. Deactivate ATCA.

5. Reset event and mission timer.

6. Deactivate Flight Inverter 2.

7. Verification of dynamic test.

8. CDR bus shutdown.

Seq. 042:

a. Major Mode Four - Vehicle Turn-Off From Major Mode Three.

1. AGS shutdown.

2. Displays shutdown.

3. RCS shutdown.

4. PROP shutdown.

5. CES shutdown.

6. COMM shutdown.

7. ECS shutdown.

8. DC power-on bus via J167.

(a) Close X-Ties

(b) Reset vehicle ground power

Test Description: (Cont)

(c) Veh PWR to bus - EPS checkout interface unit.

(d) ASC BATT off bus.

(e) Set PS 4, 2, 3, 1 OFF on EPS C/O controller.

9. Instrumentation shutdown.

10. DC power via J166 Turn-off.

11. EPS shutdown.

12. Turn-off ACE and FR1400 recorders.

b. Major Mode Four - Test 1, PGNS Auto Ascent

1. Demate Vehicle Electrically.

2. Major Mode Four - Turn-on.

(a) Verify GSE coolant, Annotate and turn-on ACE recorders and load files into GE computer.

(b) Power to bus via J166 and J167.

(c) Activate ASC ECA's - Close BATT feed ties and X-Lunar bus ties.

(d) Activate Ascent power.

(e) Activate BATT 5 and 6 normal feed to bus.

(f) PCM turn-on.

(g) Verify ASC BATT feed configuration via ACE.

(h) Activate Flight Inverter 1.

(i) Activate C and W.

(j) Activate S-Band ANT heater.

(k) Mission timer activation.

(l) Event timer activation.

(m) DUA activation.

(n) Activate IMU standby power.

Test Description: (Cont)

(o) Activate LGC/DSKY power.

(p) Verify PGNS status via ACE.

(q) LGC self check activation.

(r) Activate IMU operate power.

(s) Verify PGNS status via ACE.

(t) Activate IMU coarse align to zero.

(u) Activate IMU operational test.

(v) Initiate AGS turn-on.

(w) Initiate D113 overlay.

(x) Initiate AGS Standby.

(y) Verify AGS status via ACE.

(z) Initiate AGS operate status.

(aa) Perform DEDA EL checkout.

(ab) Verify/Load 7-10000102 and 7-10000204 in ACE.

(ac) Activate AEA self test.

(ad) Activate AEA error volt verification.

(ae) Activate counters for GSE - 5 Monitoring.

(af) Interrupt PGNS/AGS interface.

(ag) Load the load and verify routine into AEA.

(ah) Monitor GSE - 5 changing binary conditioner.

(ai) Load Memory noise test program into AEA.

(aj) Verify load of memory noise test.

(ak) Initiate AEA memory noise test.

(al) Activate PGNS/AGS interface.

(am) RCS turn-on - System A/B QUAD power.

Test Description: (Cont)

(an) RCS heater turn-on and monitor temp.

(ao) Activation of CES.

(ap) CES status verification via ACE.

c. Major Mode Four - Static Test - LM Subsystem check for normal performance, set proper configuration and confidence check for individual subsystems.

1. Activation of RR cabin controls.
2. Adjust RR resolver readout assembly.
3. Activation of lighting and RCS cabin controls.
4. Configure RCS ASC feed, cross feed, Main shutoff and isolation valves.
5. Load K-Start tape (G03-L001-K10510-00) for PGNS Auto Ascent into LGC Computer.
6. Configure COMM circuit breakers.
7. Slew S-Band Steerable Ant to -75 deg pitch/-75 deg yaw and set up for slew to +75 deg pitch +75 deg yaw.
8. Activate COMM Secondary S-Band Amplifier and XMTR/RCVR.
9. Enable COMM VOX tape recorder.
10. Monitor COMM status via ACE.
11. Adjust COMM GSE.
12. LMP activate S-Band voice.
13. LMP activate S-Band PCM.
14. LMP activate S-Band range.
15. CDR activate AUDIO CONT to NORM.
16. CDR/LMP voice on FLT Headsets - Check signal strength via cabin meter and deactivate COMM VOX tape recorder.
17. LMP activate AUDIO VHF A - Deactivate AUDIO VHF B.
18. Activate Rendezvous Radar.

Test Description: (Cont)

19. Slew RR to Zero Pitch/Zero Yaw.
20. Configure Lighting and ORDEAL cabin controls.
21. Dynamic test instructions.
22. Activate IMU fine align to Zero and record CDU Angles.
23. Configure CES cabin controls.
24. Turn-on Secondary trim control unit.
25. Turn-off Primary trim control unit.
26. Activate Glycol Pump 1.
27. Activate Glycol Pump auto transfer power.

d. Dynamic Test - LM Ascent integrated system check. (Para. 4.2.2.13.1.2)

1. Initiate and verify mission timer counting.
2. Slew Rendezvous Radar in Trunnion to Counterclockwise limit.
3. Slew RR in Trun to CW limit.
4. Slew RR in Trun to Zero position Yaw.
5. CDR deactivate AUDIO VHF A.
6. ORDEAL slew fast then slow up and down and verify via FDAI's.
7. Slew RR in shaft to lower limit.
8. Slew RR in shaft to upper limit.
9. Slew RR in Shaft to Zero position pitch.
10. Activate manual override - Engine STOP/RESET via cabin switch.
11. Deactivate Rendezvous Radar.
12. Deactivate EPS bus cross ties.
13. Activate Inflight Inverter 1 to 2 switchover.
14. CDR activate AUDIO VHF B.
15. Deactivate Inflight Inverter bus ties.

Test Description: (Cont)

16. Activate Rendezvous Radar.
17. Lock RR in Auto Track.
18. Cycle ASC Helium Regulator valves.
19. Activate/Deactivate RCS QUAD heaters.
20. Activate automatic Glycol Pump 1 to 2 switchover.
21. CDR deactivate AUDIO S-Band.
22. Activate/Deactivate flood lights.
23. Activate/Deactivate LTG ANUN and NUM lighting overrides via cabin switch.
24. Activate COMM VOX tape recorder.
25. Activate event timer.
26. Activate/Deactivate tracking and docking lights.
27. LMP deactivate AUDIO VHF A.
28. LMP activate COMM S-Band voice backup.
29. Switch ASC BATT 5 normal and backup feed to bus and deactivate BATT 6 normal feed.
30. Activate ASC BATT 6 normal and backup feed to bus and deactivate BATT 6 normal and backup feed.
31. Activate EPS bus cross-ties and deactivate BATT 6 backup feed.
32. Activate BATT 5 normal feed to bus and deactivate bus cross-ties.
33. LMP activate AUDIO VHF B.
34. Activate manual override - Descent Engine Stop/Reset function.
35. Activate/Deactivate RCS isolation valves.
36. Open RCS main shutoff valves.
37. Close RCS interconnect valves.
38. Close RCS crossfeed valves.
39. LMP deactivate audio S-Band.

Test Description: (Cont)

40. Activate S-Band Antenna slew to +75 deg pitch/+75 deg yaw.
41. Activate/Deactivate all flood lights.
42. Activate/Deactivate OVHD/FWD flood lights.
43. Deactivate COMM VOX tape recorder.
44. Verify all NUM displays Deactivate/Activate during Inverter switchover.
45. Activate PGNS Auto Ascent profile resulting in Engine ON/OFF and JET firing commands from LGC.
46. Observe FDAI Pitch and Yaw error needles and X-POINTERS during RR slew.
47. Monitor glycol pressure.
48. Activate/Deactivate speed controls of ACE recorders.
49. Monitor ASC BATTS ON/OFF bus via ACE.
50. Record CDU Angles.
51. Monitor ASC Engine ON/OFF via ACE.
52. Monitor EPS DC and AC bus voltage/Frequency.
53. Monitor cycling of RCS Isolation, Main Shutoff, Crossfeed and Interconnect valves via ACE.
54. Monitor Jet fail resulting from isolation valve cycling via ACE.
55. Monitor S-Band receiver lock.
56. QC monitor and record limited life Activation/Deactivation.
57. Monitor Activation/Deactivation of Tracking and Docking lights.
58. Monitor RR slewing and install hat coupler.
59. Activate/Deactivate RR brush recorder.
60. Verify pressure increase on engine solenoid checkout unit when ASC Engine is turned off and momentarily vent all four gages.
61. Activate/Deactivate RCS and EPS monitoring recorders.
62. Monitor S-Band Antenna slew.

Test Description: (Cont)

63. Deactivate Glycol Pump Two and Auto Transfer.

64. Activate Primary trim control unit.

65. Deactivate Secondary trim control unit.

e. Securing After Dynamic Test.

1. Deactivate Ascent Engine ARM and ARM power.

2. Deactivate Rendezvous Radar and stow ANT.

3. Deactivate ATCA power.

4. Deactivate COMM S-Band power Amplifier.

5. Stop and reset event timer.

6. Activate RCS HTR control auto.

7. Stop and reset mission timer.

8. IMU coarse align to Zero and record CDU angles.

9. Close RCS main shutoff valves.

10. Rewind K-Start tape and store.

11. Reset ED subsystem.

12. Verify dynamic test.

13. Stop AEA memory noise test.

14. Interrupt PGNS/AGS interface.

15. Dump AEA memory and verify.

Seq. 043: Vehicle Shutdown

a. Coarse align IMU to Zero and record CDU angles.

b. Deactivate IMU operate power.

c. Deactivate PGNS - LGC/DSKY power.

d. Deactivate IMU standby power.

e. Deactivate AEA and ASA power.

f. Deactivate Flight display power.

Test Description: (Cont)

g. Deactivate RR and GSE.

h. Deactivate RCS QUAD power and RCS heater power.

i. Deactivate RCS isolation, ASC feed, Main and crossfeed valve power.

j. PROP shutdown.

k. CES shutdown.

l. Communications shutdown.

m. Lighting shutdown.

n. EPS vehicle and GSE power shutdown.

OCP OUTLINE

OCP-GF-62500-SIM-LM8

Test Title:

LM Combined FEAT Test-Mission Oriented (Plugs-Out)

Subsystem:

All LM Subsystems

Test Objectives:

Verification of all LM subsystems to perform all functions as planned for a manned LM mission, with the following functional objectives:

a. Pre-Launch Checkout.

b. Earth Orbit-Translunar-Pre-Separation.

c. Separation and First DPS Burn.

d. Lunar Descent and Landing.

e. Lunar Stay.

f. Pre-Launch Checkout.

g. Powered Ascent

h. AGS Abort & Rendezvous.

Vehicle Configuration:

Mated Ascent & Descent Stages

Location:

Integrated Test Area, Plant 5.

Hazardous Operations:

a. Use of primary batteries.

b. ECS fluid line pressures of 250 psi.

Equipment Under Test:

Integrated flight-all LM panels and components used throughout a manned lunar mission.

Test Description: (Para 4.2.2.13.1.3)

A. Pre-Launch Checkout

Seq. 01: Call to Station

a. Verification of the Intercom voice communication between the test conductor and all test personnel participating in this OCP.

Seq. 02: Bus Power On via J167 (Para 4.2.2.2.2 (c))

a. GSE D.C. power supplied via MSS connector J167.

b. Closure of all pertinent EPS circuit breakers needed for pre-launch checkout.

c. Turn on 5 Volt R.C.S. stimuli.

1. Verify each channel on (stimuli) recorder.

d. Set all recorders (Control Room) at 2 MM/SEC.

Seq. 03: PCM Turn-On via LUT and Interface Unit (Para 4.2.2.2.2 (c3) and 4.2.2.12.2)

a. Insert basic D/L Flight controls via C start.

b. PCM turn on controlled externally via LUT umbilical path.

c. Verification of PCM lock-on with ACE.

1. Verification of PCM calibration voltages and bus voltages.

Seq. 04: Installation of ED Devices (Para 4.2.2.10.3)

a. ED devices are installed in place of all flight fuses.

b. Resistance measuring check.

Seq. 05: Closeout Check

a. Checkout of RCS valves, landing gear deploy, ascent and descent He regulator valves, RCS and propulsion valve power (pre-separation).

b. Verification of associated flags.

c. Ambient pressure, temperature and quantity readouts.

Seq. 06: DC power to Bus via LUT (GSE umbilical) (Para 4.2.2.2.2 (d))

a. LUT Power On.

b. J167 bus power turn off.

c. Verify GSE power supplied via LUT umbilical.

A. Pre-Launch Checkout (Cont)

Seq. 07: Descent LV Turn-On/LUT Reset (Para 4.2.2.2.2 (d))

a. LV turn on via EPS interface unit and monitor battery currents continuously until high voltage switchover.

b. Reset LUT and GSE umbilical power.

c. ASA switchover to vehicle power.

d. IMU switchover to vehicle power.

1. Activate IMU standby power.

e. Activate DC25 Program to verify battery power dissipation in amp hrs.

f. Activate LR and RR Heaters.

B. Earth Orbit - Translunar - Pre-Separation

Seq. 08: SLA Separation and CSM/LM Power Transfer (Para 4.2.2.2.2 (d))

a. SLA Separation.

b. Floodlights checkout.

c. Verification of GSE power to bus via CSM/LM interface (J9 & J10).

d. Transfer CSM power to LM (via CSM/LM interface).

Seq. 09: PCM Turn-On (Para 4.2.2.2.13.1.3 & 4.2.2.12.2)

a. PCM telemetry turn-on via vehicles CB's.

b. Turn-on S-Band (LMP) XMTR and RCVR and set to primary.

c. Verification of PCM lock-up with ACE.

d. EPS monitoring of batteries (voltage and current).

e. Verify vehicle's isolations greater than 100K OHMS.

Seq. 10: Ingress and LM Lighting Checkout (Para 4.2.2.2.5)

a. AC power turn-on.

b. Operate floodlights via docking hatch switch and lighting switch.

c. Switch over to inverter 2.

d. Turn-On numeric and integral lighting.

e. Verify operation of integral lights.

B. Earth Orbit - Translunar - Pre-Separation (Cont)

Seq. 11: Activate and Checkout Caution and Warning System (Para 4.2.2.12.4)

a. Turn-on C&WEA displays.

b. C&WEA Self-Test.

c. Lighting control override check.

Seq. 12: Activate and Checkout Heat Transport Section (Para 4.2.2.3.6.1 & 4.2.2.3.6.2)

a. Verification of C&WEA of the Primary and Secondary loops.

b. Verification of Glycol pumps auto switchover.

c. Checkout of accumulator (low level) primary and secondary.

d. Zero point checkout.

e. Descent H_2O Tank low level checkout.

f. 100% point checkout and regulator check.

Seq. 13: Activate and Checkout Water Management Section (Para 4.2.2.3.7.1 & 4.2.2.3.7.2)

a. Pressurized Ascent Water Tank Checkout.

1. Checkout of Ascent Tank #2 less than full.
2. Checkout of Ascent Tank #2 less than Tank #1.
3. Checkout of Ascent Tank #1 less than full.
4. Checkout of Ascent Tank #1 less than Tank #2.

Seq. 14: Activate and Checkout ARS (Para 4.2.2.3.6.1)

a. Checkout of the following ARS components:

1. Suit fans.
2. Water separator.
3. Suit gas diverter checkout.

B. Earth Orbit - Translunar - Pre-Separation (Cont)

Seq. 15: ARS Redundant Mode Checkout (Para 4.2.2.3.5.1 & 4.2.2.3.2)

a. Checkout of ARS components and associated C&WEA:

1. Suit fans.

2. Water separator.

3. Glycol low delta pressure.

4. CO_2 sensor.

5. Torn suit protection system checkout.

b. Activate Ascent and Descent 02 Tanks:

1. Pressurization of the descent and ascent O_2 tanks. Verification of C&WEA at low level, as well as, meter readings.

Seq. 16: Activate RCS Heaters and check Quad Temperatures (Para 4.2.2.7.1 (h))

a. Cabin verification of Quad Cluster Heaters by monitoring temperature displays.

Seq. 17: Activate UHF Voice Communication

a. Connect flight headsets to GSE adapter cables.

b. Turn-On UHF A&B transeivers, LMP & CDR's audio.

c. Demonstrate Voice Communications uplink and downlink between CTS and LMP via VHF A and VHF B.

Seq. 18: S-Band Checkout

a. Checkout S-Band Omni Fwd:

1. Verify voice communications via S-Band primary system and Omni antenna #1.

2. Verify LMP and CDR voice communication via S-Band link.

Seq. 19: Ranging Function Checkout

a. Ranging delay check.

B. Earth Orbit - Translunar - Pre-Separation (Cont)

c. FM Modulation Checkout.

d. Checkout of S-Band Aft Antenna.

e. VHF A Checkout of CDR Voice Communications.

Seq. 20: Activate Subsystem

a. Activate subsystems circuit breakers.

b. Des LV to HV switchover (if not previously performed).

Seq. 21: Ascent Batteries Checkout (Para 4.2.2.2.4)

a. Checkout Ascent Batteries on open circuit.

1. Turn-on Inverter #1 and Inverter #2 turn off.

b. Checkout Ascent Batteries connected to either bus.

1. Inverter #2 turn-on and Inverter #1 turn off.

Seq. 22: PGNS Activation (Para 4.2.2.12.4)

a. LGC/DSKY Power turn-on.

b. Initiate LGC error reset program.

c. LGC self-check via DSKY.

Seq. 23: Checkout Mission Timer.

Seq. 24: Propellant and Helium Checkout (Para 4.2.2.8.3.3)

a. Verification of Temperature and Pressure readings associated with Propellant and Helium tanks.

1. PQGS Sensor Test Dry Checkout.

Seq. 25: Verify and Set RCS Flags/Valve Status Prior to Pressurization

a. Verify RCS Valves are closed and flags are B.P.

b. Set RCS Valves to open, verify flags are gray.

Seq. 26: Activate VHF Data Transmission to Command Module

a. Record AMP Hrs on DES and ASC batteries.

b. Configure and verify transfer to lo-bit rate via C start.

B. Earth Orbit - Translunar - Pre-Separation (Cont)

c. Verify ACE-S/C decommutator lock-up (lo-bit rate) & PCM calibration measurements.

d. Verify transmission of low-bit rate split-phase and NRZ PCM data to CM via VHF Channel B.

e. Verify relay of S-Band voice back-up transmission with low-bit rate NRZ PCM data.

f. Configure and verify transfer to hi-bit rate via C start.

g. Verify ACE-S/C decommutator lock-up (Hi-bit rate).

h. Verify Octal dumps of both hi and lo bit rates in post test.

Seq. 27: Checkout RGA (Para 4.2.2.6.4)

a. Cycle Gyro Test switch to checkout FDAI's interface.

b. Verify pitch and roll GDA positions are at center if not arm descent engine to center GDA's.

Seq. 28: Pressurize RCS (Para 4.2.3.10.2 (a))

a. Set Master Arm SW and RCS He. Press SW to checkout associated simulators and CWEA.

Seq. 29: IMU in Operate Mode

a. Application of IMU operate pwr.

b. IMU Operational Test.

c. G&N Voltage and Temperature Check.

Seq. 30: Checkout RCS Jets via ACA (Para 4.2.2.6.3.7.1)

a. ACA is exercised in roll, pitch and yaw while operating in AGS guidance and pulse mode. Jet driver commands are verified for proper operation.

Seq. 31: Deploy Landing Gear

a. Command appropriate ED Simulators fire and verify associated caution lights.

B. Earth Orbit - Translunar - Pre-Separation (Cont)

Seq. 32: Activate and C/O AGS

a. AGS turn on and set to standby.

b. Verify ASA temperature (F) is within spec limits.

1. Verify ASA temperature stabilizes within ±3 DEG. F of set point.

c. Set AGS to operate mode.

d. C/O AGS utilizing DEDA.

1. C/O DEDA lighting.

e. Perform AEA self test.

Seq. 33: G&N Fine Align

a. Torque IMU to +10 ±0.1 degrees azimuth.

b. Torque IMU to -5 ±0.1 degrees pitch.

c. Torque IMU to +30 ±0.1 degrees roll.

d. Verify Stabilization and Control subsystem in OFF mode.

Seq. 34: Main propulsion flag/valve status

a. Cycling ascent and descent regulator switches to checkout associated flags and measurements.

Seq. 35: Align AGS to PGNS, Monitor FDAI's (Para 4.2.2.6.5.7)

a. Verify on FDAI the transfer of IMU Azimuth, pitch, and roll angles to AGS.

Seq. 36: DUA Turn-On (Para 4.2.2.11.1.7.1)

a. Turn-on DUA.

b. Verification of Data Uplink.

c. Clearing DUA Counts via C-Start.

1. Reset DSKY

B. Earth Orbit - Translunar - Pre-Separation (Cont)

Seq. 37: AGS State Vector Initialization (Para 4.2.2.6.5.7)

a. Verify at DEDA, the transfer of LM and CSM state vectors to the AEA.

b. Leave AGS in orbit align mode.

Seq. 38: ORDEAL Checkout (Para 4.2.2.9.4)

a. Turn-on ORDEAL assembly.

b. Verify IMU is aligned to 0^{o} via measurement monitoring.

c. Coarse align IMU via DSKY.

d. Align IMU via DEDA.

e. C/O ORDEAL via comparison of FDAI's & CRT readings.

f. Reset event timer.

g. C/O of FDAI's interface with ordeal utilizing event timer.

h. C/O ORDEAL lighting.

i. On DEDA perform body axis align.

Seq. 39: Activate and Deactivate Docking Lights (Para 4.2.2.2.5)

a. Checkout docking light operation.

C. Separation and First DPS Burn

Seq. 40: Load and Initialize for RCS Maneuver DPS Burn .

a. Verify jet driver outputs for -X translation initiated at the DSKY.

Seq. 41: Select Modes for First DPS Burn

Seq. 42: First DPS Burn

a. Set recorders at proper speeds & channels to monitor DPS Burn.

b. Monitor voltage of ED Batteries.

c. Set Master Arm switch in order to monitor C&WEA and RLY XFER's when the following switches are activated:

1. DES PRPLNT Isol Vlv.

2. DES Start He. Press.

C. Separation and First DPS Burn (Cont)

d. Verify jet drvier outputs for X-Translation initiated at the DSKY.

e. Arm Descent Engine.

f. Auto Engine On.

g. Auto Engine Off.

h. Dearm Descent Engine.

i. Reset Master Arm.

j. Verify descent He pressurization, and descent propellant, fuses are blown.

k. Set recorder speeds for resumption of static tests.

Seq. 43: C/O Tracking Light (Para 4.2.2.2.5)

a. Turn-on, checkout, and turn-off tracking light.

Seq. 44: Select EPS Modes for 2nd DPS Burn (Para 4.2.2.2.3)

a. Open cross tie bal. loads.

b. Set Batts 5 & 6 normal feeds on.

c. Inverter #2 turn-off and Inverter #1 turn on.

d. Checkout amp and voltage readings on all batteries and buses.

Seq. 45: Propellants, Gases and Fluids Checkout

a. Check RCS Systems A&B pressure and temperature Instrumentation. Check descent and ascent propulsion tank instrumentation.

D. Lunar Descent and Landing

Seq. 46: Initiate FCS Profile for Second DPS burn and Self Check of LR (Para 4.2.2.5.9.3 & 4.2.2.3.3)

a. Turn on LR air conditioner.

b. Activate LR.

c. Monitor LR temperature via cabin meter and ACE readouts.

d. Load DUA tape #40.

D. Lunar Descent and Landing (Cont)

e. Dynamic Test instructions.

f. Suit Fan & Glycol turn-on.

Turn on secondary TCU.

2. Turn on Suit Fan #1 and Glycol Pump #1.

3. Turn off primary TCU.

4. Monitor H_2O Separator Rate, Glycol Pump Delta P.

5. Activate Auto-transfer power.

g. Activate Event Timer.

h. Auto Descent Profile.

1. Arm Descent Engine.

2. Monitor GDA pitch & roll

3. LR Self Test

(a) Strobe LR

(1) Monitor LR when antenna is cycled between descent and hover positions.

4. Monitor RCS Jet firing.

i. Reset event timer.

Seq. 47: Suit Fan and Glycol Pump turn-off (Para 4.2.2.3.3)

a. Turn off of Suit Fan #1 and Glycol Pump #1.

b. Turn on primary TCU/Turn off secondary TCU.

Seq. 48: Manual Functions Associated with Hover. (Para 4.2.2.5.9.1)

a. Verify Descent Rate Switch Operation.

b. Load DUA tape #33 into LGC.

c. Verify operation of CDR's ACA via LGC.

d. Command Descent Engine On Via DSKY.

e. Verify Operation of CDR's TTCA.

D. Lunar Descent and Landing (Cont)

f. Verify Both Engine Stop Switches.

g. Leave TTCA in up (Max) position.

E. Lunar Stay

Seq. 49: RR Turn-On, Adjustment for Thermal Balance and Turn-Off (Para 4.2.2.5.7.6.1)

a. RR power verification.

b. Adjustment and verification of RR subsystem operation.

c. RR power shut-off.

Seq. 50: Deactivation of Subsystems

a. CES Power down.

b. Vent Descent Fuel-Ox.

Seq. 51: Checkout of EPS

a. Post landing checkout of EPS.

1. Monitoring the voltage and amperage of the buses and batteries.

2. Inverter #1 turn off and Inverter #2 turn on.

3. Activate cross tie bal loads.

4. Turn off batteries 5 & 6 normal feeds.

Seq. 52: AGS Lunar Align (Para 4.2.2.6.5.7)

a. PGNS Gyro - Compassing.

b. Lunar Align.

c. Align AGS to PGNS and C/O FDAI.

d. Gyro nulling validation.

Seq. 53: De-activate PGNS - Lunar Stay

a. Coarse align via DSKY.

b. De-activate IMU operate power.

E. Lunar Stay (Cont)

Seq. 54: Lunar Stay Comm C/O (Para 4.2.2.11.1.7.2.1 and 4.2.2.11.1.7.4)

a. S-Band Set-up:

1. Lo power config. (transceiver only, no pwr amp).
2. Lo Bit rate (1.6K bits/sec.) PCM.
3. TV Transmission - Hi and Lo frame rate.
4. CDR/LMP ICS verification.
5. S-Band uplink and downlink voice communication.

F. Pre-Launch

Seq. 55: Re-activation

a. Re-activate subsystems for launch.

1. Activate PGNS from standby to operate.

(a) Fine align via DSKY.

(b) Monitor voltage (PIPA).

(c) Coarse align to zero.

(d) Monitor PIPA temp F°.

Seq. 56: Propellants, Gases and Fluids Status Check

a. Check RCS Systems A&B pressure and temperature instrumentation.

b. Check ascent propulsion tanks and regulators instrumentation.

c. Check ascent and descent water tank instrumentation.

Seq. 57: Select EPS Modes for Ascent Burn (Para 4.2.2.2.3.2)

a. Tie-ascent batteries in parallel with descent batteries.

b. Turn off descent batteries.

c. Turn on Inverter #1/Turn off Inverter #2.

F. Pre-Launch (Cont)

Seq. 58: Checkout AGS (Para 4.2.2.6.5.3)

a. AEA Self-Check.

1. Monitor ASA temp.

Seq. 59: C/O Event Timer (Para 4.2.2.9.2)

Seq. 60: Select Mode for Ascent

a. Configure cabin for ascent.

Seq. 61: Activate, Self-Test and Deactivate RR - Ascent Burns, Rendezvous, & Docking

a. Verify manual slew of Rendezvous Radar.

b. Self-Test Rendezvous Radar.

c. Radar strobed by LGC for range and range rate outputs verified on DSKY.

Seq. 62: RCS/ASC Interconnect

a. Valves connecting RCS and ascent propellants are opened and verified.

G. Powered Ascent

Seq. 63: Arm Ascent Engine and PGNS Ascent (Para 4.2.2.5.10)

a. Arm Ascent Engine.

b. Initiate Auto Ascent Profile (17 minutes) Ascent Burn, Rendezvous and Docking.

c. Set master arm switch and ASC HE press in order to monitor relay XFER and CWEA.

d. Load DUA Tape #31.

e. Dynamic Test Instructions.

f. Suit Fan and Glycol Pump turn-on.

1. Turn-on secondary TCU

2. Turn-on Suit Fan #2

3. Turn-on Pump #2

4. Turn-off Primary TCU

G. Powered Ascent (Cont)

g. Arm Ascent Engine.

h. Start Event Timer

i. Monitor Auto Engine On/Off During Profile

j. Set Recorders for Dynamic Run

k. Monitor Jet Firings during Profile

l. Set Recorders for Static Run

m. De-Arm Ascent Engine

n. Reset Event Timer

o. Verify ED Simulators were Fired.

Seq. 64: Suit Fan and Glycol Pump Turn-Off Ascent Burns, Rendezvous and Docking (Para 4.2.2.3.3)

a. Turn-off suit fan #2

b. Turn-on primary TCU

c. Turn-off Glycol Pump #2

d. Turn-off secondary TCU

Seq. 65: VHF Ranging

a. Voice communication between CTS and Cabin (LMP & CDR)

b. Connect VHF Ranging Cable

c. Configure cabin and ranging test simulator

d. Verify ranging signals on DE 1 RCVR

Seq. 66: Command X-Axis RCS Burn - Ascent Burns, Rendezvous and Docking (Para 4.2.2.5.11)

a. Verify jet driver outputs for plus X-translation initiated at the DSKY.

G. Powered Ascent (Cont)

Seq. 67: Exercise Manual Translation and ACA as per docking Ascent Burns Rendezvous and Docking (Para 4.2.2.6.3.9.1)

a. Verify operation of commander's ACA

b. Verify operation of commander's T/TCA

Seq. 68: PGNS Shutdown

a. Coarse align to zero

b. Deactivate IMU operate power

c. Deactivate LGC/DSKY power

d. Turn on PTC

e. Deactivate IMU standby power

H. AGS Abort and Rendezvous

Seq. 69: AGS Abort-Abort Stage (Para 4.2.2.6.5.9 and 4.2.2.6.5 (j)(k))

During this sequence an AGS abort from powered descent is simulated. An AGS abort is initiated and ascent to orbital insertion is verified using the AEA FP3 flight program modified for simulated Lunar Missions. Staging will be simulated at an altitude in the region of 30,000 feet.

Seq. 70: Analog Autopilot Rendezvous (Para 4.2.2.6.3.9.2)

a. Exercise the commander's T/TCA with the balanced couple switch On, mode control switch in attitude hold, attitude control switches in pulse and the AEA in orbit align.

b. Place the X-translation switch in 4-Jet position and exercise the T/TCA.

c. Exercise the commander's ACA.

Seq. 71: Securing After Test S&C Shutdown

a. CES power-down

b. Turn-off heaters

c. Flight displays shutdown

d. Comm. shutdown

e. Lighting shutdown

H. AGS Abort and Rendezvous (Cont)

f. EPS shutdown

1. Inverter #2 turn-off

2. Verify cross tie bus' close

g. ECS shutdown

1. Turn off primary TCU

h. Instrumentation shutdown

i. GSE shutdown

Seq. 72: LV to HV Switchover

a. Perform the Descent LV to HV switchover if and when the DC Bus Voltage falls below 27.0 VDC during the running of this OCP.

OCP OUTLINE

OCP-GF-70010-LM8

Test Title:

OCP Support Checklist

Subsystems:

Electrical Power

Environmental Control

Instrumentation

Test Objectives:

Provision of turn-on and shutdown procedures for GSE, for ECS, and EPS Subsystems, Carry-on GSE, Instrumentation Subsystem.

Vehicle Configuration:

Ascent Stage

Location:

Integrated Workstand, Plant 5

Hazardous Operation:

Not Applicable

Equipment Under Test:

a. PCMTEA, SCEA

b. Lighting

c. EPS Buses

d. Primary Coolant Loop

Test Description:

Seq. 01: Call to Stations.

Seq. 02: Spacecraft Cabin Control Configuration

Seq. 03: DC Power Application to Vehicle DC Buses

Seq. 04: GSE 400 Hz to AC Bus Power-Up

Seq. 05: PCM T/E and SCEA Turn-On. (Para. 4.2.2.12.2.1.1)

Seq. 06: EPS AC and DC CRT Bus Readout Check

Test Description: (Cont)

Seq. 07: Carry-On Standard Word Check.

Seq. 08: Simulating LCA with Lighting Test Set (LTS).

Seq. 09: Simulated LCA with Lighting Test Set (LTS) Powerdown.

Seq. 10: PCM/TE and SCEA Shutdown.

Seq. 11: EPS Configuration Prior to GSE Shutdown.

Seq. 12: GSE 400 HZ Powerdown.

Seq. 13: DC EPS GSE Powerdown Procedure Including Functional Check of DC Power Interlock Circuitry.

Seq. 14: Carry-on Powerdown.

Seq. 15: LDW410-11270-1 DC Power Supply, ACE S/C GSE Powerdown.

Seq. 16: ECS Shutdown W/G Shutdown.

Seq. 17: W/G Refrigeration Unit Shutdown.

SECTION 7.0 - GSE USAGE MATRIX

SECTION 8.0 - CREW PARTICIPATION REQUIREMENTS

CREW PARTICIPATION

	CATEGORY MANDATORY	CATEGORY OPTIONAL
Unsuited Crew participation is required during the following tests:		
OCP 36527 DATA CHANNEL VERIFICATION (C&W ONLY)		X
OCP 62000 COMBINED SUBSYSTEM TESTS, PRE-FEAT		
ECS		X
G&N		X
COMM		X
RADAR		X
FCS		X
OCP 62500-PLG FEAT, PLUGS-IN		X
OCP 62500-SIM FEAT, PLUGS-OUT	X	
Suited Crew participation is required during the following tests:		
OCP 32016 CREW SUITING (FOR A/S, CDR, LMP)	X	
OCP 32014 A/S CREW COMPARTMENT FIT AND FUNCTIONAL	X	
OCP 32022 CREW SUITING (FOR D/S, LMP ONLY)	X	
OCP 32021 D/S CREW COMPARTMENT FIT AND FUNCTIONAL	X	

MANDATORY: One or more of the Prime or Backup Flight Crew will man the spacecraft for the test.

OPTIONAL: One or more GAEC Consulting Pilots will man the spacecraft for the test. Flight Crew manning will be at the option of the Crew Commander.

HAZARD VS OCP/SMP

NOMENCLATURE	3314	3326	3356	3357	3358	26007	26008	26019	26022	26040	26041	26043	27005	27006	27012	27015	27020	27028	27030	31031	31032	31033	31034	31035	31036	31038	32020	33001	33013	33020	33024	33030	33066	33067	33068	33071	62000-ECS	62000-EPS	62000-PROP	62000-COMM	62000-RAD	62000-RCS	62500-POI
R.F. ENERGY																																											
1. S-BAND																																								x			
2. LDG RDR																																									x		
3. RNDZ RDR																																									x		
ENVIRONMENT																																											
1. SUSPENSION OF VEHICLE																																											x
2. X-RAY																											x																
3. TRACKING LIGHT																																						x					
4. ALCOHOL FLUSH			x	x	x																																						
HIGH PRESSURE GAS																																											
1. HTS A/S																												x	x														
D/S																																			x								
2. ECS A/S	x	x																											x		x					x	x						
D/S																																x			x		x						
3. OCPS A/S																													x	x							x						
D/S																																x					x						
4. WMS A/S																																		x									
D/S																																	x										
5. ARS																														x													
6. APS													x	x	x	x	x	x	x																				x				
7. DPS						x	x	x	x	x	x	x																											x				
8. RCS																				x	x	x	x	x	x	x																x	

FOLDOUT FRAME A

FOLDOUT FRAME B

FOLDOUT FRAME C

SECTION 10.0 - LIST OF ABBREVIATIONS

SECTION 10.0 - LIST OF ABBREVIATIONS

ACA	-	Attitude Controller Assembly
ACE-S/C	-	Acceptance Checkout Equipment-Spacecraft
AGS	-	Abort Guidance System
ALSEP	-	Apollo Lunar Surface Experiments Package
AOT	-	Alignment Optical Telescope
APS	-	Ascent Propulsion System
ARS	-	Atmosphere Revitalization Section
A/S	-	Ascent Stage
ASA	-	Abort Sensor Assembly
ATCA	-	Attitude Translation Control Assembly
BPA	-	Bethpage Area
CCRDA	-	Computer Control Reticle Dimmer Assembly
CDU	-	Coupling Data Unit
CES	-	Control Electronic Section
CG	-	Center Gravity
COAS	-	Crewman's Optical Alignment Sight
COMM	-	Communication
CON	-	Control
CRT	-	Cathode Ray Tube
CSM	-	Command Service Module
CTS	-	Communication Test Station
D&C	-	Displays and Controls
DEDA	-	Data Entry & Display Assembly
DPS	-	Descent Propulsion System
DSKY	-	Displays and Keyboard
D/S	-	Descent Stage
DUA	-	Digital Uplink Assembly
ECI	-	Electrical Circuit Interrupter
ECS	-	Environmental Control System
EDS	-	Explosive Device System
EMC	-	Electromagnetic Compatibility
EPS	-	Electrical Power System
ESU	-	Engine Simulator Unit
EVA	-	Extra Vehicular Astronaut
FCS	-	Flight Control Subsystem
FDAI	-	Flight Director Attitude Indicator
FEAT	-	FormalEngineering Acceptance Test
FM	-	Frequency Modulation
GFE	-	Government Furnished Equipment
GHe	-	Gaseous Helium
G&N	-	Guidance and Navigation
GN2	-	Gaseous Nitrogen
GOX	-	Gaseous Oxygen
GPM	-	Gallons Per Minute
GSE	-	Ground Support Equipment
HTS	-	Heat Transport Section
HZ	-	Hertz (cycle)

ICS - Inter-Communication System
IMU - Inertial Measurement Unit
IPC - Initialization & Pre-Checkout
INSTR - Instrumentation
IRIG - Inertial Rate Integrating Gyro

KHZ - Kilohertz (Kilocycles)
KSC - Kennedy Space Center

LDM - Leak Detection Meter
LCA - Light Control Assembly
LGC - LM Guidance Computer
LiOH - Lithium Hydroxide
LM - Lunar Module
LPD - Landing Point Designation

LR - Landing Radar
LSP - LM Specification
LTP - LM Test Procedure
LTS - Lighting Test Set
LTL - LM Tracking Light
LUT - Launch Umbilical Tower

MESA - Modularized Equipment Stowage Assembly
MHZ - Megahertz (Megacycles)
MSOVS - Main Shutoff Valves
MSFN - Manned Space Flight Network

NASA - National Aeronautics & Space Admin.
NVR - Non Volatile Residue
N_2 - Nitrogen

OCP - Operational Checkout Procedures
O2 - Oxygen
OX - Oxidizer

PCMTEA - Pulse Code Modulation & Timing Electronics Assembly
PFI - Power Failure Indicator
PGA - Pressure Garment Assembly
PGNCS - Primary Guidance, Navigation & Control System
PIPA - Pulsed Integrating.Pendulous Accelerometer
PLSS - Portable Life Support System
PPM - Parts Per Million
PQGS - Propellant Quanity Gage System
PQMD - Propellant Quanity Measurement Device
PRM - Pulse Rate Modulation
PROP - Propellant
PSA - Power Servo Assembly
PSIA - Pounds per Square Inch, Absolute
PSIG - Pounds per Square Inch, Gage
PSID - Pounds per Square Inch, Differential
PTA - Pulse Torque Assembly

RAD	-	Radar
RCS	-	Reaction Control System
RCVR	-	Receiver
RF	-	Radio Frequency
RGA	-	Rate Gyro Assembly
RR	-	Rendezvous Radar
SCA	-	Signal Conditioner Assembly
SCS	-	Stabilization & Control System
S/C	-	Spacecraft
S&C	-	Stabilization and Control
S/CAT	-	Spacecraft Assembly and Test
SGTS	-	Stimuli Generator Test Set
SMP	-	Standard Manufacturing Procedure
STC	-	Standard Test Condition
TBD	-	To Be Determined
TCRD	-	Test & Checkout Requirement Document
TLM	-	Telemetry
TV	-	Television
T/TCA	-	Thrust Translation Controller Assembly
UHF	-	Ultra High Frequency
VHF	-	Very High Frequency
VLD	-	Volumetric Leak Detector
VSWR	-	Voltage Standing Wave Ratio
W/G	-	Water Glycol
WMS	-	Water Management Section
WTCU	-	Weigh Tank Calibration Unit
XMTR	-	Transmitter