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CONTRACT REQUIREMENTS EXHIBIT E. PARA. 3.14	CONTRACT ITEM WORK PACKAGE NO. 712	MODEL LM-6	CONTRACT NO. NAS9-1100

TYPE II DOCUMENT

LM-6 BPA FACTORY TEST AND CHECKOUT PLAN

LTP 561-6

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REVISIONS			
Date	Rev.	Revisions & Added Pages	Remarks

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LIST OF ILLUSTRATIONS

1.0 INTRODUCTION

1.1 Purpose

This document describes the Bethpage factory test program for the LM-6 vehicle. In order to verify that the vehicle and its subsystems satisfy the test program requirements and are in a condition for acceptance by NASA, a series of detailed tests are performed. These tests are identified as Operational Checkout Procedures (OCP's). Standard Manufacturing Procedures (SMP's) are included to identify their scope within the test program.

1.2 Precedence

This Factory Test and Checkout Plan shall have precedence over any other test plan pertaining to LM-6.

1.3 Amendments

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

1.4 Applicable Documents

This Factory Operations Test 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.
LED-360-7	LM-4 and Subsequent Measurement List
LPL561-6	LM-6 BPA Test and Checkout Requirements Document

1.5 Abbreviation List

(To be supplied)

2.0 VEHICLE CONFIGURATION

(To be supplied)

3.0 TEST PROGRAM

3.1 LM Test Constraint Logic Chart

(See figure 1.)

3.0 TEST PROGRAM (Cont)

3.2 Prerequisites

The following items are prerequisites on the LM-6 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

3.0 TEST PROGRAM (Cont)

3.3 Limitations

The following limitations are imposed on the LM-6 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.

3.4 Test Data Handling and Recording

(To be supplied)

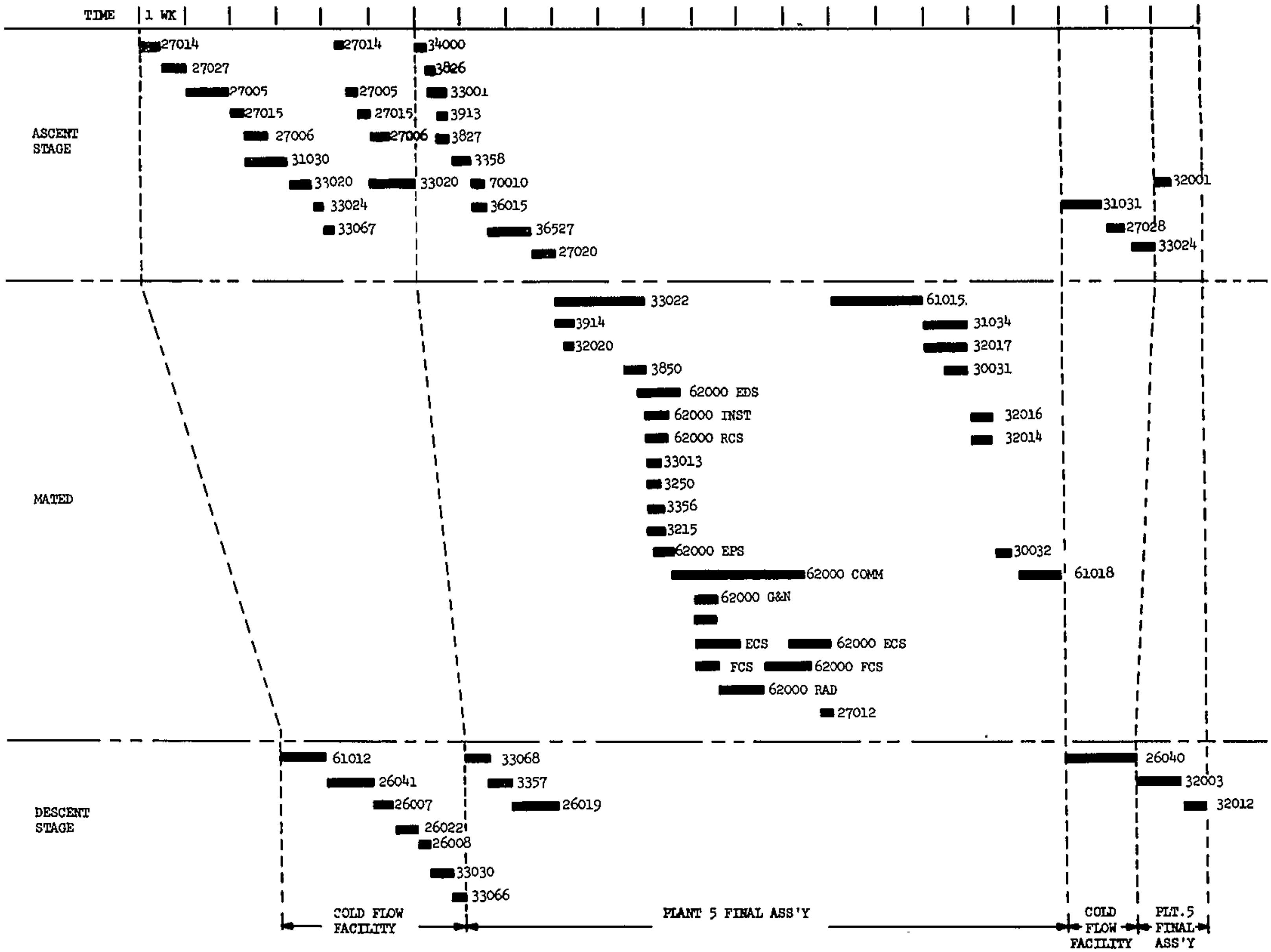

Figure 1. LM Test Constraint Logic Chart

4.0 TEST REQUIREMENTS MATRIX

4.1 Description:

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) LPL561-6, 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.

4.2 Top Spec/TCRD/OCP Sequence Matrix

(See pages 6 to 107.)

5.0 OCP and SMP OUTLINES

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-6 vehicle at GAEC, Bethpage.

NOTE

Paragraphs referenced in the Outlines refer to LSP470-2, Part II.

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	32012	32001							
4.2.2.1											
STRUCTURAL SUBSYSTEM TEST											
A/S Wt & C.G. Tests											
4.2.2.1.1	3.1.4	X									
(a)	3.1.4(a)			02							
(b)	3.1.4(b)			02							
(c)		X									
D/S Wt & C.G. Tests											
4.2.2.1.2	3.1.3	X									
(a)	3.1.3(a)		02								
(b)	3.1.3(b)		02								
(c)		X									
Landing Gear Test											
4.2.2.1.3	3.1.1	X									
(a)		X									

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	32003	62000-FCS							
4.2.2.1.(a)(1)	3.1.1(e)		03-06	14							
(2)	3.1.1(f)		03-06	14							
(b)		X									
(1)											
a	3.1.1(e)		03-06								
b	3.1.1(f)		03-06								
c	3.1.1(d)		03-06								
(2)		X									
a	3.1.1(c)(b)		03-06								
b	3.1.1(d)		03-06								
c	3.1.1(e)		03-06								
(3)		X									
a	3.1.1(f)		03-06								
(4)	3.1.1(b)		03-06								
Thermal Emissivity and Solar											
Absorptance Reqs.											
4.2.2.1.4		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	32014	33024							
A/S Proof Pressure Test											
4.2.2.1.5		X									
(a)	3.3.6.1(a)			02							
(b)	3.3.6.1(a)			02							
(c)	3.3.6.1(a)			02							
A/S Hatch Functional											
4.2.2.1.6	3.3.6.5(a)(b)			03							
Drogue Support Fittings											
Functional											
4.2.2.1.7	3.3.6.1(b)		09								

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-EPS	61015	61018						
4.2.2.2											
ELECTRICAL POWER SUBSYSTEM TESTS											
Test Equipment Required											
4.2.2.2.1		X									
Power Distribution Test											
4.2.2.2.2					012						
(a)			49, 54								
(1)	3.2.1(d),3.2.2(e)		8,9								
(2)	3.2.1(c)(b)(a)		21-25								
(b)	3.2.1(e),3.2.2(f)		28, 30								
(c)		X									
(1)		X									
(2)	3.2.1(g)		02	02	02						
(3)		X									
(d)	3.2.5(g)		27 35	03	06, 07						
(e)	3.2.5(i)		034	04	08, 09						

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-EPS	61015							
4.2.2.2.2(f)		X									
(1)	3.2.1(k)		039	04							
(2)	3.2.1(f)		039								
(3)	3.2.1(l)		039								
(g)		X									
(1)	3.2.1(c)		031								
(2)	3.2.1(c)		017, 031								
(3)	3.2.2(c)(d)		017								
(4)	3.2.2(c)(d)		031								
(h)	3.2.5(d)		018								
(i)	3.2.5(e)		036, 037								
ECA Malfunctioning Logic Test											
4.2.2.2.3		X									
(a)				012 049							
(b)				048							

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-EPS	61018							
ECA No. 1 and ECA No. 2											
4.2.2.2.3.1		X									
(a)	3.2.1(a)(c)		55-58,	012							
			41, 43,								
			45, 47								
(b)	3.2.1(i)		41, 43,								
			45, 47								
(c)	3.2.1(i)		41, 43,								
			45								
(d)	3.2.1(c)		41, 43,								
			45, 47								
(e)			045, 047								
(f)	3.2.1(c)		41, 43,								
			45, 47								
(g)	3.2.1(j)		055-058								
(h)	3.2.1(j)		055-058								
(i)			055-058								
(j)			055-057								

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-EPS	61018							
4.2.2.2.3.1(k)			055-058								
(l)	3.2.1(j)		055-058								
(m)			41, 43,								
			55-58								
ECA No. 3 and ECA No. 4											
4.2.2.2.3.2		X									
(a)	3.2.2(a)(c)		010-012	061							
(b)	3.2.2(c)(g)		012-014								
(c)	3.2.2(c)										
(d)		X									
(e)	3.2.2(h)		010, 011								
(f)			010, 011								
(g)			010, 011								
(h)	3.2.2(b)(c)		010								
(i)		X									
(j)		X									
(k)	3.2.2(a)(b)(c)(g)(h)		011, 014								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-EPS	61015	61018						
Inverter Functional Test											
4.2.2.2.4	3.2.2(i-j)		05, 06		20						
Inverter Characteristics											
4.2.2.2.4.1		X									
Lighting Tests											
4.2.2.2.5			33, 61-	010	20						
			75								
(a)	3.2.6(c)(d)			010							
(b)		X									
(1)	3.2.6(a)(b)(g)		064	042 010	010 011						
(2)	3.2.6(a)(b)(h)		065	042 010	010 011						
(3)	3.2.6(a)(b)(g)		061 065	010	010 011						

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	33020	61015	61018	62000-ECS					
4.2.2.3											
ENVIRONMENTAL CONTROL SUBSYSTEM											
(ECS) TEST											
Test Equipment Needed											
4.2.2.3.1		X									
Carbon Dioxide (CO_2) Partial											
Pressure Sensor											
4.2.2.3.2	3.3.5.3(d)			014	015	004					
Suit Circuit Assy											
4.2.2.3.3	3.3.5.3(a)(b)			014		004					
(a)	3.3.5.3(j)				014 015	004					
(b)	3.3.5.3(j)(e)					008					
(c)	3.3.5.1(a),3.3.5.2(a)		006, 008								
(d)	3.3.5.3(e)			014	015	003					
Cabin Recirculation Assy											
4.2.2.3.4	3.3.5.3(f)			015							

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	33013	33020	33030						
Oxygen Supply and Cabin Pressure											
Control Section (OCPS)											
4.2.2.3.5		X									
Proof Pressure and Leakage Test											
4.2.2.3.5.1		X									
(a)	3.3.3.1(b)				02						
(b)	3.3.3.1(a)		03	03							
Leakage Test											
4.2.2.3.5.1.1		X									
(a)	3.3.3.2(a)			005, 012							
(1)				005, 012							
(2)				005, 012							
(3)				005, 012							
(b)	3.3.3.2(b)				06						
(1)					06						
(2)					06						
(3)					06						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	33013	33020	33024	33030	61015	61018	62000-ECS		
4.2.2.3.5.1.1(c)	3.3.3.2(d)		03								
(1)			03								
(2)			03								
Oxygen Control Module Test											
4.2.2.3.5.2		X									
(a)	3.3.4.3(a)			09		09-013	014, 015	015	03		
(b)	3.3.4.3(b)			013		09-013			03		
(c)	3.3.4.3(a)			04-010		09-013					
Cabin Pressure Relief and Dump											
Valve											
4.2.2.3.5.3	3.3.6.2(a), 3.3.6.3(a)				05 03						
Cabin Pressure Switch											
4.2.2.3.5.4		X									
(a)	3.3.4.3(c)							014	03		
High Pressure Oxygen Control Assy											
4.2.2.3.5.5		X									
(a)	3.3.4					02-011					
						014 015					

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	33024	33030	61015	62000 ECS					
4.2.2.3.5.5(b)	3.3.4			02-011,							
				014, 015							
(c)	3.3.4			02-011,							
				014, 015							
GOX Tanks											
4.2.2.3.5.6	3.3.4.3(d,e)			07	018	03					
Cabin Leakage and Cabin Pressure											
Relief and Dump Valve Tests											
4.2.2.3.5.7		X									
(a)	3.3.6.2(a)		02-05								
(b)	3.3.6.2(a)		02-05								
(c)	3.3.6.3(a)		02-05								
(d)	3.3.6.3(a)		02-05								
(e)	3.3.6.3(a)		02-05								
(f)	3.3.6.3(a), 3.3.6.2(a)		02-05								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES NA	33001	33013	61015	33068	61018	62000-ECS			
Heat Transport Section (HTS) Tests											
4.2.2.3.6	3.3.1.1(a,b),		02-07	02	013	02					
	3.3.1.2(a,b,c,d)		02-07	02		02					
Coolant Recirculation Assy											
4.2.2.3.6.1	3.3.1.4(b,c,d,e,f,g,h,				013		012	05 06			
	i,j)										
Coolant Accumulator											
4.2.2.3.6.2	3.3.1.4(f)				014			05			
Cabin Temperature Control Valve											
4.2.2.3.6.3	3.3.1.4(i)	X									
(a)								07			
(b)								07			
(c)								07			

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	33022	33066	33067	62000-ECS					
Suit Temperature Control Valve											
4.2.2.3.6.4	3.3.5.3(i)					08					
W/G Fill Verification											
4.2.2.3.6.5		X									
(a)		X									
(b)		X									
(1)		X									
(2)		X									
Water Management Section (WMS)											
Tests											
4.2.2.3.7	3.3.2.1(a,b)		02, 03	02, 03	02-04						
Water Control Module											
4.2.2.3.7.1	3.3.2.6(c,d)		03, 05								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	61015	61018	62000-ECS						
Water Tanks											
4.2.2.3.7.2	3.3.2.6(a,b,d)		016	012 013	02						

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	34000	61015	61018						
4.2.2.4											
CREW PROVISIONS SUBSYSTEM TEST											
Support and Restraint Tests											
4.2.2.4.1		X									
(a)		X									
(b)		X									
(c)		X									
(d)		X									
(e)		X									
Lighting											
4.2.2.4.2	3.2.6(a-i)			010	010						
Waste Mgt. Assy											
4.2.2.4.3		X									
(a)		X									
(1)			03								

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	34000								
4.2.2.4.3(a)(2)	3.13.1(a)		03								
(3)			03								
(4)			03								
PLSS Condensate Collector Assy											
4.2.2.4.3(b)		X									
(1)		X									
(2)		X									
(3)		X									
(4)		X									
Functional Demo. of PLSS Press.											
Relief Valve											
4.2.2.4.3(c)		X									
(1)			02								
(2)			02								

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	32017	34000	32021						
Internal Leak Check of Flow											
Control Valve											
4.2.2.4.3(d)		X									
(1)		X									
(2)	3.13.2(a)			03							
(3)		X									
Scientific Equipment (Seq) Fit											
Check											
4.2.2.4.4		X									
(a)		X									
(b)		X									
Crew Compartment Fit and											
Functional Test (C^2F^2)											
4.2.2.4.5		X									
(a)			02-04		03						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	32014								
4.2.2.4.5(b)			05-07								
(c)		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61018	62000-RAD						
4.2.2.5											
PRIMARY GUIDANCE, NAVIGATION AND											
CONTROLS SUBSYSTEM (PGNS) TEST											
PGNS Tests, General											
4.2.2.5.1		X									
Test Equipment for PGNS Tests											
4.2.2.5.2		X									
LGC INTERFACES											
4.2.2.5.3		X									
(a)	3.5.4(a-g)			65							
(b)	3.6.9(a,b)			48	29						
(c)				048							
(d)				48							
(e)	3.4.18(c)				29						
(f)	3.4.18(b)		016 017								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61015	61018	62000-G&N					
4.2.2.5.3(g)	3.4.18(d)		016 017								
(h)	3.4.18(a)	X									
(i)	3.5.4(d)	X									
(j)	3.5.4	X									
(k)	3.4.2(c)					09					
(l)					37						
PSA/SCA Interfaces											
4.2.2.5.4		X									
(a)	3.5.4, 3.4.18				65						
(b)	3.4.11(a), 3.4.7(a)			022		21					
(c)					09						
IMU GIMBAL ANGLE SEQUENCING											
TRANSFORMATION ASSY' (GASTA)											
INTERFACE											
4.2.2.5.5	3.4.8(c)	X									

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-RAD	61015	61018	62000-G&N					
DSKY/Interfaces											
4.2.2.5.6		X									
(a)	3.4.2(a)					06					
(b)	3.4.3(a)				11						
RENDEZVOUS RADAR (RR) TESTS											
4.2.2.5.7		X									
R/R Self Test											
4.2.2.5.7.1		X									
(a)		X									
(1)	3.5.1(c)		05	022	067						
(2)	3.5.1(d)		05	022	067						
(3)	3.5.1(e)		05	022	067						
(b)		X									
(1)	3.5.1(g)		05								
(2)	3.5.1(f)		05	022	067						
(3)	3.5.1(f)		05	022	067						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-RAD	61015							
RR ANTENNA ANGULAR COVERAGE AND											
SLEW TEST											
4.2.2.5.7.2	3.5.2(a,b)		06	034 033							
RR ANGULAR TRACKING TEST											
4.2.2.5.7.3	3.5.7(a,c)		010								
RR RF TEST											
4.2.2.5.7.4	3.5.3(a,b)		08								
RR ACQUISITION RANGE & RANGE RATE											
4.2.2.5.7.5	3.5.3(i), 3.5.7(a,b,c,d)		09 012								
	3.5.10(d), 3.5.9		013								
	3.5.10(b,c)										
INTEGRATED RR/LGC TESTS											
4.2.2.5.7.6		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-RAD	61018							
RR/LGC Antenna Positioning Test											
4.2.2.5.7.6.1		X									
(a)	3.5.4(e,f)		011	053							
RR/LGC INTERFACE RANGE RATE TEST											
4.2.2.5.7.6.2	3.5.4(b)		012								
RR/LGC INTERFACE RANGE TEST											
4.2.2.5.7.6.3	3.5.4(a,b)		015								
TRANSPONDER (T) TESTS											
4.2.2.5.7.7		X									
LANDING RADAR (LR) TESTS											
4.2.2.5.8		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-RAD	61015							
LR Self Test											
4.2.2.5.8.1	3.6.1(a,b,c,d)		016 017	022							
(a)	3.6.1(b)			035							
(b)	3.6.1(c,d)		017								
(c)			017								
LR TRANSMITTER PARAMETERS TEST											
4.2.2.5.8.2	3.6.2(a,b,c,d)		018								
LR RECEIVER SENSITIVITIES TEST											
4.2.2.5.8.3		X									
ACQUISITION THRESHOLD TEST											
4.2.2.5.8.3.1	3.6.3(a)		020								
ACQUISITION TIME TEST											
4.2.2.5.8.3.2	3.6.3(b)		020								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-RAD	61015							
LR ANTENNA TILT TEST											
4.2.2.5.8.4	3.6.6(a,b,c)		024	033 022							
LR ALTITUDE & VELOCITY MEAS.											
TESTS											
4.2.2.5.8.5	3.6.12(a,b)		021 029	034 035							
				033							
LR/LGC INTERFACES											
4.2.2.5.8.6	3.6.9(a,b,c)		029	034 033							
				035 036							
PGNS DESCENT ENGINE CONTROL TESTS											
4.2.2.5.9		X									
PGNS Descent Engine (DE) On/Off											
Control Test											
4.2.2.5.9.1		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61015	61018	62000-G&N					
4.2.2.5.9.1(a)			019 026	033		50					
(b)			019 022			50					
			21								
PGNS DESCENT ENGINE THROTTLE											
CONTROL											
4.2.2.5.9.2			023 026	033							
(a)				033							
(b)			023	033							
PGNS DESCENT ENGINE GIMBAL TRIM											
CONTROL											
4.2.2.5.9.3		X									
(a)					048						
(b)					048						
(c)			015 026		048						
(d)			015 026		048						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61015	61018						
PGNS ASCENT ENGINE (AF) CONTROL											
TESTS											
4.2.2.5.10		X									
(a)			020 027	042	070						
(b)			020	042							
PGNS RCS CONTROL TESTS											
4.2.2.5.11	3.4.18(c)		018 026	042 037	30						
			027								
MODE & STATUS DISCRETES TEST											
4.2.2.5.12	3.4.18(g)	X									
(a)		X									
(b)		X									
(c)		X									
(d)		X									
(e)			021								
(f)			021								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61015	61018						
4.2.2.5.12(g)			021								
PGNS MANUAL OUTPUTS VERIFICATIONS											
4.2.2.5.13	3.4.18(g)		016 017		043						
PGNS DISPLAY TEST											
4.2.2.5.14	3.4.18(d)	X									
(a)	3.4.18(d)		025	033							
(b)	3.4.18(d)		02								
(c)	3.4.18(d)		03	033							
(d)	3.4.18(d)		03	033							
(e)	3.4.18(d)			042							
LM TRACKING LIGHT (LTL) TEST											
4.2.2.5.15				042							

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA									
LANDING POINT DESIGNATOR (LPD)											
AND DOCKING WINDOW TEST											
4.2.2.5.16		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS								
4.2.2.6											
STABILIZATION & CONTROL (SCS)											
TESTS											
4.2.2.6.1		X									
Test Equipment For SCS Tests											
4.2.2.6.2		X									
Attitude Translation Control											
Assy (ATCA) & N/E Control Assy											
(DECA) Test											
4.2.2.6.3		X									
Analogue Trim Test											
4.2.2.6.3.1			049								
(a)			049								
(b)			049								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS								
4.2.2.6.3.1											
(c)			049								
(1)			049								
(2)	3.7.9.1 (h)		049								
Descent Limiter Test											
4.2.2.6.3.2	3.7.9.1 (a)	X									
(a)			050								
(b)			050								
(c)			050								
(d)			050								
(e)			050								
Ascent Limiter Test											
4.2.2.6.3.3		X									
(a)			051								
(b)			051								
(c)			051								

NA -NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS								
4.2.2.6.3.3											
(d)	3.7.9.1 (a)		051								
(e)			051								
(f)			051								
4.2.2.6.3.4 (a)	3.7.9.1 (b)	X									
(1)			049								
(2)			049								
(b)		X									
(1)		X									
(a)	3.7.9.1 (b)		049								
(b)	3.7.9.1 (b)		049								
(2)	3.7.9.1		049								
(a)	3.7.9.1 (c) (d)		049								
(b)	3.7.9.1 (c) (d)		049								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS								
Pulse Ratio Modulation Prim Tests											
4.2.2.6.3.5	3.7.9.1 (e)	X									
(a)			011								
(b)			011								
(c)			011								
RCS Jet Logic Tests											
4.2.2.6.3.6	3.7.9.2. (a)	X									
(a)		X									
(1)			013								
(2)			013								
(3)			013								
(4)			013								
(b)		X									
Attitude Controller Assy (ACA)											
Tests											
4.2.2.6.3.7		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES								
		NA	62000-FCS	61018						
ACA Pulse Mode Test										
4.2.2.6.3.7.1		X								
(a)			012	030						
(b)			012	030						
(c)			012	030						
ACA Mode Control Test										
4.2.2.6.3.7.2	3.7.9.2.	X								
(a)			008							
(b)			008							
(c)			008							
(d)			008							
ACA Direct Mode Test										
4.2.2.6.3.7.3		X								
(a)			007							
(b)			007							
(c)			007							

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61018							
ACA Hardover Test											
4.2.2.6.3.7.4		X									
(a)			007								
(b)(1)(a)			007								
Plus 'X' Translation Switch Tests											
4.2.2.6.3.8			007	007							
(a)			007								
(b)			007								
Thrust/Translation Control Assy											
(T/TCA) Tests											
4.2.2.6.3.9		X									
T/TCA Throttle Mode Tests											
4.2.2.6.3.9.1	3.4.17 (b)		023	073							
(a)			023								
(b)			023								

NA - NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61015	61018	30032					
4.2.2.6.3.9.1 (b)											
(1)			010								
(2)			010								
(3)			010								
(c)			023								
T/TCA Translation Mode Tests											
4.2.2.6.3.9.2	3.7.9.2 (c)		010		076						
(a)			010								
(b)			010								
(c)			010								
(d)			010								
(e)			010								
4.2.2.6.4	3.7.1.2 (c)		004		27						
(a)				030							
(1)			001			003					
(2)			057								

NA ≐ NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61015	61018	30032					
4.2.2.6.4 (a)											
(3)			057								
(b)			051								
(c)			051								
Abort Guidance Sec (AGS) Test											
4.2.2.6.5		X									
AGS Power ON & AGS/CES Interface											
Test											
4.2.2.6.5.1	3.7.1.1	X									
(a)	3.7.1.1 (a)			030 022	032						
(b)	3.7.1.1 (a)		029		032	007					
(1)			029								
(c)			029		032						
(1)			029								
(d)	3.7.1.1. (f)		029		032						
(1)			029								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61018							
4.2.2.6.5.1 (d)											
(2)			029								
(e)	3.7.1.1 (b)		029								
(f)	3.7.1.1 (c)		029 052								
(g)	3.7.1.1 (d)		029								
(h)	3.7.1.1 (g)		029								
(i)	3.7.9.6 (a)		042								
(j)	3.7.9.6 (e)		042 052	075							
(K)	3.7.9.6 (d)		042, 052	075							
(l)	3.7.9.3 (b)		042, 052								
(m)	3.7.9.3 (b)		042, 052								
(n)	3.7.9.6 (g)		042								
AGS/DEDA TESTS											
4.2.2.6.5.2	3.7.2		030								
(a)			030								
(b)			030								
(c)			030								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61015	61018						
4.2.2.6.5.2 (c)											
(1)			030								
(d)			030								
(1)			030								
(e)			030								
(1)			030								
(f)				030							
(1)				030							
AGS Self Test											
4.2.2.6.5.3	3.7.3		031,		32, 62						
			033, 030								
(a)			042	030	036 064						
(b)				030	036 064						
(c)				031 032	036 064						
(1)				031 032							
(2)				030 031							
(3)				031 030							

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61015	61018						
4.2.2.6.5.3 (c)											
(4)				030 031							
(5)				030 031							
AGS Attitude Hold Mode Test											
4.2.2.6.5.4	3.7.7 (a,b)	X									
(a)			053								
(b)			053								
(c)			053								
(d)			053								
(e)			053								
(1)			053								
(f)			053								
(1)			053								
(2)			053								
(3)			053								
(g)			053		008-010						
(1)			053								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS								
AGS Display Interface Tests											
4.2.2.6.5.5	3.7.8	X									
(a)			036								
(1)			036								
(2)			034								
(3)			038								
(4)			037								
(5)			037								
(b)		X									
(1)			034								
(2)			038								
(3)			037								
(4)			037								
(5)			035 037								
AGS Gyro Drift & Accel Bias Test											
4.2.2.6.5.6		X									
(a)			039								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS	61018	30032						
4.2.2.6.5.6											
(b)			039								
AGS IMU Elec. Alignment											
4.2.2.6.5.7	3.7.4.1 (a)		044 048	036 038 054							
AGS Performance											
4.2.2.6.5.8			040		007						
(a)			040								
(b)	3.7.6.(a)(b)		040								
(c)	3.7.6.(a)(b)		040								
AGS Down Link											
4.2.2.6.5.9	3.7.6		041								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	31008								
4.2.2.7											
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		X									
(a)(1)	3.8.2(a)		03								
(2)	3.8.2(a)		04								
(3)	3.8.2(a)		03								
(b)(1)	3.8.6(a)	X									
(2)	3.8.6(b)(c)	X									
(3)	3.8.2(b)	X									
(4)	3.8.6(a)	X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	31008	31030	31033	31034	62000-RCS				
Thrust Chamber Assembly and											
Propellant Manifold Pressure and											
Leakage Test											
4.2.2.7.3		X									
(a)	3.8.5(b)						07				
(b)	3.8.6(g)				02		07-010				
(1)	3.8.6(g)						07-010				
(2)	3.8.6(g)						07-010				
(3)	3.8.6(g)						07				
(4)	3.8.6(g)			02							
(5)	3.8.6(g)			02							
(6)				03	03						
(c)	3.8.6(i)		03	02	02						
(d)	3.8.6(i)				02						
(e)	3.8.6(k)				05	03					
					05, 02						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	31033	61015	62000-RCS	61018					
4.2.2.7.3											
(f)			02 05								
(g)			02								
(h)	3.8.6.(g), (i) (k)		02								
(i)			02								
Thruster Cluster Heater Functional											
Test											
4.2.2.7.4											
(a)	3.8.4(b)			023	016 019						
(b)	3.8.4(b)				016 019						
(c)	3.8.4(b)			023	016 019	016					
(d)	3.4.4(b)			042	016 019						
(e)	3.8.4(b)			042	016 019						
(f)	3.8.4(c)			042	016 019						
(g)	3.8.4(a)				022						

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	31008	31031	31033	31034	62000-RCS				
RCS Cleanliness Maintenance											
4.2.2.7.5	3.8.1(a)(b)(c)(d)		02		06						
RCS Component Functional Tests											
4.2.2.7.6		X									
(a)	3.8.6(b)		03	02							
(b)(1)	3.8.6(d)		09								
(2)	3.8.6(d)		09								
(3)	3.8.6(d)		09								
RCS Helium Quad Check Valve Assy											
(c)(1)	3.8.6(b)					04, 06					
(2)	3.8.6(d)		07			04, 06					
RCS Helium Pressure Relief Valve		X									
(d)(1)	3.8.6(d)		06	05, 06							
(2)	3.8.6(d)	X									
(3)(a)	3.8.6(d)		06	05, 06							
(b)	3.8.6(b)		05	09, 10							
(e)	3.8.6(e)		04	03, 04							

NA = NOT APPLICABLE

a

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	30031	31008	31031	31032	31034	62000-RCS			
4.2.2.7.6											
(f)	3.8.6(h)			03							
(g)	3.8.6(f)					04					
(h)	3.8.6(h)						02				
(i)(1)	3.8.6(c)			010	11, 12						
(2)	3.8.6(c)			010	11, 12						
(j)(1)	3.8.6(1)			010							
(2)	3.8.6(1)			010							
(3)	3.8.6(1)			010							
(4)	3.8.6(1)			010							
(5)	3.8.6(1)			010							
(6)	3.8.6(1)	X									
RCS Valve Tests											
4.2.2.7.7		X									
(a)(1)	3.8.8(c), 3.8.3(a)(b)(c)		04-07					04			
(2)	3.8.8(c), 3.8.3(a)(b)(c)		04-07					04			
(3)	3.8.8(c), 3.8.3(a)(b)(c)		04-07					04			

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	30031	31033	31034	62000-RCS					
4.2.2.7.7(a)(3)											
(a)	3.8.8(c), 3.8.3(a)(b)(c)		04-07			04					
(b)	3.8.8(c), 3.8.3(a)(b)(c)		04-07			04					
(c)	3.8.8(c), 3.8.3(a)(b)(c)		04-07			04					
(4)(a)	3.8.8(c), 3.8.3(a)(b)(c)		04-07			04					
(b)	3.8.8(c), 3.8.3(a)(b)(c)		06-07			04					
(5)(a)	3.8.8(c), 3.8.3(a)(b)(c)		04-07			04					
(b)	3.8.8(c), 3.8.3(a)(b)(c)		04-07			04					
(c)	3.8.8(c), 3.8.3(a)(b)(c)		04-07			04					
(d)	3.8.8(c), 3.8.3(a)(b)(c)		04-07			04					
(b)	3.8.8(b)					04					
(c)(1)	3.8.8(a)			04	04						
(2)	3.8.8(a)			04	04						
(3)	3.8.8(a)			04	04						
(4)	3.8.8(a)			04	04						
(5)	3.8.8(a)			04	04						
(6)	3.8.8(a)			04	04						
(7)	3.8.8(a)			04	04						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	31030	31033							
Thrust Chamber Pressure Switches											
4.2.2.7.8	3.8.8(d)			03							
RCS/APS Backup Test											
4.2.2.7.9		X									
(a)	3.8.6(g)		02								
(b)	3.8.6(j)		02								
Verification of Untested											
Requirements											
4.2.2.7.10		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA									
4.2.2.8											
PROPULSION SUBSYSTEM											
Test Equipment Requirement for											
Propulsion Subsystem Tests (GSE)											
4.2.2.8.1		X									
Ascent Propulsion Subsystem											
(a)		X									
Descent Propulsion Subsystem											
(b)		X									
Equipment Necessary to Perform											
the Following Functions											
(c)		X									
Ascent Propulsion Subsystem											
(APS) Tests											
4.2.2.8.2		X									
(a)		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	27027								
4.2.2.8.2											
(b)		X									
(c)		X									
(d)		X									
APS Proof Pressure Test											
4.2.2.8.2.1		X									
(a)		X									
(b)		X									
(1)			02								
(2)	3.9.8(a)		08								
(a)			08								
(b)			08								
(c)			08								
(1)			08								
(2)			08								
(3)	3.9.8(b)		06, 07, 08								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	27014	27027	27028						
4.2.2.8.2.1(b)(3)											
(a)				06, 07							
(b)				08							
(c)				08							
(c)				02, 08							
APS External Leak Test/											
Verification											
4.2.2.8.2.2		X									
(a)		X									
(b)		X									
(1)				02							
(2)				09							
(3)		X									
(4)			02								
(5)	3.9.8(f), 3.9.14(e)		02	02, 09, 08	02, 05, 09						

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	27015	27027	27028						
APS Installed Component											
Verification Tests											
4.2.2.8.2.3		X									
Helium Tank Explosive Valves											
Leakage Test											
(a)	3.9.8(e), 3.9.14(d)			03	09						
(1)				02	09						
(2)	3.9.14(d), 3.9.8(e)			03	09						
Solenoid Latching Valves											
Leakage Tests											
(b)	3.9.9(a)		04, 05	09	05						
(1)			04	09	05						
(2)	3.9.9(a)		04, 05	09	05						
APS Pressure Reducers Operation											
and Leakage Tests											
(c)	3.9.14(b)(d), 3.9.8(c)		05		06						
(1)					06						
(2)					06						

NA =NOT APPLICABLI

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	27028								
4.2.2.8.2.3(c)											
(3)	3.9.14(b)		06								
(4)	3.9.8(c), 3.9.14(d)		06								
APS Pressure Reducers Full											
Open Failure Test											
(d)	3.9.11(b), 3.9.14(b)		04								
(1)			04								
(2)			04								
(3)	3.9.11(b)		04								
(4)			04								
(5)			04								
(6)	3.9.11(b)		04								
(7)			04								
(8)			04								
(9)	3.9.11(b)		04								
(10)			04								
(11)			04								
(12)	3.9.11(b)		04								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	27015	27027	27028						
4.2.2.8.2.3											
Quad Check Valves Leakage Test											
(e)	3.9.8(e),3.9.9(a),		07	10	07, 02						
	3.9.14(d)										
(1)			07	10	02, 07						
(2)	3.9.8(e),3.9.9(a),		07	10	02, 07						
	3.9.14(d)										
(a)			07	10	02, 07						
(b)			07	10	02, 07						
Pressure Relief Assemblies											
Operation and Leakage Test											
(f)	3.9.8(e),3.9.9(a),										
	3.9.14(a)										
(1)			06		08						
(2)	3.9.9(a)		06	10	08						
(3)				08	08						
(4)		X									
(a)	3.9.8(d),3.9.14(a)			08	08						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	27012	27015	27027	27028	62000-PROP				
4.2.2.8.2.3(f)(4)											
(b)	3.9.8(d), 3.9.14(a)				08	08					
(c)	3.9.8(e)				08	08					
(d)	3.9.14(a)				08	08					
(e)	3.9.14(a)				08	08					
Filters											
(g)		X									
Quick Disconnects											
(h)			02, 03			08					
(1)						05					
(2)						05					
(3)			02, 03			08					
Engine											
(i)		X									
Low Level Sensor Tank Empty											
(j)	3.9.13(e)			08			17				

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	27005	27015	27027						
APS Substitute Propellant Cold											
Flow Test											
4.2.2.8.2.4	3.9.11(a)	X									
(a)		X									
(1)		X									
(2)		X									
(b)		X									
(1)		X									
(2)			08								
(c)		X									
(1)			2,3, 9,10 15, 16, 21, 22, 27, 28, 33, 34	02 03	10						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES										
		NA	27005	27012								
4.2.2.8.2.4(c)												
(2)			4,11 17, 23, 29, 35									
(3)	3.9.11(a)		6,13, 19, 25, 31, 37									
APS Low Pressure Leak Test/												
Verification												
4.2.2.8.2.5		X										
(a)		X										
(b)				02 03								
(c)	3.9.18(a)(b),3.9.14(e)			02 03								
(1)	3.9.18(a)			02								
(2)	3.9.18(a)			03								
(3)				03								
(4)				02								
(5)				03								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	27012	27020	27028						
4.2.2.8.2.5(c)											
(6)	3.9.18(a)		03								
(7)	3.9.14(e), 3.9.18(b)		02, 03								
(d)	3.9.19(a)(c)			04, 06							
(e)	3.9.19(a)			04, 05							
APS Flight Configuration											
4.2.2.8.2.6		X									
(a)		X									
Compatibility Explosive Valve											
Leakage Test											
(b)	3.9.8(e), 3.9.14(d)				08						
(1)					08						
(2)	3.9.8(e), 3.9.14(d)				08						
Pre-Valve Assy Leakage and											
Operational Test (Thermal Relief)											
(c)	3.9.19(b), 3.9.14(c)			06, 03	10, 08						
(1)				03	08						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	27020	27028							
4.2.2.8.2.6(c)											
(2)	3.9.14(c), 3.9.19(b)		06								
(3)	3.9.19(b)		03	08							
Solenoid Valves Leakage Test											
(d)	3.9.19(a)		03								
(1)			03								
(2)	3.9.19(a)		03								
Isolation and Propellant											
Valve Assemblies Leakage Test											
(e)	3.9.14(c), 3.9.19(a)		07	10, 8							
(1)			07	08							
(2)	3.9.14(c)		07	08, 10							
(3)	3.9.19(a)		07	10							
Descent Propulsion Subsystem											
(DPS) Tests											
4.2.2.8.3		X									
(a)		X									
(b)		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26022	26040	26041						
4.2.2.8.3											
(c)		X									
(d)		X									
DPS Proof Pressure Test											
4.2.2.8.3.1	3.9.1(c)	X									
(a)		X									
(b)	3.9.3(a)(b)(c)				10						
(1)	3.9.3(a)				10						
(2)					10						
(3)	3.9.3(a)(b)			05	10						
(4)	3.9.3(a)		04								
(5)			04								
(a)			04								
(b)			04								
(6)	3.9.3(c)		02, 03, 04								
(a)			02, 03								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26022	26040	26041	61012					
4.2.2.8.3.1(b)(6)											
(b)	3.9.3(c)		04								
(c)			04								
(c)			04		10						
DPS External Leak Check											
4.2.2.8.3.2		X									
(a)		X									
(b)	3.9.3(d),3.9.5(c)(d)(e)			05	05, 10						
(1)				05							
(2)				05	10						
(3)				05							
(4)		X									
(5)					05						
(6)	3.9.3(d),3.9.5(c)(d)(e)			05	10, 05	05					

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26040	26041							
DPS Installed Component											
Verification Tests											
4.2.2.8.3.3		X									
Helium Start Tank Explosive											
Valve Leakage Test											
(a)	3.9.15(c)		05								
(1)			05								
(2)	3.9.15(c)		05								
DPS Supercritical Helium (SHe)											
Heat Leak Test											
(b)	3.9.4(b),3.9.15(a),(c)		03, 04,	07, 08,							
	3.9.5(c),3.9.3(e)		05	10-14							
(1)			03	07, 08,							
				11, 12							
(2)	3.9.3(e),3.9.15(a)		04	13							
(3)			04								
(4)	3.9.4(b)			10, 14							

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26022	26040	26041						
4.2.2.8.3.3(b)											
(5)	3.9.5(c)			05							
(6)	3.9.5(c)			05							
(7)	3.9.15(c)			05							
SHe Tank Dual Burst Disc Assy											
Tests											
(c)	3.9.4(b)				10						
(1)					10						
(2)					10						
(3)	3.9.4(b)				10						
Solenoid Latching Valves											
Leakage Test											
(d)	3.9.4(a)			05	05, 10						
(1)				05	05, 10						
(2)	3.9.4(a)			05	05, 10						
DPS Pressure Reducer Operation											
and Leakage Test											
(e)	3.9.6(b),3.9.15(d)		04	06							

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26022	26040	26041						
4.2.2.8.3.3(e)											
(1)			04	06							
(2)		X									
(3)			04	06							
(4)	3.9.6(b),3.9.15(d)		04	06							
(5)			04	06							
(6)	3.9.6(b),3.9.15(d)		04	06							
Quad Check Valves Leakage Test											
(f)	3.9.15(c),3.9.4(b)		05	07	02						
(1)			05	07	02						
(2)		X									
(a)	3.9.4(b),3.9.15(c)		05	07							
(b)	3.9.4(b),3.9.15(c)		05	07	02						
Pressure Relief Assemblies											
Operation and Leakage Test											
(g)	3.9.4(b),3.9.15(c)		04	07	05						
(1)			04								
(2)	3.9.4(b)		04		05						

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26022	26040	26041						
4.2.2.8.3.3(g)											
(3)			04								
(4)		X									
(a)				07	05						
(b)				07	05						
(c)	3.9.15(c)				05						
Filter											
(h)		X									
Quick Disconnect											
(i)			07	05,	05, 10						
(1)				05, 07	10						
(2)				05, 07							
(3)				07	05						
Lunar Dump Explosive Valve											
Leakage											
(j)	3.9.4(c)				05						
(1)					05						
(2)	3.9.4(c)				05						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26041	62000-PROP							
4.2.2.8.3.3											
Lunar Dump Solenoid Latching											
Valve Leakage											
(k)	3.9.15(c)		05								
(1)			05								
(2)	3.9.15(c)		05								
Heater Exchange Leakage											
(l)	3.9.5(e)		05								
(1)			05								
(2)	3.9.5 (e)		05								
Engine											
(m)		X									
DSP Propellant Quantity Gaging											
Sys. (PQGS) Tests											
(n)	3.9.13(a)(b)(c)(e)			15, 16, 17							
(a)	3.9.13(a)(b)			15							
(b)	3.9.13(c)			16							

NA ≐ NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26007	62000-PROP							
4.2.2.8.3.3(n)(b)											
(1)				16							
(2)				16							
(3)				16							
Low Level Sensor Tank Empty Test											
(c)	3.9.13(c)			17							
Descent Stage Substitute											
Propellant Cold Flow Test											
4.2.2.8.3.4		X									
(a)		X									
(1)			05, 08								
(2)		X									
(b)		X									
(1)			05, 08								
(2)			07, 11								
(c)		X									
(1)			02, 12								

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26007	26041							
4.2.2.8.3.4(c)											
(2)			03								
(3)			06, 09								
(4)	3.9.6(a)		15								
DPS Mission Duty Cycle											
4.2.2.8.3.5	3.9.6(c)	X									
(a)		X									
(1)		X									
(2)		X									
(b)		X									
(1)		X									
(2)		X									
(c)				11, 12							
(d)				14							
(e)		X									
(f)		X									
(1)	3.9.6(c)			03, 04							

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26019	26040	26041	62000-PROP					
4.2.2.8.3.5(f)											
(2)	3.9.6(c)				14						
(3)	3.9.6(c)				14						
DPS Low Pressure Leak Test/											
Verification											
4.2.2.8.3.6		X									
(a)		X									
(b)			02								
(c)	3.9.2(a)(b),3.9.17(a)		02	09							
(d)	3.9.17(b)					20					
DPS Flight Configuration Test											
4.2.2.8.3.7		X									
(a)		X									
Compatibility Explosive Valve											
Leakage Test											
(b)	3.9.15(c)			07							

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26040	62000-PROP							
4.2.2.8.3.7(b)											
(1)			07								
(2)	3.9.15(c)		07								
Pre-Valve Assy Leakage and											
Operational Test (Thermal Relief)											
(c)	3.9.15(f)		07	20, 19							
Solenoid Valves Leakage Test											
(d)	3.9.17(a)			19							
(1)				19							
(2)	3.9.17(a)			19							
Isolation and Propellant Valve											
Assy's Leakage Test (Propellant											
Shutoff Valves A, B and D)											
(e)	3.9.15(e)		07, 08	21							
(1)			07, 08								
(2)	3.9.15(e)		07, 08								

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	26008	26019	26040						
Propulsion Subsystem Cleanliness											
4.2.2.8.4	3.9.12(a)(b)(c), 3.9.7(a)(b)(c)		01-15	03	10						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-PROP.	62000-RCS							
4.2.2.9											
DISPLAYS AND CONTROLS SUBSYSTEM											
General D&C Tests											
4.2.2.9.1	3.9.21(a)(b)(c)	X									
	3.9.13(d)										
(a)			04, 06-08, 011 012, 013, 015, 018	03-013							
(b)			02, 04, 06-08, 010, 012, 013, 015, 018	03-013							

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	61015	62000-FCS							
Digital Event Timer Test											
4.2.2.9.2	3.12.1(j)		010	05							
(a)				05							
(1)				05							
(2)				05							
(b)	3.12.1(j)			05							
(1)				05							
(2)				05							
(3)				05							
(4)				05							
(c)	3.12.1(j)			05							
(1)				05							
(2)				05							
(3)				05							
(4)				05							
(d)	3.12.1(b)			05							
(1)				05							
(2)				05							

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS								
4.2.2.9.2											
(e)			05								
(1)			05								
(2)			05								
(3)			05								
(4)			05								
(5)			05								
(6)			05								
(7)			05								
(8)			05								
(9)	3.12.1(b)		05								
(10)			05								
(11)			05								
(12)			05								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	61015	61018	62000-FCS						
Digital Mission Timer											
4.2.2.9.3		X									
(a)	3.12.1(b)		010	024	06						
(1)					06						
(2)					06						
(3)					06						
(b)					06						
(1)	3.12.1(b)				06						
(2)					06						
(3)					06						
(4)					06						
(5)					06						
(6)					06						
(c)	3.12.1(b)				06						
(1)					06						
(2)					06						
(3)					06						
(4)					06						

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS								
4.2.2.9.3(c)											
(5)			06								
(6)			06								
(7)			06								
(8)			06								
(9)			06								
(10)			06								
(11)			06								
(12)			06								
(13)			06								
(14)			06								
(15)			06								
(16)			06								
(17)			06								
(18)			06								
(19)			06								
(20)			06								
(21)			06								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	61015	61018	62000-FCS						
4.2.2.9.3(c)											
(22)					06						
(23)					06						
(24)					06						
(25)					06						
(26)					06						
(27)					06						
(d)		X									
(1)			010	024							
Ordeal (GFE) Test											
4.2.2.9.4											
(a)				039	045						
(b)					045						
(c)					045						
(d)					045						
(e)					045						
(f)					045						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS								
4.2.2.9.4(f)											
(1)			045								
(a)			045								
(g)			045								
(1)			045								
(h)			045								
(i)			045								
(1)			045								
(j)			045								
(1)			045								
(k)			045								
(1)			045								
(l)			045								
(m)			045								
(1)			045								
(n)			045								
(o)			045								
(p)			045								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-FCS								
4.2.2.9.4											
(q)			045								
(l)			045								
(r)			045								
(s)			045								
(t)			045								
(u)			045								
(v)			045								
(w)			045								

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	61015	61018	62000-EDS						
4.2.2.10	3.10 Explosive Device										
EXPLOSIVE DEVICES (ED)	Subsystem										
Test Equipment Req'mts											
4.2.2.10.1		X									
ED Circuitry Funct. Tests	3.10.1(a), 3.10.2										
4.2.2.10.2		X									
(a)			04	053 031	07 09						
(b)				053							
(1)				053							
(2)					016						
(3)					017						
(c)					08						
(1)					07						
(2)					08						
(3)					08						
(d)					016						

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	61015	61018	62000-EDS						
Circuitry Tests	3.10.4, 3.10.3		04	053 04	02-09 11-12						
4.2.2.10.3											
ED											
4.2.2.10.4(a).					02-09 11-12						
(b)					02-09 011-012						
(c)	3.10.5				02-09 011-012						
(d)					02-09 011						

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-COMM								
4.2.2.11											
COMMUNICATIONS SUBSYSTEM.											
CS Tests											
4.2.2.11.1		X									
Test Equip Requirements											
4.2.2.11.1.1		X									
Subsys C/O Requirements											
4.2.2.11.1.1.1		X									
(a)		X									
(1)			02								
(2)			02								
(3)			02								
(4)			02								
(5)			02								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES NA	61015	62000-COMM							
4.2.2.11.1.1.1											
(b)		X									
(1)				02							
(2)				02							
(3)				02							
(4)				02							
(c)				02							
(d)				02							
Intercommunications Sys (ICS)											
4.2.2.11.1.2		X									
(a)	3.11.1(e)		017	06, 09							
(b)	3.11.1(b)		017	04, 07							
(c)	3.11.1(e)		017	06, 09							
(d)	3.11.1(d)(b)		017	04, 07							
(e)	3.11.1(b)		017	04							
(f)	3.11.1(c)		017	04, 05							
(g)	3.11.1(c)		018	04,07 08							

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	61015	62000-COMM							
Mike & Bio Power Supplies											
4.2.2.11.1.3		X									
(a)	3.11.1(a)			03							
(b)	3.11.1(a)			03							
VHF Performance Tests											
4.2.2.11.1.4		X									
VHF Transmitter Tests											
4.2.2.11.1.4.1		X									
(a)	3.11.2(f)		06	017							
(b)			06	017							
(c)	3.11.2(f)		06	016							
(d)			06	016							

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	61015	62000-COMM							
VHF Receiver Tests											
4.2.2.11.1.4.2			08								
(a)	3.11.2(a),(b),(g),(q)			011, 012, 014, 015							
(b)	3.11.2(a),(b),(g),(q)			010, 012, 013, 014							
VHF RF Path Verification											
4.2.2.11.1.4.3		X									
(a)	3.11.2(j)		06								
(b)	3.11.2(j)		06								
(c)	3.11.2(k)		06								
(d)	3.11.2(r)		06								
S-Band Performance Tests											
4.2.2.11.1.5		X									

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	61015	62000-COMM							
S-Band Receiver Verification			008 007								
4.2.2.11.1.5.1											
(a)	3.11.3(j), (l)			023, 022							
(b)	3.11.3(j)			022							
(c)	3.11.3(j), (l)			022 023							
S-Band Transmitter Verification	3.11.3										
4.2.2.11.1.5.2		X									
(a)	3.11.3(f), (i)(l)		006 007	032							
(b)	3.11.3(f), (i)(l)		006 007	032							
(c)	3.11.3(f), (i)(l)		006 007	032							
(d)	3.11.3(f), (i)(l)		006 007	032							
(e)	3.11.3(i)(l)		006 007	032							
(f)	3.11.3(h)		006 007	032							

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-COMM	61015							
S-Band RF Path Verification											
4.2.2.11.1.5.3		X									
(a)	3.11.3(a, b, g, n)		031								
(b)	3.11.3(a, b, g, n)		031								
(c)	3.11.3(a, b, g, n)		031								
(d)	3.11.3(a, b, g, n)		031								
(e)	3.11.3(a, b, g, n)		032								
			031								
1.25 MHZ Subcarrier Modulation											
Index Verification											
4.2.2.11.1.5.4	3.11.3(i, j)		035								
Up Voice BU(DUA) Verification											
4.2.2.11.1.5.5	3.11.4(d)		028	008							
GSE Interface Verification											
4.2.2.11.1.6		X									

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-COMM								
S-Band Power Ampl Current Margin											
Test											
4.2.2.11.1.6.1		X									
(a)	3.11.3(f)		024 025								
(b)			026								
VHF Transceiver GSE Interface											
Verification											
4.2.2.11.1.6.2	3.11.3(b)	X									
Signal Processor Ass'y GSE											
Interface Verification											
4.2.2.11.1.6.3		X									
Steerable Antenna Tests											
4.2.2.11.1.6.4		X									
(a)	3.11.3(g)		042								
(b)	3.11.3(g)		042								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-COMM	61015	61018						
4.2.2.11.1.6.4 (b)											
1	3.11.3(g)		042								
2	3.11.3(g)		042								
3	3.11.3(g)		042								
4	3.11.3(g)		042								
5	3.11.3(g)		042	033							
6	3.11.3(g)		043								
7	3.11.3(g)		043								
8	3.11.3(g)		043								
9	3.13.(c)		045								
S-Band Mode Verification											
4.2.2.11.1.7		X									
Verification of ST-2 (SR-6) Modes											
4.2.2.11.1.7.1	3.11.3(i, e)		036		018						
(a)	3.11.3(i, e)				018						
(b)	3.11.3(i, e)				018						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-COMM	61015	61018						
4.2.2.11.1.7.1											
(c)	3.11.3(i, e)			008	018						
(d)	3.11.3(i, e)				018						
Stimuli											
4.2.2.11.1.7.1.1	3.11.4(c, d)				018						
(a)			026								
(b)			026								
Success Criteria											
4.2.2.11.1.7.1.2	3.11.4(c)	X									
(a)			036 027								
(b)			036 027	008							
(c)	3.11.3(e)		036								
(d)	3.11.3(j)		036	008							
Verif. of ST-4 (SR-2) Modes											
4.2.2.11.1.7.2	3.11.3(i)	X									

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-COMM								
4.2.2.11.1.7.2											
(a)	3.11.3(j)		040								
(b)	3.11.3(i-2)		040								
Stimuli											
4.2.2.11.1.7.2.1	3.11.3(j)	X									
(a)	3.11.3(j)		040								
(b)	3.11.3(i-2)		040								
Success Criteria											
4.2.2.11.1.7.2.2	3.11.3(i)	X									
(a)	3.11.3(j)		040								
(b)	3.11.3(i-2)		040								
Verif. of ST-6 (SR-2) Modes											
4.2.2.11.1.7.3	3.11.3(i)	X									
(a)			037								
(b)			037								

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-COMM	61015	61018						
Stimuli											
4.2.2.11.1.7.3.1		X									
(a)			037								
(b)			037								
Success Criteria											
4.2.2.11.1.7.3.2		X									
(a)				008							
(b)				008							
Verif. of ST-10 (SR-2) Modes											
4.2.2.11.1.7.4		X									
(a)	3.11.3(h)		038		056						
(b)	3.11.3(i-3)		038	008	056						
(c)	3.11.2(r)		038	008	056						
(d)	3.11.3(m)		038	008							
(e)	3.11.2(r), 3.11.3(i)		038		017 018						

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-COMM	61015							
Stimuli											
4.2.2.11.1.7.4.1		X									
(a)	3.11.3(h)		038	007							
(b)	3.11.3(i-3)		038								
(c)	3.11.2(r)		038								
(d)	3.11.3(m)		038								
Success Criteria											
4.2.2.11.7.4.2		X									
(a)			038								
(b)			038								
(c)			038								
(d)	3.11.3(m)		038								
(e)	3.11.3(j)		038								
Verification of ST-8A Mode											
4.2.2.11.1.7.5		X									
(a)	3.11.3(i-2)		041								

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-COMM	61015							
4.2.2.11.1.7.5											
(b)	3.11.3(k)		04								
(c)	3.11.3(j)		041								
Stimuli											
4.2.2.11.1.7.5.1	3.11.3(i)	X									
(a)	3.11.3(i-2)		041								
(b)	3.11.3(k)		041								
(c)	3.11.3(j)		041								
(d)			041								
Verif. of SR-8 Mode											
4.2.2.11.1.7.6		X									
(a)	3.11.4 (d)		041	008							
Stimuli											
4.2.2.11.1.7.6.1	3.11.4(d)	X									

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-COMM								
Success Criteria											
4.2.2.11.1.7.6.2	3.11.4(d)		041								
DSEA Verif.											
4.2.2.11.1.8	3.11.5(b, d, e, f)		030								
(a)	3.11.5(b, d, e, f)		030								
(b)	3.11.5(b, d, e, f)		030								
VHF 'B' PCM Split Phase Data											
4.2.2.11.1.9	3.11.2(m)		039								
TLM Verification											
4.2.2.11.1.10		X									
(a)			021 020								
(b)			021 020								
(c)			020								
(d)			020								

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SÉQUENCES									
		NA	62000 PROP	36527	36015	61015	61018	62000 INSTR			
4.2.2.12											
INSTRUMENTATION SUBSYSTEM (IS)											
Test Equipment Requirements for											
IS Tests											
4.2.2.12.1		X									
Operational Instrumentation											
Turn-On											
4.2.2.12.2		X				011					
(a)	3.12.2(a)			02				02			
(b)	3.12.3(a)			021		011	011	03			
(c)	3.12.1(a)			02	03	04 02	09	02			
Test Verification and											
Measurements											
4.2.2.12.2.1		X									
(a)	3.12.1(c,g)		03		03						

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000-PROP	36527	61012	36015	61015	61018	62000 RCS	62000 FCS	62000 INSTR
4.2.2.12.2.1(b)	3.12.1(h), 3.12.2(b)		013, 015, 021				02	03			02
PCMTEA High-Bit-Rate Mode Test						04					
4.2.2.12.2.1.1	3.12.1 (b,d,e,h,i,)			03 020		05, 06	02	03			02
PCMTEA Low-Bit-Rate Mode Test											
4.2.2.12.2.1.2	3.12.1 (b,d,e,h,i)			020		07-09					
Operational Instrumentation											
Test/Verification											
4.2.2.12.3				04-019							
Transducers & Signal Sensors											
4.2.2.12.3.1					04, 011, 06-09	12	26				
(a)	3.12.2(e)		02				05		014-017	014	04
(b)		X									

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	62000 PROP	36527	61018	62000 RCS	62000 FCS	62000 INSTR			
Caution & Warning (C & W) Test											
4.2.2.12.4	3.12.3(b,c,d,e,f)		04, 014, 015, 016, 017	022-088	021	04 014-017	028	04			
Data Storage Electronics Assy.											
(DSEA Tests)											
4.2.2.12.5		X									
(a)		X									
(1)		X									
(2)		X									
(b)		X									
(1)		X									
(2)		X									
(3)		X									
FEAT Scope											
4.2.2.13.1		X									

NA = NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES NA	61015	61018							
FEAT System Verification Test											
4.2.2.13.1.1		X									
FEAT Mission Oriented Plugs-in Test											
4.2.2.13.1.2			033, 036, 037, 039, 041, 042								
FEAT Mission Oriented Plugs-out Test											
4.2.2.13.1.3				011, 015-023, 025-029, 031-037, 041 045-048 050, 052-							

NA =NOT APPLICABLE

LSP 470-2 PART II	TCRD	OCP'S SEQUENCES									
		NA	61018								
4.2.2.13.1.3			058, 060 062-066 068, 071-073, 076 078-080								

NA = NOT APPLICABLE

4.0 OCP and SMP OUTLINES

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-6 vehicle at GAEC, Bethpage.

NOTE

Paragraphs referenced in the OCP Outlines refer to LSP470-2, Part II.

Test Title:

RCS Flush

Subsystems:

RCS

Test Objectives:

Verification of the cleanliness level of the RCS Propellant Manifolds by flushing with Freon TF.

To dry the manifolds subsequent to the Freon Flush.

To verify the dryness of the RCS Propellant Tank Bladders after flushing the feed manifolds.

To leak check the solenoid valves in system "A" and "B".

To hydrostatically proof test the manifold system.

To leak test the braze fittings in the RCS System.

Vehicle Configuration:

Ascent Stage - RCS System prior to installation of RCS Engines.

Location:

Plant #2 - Assembly Area

Hazardous Operations:

Proof pressure to 330 psig

Pneumatic pressures (GHe) to 200 psig

Components Under Test:

All RCS Parker Valves

Filters and manifold lines

Test Description:

Seq. 01: First flush and sample oxidizer system

Seq. 02: First purge and dry oxidizer system

Seq. 03: First flush and sample fuel system

Seq. 04: First purge and dry fuel system

Seq. 05: Proof pressure test oxidizer system

Test Description: (Cont)

Seq. 06: Final flush and sample oxidizer syste

Seq. 07: Final purge and dry oxidizer system

Seq. 08: Proof pressure test fuel system

Seq. 09: Final flush and sample fuel system

Seq. 10: Final purge and dry fuel system

Seq. 11: Solenoid valve leak check system A

Seq. 12: Solenoid valve leak check system B

Seq. 13: Leak check RCS Braze Joints

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 dead face 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.

Test Title:

Explosive Devices Subsystem Resistance Measurement Test

Subsystem:

Explosive Devices

Test Objectives:

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 Boxes
Vehicle Wiring (Pyro Lines)

Test Description:

Seq. 01: Call to Station and EPS Activation

Seq. 02: Firing Circuit Resistance Measurements

Test Title:

Water Glycol Drain of the Primary HTS D/S.

Subsystem:

Environmental Control (ECS)

Test Objective:

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

Vehicle Configuration:

Descent Stage alone or with Mated Ascent Stage

Location:

Integrated Workstand, Plant 5.

Hazardous Operation:

Alcohol flush

Equipment Under Test:

Primary HTS D/S

Test Description:

Seq. 01: Call to Stations

Seq. 02: Primary HTS D/S Flush and Purge

a. Flush with isopropyl alcohol

b. Sample of isopropyl alcohol to determine the cleanliness level.

c. Purge with warm GN2

d. Evacuate

e. Pressurize with GN2 to blanket pressure.

Seq. 03: 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 1465 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 and Leak Test

a. Pressurize the following interfaces to a proof pressure of 1465 psig. Reduce pressure to operating pressure (1100 ± 25 psig) and perform a leakage test using a Mass Spectrometer Leak Detector.

1. line between the LSC 330-190 and the Asc GOX #1 304 valve.

2. line between the LSC 330-190 and the Asc GOX #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 ± .1 psig. Reduce pressure to operating pressure (4.9 ± .2) psig and perform a leakage test using a Mass Spectrometer Leak Detector.

Seq. 03: Securing after test

Test Title:

Cabin Leak Test

Subsystems:

ECS

Test Objectives:

Verification that the leakage rate of LM Cabin at operating pressure is with in 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:

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, 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

Test Description: (Cont)

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

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

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:

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

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

To dry the HTS with a GN2 Purge (pressure decay) and a vacuum.

To perform vacuum decay verifying system dry.

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

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

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: Call to stations.

Seq. 02: HTS - GSE Power Activation

Seq. 03: HTS - Primary Coolant Loop Evacuation and Flush D/S only.

Seq. 04: HTS - Primary Coolant Evacuation and W/G Fill est Description: (Cont)

Seq. 05: Water/Glycol Circulation

Seq. 06: Securing After Test

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 Description:

Seq. 01: Call to Stations

Seq. 02: HTS - GSE Power Activation

Test Description: (Cont)

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

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

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

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

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:

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

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

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 Description: (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 Seq. 05.

Seq. 09: Test Operations

a. Calibration of flowmeters. Refer to Seq. 06.

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 refer to Seq. 03.

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

a. Refer to Seq. 04.

Seq. 15: Test Operations-Propellant Utilization

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

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

Seq. 16: Secure From Test.

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 sample taken in Seq. 10 fail. This sequence is essentially a duplicate of Seq. 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 Seq. 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 Seq. 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 Seq. 11, 12 and 13 as necessary, then repeat Seq. 14.

Seq. 15: Securing After Test

a. Application of GN2 blanket pressure of 10-20 psig to fuel and oxidizer tanks through GQ 9440 and GQ 9441. (Para. 4.2.2.8.4).

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).

Test Description (Cont)

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

f. Venting of GHe from propellant tanks.

Seq. 03: GN_2 Blanket Pressure Application

a. Pressurization and venting of the D/S propellant tanks with GN2 (3 cycles) to clear them of GHe.

b. Pressurization of the propellant tanks to 15 psig with GN2.

Seq. 04: Securing After Test

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 at proof pressure.

Vehicle Configuration:

Descent Stage.

Location:

Cold Flow Facility

Hazardous Operations:

Pneumatic pressures up to 1000 psig.

Components Under Test:

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

Test Description:

Seq. 01: Call to Station

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 to be stored in tank during Seq. 04.

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

Typical to Seq. 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. Apply vacuum on reference ports of primary and secondary regulators.

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

Test Description: (Cont)

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

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

e. Open primary solenoid valve.

f. Monitor primary regulator creep by observing for a specified period of time the pressure rise in the regulator creep verification unit.

g. Repeat above steps for secondary regulator. (Seq. 04-038).

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

a. Pressurize low pressure manifold to 358 to 367 psig GHe through port GQ 9425 with SHE primary and secondary solenoid valves closed.

b. Vent 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. Pressurize oxidizer and fuel propellant feed system to regulator lock-up pressure (238 psig/253 psia maximum).

b. Using an LDM at ports GQ 9445 and GQ 9444 collect, for a specified period of time, the quantity of helium leaking past the fuel and oxid burst discs.

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

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

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

c. Rapidly vent the oxidizer tank to below 270 psig.

d. Pressurize the fuel tank to a proof pressure or 358 to 367 psig.

e. Rapidly vent the oxidizer tank to below 270 psig.

f. Vent 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. Vent low pressure manifold upstream of check valves through GQ 9425 to atmosphere.

Seq. 05-005: Leak Check Downstream Check Valves

a. With LDM at GQ 9432, collect, for a specified period of time, the quantity of helium leaking past the check valve.

b. Repeat previous step for GQ 9433, GQ 9430 and GQ 9431.

Seq. 05-021: Leak Check Upstream Check

a. Pressurize GQ 9431 to 10 psig GHe.

b. With LDM at GQ 9425, collect, for a specified period of time, the quantity of helium leaking past check valve upstream of GQ 9431.

c. Repeat similar steps for check valves upstream of GQ 9430, GQ 9432 and GQ 9433.

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

a. Close GQ 9432 and GQ 9433.

b. With LDM at GQ 9425 collect, for a specified period of time, the quantity of helium leaking past fuel check valve assembly.

c. Repeat similar steps for oxidizer check valve assembly.

Seq. 06: Substitute Propellant Offloading

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

b. Open GQ 9452 and GQ 9453 to offload propellants.

c. When propellants are offloaded, close GQ 9452 and GQ 9453.

d. Close helium supply at GQ 9442 and GQ 9443.

e. Vent propellant tanks to 15 psig through GQ 9442 and GQ 9443.

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 and Factory Floor.

Hazardous Operations:

High pneumatic pressures.

Equipment 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 Station

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)

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

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 Leak Test (Para. 4.2.2.8.3.3)

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

Seq. 08: Engine Ball Valve Leakage Check, using GN2 (Para. 4.2.2.8.3.7)

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)

Test Title:

D/S Propulsion Subsystem Proof Pressure, Leak Check, and SHe Tank Heat Leak Test

Subsystem:

D/S Propulsion

Test Objectives:

Establishment of Structural Integrity of the following:

a. SHe tank and He start tank with associated lines.

b. The Lunar Dump System including verification of relief valve functional operation.

Establishment of Leakage Integrity of the following:

a. Pressurization and Propellant Feed Sections of the LM Descent Stage.

b. LM SHe tank.

c. Quad Check Valves.

Performance of a Mission Simulation Run

Vehicle Configuration:

Descent Stage

Location:

Cold Flow Facility

Hazardous Operations:

Seq. 05: Pressurization of the propellant tanks, 230 to 240 psig; pressurization of the Lunar Dump Valves, 345 to 360 psig.

Seq. 11: Pressurization of the high pressure manifold, 2174 to 2274 psig; pressurization of SHe tank, 1880 to 1925 psig.

Components Under Test:

Quad Check Valves, plumbing connections, SHe and He tanks with associated lines, propellant storage tanks and Feed Section.

Test Description:

Seq. 01: Call to Stations

Test Description: (Cont)

Seq. 02: Quad Check Valve Gross Leak Check

a. 1. Pressurization of Quad Check Valve, from 8-10 psig.

2. Sequence 02-007: Leak Check of the Quad Check Valve. (Para. 4.2.2.8.3.3(f)(2)).

Seq. 03: Substitute propellant fill (fuel side)

a. Filling of Fuel Tanks with freon.

Seq. 04: Substitute Propellant Fill (Oxidizer Side)

a. Filling of Oxid Tanks with freon.

Seq. 05: Relief Valve Functional Test and Leak Check of Propellant Low Pressure Manifold.

a. Seq. 05-029.
Fuel Relief Valve Vent Functional Test

b. Seq. 05-035.
Oxidizer Relief Valve Vent Functional Test.

c. Seq. 05-046.
Fuel Relief Valve Functional Test

(Para. 4.2.2.8.3.3(G)(4).

d. Seq. 05-053.
External Leak Check of Fuel Relief Valve Cavity.

e. Seq. 05-057.
Internal Leak Check Past Fuel Relief Valve Poppet.

(Para. 4.2.2.8.3.3(G)(4)(c)).

f. Seq. 05-057 D.
Internal Leak Check of Fuel Burst Disc.

(Para. 4.2.2.8.3.3(G)(2)).

g. Seq. 05-058/059.
Oxidizer Relief Valve Functional Test.

(Para. 4.2.2.8.3.3(G)(4)).

h. Seq. 05-064.
External Leak Check of Oxidizer Relief Valve Cavity.

Test Description: (Cont)

Seq. 05: (Cont)

i. Seq. 05-067.
Internal Leak Check Past Oxidizer Relief Valve Poppet.

(Para. 4.2.2.8.3.3(G)(4)(c)).

j. Seq. 05-068C.
Internal Leak Check of Oxidizer Burst Disc.

(Para. 4.2.2.8.3.3(G)(2)).

k. Seq. 05-073.
External Leak Check of Low Pressure Manifold from Regulator Outlets to Quad Check Valve Outlets.

l. Seq. 05-077.
Internal Leak Check of Lunar Dump Squibs, Fuel and Oxidizer.

(Para. 4.2.2.8.3.3(j)(2)).

m. Seq. 05-081.
Internal Leak Check of Primary and Secondary Latching Valves.

(Para. 4.2.2.8.3.3(d)(2)).

n. Seq. 05-089.
Proof Pressurization of Fuel Lunar Dump Valve Cavity.

o. Seq. 05-098.
Internal Leak Check of Fuel Lunar Dump Latch Valve.

(Para. 4.2.2.8.3.3(k)(2)).

p. Seq. 05-100
External Leak Check of Fuel Lunar Dump System.

q. Seq. 05-108.
Proof Pressurization of Oxidizer Lunar Dump Valve Cavity.

r. Seq. 05-116.
Internal Leak Check of Oxidizer Lunar Dump Latch Valve.

(Para. 4.2.2.8.3.3(k)(2)).

s. Seq. 05-118.
External Leak Check of Oxidizer Lunar Dump System.

Seq. 06: SHe tank purge and sample

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

Test Description: (Cont)

Seq. 07: SHe tank cold gas flow, LHe fill and cold soak.

a. Cooling of the SHe tank followed by filling with LHe then cold soak for six hours to condition and stabilize the tank.

Seq. 08: SHe tank Stabilization

a. Monitoring of pressure in SHe tank.

Seq. 09: Safety precautions for emergency SHe tank venting (LDG 563-26041-11)

a. Verification of hook-up with exception of line 05 to GQ9405 is accomplished.

Seq. 10: High pressure manifold proof and leak test, SHe tank modified proof and leak test, ambient helium start tank proof and leak test and latching valve leak test.

a. Seq. 10-014.
Pressurization of the line that connects to GQ9405.

b. Seq. 10-024.
Proof Pressurization of high pressure manifold. (Para. 4.2.2.8.3.1(b)(2)).

c. Seq. 10-030.
Pressurization of SHe, tank to proof pressure. (Para. 4.2.2.8.3.1(b)(1)).

d. Seq. 10-040.
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. Seq. 10-044.
Leak Check of primary (upstream) burst disc. (Para. 4.2.2.8.3.3(b)(4)).

f. Seq. 10-048.
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. Seq. 10-051.
Leak check of GQ9401 for one hour with cap closed followed by a leak check for one hour with the cap open.

h. Seq. 10-066.
Internal leak check of primary and secondary shutoff valves.

Test Description: (Cont)

Seq. 10: (Cont)

i. Seq. 10-080/086
Proof pressurization and leak check of ambient helium tank (Para. 4.2.2.8.3.2(b).(1)).

j. Leak check of all brazes and mechanical joints as seen on Figure 2-1, sheet 2 of 2 OCP-GF-26041 LM-6. This is a dry leak check of ambient helium tank.

Seq. 11: LHe fill and cold soak

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

Seq. 12: 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. 13: SHe tank heat Leak Test hook up.

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

Seq. 14: 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.

1. Sequence 14-015.
Observation of Helium Quantity leaking past SHe primary burst disc. (Para. 4.2.2.8.3.3(g)(2)).

Seq. 15: Securing after test

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

Seq. 16: Substitute Fuel Propellant Off Loading

a. Draining of the freon from the fuel tanks to prepare for a refilling witn water for orificing runs.

Seq. 17: SHe Tank Venting (to be done only if required)

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

Test Description: (Cont)

Seq. 18: Securing SHe tank (to be done only if required)

a. Venting of facility pressure to zero.

Seq. 19: Securing after Test

Test Title:

Ascent Stage Substitute Propellant Cold Flow Test.

Subsystem:

Ascent Stage Propulsion.

Test Objectives:

To hydraulically balance the ascent stage propellant feed system.

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

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.

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.

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. 05-044: Recording of ambient bled-in zeros with instrumentation module in 'isolate mode' and 'test mode'.

g. Seq. 05-046: 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)

Seq. 06: (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. 07-005: 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.

Test Description: (Cont)

Seq. 15: Substitute Propellant Fill, Fuel.

Typical to Sequence 02.

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.

Test Description: (Cont)

Seq. 28: Substitute Propellant Fill, Oxidizer.

Typical to Sequence 03.

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. Seq. 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.

Test Description: (Cont)

Seq. 37: (Cont)

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

c. Seq. 37-009: Closing of 'He Pri Shutoff' and 'He Sec Shutoff' valves.

d. Seq. 37-010: Continuation of pressurization of the helium tank until approximately six pounds (mass) of helium are contained within the tank.

e. Seq. 37-012: Isolation of vehicle from facility pressurization system.

f. Seq. 37-013: Opening of 'He Pri Shutoff' and 'He Sec Shutoff' valves.

g. Seq. 37-017: Recording of pre-run pressurized bled-in zeros with instrumentation module in 'test mode' and 'isolate mode'.

h. Seq. 37-020: 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.

i. Seq. 37-021: Recording of post-run pressurized bled-in zeros with instrumentation 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. 38-005B: Depressurization of propellant tanks to 10-20 psig.

Test Description: (Cont)

Seq. 38: (Cont)

d. Seq. 38-005D: Isolation of instrumentation module from vehicle.

e. Seq. 38-009: Purge of instrumentation module of fluid.

f. Seq. 38-022: 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. 38-027: Turn off of all instrumentation recorders.

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: GN2 Warm Up and Purge

a. Drying of the system:

1. Purge the oxid and fuel tanks with warm GN2 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. Seq. 07 will be performed only in the event that the samples taken in Seq. 06 fail. This sequence is essentially a duplicate of Seq. 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 Seq. 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 Seq. 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 Seq. 07, 08, or 09 as necessary, then repeat Seq. 10.

Seq. 11: Securing After Test

a. Application of GN2 blanket pressure of 10-20 psig to fuel and oxidizer tanks through GP9440 and GP9441. (Para. 4.2.2.8.4)

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)

Test Description: (Cont)

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)

d. Seq. 03-091: Application of GN_2 pad pressure.

Seq. 04: Securing After Test.

Test Title:

Ascent Stage Propulsion Subsystem Dry Leak Check.

Subsystem:

A/S Propulsion

Test Objectives:

Establishment of leakage integrity of the A/S Propellant Pressurization and Feed Subsystem Components.

Vehicle Configuration:

Ascent Stage

Location:

Cold Flow Facility

Hazardous Operations:

Pneumatic Pressures up to 200 psig

Components Under Test:

Low Pressure Manifold
Fuel and Oxidizer Propellant Tanks
Propellant Pressurization and Feed Lines
APS/RCS Interconnect Valves
Harness Check of Transducers GP0018P, GP0025P, GP0501P, GP1001P, GP0718T, and GP1218T.

Test Description:

Seq. 01: Call to Stations

Seq. 02: Ascent Stage Low Pressure Manifolds, Propellant Feed Section and RCS Interconnect Valve Leak Test. Partial APS Harness Check

a. External leak check at 183^{+5}_{-10} psig if pressurization and propellant section downstream of the pressure regulators. (Para. 4.2.2.8.2.2. (b) (4).)

b. APS/RCS Interconnect Valves Internal Leakage Test (Para. 4.2.2.7.6 (g))

c. Partial APS Transducer Harness Check. (Para. 4.2.2.12.3.1)

Seq. 03: Securing After Test

a. Application of blanket pressure.

Test Title:

Ascent Stage Internal Component Leak Checks

Subsystems:

A/S Propulsion

Test Objectives:

Establishment of Leakage Integrity of the A/S Propulsion Subsystem Components.

Vehicle Configuration:

A/S Stage

Location:

Cold Flow Facility

Hazardous Operations:

Pneumatic Pressures Up to 3500 psig.

Components Under Test:

He Solenoid Shutoff Valves.
Pressure Reducing Valves (Regulator)
Burst Discs
Quad Check Valves
Propellant Low Level Sensors

Test Description:

Seq. 01: Call To Station

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).

Seq. 04: Helium Solenoid Latching Valve Leak Check

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

1. Pressurization of primary and secondary solenoid latching valves with GHe to 3500 psig.

Test Description: (Cont)

2. Seq. 04-017: Leak check of primary and secondary solenoid latching valves (Para. 4.2.2.8.2.3 (b)).

Seq. 05: Regulator Creep Test (Paragraph 4.2.2.8.2.3 (b))

a. Regulator Creep Test, Class 1 secondary.

1. Pressurization of Propellant Tanks with GHe

2. Pressurization of High Pressure Manifold with GHe.

3. Flow of GHe through Class 1 regulator then lockup.

4. Seq. 05-031: Creep Test of Class 1 secondary regulator.

b. Regulator Creep Test, Class 1 Primary

1. Flow of GHe through Class 1 regulator then lockup.

2. Seq. 05-041. Creep Test of Class 1 primary regulator.

c. Regulator Creep Test, Class 2 Secondary

1. Flow of GHe through Class 2 secondary regulator then lockup.

2. Seq. 05-050. Creep Test of Class 2 secondary regulator.

d. Regulator Creep Test, Class 2 Primary

1. Flow of GHe through Class 2 primary regulator then lockup.

2. Seq. 05-059. Creep Test of Class 2 primary regulator.

Seq. 06: Relief Valve Burst Disc Leak Check

a. With Propellant Tanks pressurized to operating pressure leak check of fuel and oxidizer burst discs. (Para. 4.2.2.8.2.3 (f))

1. Seq. 06-006: Leak check of fuel burst disc.

2. Seq. 06-011: Leak check of oxidizer burst disc.

Seq. 07: Quad Check Valve Low Pressure Internal Leak Check. (Para. 4.2.2.8.2.3. (e))

a. Leak check of downstream fuel check valves.

1. Venting of low pressure manifold.

2. Seq. 07-004 and 07-006: Leak check of fuel downstream check valves.

Test Description: (Cont)

b. Seq. 07-010 and 07-013. Leak check of downstream oxidizer check valves.

c. Leak check of upstream oxidizer check valves.

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

2. Seq. 07-025 and 07-030: Leak check of upstream check valves, oxidizer side.

d. Seq. 07-035 and 07-040: Leak check of upstream check valve, fuel side.

e. Seq. 07-045 and Seq. 07-049: Leak check of total check valve assembly.

Seq. 08: Securing After Test and Low Level Sensor Check

a. Pressurization of Propellant Tanks to 50 psig.

b. Verification of low level sensors on fuel and oxidizer tanks. (Para. 4.2.2.8.2.3. (j))

c. Drain fuel and oxidizer tanks of propellant.

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/bipropellant 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 engine solenoid valves with GN_2 to 190 psig.

Test Description: (Cont)

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

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

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

5. Seq. 03-021: Leak check of the bi-propellant solenoid valve 'B'. (Para. 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 prevalves relieve. (Para. 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. (Para. 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. (Para. 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. (Para. 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. (Para. 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.

Test Description: (Cont)

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

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. (Para. 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. (Para. 4.2.2.8.2.6)

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

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

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

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

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

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

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

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

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

Test Description: (Cont)

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

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

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

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

r. Seq. 07-056: Leakage check of propellant valve A actuator. (Para. 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:

A/S Pressurization and Propellant Feed System Proof Pressure and Leak Checks

Subsystem:

A/S Propulsion

Test Objectives:

1. Verification of the structural integrity of the A/S Pressurization Section when subjected to proof pressure.

2. Verification of the structural integrity of the A/S propellant feed section when subjected to a modified proof pressure.

3. Verification of leakage integrity of the pressurization section at operating pressures.

4. Verification of relief valve functional operation.

5. Verification that internal leakage across the explosive valves, check valves, relief valves, and burst discs is within allowable limits.

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
Pressure Reducers (Regulators)
Quad Check Valves
Pressure Relief Valves
Burst Discs
Propellant Tanks

Test Description:

Seq. 01: Call To Stations

Seq. 02: Proof Pressurization of Helium Tanks

Test Description: (Cont)

a. Electrical verification of Number 2 helium storage tank pressure transducer location at 500 PSIG using GHe.

b. Electrical checkout of helium storage tank transducers at 500 and 1000 psig using GHe.

c. Pressurization of helium storage tanks to 4650 psig. with GHe; hold for 10-15 seconds. (Para. 4.2.2.8.2.1 (b) (1)).

d. Venting of helium storage tanks to 3400-3500 psig. (Para. 4.2.2.8.2.3 (a) (1)).

e. Inspection of helium storage tanks for visible signs of damage. (Para. 4.2.2.8.2.1 (c)).

f. Leak checking of helium storage tanks and lines downstream to the helium explosive valves utilizing an MSLD. (Para. 4.2.2.8.2.2. (b) (5)).

Seq. 03: Leak Check of Helium Tank Explosive Valves at Operating Pressure

a. Collection for a specified period of time of the quantity of helium leaking past the helium explosive valves. (Para. 4.2.2.8.2.3.(a)(2)).

b. Venting of helium storage tanks to ambient pressure for electrical checkout of helium storage tank transducers.

Seq. 04: Application of Blanket Pressure to Helium Storage Tanks

a. Pressurization of helium storage tank with GHe to 25-75 psig.

Seq. 05: RCS Manifold Pressurization

a. Pressurization of RCS manifold to 180-200 psig.

Seq. 06: Substitute Propellant Fill - Fuel Tank

a. Filling of fuel tank with substitute propellant (water) to minimize the pneumatic energy stored in the tank during Seq. 08.

Seq. 07: Substitue Propellant Fill - Oxidizer Tank

Typical of Seq. 06. Oxidizer tank is filled with water.

Seq. 08: Proof Pressurization of High Pressure Helium Manifold and Modified Proof Pressurization of Low Pressure Helium Manifold and Propellant Feed Sections; Relief Valve Functional Test

08-017: High Pressure Manifold Proof Pressurization

Test Description: (Cont)

a. Pressurization of High Pressure Manifold with GHe to 4550-4650 psig; hold for 10-15 seconds. (Para. 4.2.2.8.2.1 (b) (2).

b. Concurrently with Step a, pressurization of propellant tanks with GHe to 190 psig.

c. Venting of High Pressure Manifold to 1000-1500 psig.

08-033: Relief Valve Functional Test (Para. 4.2.2.8.2.3. (f)).

a. Pressurization of fuel and oxidizer burst disc cavities with GHe to 140-160 psig.

b. Pressurization of fuel tank and fuel burst disc cavity with GHe to determine fuel relief valve cracking and reseat pressures. Simultaneous modified proof pressurization of fuel tank and low pressure manifold.

c. Repeat Step e.

d. Venting of fuel tank and fuel burst disc cavity.

e. Pressurization of oxidizer tank and oxidizer burst disc cavity with GHe to determine oxidizer relief valve cracking and reseat pressures. Simultaneous modified proof pressurization of oxidizer tank and low pressure manifold.

f. Repeat Step e.

g. Venting of oxidizer tank and oxidizer burst disc cavity.

h. Inspection of tanks and feed section for visible signs of damage. (Para. 4.2.2.8.2.1 (c)).

08-074: Relief Valve Leakage, External Leakage, and Relief Valve Internal Vent Valve Functional Testing.

a. Collection for a specified period of time at GP 9446 the helium leaking past the oxidizer relief valve. (Para. 4.2.2.8.2.3. (f) (4)).

b. Collection for a specified period of time at GP 9447 the helium leaking past the fuel relief valve. (Para. 4.2.2.8.2.3. (f) (4)).

c. Using an MSLD to perform external leak check of lines and QD's between the pressure regulators and quad check valves. (Para. 4.2.2.8.2.2. (b) (5)).

d. Venting of burst disc cavities to ambient pressure.

e. Application of GHe pressure (100 psig) to fuel burst disc cavity to verify closure of relief valve internal vent valve. (Para. 4.2.2.8.2.3. (f) (4) d).

Test Description: (Cont)

f. Venting of fuel burst disc cavity in increments to verify opening of fuel relief valve internal vent valve. (Para. 4.2.2.8.2.3. (f) (4) e).

g. Application of GHe pressure (100 psig) to oxidizer burst disc cavity to verify closure of oxidizer relief valve internal vent valve. (Para. 4.2.2.8.2.3. (f) (4) d).

h. Venting of oxidizer burst disc cavity in increments to verify opening of oxidizer relief valve internal vent valve. (Para. 4.2.2.8.2.3. (f) (4) e).

Seq. 09: Internal and External Leak Check of Pressurization System

a. Pressurization of the Helium High Pressure Manifold downstream of explosive valves with GHe to 3500 psig with the solenoid latching valves closed. (Para. 4.2.2.8.2.2 (b) (2)).

b. Collection for a specified period of time at GP 9425 of the helium leaking past the solenoid latching valves. (Para. 4.2.2.8.2.3. (b)).

c. Opening of the solenoid latching valves and check of the pressurization section from the explosive valves to the pressure regulators for external leaks with an MSLD. Removal of the high pressure helium line from GP 9406 and check of QD for external leakage using an MSLD. (Para. 4.2.2.8.2.2 (b) (5)).

Seq. 10: Leak Check of Propellant System Burst Disc and Quad Check Valves

a. Collection for a specified period of time at GP 9444 of the helium leaking past the oxidizer burst disc. (Para. 4.2.2.8.2.3 (f) (2)).

b. Collection for a specified period of time at GP 9445 of the Helium leaking past the fuel burst disc. (Para. 4.2.2.8.2.3 (f) (2)).

10-015: Preparation for Quad Check Valve Leak Check (Para. 4.2.2.8.2.3 (e)).

a. Venting of propellant tanks to 8-10 psig.

b. Venting of low pressure manifold to ambient pressure.

10-022: Leak Check of Downstream Check Valves (Para. 4.2.2.8.2.3 (e)).

a. Collection for a specified period of time at GP 9432 of the helium leaking past the check valve.

b. Repeat of previous step at GP 9430, GP 9431 and GP 9433.

Test Description: (Cont)

10-037: Leak Check of Upstream Check Valves (Para. 4.2.2.8.2.3. (e))

a. Pressurization of GP 9431 to 8-10 psig with GHe.

b. Vent of GP 9430, GP 9432, and GP 9433.

c. Collection for a specified period of time at GP 9425 of the helium leaking past the check valve upstream of GP 9431.

d. Repeat of the preceding steps for check valves upstream of GP9430, GP9432 and GP9433.

10-061: Leak Check of Whole Check Valve Assemblies (Para. 4.2.2.8.2.3. (e)).

a. Closure of GP9432 and GP9433.

b. Collection for a specified period of time of the helium leaking past the fuel quad check valve assembly.

c. Repeat similar steps for oxidizer check valve assembly.

d. Inspection of pressurization and propellant feed section downstream from explosive valves for visible signs of damage.

Seq. 11: Dumping Water From Oxidizer Tank and Refilling with Freon (Para. 4.2.2.8.2.4 (c) (1)).

a. Application of 15-25 psig of GHe to pressurize propellant tanks.

b. Dumping of water from oxidizer tank.

c. Refilling of oxidizer tank with freon.

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:

Cold Flow Facility.

Hazardous Operations:

Pneumatic pressures up to 4025 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.

l. Quick Disconnects

Test Description:

Seq. 01: Call to Station (Plant 5 Final Assembly Area)

Test Description: (Cont)

Seq. 02: Quad Check Valve Low Pressure Leakage Test, Low Pressure Manifold External Leak Check and Cumulative Leak Check of Q. D.'s. During this sequence the internal leakage of each poppet assembly of the check valve and the gross leakage of each quad check valve assembly is determined. A leak check of the helium low pressure manifold is also performed.

a. Pressurize fuel side of propellant feed system to 8-10 psig He through port GP9441.

b. Vent fuel downstream poppet assemblies to ambient through port GP9432 and GP9433.

c. Vent low pressure manifold to ambient through port GP9425.

d. With LDM at port GP9432, collect, for a specified period of time the quantity of helium leaking past the GP9432 downstream poppet assembly. (Para. 4.2.2.8.2.3)

e. Repeat preceding step at port GP9433 for the GP9433 downstream poppet assembly. (Para. 4.2.2.8.2.3).

f. Close ports GP9432 and GP9433.

g. With LDM at port GP9425, collect, for a specified period of time, the quantity of helium leaking past the fuel quad check valve assembly. (Para. 4.2.2.8.2.3)

h. Pressurize port GP9433 to 8-10 psig He.

i. Vent the GP9432 downstream and upstream poppet assembly through port GP9432.

j. With LDM at port GP9425, collect for a specified period of time, the quantity of helium leaking past the GP9433 upstream poppet assembly.

k. Pressurize port GP9432 to 8-10 psig He.

l. Vent the GP9433 upstream and downstream poppet assembly through port GP9433.

m. Repeat Step j for the GP9432 upstream poppet assembly.

n. Pressurize oxidizer side of propellant feed system to 8-10 psig He through port GP9440.

o. Repeat steps similar to b through l for oxidizer side check valves. (Para. 4.2.2.8.2.3.)

Test Description: (Cont)

p. Verify primary and secondary latch valves open.

q. Pressurize vehicle through GP9406 to 180-190 psig.

r. Using LDM and QD Leak Check Adapters collect, for a specified period of time, the helium leaking past the following QD's. (Para. 4.2.2.8.2.2.)
GP9430
GP9431
GP9440
GP9432
GP9433
GP9425
GP9441

s. Using a mass spectrometer, check for leakage of all new brazes and all mechanical joints between the helium regulators and the compatibility explosive valves. (Leak check pressure 180-190 psig.) (Para. 4.2.2.8.2.2).

t. Vent vehicle to 5-15 psig through ports GP9440 and GP9441.

Seq. 03: Call to Stations (Cold Flow Facility)

Seq. 04: Regulator Flow Test

During this sequence, the temperature and pressure upstream and downstream of each regulator is determined under flow conditions.

a. Apply vacuum to reference ports of Class I primary and Class II primary regulators.

b. Open primary latching solenoid, and close secondary latching solenoid.

c. Pressurize the high pressure manifold to 3400-3500 psig He through port GP9406.

d. Open GP9425 and establish flow rate of 1.45 lbs/min minimum for 30 seconds.

e. Record upstream and downstream pressure and temperature for Class I primary regulator. (Para. 4.2.2.8.2.3.)

f. Close GP9425 and primary latching valve.

g. Open secondary latching valve.

h. Repeat Steps d and e above for Class II primary regulator. (Para. 4.2.2.8.2.3.)

Test Description: (Cont)

i. Close GP9425 and secondary latching valve.

j. Connect vacuum lines to reference ports of Class I secondary and Class II secondary regulators and disconnect from reference ports of Class I primary and Class II primary regulators.

k. Pressurize Pri Reg sense ports JP9410 and JP9412 to 50-60 psig He.

l. Open primary latching valve.

m. Repeat steps d, e, and f above for Class I secondary regulators. (Para. 4.2.2.8.2.3).

n. Close primary latching valve and open secondary latching valve.

o. Repeat steps d and e above for Class II secondary regulator. (Para. 4.2.2.8.2.3.)

p. Close GP9425 and open primary and secondary latching valves.

q. Vent primary regulator sense ports JP9410 and JP9412 to ambient.

Seq. 05: External Leak Check of Helium Pressurization Section

During this sequence the internal leakage of the solenoid latching valves is measured. The high pressure and low pressure manifolds are brought to operating pressures and external leakage of all new brazes and all mechanical joints between the helium explosive valves and the compatibility explosive valves is determined.

a. Through port GP9406, increase pressure in high pressure manifold to 4000-4025 psig. (1.15 MDOP)

b. Record high pressure manifold pressure (4000-4025 psig) and low pressure manifold pressure (180-203 psig).

c. Vent high pressure manifold through ports GP9440 and GP9441 to 3400-3500 psig.

d. Repeat step b.

e. Using LDM and QD leak check adapter collect, for a specified period of time, the helium leaking past QD GP9406.

f. Using a mass spectrometer check for leakage of all new brazes and all mechanical joints between the helium explosive valves and the compatibility explosive valves. (System pressures: 3400-3500 psig above the regulators and 180-203 psig below the regulators.)

g. Close primary and secondary solenoid latching valves.

Test Description: (Cont)

h. Vent low pressure manifold to ambient through port GP9425, GP9440, and GP9441.

Seq. 05-030: Low Pressure Manifold Proof

a. Apply vacuum to reference ports of four regulators.

b. Open primary and secondary latching valves and allow system to come to lockup.

c. Pressurize low pressure manifold to 240-250 psig through port GP9425. Hold pressure for fifteen (15) seconds maximum.

d. Vent low pressure manifold to lockup pressure through GP9425.

Seq. 05-036: Cumulative Leak Check of QD's and External Leak Check

a. Record high pressure manifold and low pressure manifold pressures.

b. With LDM at port GP9430 collect, for a specified period of time, the quantity of helium leaking past QD GP9430.

c. Repeat Step b at ports GP9431, GP9440, GP9406, GP9432, GP9433, GP9425 and GP9441 to measure leakage past these QD's.

d. Using a mass spectrometer check for leakage of all new brazes and all mechanical joints between the helium explosive valves and the compatibility explosive valves. (System pressures: 3400-3500 psig above the regulators and 180-203 psig below the regulators.)

e. Close primary and secondary solenoid latching valves.

f. Vent low pressure manifold to ambient through ports GP9425, GP9440, and GP9441.

Seq. 06: Regulator Creep Test

During this sequence the internal leakage (creep) of each regulator is determined.

a. Apply vacuum to reference port of Class I secondary regulator.

b. Open primary latching valve (secondary latching valve remains closed).

c. Pressurize reference port of Class I primary regulator to 50-60 psig He.

Test Description: (Cont)

d. Allow pressure and temperature to stabilize then record lockup pressure.

e. Allow regulator to flow for twenty to thirty seconds through port GP9425, then stop flow at port GP9425.

f. Allow pressure and temperature to stabilize, then record start time and lockup pressure.

g. Monitor lockup pressure for twenty minutes, then record end time and final pressure. Verify that leak rate of Class I secondary regulator is within allowable limits. (Para. 4.2.2.8.2.3)

h. Close Primary latching solenoid.

i. Vent reference port of Class I primary regulator to ambient.

j. Attach vacuum hose to Class I primary regulator and remove from Class I secondary regulator.

k. Open primary latching solenoid.

l. Repeat steps e through h above for Class I primary regulator. (Para. 4.2.2.8.2.3)

m. Attach vacuum hose to Class II secondary regulator and remove from Class I primary regulator.

n. Pressurize reference port of Class II primary regulator to 50-60 psig He.

o. Open secondary solenoid latching valve.

p. Allow regulator to flow for twenty to thirty seconds through port GP9425, then stop flow at port GP9425.

q. Allow pressure and temperature to stabilize, then record start time lockup pressure.

r. Monitor lockup pressure for twenty minutes, then record end time and final pressure. Verify that leak rate of Class II secondary regulator is within allowable limits. (Para. 4.2.2.8.2.3. (d))

s. Close secondary solenoid latching valve.

t. Vent reference port of Class II primary regulator to ambient.

u. Attach vacuum hose to Class II primary regulator and remove from Class II secondary regulator.

Test Description: (Cont)

v. Repeat steps o through r above for Class II primary regulator. (Para. 4.2.2.8.2.3 (d))

w. Vent vehicle to 5-15 psig through ports GP9440 and GP9441.

x. Close secondary latching valve.

Seq. 07: Quad Check Valve Flow and Low Pressure Leakage Test

During this sequence the flow and internal leakage of each poppet assembly quad check valve will be determined. The Gross Leakage of each quad check valve assembly will also be determined.

a. Pressurize port 9425 to 8-10 psig He.

b. Monitor for a flow of helium past the upstream poppet assembly. Quad check valves at each of the following Q. D.'s, GP9433, GP9432, GP9431, and GP9430.

c. Close port GP9425.

d. Pressurize port GP9430 to 8-10 psig He.

e. Monitor for a flow of helium past the GP9430 downstream poppet valves at Q.D. GP9440.

f. Pressurize port GP9431 to 8-10 psig He.

g. Monitor for a flow of helium past the GP9431 downstream poppet valve at Q.D. GP9440.

h. Pressurize port GP9432 to 8-10 psig He.

i. Monitor for a flow of helium past the GP9432 downstream poppet valve at Q.D. GP9441.

j. Pressurize port GP9433 to 8-10 psig He.

k. Monitor for a flow of helium past the GP9433 downstream poppet valve at Q.D. 9441.

l. Pressurize fuel side of propellant feed system to 8-10 psig He, through port GP9441.

m. Vent low pressure manifold to ambient through port GP9425.

n. With LDM at port GP9432, collect for a specified period of time the quantity of the helium leaking past the GP9432 downstream poppet assembly. (Para. 4.2.2.8.2.3)

Test Description: (Cont)

o. Repeat preceding step at port GP9433 for the GP9433 downstream poppet assembly. (Para. 4.2.2.8.2.3.)

p. Close ports GP9432 and GP9433.

q. With LDM at port GP9425, collect for a specified period of time, the quantity of helium leaking past the fuel quad check valve assembly. (Para. 4.2.2.8.2.3.)

r. Pressurize port GP9433 to 8-10 psig He.

s. Vent the GP9432 downstream and upstream poppet assembly through port GP9432.

t. With LDM at port GP9425, collect for a specified period of time, the quantity of helium leaking past the GP9433 upstream poppet assembly.

u. Pressurize port GP9432 to 8-10 psig He.

v. Vent the GP9433 downstream and upstream poppet assembly through port GP9433.

w. Repeat step t for the GP9432 upstream poppet assembly.

x. Pressurize oxidizer side of propellant feed system to 8-10 psig He through port GP9440.

y. Repeat steps similar to m through w for oxidizer side check valves. (Para. 4.2.2.8.2.3)

Seq. 08: Helium Relief Valve Functional Internal Leak Check of Compatibility Explosive Valves, Engine Pre-valve and Ball Valves, RCS Interconnect Valves, Cumulative Leak Check of QD's and External Leak Check.

The following tests are performed during this sequence:

Application of relief valve cracking pressure to propellant system (245 psig max).

Determination of relief valve cracking and reseat pressures.

Measurement of relief valve and burst disc internal leakages.

Function of relief valve vent valves.

External leak check of all new brazes and all mechanical joints between the compatibility explosive valves and the engine shut off valves.

Test Description: (Cont)

Internal leak check of the compatibility explosive valves, valves and engine ball valves.

Thermal relief function of engine pre-valve with fuel tank at operating pressure.

a. Simultaneously pressurize propellant tanks and burst disc cavities to 50-60 psig with He through ports GP9452 and GP9453.

b. Check vehicle, GSE, and connecting lines for audible leakage.

c. Increase propellant tanks and burst disc cavities pressure to 90-100 psig.

d. Open propellant ball valve "A" and isolation ball valve "A" by pressurizing GP9471 and GP9473 with 180-190 psig helium.

e. Verify throat plug seal integrity by monitoring pressure at throat plug port for thirty minutes.

f. Close propellant ball valve "A" and isolation ball valve "A" by venting to ambient at GP9471 and GP9473.

g. Simultaneously increase pressure in propellant tanks and burst disc cavities to 190-210 psig.

h. Simultaneously increase pressure in oxid tank and burst disc cavity until oxid relief valve cracks.

i. Block pressure to oxid tank and burst disc cavity so oxid relief valve reseats.

j. Repeat steps f and g above for second cracking and reseat pressure determination. Record values. (Para. 4.2.2.8.2.3)

k. Decrease pressure in oxid tank and burst disc cavity to 180-190 psig.

l. Record oxid tank pressure.

m. Repeat steps, similar to f through j above, for fuel side of vehicle. (Para. 4.2.2.8.2.3)

n. Visually inspect fuel and oxid lines, tanks, and fittings for structural damage.

Test Description: (Cont)

Relief Valve Internal Leak Check

a. With LDM at the thrust neutralizer tee, GP9447, collect, for a specified period of time, the quantity of helium leaking past the fuel relief valve. (Para. 4.2.2.8.2.3)

b. Repeat step, similar to preceding step, for oxidizer relief valve.

External Leak Check Downstream of Burst Discs and Cumulative Leak Check of QD's.

a. Using mass spectrometer, sheck all new brazes and all mechanical joints between ports GP9444, and GP9445 and their respective burst disc cavities. (Para. 4.2.2.8.2.3)

b. Using LDM and QD Leak Check Adapters collect, for a specified period of time, the quantity of helium leaking past the following QD's:

GP9444
GP9443
GP9445
GP9458
GP9442
GP9452
GP9463
GP9453
GP9459
GP9464

c. Vent oxid and fuel burst disc cavities to ambient through ports GP9444 and GP9445.

d. Using the mass spectrometer, check for leakage (180-190 psig) of all new brazes and all mechanical joints between the compatability explosive valves and engine shutoff valves.

R.V. Vent Valve Functional

a. Pressurize fuel burst disc cavity to 30-40 psig with He, through port GP9445.

b. Verify R.V. vent valve is closed. (Para. 4.2.2.8.2.3.). Vent valve closing pressure (100 psig max.).

c. Vent fuel burst disc cavity until vent valve opens. (Para. 4.2.2.8.2.3.)

d. Repeat steps, similar to a, b, and c above, for oxidizer R.V. vent valve. (Para. 4.2.2.8.2.3)

Test Description: (Cont)

Relief Valve Burst Disc Internal Leak Check

a. Seal off oxidizer thrust neutralizer tee GP9446.

b. With LDM at port GP9444, collect, for a specified period of time, the quantity of helium leaking past the oxidizer R.V. burst disc. (Para. 4.2.2.8.2.3.)

c. Repeat steps, similar to a and b above, for the fuel burst disc.

Thermal Relief Test of Pre-Valves, Cumulative Leak Check of QD's, External Leak Check Downstream of Pre-Valves

a. With LDM at port GP9445 collect, for a specified period of time, the quantity of helium leaking past QD GP9455. (Para. 4.2.2.8.2.6.(c)).

b. Pressurize downstream side of pre-valves to 290-300 psig, with He through port GP9455.

c. Continue pressurization pre-valve in 10 psig increments until pre-valve opens. Record cracking pressure.

d. Vent through port GP9455 to 170-180 psig then repressurize to 180-190 psig.

e. Using mass spectrometer check for leakage (180-190 psig) of all new brazes and all mechanical joints downstream of pre-valve outlet to engine shutoff valve. (Para. 4.2.2.8.2.6).

f. Vent downstream side of pre-valves to ambient through port GP9455.

Leak Test of Compatibility Explosive Valves

a. Verify pressure downstream of compatibility squibs is 180-190 psig.

b. Close pressurization ports GP9442 and GP9443.

c. Vent lines upstream of compatibility explosive valves to ambient through ports GP9425, GP9440, GP9441, GP9430, GP9431, GP9432, and GP9433.

d. With LDM at port GP9440, collect, for a specified period of time, the quantity of helium leaking past the oxidizer explosive valves. (Para. 4.2.2.8.2.6.)

e. Repeat preceding step with LDM at port GP9441 for fuel explosive valve.

Test Description: (Cont)

Leak Test of Engine Interface Primary Seals

a. Remove screw from primary seal leak test port JP9480.

b. With LDM at port GP9480, collect for a specified period the quantity of helium leaking past the primary seal of JP9480.

c. Repeat preceding steps (a and b) with LDM at port JP9482.

Internal Leak Check of RCS Interconnect Valves

a. Open fuel and oxidizer "A" secondary interconnect valves.

b. Vent RCS manifolds to ambient through ports GR6321, GR6322, GR6323 and GR6324.

c. With LDM at GR6322 collect, for a specified period of time, the quantity of helium leaking past the oxidizer "A" primary interconnect valve.

d. With LDM at GR6321 collect, for a specified period of time, the quantity of helium leaking past the fuel "A" primary interconnect valve.

e. Close fuel and oxidizer "A" secondary interconnect valves.

f. Open fuel and oxidizer "A" primary interconnect valves.

g. Repeat Step d for fuel "A" secondary interconnect valve leakage.

h. Repeat Step C for oxid "A" secondary interconnect valve.

i. Close fuel and oxidizer "A" primary interconnect valves.

j. Open fuel and oxidizer "B" secondary interconnect valves.

k. Repeat steps similar to c through i above for leakage of fuel and oxidizer "B" primary and fuel and oxidizer "B" secondary interconnect valves.

Gross Leakage Check of Engine Ball Valves

a. Open propellant "A" and "B" ball valves by pressurizing to 180-190 psig helium at GP9473 and GP9474.

b. With LDM at engine throat plug leakage port collect, for a specified period of time, the quantity of helium leaking past the isolation "A" and "B" ball valves.

c. Close propellant "A" and "B" ball valves by venting to ambient at ports GP9473 and GP9474.

Test Description: (Cont)

d. Open isolation "A" and "B" ball valves by pressurizing to 180-190 psig helium at GP9471 and GP9472.

e. Repeat Step b for leakage of propellant "A" and "B" ball valves.

f. Vent propellant tanks to 5-15 psig through ports GP9452 and GP9453.

g. Close isolation "A" and "B" ball valves by venting to ambient through ports GP9471 and GP9472.

Seq. 09: Leak Check of Helium Tanks and Helium Explosive Valves

During this sequence the external leakage of all new brazes and all mechanical joints between the helium tanks and the helium explosive valves is determined. Also, the internal leakage of the helium explosive valves is measured.

a. Pressurize helium tanks to reproof pressure (1.15 MDOP) of 4000-4025 psig with He through ports GP9401 and GP9402.

b. Decrease helium tank pressure to 3400-3500 psig.

c. Visually inspect helium tanks and lines for structural damage.

d. With LDM at port GP9401, collect, for a specified period of time, the quantity of helium leaking past QD GP9401. (Para. 4.2.2.8.2.2)

e. With LDM at port GP9402, repeat step d for the leakage past QD GP9402.

f. Using mass spectrometer, check for leakage (3400-3500 psig) of all new brazed and all mechanical joints between the helium tanks and the helium explosive valves. (Para. 4.2.2.8.2.3)

Seq. 09-032: Leak Check of Helium Explosive Valves

a. Vent high pressure manifold downstream of helium explosive valve to ambient through port GP9406.

b. With LDM at port GP9406, collect, for a specified period of time, the quantity of helium leaking past both helium explosive valves. (Para. 4.2.2.8.2.2.)

c. Vent helium tanks to pad pressure (5-15 psig) through ports GP9401 and GP9402.

Test Description: (Cont)

Seq. 10: Engine Ball Valve, Shaft Seal and Actuator Leakage and Pre-Valve Thermal Relief Check

During this sequence the leakage rate of the following valves, seals and actuators will be determined.
Isolation and Propellant Ball Valves.
Isolation and Propellant Valve Seals.
Isolation and Propellant Valve Actuators.

Also, the thermal relief pressure of the pre-valves will be determined.

a. Pressurize fuel and oxid tanks to 50-60 psig GN2 through port GP9452 and GP9453.

b. Open propellant valve "A" and isolation valve "A" by pressurizing to 180-190 psig GN2 at ports GP9471 and GP9473.

c. Verify combustion chamber pressure is within ± 10 psig of propellant tank pressure by observing pressure at throat plug leak port.

d. Close propellant valve "A" and isolation valve "A" by venting to ambient at GP9471 and GP9473.

e. Monitor combustion chamber pressure for thirty minutes.

f. Pressurize fuel tank to 180-190 psig with GN2 through port GP9443.

g. Pressurize oxidizer tank to 180-190 psig with GN2 through port GP9442.

h. Activate Isolation Valve "A" by pressurizing to 180-190 psig with GN2 at port GP9472.

i. Activate Isolation Valve "B" by pressurizing to 180-190 psig with GN2 at port GP9472.

j. With LDM at port GP9477, collect for a specified period of time, the quantity of GN2 leaking past the Fuel Isolation Valves "A & B" shaft seals, Fuel Prop Valves "A & B" shaft seals and Fuel Isolation Valves "A & B" actuators.

k. With LDM at throat plug leakage port, collect for a specified period of time, the quantity of GN2 leaking past the Fuel and Oxid Prop Valves "A & B". (Para. 4.2.2.8.2.6(2).)

l. With LDM at port GP9476, collect for a specified period of time, the quantity of GN2 leaking past the Oxid Isolation Valves "A & B" shaft seals and the "Oxid" Prop Valves "A & B" shaft seals. (Para. 4.2.2.8.2.6 (3).)

Test Description: (Cont)

m. Deactivate Isolation Valve "A" by venting to ambient through port GP9471.

n. Deactivate Isolation Valve "B" by venting to ambient through port GP9472.

o. Activate Prop Valve "A" by pressurizing to 180-190 psig with GN2 through port GP9473.

p. Activate Prop Valve "B" by pressurizing to 180-190 psig with GN2 through port GP9474.

q. With LDM at port GP9477, collect for a specified period of time, the quantity of GN2 leaking past the Fuel Isolation Valves "A" & "B" shaft seals and the Prop Valves "A & B" shaft seals and the Prop Valves "A & B" actuators. (Para. 4.2.2.8.2.6. (3).)

r. With LDM at throat plug, collect for a specified period of time, the quantity of GN2 leaking past the Fuel and Oxid Isolation Valves "A & B". (Para. 4.2.2.8.2.6 (2).)

s. With LDM at port GP9476, collect for a specified period of time, the quantity of GN2 leaking past Oxid Isolation Valves "A & B" shaft seals. (Para. 4.2.2.8.2.6 (3).)

t. Subtract leakage rate obtained in Step s, from that in Step l to obtain leakage rate of Oxid Prop Valves "A & B" shaft seals.

u. Deactivate Prop Valve "A" by venting to ambient through port GP9473.

v. Deactivate Prop Valve "B" by venting to ambient through port GP9474.

w. Depressurize Fuel tank by venting to pad pressure through port GP9442.

x. Depressurize Oxid tank by venting to pad pressure through port GP9443.

NOTE

If excessive leakage is obtained in any of above steps, additional steps will be performed to determine leakage path.

Seq. 11: Securing After Test

a. Vent helium tanks to ambient through port GP9401 and GP9402.

b. Pressurize helium tanks to 5-15 psig with GN2.

Test Description: (Cont)

c. Repeat step a above.

d. Pressurize helium tanks to 75-85 psig with GN2.

e. Obtain gas samples at port GP9402 for particle count.

f. Vent helium tanks to pad pressure.

g. Open primary and secondary latching solenoid valves.

h. Establish GN2 flow through helium pressurization system by pressurizing at port GP9406 and venting at port GP9425. Maintain flow at 5 psig minimum for a period of three (3) minutes.

i. Obtain gas samples at port GP9425 for particle count.

j. Secure helium pressurization system with GN2 pad pressure. (Para. 4.2.2.8.2.6.)

k. Repeat steps, similar to h, i, and j above for oxidizer side of propellant system by pressurizing at port GP9442, and venting at port GP9463.

l. Determine condition of oxidizer burst disc by monitoring oxidizer thrust neutralizer tee for audible leakage.

m. Repeat steps, similar to h, i, j and l above for fuel side of propellant system by pressurizing at port GP9443 and venting at port GP9464.

Test Title:

RCS Valve Response

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.

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 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.

d. 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 Systems channels.

Seq. 06: G&N Turn-On

a. Verification of nominal +28 VDC power application to Commander's bus and System Engineer's 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

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 channels.

Seq. 08: Securing After Test

Test Title:

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, exercised by rotation of the vehicle to verify polarity of RGA gyros in response to the physical rotation above X, Y and Z axes.

b. Verification of the polarity of ASA gyros 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, observe RCS jets and event lights and verify on light beam recorder 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 GFE 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 GYRO run-up

e. AEA self test

f. Body axis align

g. Earth rate compensation X, Y, Z axes.

Seq. 08: Yaw Rotation

a. Verification of GSE guide and drive equipment for yaw rotation.

b. Selection of AGS attitude hold mode.

3.

Test Description: (Cont)

c. Activation of Control Switch Box.

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, record 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. Boxy 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 comp. 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 comp. 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 sub-systems.

Test Title:

RCS Module Proof, Leakage and Functional Tests

Subsystem:

Reaction Control

Test Objectives:

Establish the structural and leakage integrity and proper operation of components of the RCS module.

Vehicle Configuration:

Not applicable; tankage module assembly only.

Location:

Controlled Environment Facility, Plant 2.

Hazardous Operations:

Pneumatic pressures up to 4655 psig.

Components Under Test:

a. Quad Check Valves

b. Relief Valves

c. Main Shutoff Valves

d. Helium Regulators

Test Description:

Seq. 01: Call to Station

Seq. 02: Freon Flush of RCS Fuel and Oxidizer Tank Bladders, Followed by Purging and Drying With Warm GN2, System A. (Para. 4.2.2.7.3 (a)(d), 4.2.2.7.5 and 4.2.2.7.6 (j))

a. Flush fuel and oxidizer tank bladders through bleed (GR 6301, GR 6302), fill (GR 6311, GR 6312) and service (GR 6321, GR 6322) QD's with PCA freon to meet cleanliness requirements.

b. Purge and dry bladders with warm GN2 through bleed, fill and service QD's to meet moisture and freon vapor requirements.

Seq. 03: Proof Pressure Test of Helium Tank and Leakage Test of All Joints Between Helium Tank and Squib Valves, System A. (Para. 4.2.2.7.2 (a)(1) (a)(2), (a)(3), 4.2.2.7.6 (a), 4.2.2.7.3 (c)(d))

a. Pressurize helium tank to 4560-4655 psig GHe through GR 6201 helium fill port. Hold pressure for specified period of time.

Test Description: (Cont)

b. Reduce pressure in helium tank to 3500 ± 50 psig GHe, inspect for damage and leak check tank fittings and all joints between tank and squib valves. Leak check squib valves at GR 6211 helium test port.

c. Vent helium tank to 10-50 psig GHe through GR 6201.

d. Monitor tank temperatures while pressurizing and venting to maintain proper temperatures.

e. Verify proper operation of PQMD (GR 1085Q) and flight helium supply pressure transducer (GR 1101P)

Seq. 04: Proof Pressure Test of RCS Propellant Tanks and Regulator Inlet Section. Leak Check of All Joints Between Squib Valves and Main Shutoff Valves, System A. (Para. 4.2.2.7.2 (b), 4.2.2.7.3 (b)(d), 4.2.2.7.6 (e))

a. Pressurize liquid and gas sides of propellant tanks simultaneously through fill and GHe vent QD's to 325 - 335 psig while, for a specified period of time, maintaining a positive delta P between inside and outside of the bladders.

b. Reduce pressure in tanks to 200 to 210 psig while maintaining positive delta P.

c. Pressurize the helium regulator inlet section to 4560 to 4655 psig through the helium test QD (GR 6211). Hold for five to ten minutes. Verify proper operation of regulator outlet transducer (GR 1201P).

d. Reduce pressure to 3450 to 3550 psig, inspect module for visual evidence of damage and leak check all joints and fittings.

e. Leak check all QD's.

f. Perform forward leakage check of main shutoff valves by measuring volumetric leakage out of propellant line tube stubs.

g. Reduce pressure in propellant tanks to zero on gas side of 5-15 psig on liquid side while maintaining a positive delta P.

Seq. 05: Leakage Test of Relief Valve Burst Discs. Reverse Leakage of Overall Quad Check Valve Assembly, System A.

a. Pressurize propellant tanks 165 to 170 psig outside bladders through fill (GR 6311 and GR 6312) and vent (GR 6281 and GR 6282), QD's simultaneously while maintaining a 5-15 psig positive delta P on the bladder.

b. Using a helium mass spectrometer at ports "G" (GR 6262) and "H" (GR 6261) measure burst disc leakage.

Test Description: (Cont)

c. Connect a VLD to port "D" (GR 6233) and measure quad check valve assembly leakage.

d. Decrease pressure on propellant tanks to 5-15 psig pad pressure inside of bladders while maintaining a positive delta P.

Seq. 06: Verification of Cracking and Reseat Pressures or Relief Valves, System A.(Para. 4.2.2.7.6 (d))

a. Pressurize fuel tank with GHe to 224 to 240 psig through fuel fill, vent and port "H" (GR 6261) simultaneously while maintaining 5-15 psig positive delta P on bladder.

b. Determine relief valve cracking pressure while raising pressure in step (a) by monitoring for leakage from relief valve outlet.

c. Lower pressure on tank to 212 psig and monitor relef valve reseating pressure.

d. Lower pressure to 200 psig. Connect VLD to relef valve outlet and monitor relef valve leakage.

e. Reduce pressure to 5-15 psig and pressure while maintaining 5-15 psig delta P on bladder.

f. Repeat above steps for oxidizer relief valve, using oxidizer fill, vent and port "G" (GR 6262) QD's.

Seq. 07: Verification of Cracking Pressures of Individual Quad Check Valve Elements, System A (Para. 4.2.2.7.6 (c)(1))

a. Pressurize inside of propellant tank bladders with GHe to 5-15 psig through fill QD's.

b. Determine quad check valve elements cracking pressure by monitoring for leakage from oxidizer vent Q.D.

c. Pressurize ports "E" (GR 6251) and "C" (GR 6253) in turn from 0 to 5.0 psig and monitor VLD connected to oxidizer vent QD for indication of cracking pressure.

d. Connect VLD to fuel vent QD and monitor for leakage to determine quad check valve elements cracking pressure.

e. Pressurize ports "F" (GR 6241) and "D" (GR 6242) in turn form 0-5 psig and monitor VLD connected to fuel vent QD for indication of cracking pressure.

Test Description: (Cont)

Seq. 08: Internal Leak Check of Individual Quad Check Valve Elements at 0.5 psig and 100 psig. Respectively.

a. Pressurize inside of propellant tank bladders to 5-15 psig through fill QD's GR 6311 and GR 6312.

b. Pressurize through oxidizer vent QD, GR 6282, to 0.5 to 0.8 psig and monitor leakage at ports "E" (GR 6253) respectively, with VLD.

c. Pressurize through fuel vent QD, GR 6281 to 0.5 to 0.8 psig and monitor leakage at ports "F" (GR 6241) and "D" (GR 6242) respectively, with VLD.

d. Connect VLD to port "B" (GR 6233) and pressurize to 0.5 to 0.8 psig through ports "E", "F", "C" and "D" in turn while monitoring leakage at port "B".

e. Pressurize propellant tanks through fill QD's GR 6311 and GR 6312, outside of bladders and vent QD's GR 6281 and GR 6282, simultaneously while maintaining positive delta P of 5-15 PSIG, until pressure outside bladders is 95-105 PSIG.

f. Pressurize 95 to 105 psig through ports "B" "C" "F" and "D" in turn while monitoring upstream poppet leakage at port "B" (GR 6233) with VLD.

g. Connect VLD to ports "E", "C", "F" and "D" in turn to monitor downstream valve leakage.

h. Reduce pressure on tanks to 5-15 psig pad pressure inside bladders while maintaining a positive delta P.

Seq. 09: Functional Test of Primary and Secondary Helium Pressure Regulators at High Flow, Low Flow and Lockup Conditions, System A (Para. 4.2.2.7.3 (c)(d), 4.2.2.7.6 (b)(1)(2))

a. Pressurize propellant tanks to 205 to 215 psig through fill (GR 6312 and GR 6311) and vent (GR 6281) and (GR 6282) QD's and ports "G" (GR 6262) and "H" (GR 6261) simultaneously while maintaining 5-15 psig positive delta P on bladders.

b. Pressurize regulator inlet to 950-1050 psig through port "A" (GR 6211).

c. Flow through port "B" (GR 6233), adjusting flow sequentially to 0.19 to 0.21 lbs/min, 0.036 to 0.040 lbs/min and zero (lockup).

d. Pressurize regulator inlet to 3450-3550 psig through port "A" (GR 6211).

Test Description: (Cont)

e. Flow through port "B" (GR 6233) to flowmeter, adjusting flows to 0.19 to 0.21 lbs/min, 0.036 to 0.040 lbs/min and zero (lockup).

f. Bleed pressure in regulator section to zero psig.

g. Pressurize primary regulator vent port to 50-55 psig to lock out primary regulator.

h. Pressurize inlet to 950-1050 psig through port "A" (GR 6211).

i. Flow through port "B" (GR 6233) to flowmeter, adjusting flows to 0.19 to 0.21 lbs/min, 0.036 to 0.040 lbs/min and zero (lockup).

j. Pressurize regulator inlet to 3450-3550 psig through Port "A" (GR 6211).

k. Flow through port "B" (GR 6233) to flowmeter, adjusting flows to 0.19 to 0.21 lbs/min, 0.36 to 0.040 lbs/min and zero (lockup).

l. Bleed pressure in regulator section to zero psig.

m. Disconnect line and QD from port "B" and connect burst disc safety device.

n. Pressurize regulator inlet to 3450-3550 psig through port "A" (GR 6211) and record creep rate.

o. Reduce pressure on regulator inlet to 300-350 psig, remove burst disc safety device from port "B" and reconnect line to port "B".

p. Remove line from primary regulator vent port and connect to secondary regulator vent port.

q. Repeat steps g, h, i, j, k, l, m, n, and o for primary regulator check.

r. Reduce pressure in regulator section to zero psig.

s. Reduce pressure in propellant tanks to 5-15 psig inside bladders, 0 psig outside bladders while maintaining a positive delta P.

Seq. 10: Verification Test of Fuel and Oxidizer Tank Bladder Leakage Rates, System A. (Para. 4.2.2.7.6 (b)(3), (i))

a. Pressurize inside of bladder to 9 to 10 psig through fill QD's.

b. Connect VLD's to tank vent QD's and monitor bladder leakage.

c. Close all QD's and remove all GSE equipment.

Test Description: (Cont)

Seq. 11
through
Seq. 19: Repeat above Seq. 02 through 10 for RCS System B Module.
(Para. 4.2.2.7.2, 4.2.2.7.3, 4.2.2.7.5, 4.2.2.7.6)

Test Title:

Propellant Feed Section Proof, Leakage and Functional Test.

Subsystem:

Reaction Control Subsystem (RCS)

Test Objectives:

Establishment of the structural integrity and functional capability of the RCS propellant manifold lines and components after assembly on the vehicle.

Vehicle Configuration:

Ascent Stage.

Location:

Cold Flow Facility.

Hazardous Operations:

Pneumatic pressures up to 340 psig.

Components Under Test:

a. Propellant manifold lines.

b. Manifold flight transducers.

c. Chamber pressure switches.

d. Injector valves.

e. Isolation valves.

Test Description:

Seq. 01: Call to Stations

Seq. 02: Proof Pressure and External Leak Check of RCS Propellant Manifolds. (Para. 4.2.2.7.2 (b)(3), 4.2.2.7.3 (b))

a. Sequential venting of propellant tanks by first venting volume external to the bladders, then volume inside the bladders. Ports remain open and capped as a safety precaution.

b. Verification of acceptable output from manifold pressure transducers at ambient pressure.

c. Pressurization of the propellant manifolds at 30 to 40 psig GHe.

Test Description: (Cont)

d. Verification that main shutoff valves are closed, as indicated by no audible evidence of leakage at tank fill ports. Verification that interconnect valves are closed by monitoring of pressures indicated by gages connected to APS ports. An increase in pressure indicates a leaking interconnect valve.

e. Pressure is increased in propellant manifolds to 320 to 340 psig GHe. Proof pressure is held for a specified period of time.

f. Venting of propellant manifolds to ambient, visual inspection of the manifolds for physical damage.

g. Pressurization of the propellant manifolds to 195 to 205 psig GHe. Leak check of all brazed, weld and mechanical joints. Leak check of flight half service Q.D. poppets.

h. Verification of accuracy of propellant manifold pressure transducers with the propellant manifolds pressurized to 195 to 205 psig.

i. Correlation of each propellant manifold pressure transducer output to its respective manifold by individually venting manifold to ambient.

j. Verification of acceptable output from manifold pressure transducers at ambient pressure.

Seq. 03: Engine Thrust Chamber Switch Leak Check and Functional Tests. Leak Check of Fuel and Oxid Injector Valve Flange Interface. (Para. 4.2.2.7.3 (e), 4.2.2.7.8)

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

b. Installation of throat plug into the engine under test and pressurization of thrust chamber to 100 to 110 psig (GHe).

c. Leak check of mechanical connections of pressure switch.

d. Leak check of fuel and oxid injector valve flange interface.

e. Venting of thrust chamber pressure through throat plug to ambient.

f. Slow evacuation of the thrust chamber to approximately 2 psia through the throat plug. Record of the pressure when the chamber pressure switch opens.

g. Slow increase of pressure in the thrust chamber to approximately 15 psia through the thrust plug. Observance and recording of the pressure when the pressure switch closes.

h. Repeat of steps (f) and (g) two times.

i. Venting of pressure in thrust chamber through the throat plug to ambient.

Test Description: (Cont)

j. Repeat steps (b) through (i) for each remaining RCS engine.

k. Vending of pressure in propellant manifolds.

Seq. 04: Fuel and Oxid Injector Valve, Secondary Coil Wiring Verification and Gas Flow Check Using GN2. (Para. 4.2.2.7.7)

a. Pressurization of the propellant manifolds to 20 to 30 psig GN_2.

b. Verification of proper harness wiring to the secondary coil of the fuel injector valves by actuating the valves individually and varying gas flow through the respective engines.

c. Verification of proper harness wiring to the secondary coil of the oxidizer injector valves by actuating the valves individually and verifying gas flow through the respective engines.

d. Opening of If engine, fuel injector valves and pressurization of fuel manifold with GN_2 through an orifice flowmeter. Establishment of flow with 24.95 to 25.05 psig in the fuel manifold. Pressurization of oxid manifold to approximately 160 psig.

e. Increase of INLET pressure to flowmeter (approximately 10 psig) and determination of stabilized fuel manifold pressure. Decrease of INLET pressure to flowmeter (approximately 20 psig) and determination of stabilized fuel manifold pressure. Increase of pressure to establish original flow conditions.

f. While maintaining initially established input pressure, the fuel injector valve in each engine is flowed individually. Stabilized flowmeter input pressure is recorded, as well as corresponding fuel manifold pressure for each engine.

g. Decrease of manifold supply pressure to zero psig.

h. Repeat of steps (a) through (g) for the oxid injector valves, establishing a controlled GN_2 flow to the oxid manifold through the flowmeter orifice and a backup pressure to the fuel manifold.

Seq. 05: Injector Valve Forward Leakage Check Using GN_2. (Para. 4.2.2.7.7(c))

a. Pressurization of the fuel manifold to 95 to 105 psig GN_2.

b. With VLD's attached to throat plugs installed in the If and IIf engine thrust chambers, collection, for a specified period of time,of the nitrogen leaking through the fuel injector valves.

c. Venting of the fuel manifold ambient.

d. Pressurization of the oxidizer manifold to 95 to 105 psig GN_2.

Test Description: (Cont)

Seq. 05: Injector Valve Forward Leakage Check Using GN_2. (Cont)

e. With VLD's attached to throat plugs installed in the If and IIf engine thrust chambers, collection, for a specified period of time, of the nitrogen leaking through the oxidizer injector valves.

f. Venting of the oxidizer manifold to ambient.

g. Repeat of steps (a) through (f) for remaining RCS engines.

h. Pressurization of fuel and oxidizer manifolds to 10 to 20 psig.

i. Close systems 'A' and 'B' service QD's.

Seq. 06: Reapplication of Pad Pressure in RCS Tankage Modules. (Para. 4.2.2.7.3(g), 4.2.2.7.7(b))

a. Pressurization of system 'A' fuel and oxidizer propellant tank bladders to 5 to 15 psig GHe.

b. Close system 'A' vent and fill QD's.

c. Pressurization of system 'B' fuel and oxidizer propellant tank bladders to 5 to 15 psig GHe.

d. Close system 'B' vent and fill QD's.

Test Title:

RCS Verification.

Subsystem:

Reaction Control Subsystem (RCS).

Test Objectives:

a. Verification of helium high pressure section through proof pressurization and leak tests of braze and mechanical joints.

b. Verification of normal functioning of PQMD.

c. Verification of acceptance leakage rates for main shutoff valves, helium couplings, propellant quick disconnects, 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:

Plant 5, Cold Flow Facility.

Hazardous Operations:

Pneumatic pressures up to 4000 psig.

Components Under Test:

RCS tankage module.

RCS helium tank.

Helium module components (PQMD's, relief valves, burst disc, regulators and squib valve, etc.).

Test Description:

Seq. 01: Call to Stations.

Seq. 02: Helium Module Pressure Tests. (Para. 4.2.2.7.2)

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

Test Description: (Cont)

Seq. 02: (Cont)

b. Leak check of mechanical and brazed joints and fittings upstream of the explosive valves at 3500 psig.

c. Leak check of explosive valves and fill and vent quick disconnects upstream of explosive valves at 3500 psig.

d. Functional test of high pressure transducer and PQMD.

Seq. 03: System 'A' Relief Valve Tests (Para. 4.2.2.7.6)

a. Verification of relief valve cracking and reseating pressures.

b. Check of relief valve internal leakage.

c. Verification of bleed valve opening and closing pressures.

d. Verification of burst disc integrity at 20-30 psig. (Verification of no gas flow through the burst disc port).

Seq. 04: System 'A' Propellant Tank System (Para. 4.2.2.7.2)

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

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

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.

b. Check of primary and secondary regulator leakage at 3500 psig inlet pressure.

Seq. 06: System 'A' Quad Check Valve Tests (Para. 4.2.2.7.6)

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.

Seq. 07: System 'A' Burst Disc Leak Check (Para. 4.2.2.7.6)

a. Check of relief valve burst disc leakage at 180-185 psid.

Test Description: (Cont)

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

a. Check of propellant tank bladder leakage at 10 psid.

Seq. 09: System 'B' Relief Valve Tests (Para. 4.2.2.7.6)
(same as for sequence 03)

Seq. 10: System 'B' Propellant Tank System (Para. 4.2.2.7.2)
(same as for sequence 04)

Seq. 11: System 'B' Regulator Test (Para. 4.2.2.7.6)
(same as for sequence 05)

Seq. 12: System 'B' Quad Check Valve Tests (Para. 4.2.2.7.6)
(same as for sequence 06)

Seq. 13: System 'B' Burst Disc Leak Check (Para. 4.2.2.7.6)
(same as for sequence 07)

Seq. 14: System 'B' Bladder Leak Check (Para. 4.2.2.7.6)
(same as for sequence 08)

Seq. 15: Reapplication of Pad Pressure (Para. 4.2.2.7.5)

a. Application of GN_2 pad to systems 'A' and 'B' propellant tanks and manifolds.

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:

(Para. 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. (Para. 4.2.2.7.5)

a. Flushing freon through entire assembly 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.

Seq. 04: Helium Leak Check and Latch Force Test - Oxidizer Interconnect Valve Assembly.

(Para. 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.

(Para. 4.2.2.7.5)

Same as Seq. 02.

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

Same as Seq. 03.

Seq. 07: Helium Leak Check and Latch Force Test - Fuel Interconnect Valve Assembly.

(Para. 4.2.2.7.6(g) and (j).)

Same as Seq. 04.

Test Title:

Prop. Feed Sect. Proof Leak and Functional Test.

Subsystems:

Reaction Control Subsystem (RCS).

Test Objective:

1. Verification of RCS Manifold Integrity Through Proof Pressurization and External Leak Checks at Operating Pressure.

2. Verification that Forward Leakage of the Injector Valves is Within Allowable Limits.

3. Verification of Proper Pressure of the Chamber Pressure Switches, Flight Pressure Transducers, and Injector Valves.

4. Verification of Engine Gas Flow Using GN_2 Flow.

Vehicle Configuration:

Ascent Stage.

Location:

Cold Flow Facility.

Hazardous Operation:

Escaping High Pressure Gas.

Equipment Under Test:

RCS Ox and Fuel Injector Valves Chamber Pressure Switches Propellant Manifold Lines.

Test Description:

Seq. 01: Call to Stations.

Seq. 02: Proof pressure and external leak check of RCS propellant manifold.

(Para. 4.2.2.7.3(B),(C),(D),(F) partial)

Seq. 03: Engine thrust chamber switch leak check and functional test. Leak check of fuel and oxidizer injector valve flange interface.

(Para. 4.2.2.7.8, 4.2.2.7.3)

Test Description:

Seq. 04: Fuel and oxidizer injector valve, secondary coil wiring verification and gas flow check using GN_2.

(Para. 4.2.2.7.7(c))

Seq. 05: Injector valve forward leakage check using GN_2

(Para. 4.2.2.7.3 (E), (F) partial)

Seq. 06: Reapplication of pad pressures in RCS tankage modules

(Para. 4.2.2.7.5 partial)

Test Title:

RCS Functional.

Subsystem:

Reaction Control Subsystem (RCS).

Test Objectives:

a. Verification that the helium leak rates of all isolation valves (Systems 'A' and 'B'), the fuel and oxidizer crossfeed valves (both directions), and mechanical joints 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 channel identification.

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

e. Verification of main shutoff valve channel identification.

Vehicle Configuration:

Ascent Stage.

Location:

CEF, Plant 5.

Hazardous Operations:

Pneumatic pressures to 205 psig.

Components Under Test:

Isolation and crossfeed valves.

Engine orifices and injector valves.

Quad check valves.

Propellant tank bladders.

Test Description:

Seq. 01: Call to Stations.

Seq. 02: Leak Check of Isolation Valves, Crossfeed Valves and Service QD's.

(Para. 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 QD's.

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 ports. System 'B' is then pressurized with leakage collected at System A service ports.

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

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 GN_2, 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 flow 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.

c. Obtaining of channel I.D. of each isolation valve by closing and opening valve with gas flow through appropriate engine and monitoring on recorder.

Seq. 04: Injector Valve Forward Leakage, Main Shutoff Valve Channel I.D. and Reapplication of Pad Pressure.

(Para. 4.2.2.7.3(e))

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 I 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.

Test Description: (Cont)

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: Reapplication of Pad Pressure in RCS Tankage Modules

a. Pressurization of System 'A' and 'B' fuel and oxidizer propellant tank bladders to 5 to 15 psig GH_2.

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. (Para. 4.2.2.1.1)

Test Title:

Landing Gear Functional Tes

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 deployed 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. (Para. 4.2.2.1.3)

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

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. (Para. 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 LM-6 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 LM-6 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-LM6.

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)

Seq. 05: Ingress and Checkout (Cont)

c. Verification of communication 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-LM6. (Para. 4.2.2.4.5(b))

Seq. 08: Egress/Ingress Procedure for Lunch Break

Seq. 09: Drogue Installation and Removal Fit Check

Seq. 10: Securing After Test

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

Egress of the LM Crew from the Vehicle.

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 LM6 Stowage List, List B plus tv camera and associated equipment stowed in descent 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.

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

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 LM-6 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-LM-6.

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. Weighting of SRC No. 2 (Quad IV).

Test Description: (Cont)

i. Return of LMP to control of OCP-GF-32022-LM-6.

Seq. 04: Removal of all stowed items and return to bond area.

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 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.

Seq. 03: PGA Donning

Suiting of the IMP, and donning of associated equipment.

Seq. 04: Crew LM Ingress

Ingress of the IMP to the Descent Stage.

Seq. 05: Crew LM Egress

Egress of the IMP from the Descent Stage.

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:

A/S HTS Including:

Coolant Recirculation Assembly.

Secondary Filter

Isolation Valve

ARS H/X S

Suit Diverter Valve

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

Components Under Test: (Cont)

LGC Cold Plate

LCA Cold Plate

GASTA Cold Plate

Coolant Accumulator

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

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: WMS Secondary HTS Interloop Test

a. Leakage test of the LSC 330-410 Isolation Valve (Para. 4.2.2.3.6).

Seq. 04: 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. 05: 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. 06: 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 one hour pressure decay test on the secondary HTS.

Test Description: (Cont)

Seq. 07: 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 LSC330-210 disconnected from the system.

c. Performance of a volumetric leakage test of the accumulator LSC330-210 in accordance with the following:

1. Accumulator LSC330-210 connected to the Primary HTS A/S.

2. Displacement Leak Meter connected to port JF 9137 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. 08: Securing After Test

a. Venting of the Primary HTS A/S to ambient pressure.

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 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

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 with helium at 60 psig for 5 minutes. (Para. 4.2.2.3.6).

c. Leakage test of the HTS Interstage Disconnects with a Mass Spectrometer using helium at 45 psig, (Para. 4.2.2.3.6).

d. Leakage test of the HTS A/S Interstage Disconnects in a demated configuration with a mass spectrometer using helium at 45 psig. (Para. 4.2.2.3.6).

Seq. 03: GOX Interstage Disconnect Proof Pressure and Leak Check

a. Proof Pressure Test of the GOX Interstage Disconnect with helium at 1340 psig for 1 minute. (Para. 4.2.2.3.5.1(b)).

b. Leakage Test of the GOX Interstage Disconnect with a Mass Spectrometer using helium at 950 psig, (Para. 4.2.2.3.5.1.1(c)(2)).

Seq. 04: Securing After Test

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

Test Description: (Cont)

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.

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 5 minutes (Para. 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 GH 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 five minutes (Para. 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.

Test Description: (Cont)

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.

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)).

Test Description: (Cont)

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))

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 "Reg 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" in "Egress" and "Reg B" closed measure the make-up flow through JF9555 required to maintain 935 psig GOX in the OCPS (Para. 4.2.2.3.5.1.1(A)).

c. With "Reg A" in "Cabin" and "Reg B" closed measure the make-up flow through JF9555 required to maintain 935 psig GOX in the OCPS. (Para. 4.2.2.3.5.1.1(A)).

d. With "Reg A" closed and "Reg B" in "Egress" measure the make-up flow through JF9555 required to maintain 935 psig GOX in the OCPS. (Para. 4.2.2.3.5.1.1(A)).

e. With "Reg A" closed and "Reg B" in "Cabin" measure the make-up flow through JF9555 required to maintain 935 psig GOX in the OCPS (Para. 4.2.2.3.5.1.1 (a)).

f. Vent the OCPS to ambient through JF9555.

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.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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 of GF9117, take two Dew Point readings from GOX Tank #2 through GF9117.

b. Vent GOX Tank #2 to Ambient through GF9117.

c. Remove and Stow GSE.

d. Configure Vehicle for storage .

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 with H_2O.

c. To verify leakage rate through WMS bladders is within specifications.

d. To check internal leakage of water tank select valve, check valves (except Descent tank check valve), manual valves, delta P transducers and regulators.

e. The functional check of the delta P transducer and water regulators.

f. To flush the water tanks and WCM to verify cleanliness level that will meet requirements of LSP 14-0020 Table II.

Vehicle Configuration:

Mated Stages

Location:

Integrated Workstand, Plant 5

Hazardous Operations:

Proof pressure with GHe to 10.6 psig. Gas pressure to 50 psig.

Equipment Under Test:

Water Control Module
Ascent Water Tanks
Descent Water Tank

Test Description:

Seq. 01: Call to Stations

Seq. 02: WMS High Pressure Network and Low Pressure Network Proof Pressure and Helium Leak Test

a. The high pressure network (excluding the Ascent and Descent Water Tanks) is subjected to proof pressure with helium at 64 psig.

Test Description: (Cont)

b. The high pressure network is subjected to a helium leakage test at 50 psig. (Para. 4.2.2.3.7.)

c. Pressurization of the ASC tanks to 15 psig with GHe.

d. Proof pressure test of the low pressure network with GHe at 10.6 psig (excluding 209 & 224 W/B's). (Para. 4.2.2.3.7)

e. Helium leak check of the WMS low pressure network at 9 psig (Para. 4.2.2.3.7).

Seq. 03: Leak Check of Tank Bladder and WCM

a. Leakages of the water tank bladders from water side to gas side (bladder inflated) as well as from gas side to water side (bladder deflated) at 5 psig GN_2.

b. Internal leakage of water tank check valves (except the des. tank check valve due to impracticability), of des. H_2O check valve, of des. H_2O valve, of ASC. H_2O valve, and of tank selector valve from D/S to A/S and A/S to D/S at 50 psig with GN_2.

c. Internal leakage of water separator check valves, of prim. evap. flow #1 valve, of sec. evap. flow valve, and of prim. evap. flow #2 valve at 9 psig with GN_2. (Para. 4.2.2.3.7 and 4.2.2.3.7.1)

Seq. 04: Ascent tanks and Descent tank Water Side - 5 Hour Pressure Decay Test

a. Fill of the water tanks with GN_2 to 50 psig.

b. Pressurization of the low pressure network (excluding water boiler) to 9 psig.

Seq. 05: WMS Tank Gas Side Pressure Decay; Regulator Redundancy and Flow Check With Water

a. Evacuation of the water side WMS and fill with water to 50 psig for a 5 hour pressure decay on the gas side of the tanks.

b. Cycling of regulators and measuring water outlet pressure and flow rates (Para. 4.2.2.3.7.1).

Seq. 06: WMS Flush, Purge, Evacuation, and Blanket Pressure

a. Flush of WMS with water according to cleanliness spec.

b. Hot N_2 purge of WMS

c. Evacuation of WMS to 500 microns.

Test Description: (Cont)

d. N_2 fill and dew point verification.

e. N_2 blanket pressure

f. 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 relief capabilities.

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, 4.2.2.1.6, 4.2.2.1.7).

a. Determine upper and forward hatch torque required to lock and open with latching mechanism.

b. Proof pressure cabin with nitrogen to 7.7 psig for 1 minute.

c. Determine cracking pressure of Upper Hatch.

Seq. 03: Cabin and Docking Tunnel Leak Test and Cabin Relief/Dump Valve (FWD) Functional Test (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 (Para. 4.2.2.3.5.7)

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.

Seq. 05: Cabin Relief/Dump Valves Functional Test (Para. 4.2.2.3.5.3)

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 and latching torque. Test at Ambient Pressure in cabin.

Seq. 06: Securing After Test

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 5 minutes.

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 five (5) minutes.

c. The system upstream of regulators is vented through port GF9150 to 1150 psig.

d. The system downstream of regulators is vented thru port of GF9118 to ambient.

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. 4.2.2.3.5.6)

a. Helium is evacuated from system through port GF9118.

b. System is pressurized with GOX through GF9150 in 2 steps, first to 1400 psig, then 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.

Test Description: (Cont)

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.

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 900 psig with GN_2 through GF9150.

c. Vent system through GF9118 to ambient.

d. Pressurize Descent Stage GOX Tank to 900 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 and Gas GF9108, GF9109

Lines and Fittings

Test Description:

Seq. 01: Call to Stations

Seq. 02: D/S WMS Proof Pressure Test and Decay Check (Para. 4.2.2.3.7)

a. Pressurization of inside and outside of tank bladder simultaneously to 65 psig, with helium.

b. Pressurization of the system from 49 to 51 psig for a two (2) minute decay check with a maximum allowable decay of 1 PSI.

Test Description: (Cont)

Seq. 03: D/S WMS GHe Leak Test (Para. 4.2.2.3.7)

a. External leak check of D/S water tank, lines, and fittings.

b. Repair or replacement of any item where leak rate exceeds $2X10^{-7}$ SCC/SEC, indicated.

c. Venting of the system to a pressure of 5 psig.

Seq. 04: Securing After Test

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 high pressure WMS network including tanks, lines and fittings.

b. Verification of maximum indicated leak rate at any single point from the tanks to the WMS module of $4X10^{-8}$ SCC/SEC.

Vehicle Configuration:

Ascent Stage

Location:

Cold Flow Test Facility

Hazardous Operation:

Water line pressures up to 65 psig.

Components Under Test:

WMS high pressure lines and fittings less module.

Test Description:

Seq. 01: Call to Stations

Seq. 02: A/S WMS Proof Pressure Test (Para. 4.2.2.3.7)

a. Pressurize WMS to 65 psig and hold for one minute.

Seq. 03: Pressure Decay Check (Para. 4.2.2.3.7)

a. Pressurize WMS to 49 to 51 psig and hold for two minutes. Verify decay is less than 1 psi.

Seq. 04: A/S WMS GHe Leak Test- High Pressure Side (Para. 4.2.2.3.7)

a. External leak check of all tanks, lines, and fittings in the high pressure system.

Test Description: (Cont)

Seq. 05: Venting

a. Vent all lines to a pad pressure of 5 psig helium.

Seq. 06: Securing After Test

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 5 minutes (Proof Pressure Test) (Para. 3.1.3.2.3)

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).

Test Description: (Cont)

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).

Seq. 03: D/S Primary HTS Pressure Decay Test

a. Pressure Decay Test of the D/S HTS with nitrogen at 45 psig for two hours.

Seq. 04: Securing After Test

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

Test Title:

Pulse Code Modulation and Timing Electronics Assembly Turn-On and Verification

Subsystem:

Instrumentation

Test Objectives:

a. Verification of the functional operation of the Pulse Code Modulation and Timing Electronics Assembly.

b. Verification of the synchronization of the Acceptance Checkout Equipment with the Airborne Pulse Code Modulation and Timing Electronics.

c. Verification of data transmission by the Pulse Code Modulation and Timing Electronics Assembly of:

1. Calibration Voltages

2. Mission Elapsed Time

3. Format words in assigned time slots

Vehicle Configuration:

Ascent Stage

Location:

Integrated work stand, Plant 5 CEF

Hazardous Operation:

Not applicable

Component Under Test:

LSC 360-2-5-8 PCMTEA

Test Description:

Seq. 01-000: Call to Stations

Seq. 02-000: Verification of GPS and ACE-S/C activation.

Seq. 03-000: Verification of Pulse Code Modulation and Timing Electronics Assembly and signal verification (Para. 4.2.2.12.2(c))

Seq. 03-005: Verification of PCMTEA timing signals as measured at the GSE connector. (Para. 4.2.2.12.2.1(a))

Test Description: (Cont)

Seq. 04-000: Verification of PCMTEA/GSE umbilical interface high-bit rate (Para. 4.2.2.12.2.1.1)

04-003: Verification of 85 PCT HL calibration voltage

04-004: Verification of 15 PCT HL calibration voltage

04-005: Verification of format identification word 00011011

Seq. 05-000: Verification of PCMTEA mission elapsed time reset. (Para. 4.2.2.12.2.1.1)

05-006: 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

06-002 Verification of prime frame synch (Para. 4.2.2.12.2.1.1)

06-006: Verification of PCMTEA hi bit to low bit rate switchover (Para. 4.2.2.12.2.1.1).

Seq. 07-000: Verification of PCMTEA umbilical interface lo bit rate (Para. 4.2.2.12.2.1.2)

07-002: Verification of 85 PCT HL calibration voltage.

07-003: Verification of 15 PCT HL calibration voltage.

07-004: Verification of format identification word 11100100.

Seq. 08-000: Verification of PCMTEA lo bit to hi bit rate switchover (Para. 4.2.2.12.2.1.2)

08-002: Verification of prime frame synch (Para. 4.2.2.12.2.1.2)

Seq. 09-000: Verification of 204.8 KHZ crystal oscillator failure detector circuit (Para. 4.2.2.12.2.1.2 & 4.2.2.12.2.1.1)

a. Verification of internal osc failure detector discrete signal

b. Verification of internal osc failure detector analog signals with the LGC off

Seq. 10-000: Securing After Test

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

Test Description: (Cont)

Seq. 02: Verification of support system status

Seq. 03: Verification of displays turn-on

Seq. 04: Verification of 0-5 VDC analog channel

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

Seq. 21: ISG CWEA test preparation

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)

Test Description: (Cont)

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)

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)

Test Description: (Cont)

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)

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 -6VDC 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)

Test Description: (Cont)

Seq. 76: Verification of RGA 1PH pickoff, 0.8 KHZ channel (Para. 4.2.2.12.4)

Seq. 77: Verification of inv. bus volt 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)

Seq. 84: Verification of L/R ant. temp. channel (Para. 4.2.2.12.4)

Seq. 85: Verification of R/R ant. loop channel (Para. 4.2.2.12.4)

Seq. 86: Verification of temp S-band ster. ant. channel (Para. 4.2.2.12.4)

Seq. 87: Verification of master alarm relay driver redundancy (Para. 4.2.2.12.4)

Seq. 88: Verification of CWEA Pwr Caution (Para. 4.2.2.12.4)

Seq. 89: Securing After Test

Test Title:

D/S Fluid System Test Harness Electrical Check and Preliminary Dry Structural Integrity Check

Subsystem:

Descent Stage Propulsion

Test Objectives:

a. Verification of the vehicle/facility compatibility of parts of the electrical interface wiring harnesses.

b. Verification of responses of fluid control and monitoring devices in the Descent Stage Propulsion Subsystem to known stimuli, and identification of sensor output channels at the Ascent Stage - Descent Stage Interface.

c. Establishment of a confidence level in the structural integrity of the low pressure lines and tanks in the Descent Stage Propulsion Subsystem prior to the performance of other checkout procedures at Cold Flow.

d. Preliminary verification of the helium external leakage integrity of the propellant feed section and associated hardware.

Vehicle Configuration:

Descent Stage

Location:

Cold Flow Facility.

Hazardous Conditions:

Helium high pressure manifold up to 1000 psig. Helium low pressure manifold up to 253 psig. Propellant Tanks up to 257 psig.

Equipment Under Test:

Pressure transducers and wiring harness associated with the low pressure helium manifold and the propellant storage and feed sections.

Temperature transducers and wiring harness associated with the propellant feed section.

Propellant storage and feed sections. Low pressure helium lines, engine bleed and drain lines.

Latching solenoid valves and wiring harness associated with the helium high pressure manifold and the thrust neutralizer ports.

Test Description:

Seq. 01: Call To Stations

Seq. 02: Deleted

Seq. 03: Deleted

Seq. 04: Descent Propulsion Subsystem Pressurization and Propellant Feed Sections Harness/Dry Structural Integrity Check

Test Description: (Cont)

a. Venting of low pressure helium manifold and propellant storage and feed sections to ambient pressure.

b. Comparison of expected indications with electrical responses of the following transducers (at ambient pressure). (Para. 4.2.2.12.3.1)

1.	Pressure, He Regulator Outlet Manifold	GQ3018P
2.	Pressure He Reg. 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
7.	Temperature, Fuel Tank No. 1 Bulk	GQ3718T
8.	Temperature, Fuel Tank No. 2 Bulk	GQ3719T
9.	Temperature, Oxidizer Tank No. 1 Bulk	GQ4218T
10.	Temperature, Oxidizer Tank No. 2 Bulk	GQ4219T

c. Pressurization of the fuel storage and feed section to approximately 55 psig through port GQ9441; comparison of outputs of transducers in (b) above to expected indications.

d. Pressurization of the oxid feed section to approximately 55 psig through port GQ9440; comparison of outputs of transducers in (b) above to expected indications.

e. Pressurization of the entire propellant storage and feed section to approximately 125 psig through ports GQ9440 and GQ9441; comparison of the expected indications with electrical responses of the following transducers:

1.	Press He Reg Outlet Manifold	GQ3018P
2.	Press He Reg Outlet Manifold Redundant	GQ3025P
3.	Press No. 1 Fuel Tank Ullage	GQ3501P
4.	Press No. 1 Oxid Tank Ullage	GQ4001P
5.	Press Eng. Interface Fuel	GQ3611P
6.	Press Eng. Interface Oxid	GQ4111P

f. Pressurization of the entire propellant storage and feed section to approximately 205 psig through ports GQ9440 and GQ9441.

g. Pressurization of the fuel and oxidizer burst disc/relief valve cavities to approximately 80 psig through ports GQ9444 and GQ9445.

h. Disablement of the helium secondary regulator by closing the helium secondary solenoid valve and opening the helium primary solenoid valve.

Test Description: (Cont)

i. 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

j. Pressurization of the helium high pressure manifold to approximately 520 psig through port GQ9404 and 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

k. Venting of helium low pressure manifold to approximately 220 psig through port GQ9425.

l. Disablement of the helium primary regulator by closing the helium primary solenoid valve and opening the helium secondary solenoid valve.

m. Repressurization of the helium high pressure manifold to approximately 520 psig through port GQ9404 and low pressure manifold to secondary helium regulator lockup pressure.

n. Leak checking of flight half quick disconnects listed below, using liquid displacement leak detector:

   1. GQ9440

   2. GQ9441

o. Leak checking of flight half quick disconnects listed below with dust caps installed, using mass spectrometer leak detector:

   1. GQ9440

   2. GQ9441

p. Pressurization of helium high pressure manifold to approximately 1000 psig through port GQ9404.

q. Pressurization of oxidizer tanks to approximately 255 psig through port GQ9440.

r. Comparison of expected indications with electrical responses of the following transducers:

Test Description: (Cont)

1. Pressure, No. 1 Oxidizer Tank Ullage GQ4001P

2. Pressure, Engine Interface Oxidizer GQ4111P

s. Rapid venting of oxidizer ullage pressure from approximately 255 psig to approximately 200 psig in 15 seconds or less, using port GQ9452.

t. Venting of oxidizer burst disc/relief valve cavity to ambient pressure.

u. Pressurization of fuel tanks to approximately 255 psig through port GQ9441.

v. Comparison of expected indications with electrical responses of the following transducers:

1. Pressure, No. 1 Fuel Tank Ullage GQ3501P

2. Pressure, Engine Interface Fuel GQ3611P

w. Rapid venting of fuel ullage pressure from approximately 255 psig to approximately 200 psig in 15 seconds or less, using port GQ9453.

x. Venting of fuel burst disc/relief valve cavity to ambient pressure.

Seq. 05: Propellant Feed Section Dry Leak Check

a. Venting of propellant tank pressures to 195 to 210 psig.

b. Leak checking of propellant feed section from check valves to engine interface. (Para. 4.2.2.8.3.2. (b) (5)).

c. Venting of helium manifolds and propellant feed section to pad pressure.

Seq. 06: Deleted

Seq. 07: Propulsion Transducer Blanket Pressure Readout (Para. 4.2.2.12.3.1)

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

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

Test Description (Cont)

Seq. 08: Deleted

Seq. 09: Solenoid Latching Valve Channel Identification (Para. 4.2.2.12.3.1)

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

Seq. 10: Leak Check of Engine Bleed Lines

a. External helium leak checking of following lines at approximately 250 psig:

1. Oxidizer Low Point Drain Line.
2. Oxidizer High Point Bleed Line.
3. Fuel Low Point Drain Line.
4. Fuel High Point Bleed Line.
5. Pre-Valve Test Shutoff Valve Line.

b. Venting of above lines to ambient pressure after respective leak checks.

Seq. 11: Propellant Tank Temperature Transducer Partial Channel Identification (Para. 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 increases in outputs of above transducers.

Test Description (Cont)

Seq. 12: Pressure Transducer Partial Channel Identification

a. Comparison of expected indications with electrical response of the following transducers (with pad pressure applied): (Para. 4.2.2.12.3.1).

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 pressure transducers above and verification of appropriate channel output loss.

Seq. 13: Securing After Test

Test Title:

Feat/EMC 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) Quads & TCA CB turn-on.

e. INSTR. PCM Telemetry turn-on; Hi Rate, controlled externally via LUT umbilical path. (Para. 4.2.2.2.2(D2))

f. PCM/TE calibration level readout (Para. 4.2.2.12.2.1.1)

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 LM LVT-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. Resetting 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 XMTER Power Verification and S-Band Power Measurements

a. Activation and c/o of pri and sec S-band. (Para. 4.2.11.1.5.2)

b. Activation and 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.

Test Description (Cont)

k. S-band voice check.

l. S-band/intercom voice intelligibility test.

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 verify mission timer lighting. (Para. 4.2.2.9.3)

e. Event timer ON/STOP/RESET and verify 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

Test Description: (Cont)

Seq. 012: AC/DC BUS C/W Trip Level Checkout

a. DC BUS trip level check.

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. (Para. 4.2.2.3.2)

5. Torn suit protection.

6. Cabin suit 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.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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. Selection of cabin controls.

d. Setting ACE-S/C control room recorders.

e. RGA SMRD verification.

f. Verification of start stop buttons are off.

g. Activation of engine control circuit.

h. 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. Activation of the engine control circuits.

e. ACE counter setup.

Seq. 022: Activation of Radars

a. Activate LR coolant unit.

b. Cabin control setup for LR activation.

c. Landing radar activation.

d. LR gain states and BTC signal checkout.

e. Landing radar self-test. (Para. 4.2.2.5.8.1)

f. LRAA to hover.

g. LRAA to descent.

Test Description: (Cont)

h. RNDZ radar activation.

i. RNDZ radar 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 checkout.

b. Activation 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.

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.

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.

Test Description: (Cont)

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.
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.

Test Description: (Cont)

Seq. 028: Descent Engine Manual Start/Stop Functional Checkout

a. DES ENG controls activation.

b. ED master arm activation and verification.

c. ED DESC 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.

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. Dearm 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.

Test Description: (Cont)

f. ACE 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.

c. Interrupt PGNS interface to AEA.

d. Counteractivation 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.

Test Description: (Cont)

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 .2 volts DC below trip level (C&W).

5. Adjust power supplies 1 and 2 feeding low taps to .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.

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.

Test Description: (Cont)

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 CCMM primary amplifier and diplexer.

18. Activate landing radar.

19. Set up landing radar for standard test condition number 8A.

19A. LR caution warning test (LM5 ONLY - 62000 for LM6 and subsequent).

20. Strobe landing radar.

20A. Obtain forward and lateral velocity and altitudes 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 SE bus are below 26.0 VDC.

26. Dynamic test instructions.

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.

Test Description: (Cont)

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 tape 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.
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.

Test Description: (Cont)

25. Obtain and record ALT reading via ALT/ALT RT meter.

26. Obtain and record PQGS fuel and OXID readings initiated via R and C 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/turn angles.

43. Activate/deactivate RR brush recorder.

44. Scan LR preamps (DI zero angle then D1 90 angle).

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.

Test Description: (Cont)

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 course 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.

1. BATT 5 normal and backup feed to bus on.
2. DES BATT high taps off bus via deadface.

Test Description: (Cont)

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 .2 volts DC below trip level (C&W).

9. Adjust power supplies 1 and 2 feeding low taps to .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 PTT-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.

25 Strobe landing radar.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

10. CDR deactivate audio S-band.
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.

Test Description: (Cont)

34. Obtain and record PQGS fuel and OXID readings initiated via R and C starts.

35. Activate/deactivate speed controls of ACE recorders.

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 or 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.

Test Description: (Cont)

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 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).

Test Description: (Cont)

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. 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.

Test Description: (Cont)

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.
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. 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.

Test Description: (Cont)

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.
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.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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 course 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.

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).

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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.

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 dynamic 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.

Test Description: (Cont)

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.

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 0.2 volts dc below trip level (C&W).

Test Description: (Cont)

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.
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.

Test Description: (Cont)

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 CCW 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.

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.

Test Description: (Cont)

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.
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.

Test Description: (Cont)

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).

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.

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 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 buss off.

15. Adjust inverter simulator to 400 Hz.

16. Verification of dynamic test.

Seq. 038: Major Mode Three (FCS), AGS Aborts.

a. Stop AEA memory noise test.

b. Interrupt PGNS/AGS interface.

c. Dump AEA memory.

d. Load AEA ABORT/ABORT STAGE program.

e. 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.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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.
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.

Test Description: (Cont)

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.
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 Condition 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.

Test Description: (Cont)

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.

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 COMM 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.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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.

a. AGS shutdown.

b. Displays shutdown.

c. RCS shutdown.

d. PROP shutdown.

e. CES shutdown.

f. COMM shutdown.

g. ECS shutdown.

h. DC power on bus via J167.

1. Close X-Ties.

2. Reset vehicle ground power.

3. Veh PWR to bus - EPS checkout interface unit.

4. ASC BATT off bus.

5. Set PS 4, 2, 3, 1 OFF on EPS C/O controller.

i. Instrumentation shutdown.

j. DC power via J166 turn-off.

k. EPS shutdown.

l. Turn-off ACE and FR1400 recorders.

B - Major Mode Four - Test 1, PGNS Auto Ascent.

a. Demate vehicle electrically.

b. Major mode four - Turn on.

1. Verify GSE coolant, annotate and turn-on ACE recorders and load files into GE computer.

Test Description: (Cont)

2. Power to bus via J166 and J167.
3. Activate ASC ECA'S - Close BATT feed ties and X-lunar bus ties.
4. Activate ascent power.
5. Activate BATT 5 and 6 normal feed to bus.
6. PCM turn-on.
7. Verify ASC BATT feed configuration via ACE.
8. Activate flight inverter 1.
9. Activate C and W.
10. Activate S-band ant heater.
11. Mission timer activation.
12. Event timer activation.
13. DUA activation.
14. Activate IMU standby power.
15. Activate LGC/DSKY power.
16. Verify PGNS status via ACE.
17. LGC self check activation.
18. Activate IMU operate power.
19. Verify PGNS status via ACE.
20. Activate IMU coarse align to zero.
21. Activate IMU operational test.
22. Initiate AGS turn-on.
23. Initiate D113 overlay.
24. Initiate AGS standby.
25. Verify AGS status via ACE.
26. Initiate AGS operate status.

Test Description: (Cont)

27. Perform DEDA EL checkout.
28. Verify/Load 7-10000102 and 7-10000204 in ACE.
29. Activate AEA self test.
30. Activate AEA error volt verification.
31. Activate counters for GSE - 5 monitoring.
32. Interrupt PGNS/AGS interface.
33. Load the load and verify routine into AEA.
34. Monitor GSE - 5 changing binary conditioner.
35. Load memory noise test program into AEA.
36. Verify load of memory noise test.
37. Initiate AEA memory noise test.
38. Activate PGNS/AGS interface.
39. RCS turn-on - System A/B Quad power.
40. RCS heater turn-on and monitor temp.
41. Activation of CES.
42. 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.

Test Description: (Cont)

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.

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 CCW limit.

Test Description: (Cont)

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.
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.

Test Description: (Cont)

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.
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.

Test Description: (Cont)

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.
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.

Test Description: (Cont)

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.
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.

Test Title:

FEAT/EMC Mission Oriented Plugs-Out Test

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, Plt 5.

Hazardous Operations:

Not Applicable.

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.

Test Description: (Cont)

Seq. 02: Bus Power On via J167 (Para. 4.2.2.2.(c2)

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 4.2.2.1.2.2.1.1)

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

Seq. 07: Descent LV Turn-On/LUT Reset (Para. 4.2.2.2.2 (d))

Test Description: (Cont)

a. LV turn on via EPS interface unit and monitor battery currents continuously until high voltage switch over.

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 D025 program to verify batter 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.e)

a. SLA separation

b. Flooplights 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 Descent 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 flood light via docking hatch switch and lighting switch.

c. Switchover to Inverter #2

d. Turn-on Numeric and integral Lighting.

Test Description: (Cont)

e. Verify operation of Integral lights.

Seq. 11: Activate and Checkout Caution and Warning System (Para. 4.2.2.1.2.4)

a. Turn on C&WEA displays

b. C&WEA Self-Test

c. Lighting Control override check

d. Verification of flood lights

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)

d. Zero PT. C/O

e. Descent H_2O Tank Low Level C/O

f. 100% PT C/O and regulator check

Seq. 13: Activate & C/O WMS (Para. 4.2.2.3.7.1 & 4.2.2.3.7.2)

a. Pressurized Ascent Water tank C/O

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 & C/O ARS (Para. 4.2.2.3.6.1)

a. Checkout of the following ARS component.

1. Suit fan

2. Water separator

3. Suit gas diverter C/O

Seq. 15: ARS redundant mode C/O (Para. 4.2.2.3.5.1.1 & 4.2.2.3.2)

Test Description: (Cont)

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 O_2 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 circuitry.

Seq. 17: Activate UHF Voice Communication

a. Connect flight headsets to GSE Adapter cables.

b. Turn-on UHF A&B transceivers, LMP & CPR's audio.

c. Demonstrate Voice Communications uplink and downlink between CTS and LMP via VHF A.

d. UHF A Test Transmitter.

Seq. 18: S-Band Checkout

a. Checkout S-Band Omni Fwd.

1. Verify voice communications via S-Band secondary system and omni antenna #1.

2. Verify LMP voice communication via CDR S-Band link.

3. Verify voice communications via S-Band Primary system and Omni antenna #2.

b. Ranging Function Checkout

1. Ranging delay check

Test Description: (Cont)

c. FM Modulation Checkout

d. Checkout of S-Band Aft Antenna

e. VHF-A Checkout of CDR Voice Communications

Seq. 19: Activate Subsystems

a. Activate subsystems circuit breakers

b. DES LV to HV Switchover (if not previously performed)

Seq. 20: 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. 21: PGNS Activation (Para. 4.2.2.12.4)

a. LGC/DSKY Power turn-c

b. Initiate LGC error reset program.

c. LGC self-check via DSKY

Seq. 22: C/O Mission Timer (Para. 4.2.2.9.3)

Seq. 23: Propellant and Helium Checkout (Para. 4.2.2.8.3.3 (n (b))

a. Verification of Temperature and Pressure readings associated with Propellant and helium tanks.

1. PQGS Sensor Test Dry Checkout

Seq. 24: 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 grey.

Seq. 25: 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

Test Description: (Cont)

c. Verify ACE - S/C decommutator lock-up (Lo Bit Rate) & PCM calibration measurements.

d. Verify transmission of low-bit-rate split-phase RZ PCM data to CM via VHF Channel B.

e. Verify relay of S-Band voice backup 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. 26: Maintain Communications with MSFN

a. CSM to LM to MSFN voice conference.

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 decent engine to center GDA'S.

Seq. 28: Pressurize RCS (Para. 4.2.3.1.0.2(a)d)

a. Set Master ARM SW and RCS HE Press SW to C/O associated Simulators & C&WEA.

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 and Caution & Warning indications are verified for proper operation.

Seq. 31: Deploy Landing Gear (Para. 4.2.2.10.4 (b) & 4.2.2.10.2)

a. Command appropriate ED simulators to fire and verify associated CAUTION lights.

Test Description: (Cont)

Seq. 32: Activate and C/O AGS (Para. 4.2.2.6.5.3)

a. AGS Turn-on and set to Standby.

b. Verify ASA temperature (F) is within spec limits.

1. Verify ASA temperature stabilizes within ± 3Deg 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 measurements.

Seq. 35: Checkout LM Relay of CSM Data to MSFN

a. Verification of VHF A (LMP) voice relayed via S-Band to CTS.

Seq. 36: 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. 37: 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

Test Description: (Cont)

Seq. 38: 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. 39: 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. 40: Activate and Deactivate Docking Lights (Para. 4.2.2.2.5)

a. Checkout docking light operation.

C. Separation and First DPS Burn

Seq. 41: Load and Initialize for RCS Maneuver DPS Burn

a. Verify jet driver outputs for -X translation initiated at the DSKY.

Seq. 42: Select Modes for First DPS Burn

Seq. 43: 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.

Test Description: (Cont)

2. DES Start He. Press.

d. Verify jet driver 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. 44: C/O Tracking Light (Para. 4.2.2.2.5)

a. Turn-On, checkout, and turn-off tracking light.

Seq. 45: 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. 46: 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. 47: Initiate FCS Profile for Second DPS BURN and Self Check of LR. (Para. 4.2.2.5.9.3)

a. Turn on LR air conditioner.

b. Activate LR.

c. Monitor LR temperature via cabin meter and ACE readouts.

Test Description: (Cont)

d. Load DUA tape #40.

e. Dynamic Test instructions.

f. Suit Fan & Glycol turn-on.(Para. 4.2.2.3.3)

1. 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. 48: 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. 49: 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

Test Description: (Cont)

e. Verify Operation of CDR's TTCA

f. Verify Both Engine Stop Switches

g. Leave TTCA in up (max) position.

E. Lunar Stay

Seq. 50: 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. 51: Deactivation of Subsystems

a. CES Power down

b. Vent Descent Fuel-Ox

Seq. 52: Checkout of EPS (Para. 4.2.2.2.4)

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 and 6 normal feeds.

Seq. 53: 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. 54: De-activate PGNS - Lunar Stay

a. Coarse align via DSKY

b. De-activate IMU operate power

Test Description: (Cont)

Seq. 55: Lunar Stay Comm C/O and PLSS Test (Para. 4.2.2.11.1.7.2.1 & 4.2.2.11.1.7.4)

a. S-Band Set-up, Low power config. (no pwr amp)
   1. Lo Bit rate (1.6K bits/sec.) PCM
   2. TV Transmission - Hi and Lo frame rate
   3. Relay of EVA voice and bio med. data to MSFN

. VHF Set Up:
   1. Voice relay of MSFN to EVA
   2. Dual EVA - Both CDR and LMP using PLSS space Suit Comm Systems. (TBD)

F. Pre-Launch

Seq. 56: 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. 57: 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. 58: 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

Test Description: (Cont)

Seq. 59: Checkout AGS (Para. 4.2.2.6.5.3)

a. AEA Self-Check

1. Monitor ASA temp.

Seq. 60: C/O Event Timer (Para. 4.2.2.9.2)

Seq. 61: Select Mode for Ascent

a. Configure cabin for ascent.

Seq. 62: 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. 63: RCS/ASC Interconnect

a. Valves connecting RCS and ascent propellants are opened and verified.

G. Powered Ascent

Seq. 64: 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. 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

Test Description: (Cont)

f. Arm Ascent Engine

g. Start Event Timer

h. Monitor Auto Engine On/Off During Profile

i. Set Recorders for Dynamic Run

j. Monitor Jet Firings during Profile

k. Set Recorders for Static Run

l. De-Arm Ascent Engine

m. Reset Event Timer

n. Verify ED Simulators were Fired.

Seq. 65: 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. 66: 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. 67: 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

Seq. 68: 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

Test Description: (Cont)

Seq. 69: 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. 70: AGS Abort-Abort Stage (Para. 4.2.2.6.5.9 & 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. 71: 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. 72: Securing After Test S&C Shutdown

a. CES power down

b. Turn off heaters

c. Flight displays shutdown

d. Comm. shutdown

e. Lighting shutdown

f. EPS shutdown

1. Inverter #2 turn off

2. Verify cross tie bus' close

Test Description: (Cont)

Seq. 72: (Cont'd)

g. ECS shutdown

1. Turn off primary TCU

h. Instrumentation shutdown

i. GSE shutdown

Seq. 73: LV to HV Switchover

a. Perform the Descent LV to HV switchover if and when the D.C. Bus Voltage's falls below 27.0 V.D.C. during the running of this OCP.

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 conditons.

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 functionally 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

Test Description: (Continued)

parallel operation of the final sequences to verify performance of ECS, PROP, COMM and EPS.

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:

To verify pump parameters and the response of the Heat Transport Section (HTS) to the cabin temperature control valve settings.

To verify the performance of the Atmosphere Revitalization Section (ARS).

To verify the operation of the ECS Operational Instrumentation.

To verify the operation of applicable ECS portions of the Caution and Warning Subsystems.

To verify the integrated performance of the HTS and ARS.

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.

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.

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, Plt. 5

Hazardous Operation:

Pneumatic pressures up to 250 psig

Equipment Under Test:

Water Control Module (All Valves & Regs.
Suit Circuit Assembly
Oxygen Control Module (All Valves)
Cabin Air Recirculation Assy (H/X & Fans)
ECS Relay Box
Water Glycol Pumps (Both Prim. & Sec.)
Water Glycol Accumulator

Equipment Under Test: (Cont)

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 Stations

Seq. 02: Water Management Section

a. WQMD Calibration

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

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).

1. Low level (10 pct) of D/S water tank

2. Non-full condition (95 pct) of either or both A/S water tanks

3. Unequal level (15 pct difference) between the two A/S water tanks.

c. WMS GN_2 Flow Tests

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)

Test Description: (Cont)

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 and 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)

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

Test Description: (Cont)

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. 4.2.3.3)

1. Verify suit fan 2 failure input to the 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.

Test Description: (Cont)

2. Verifies the primary and secondary low glycol accumulator level input 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 PFR.

4. Verify springload of primary and secondary accumulator 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.

Test Description: (Cont)

Suit Circuit Assembly - Heat Transport Section Interface Functional Test (Normal Mode, 4.8 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 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

3. Drain H_2O accumulated in 'canned-man' (LSC 4302-91033-11) 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.

Test Title:

LM Combined Subsystem Pre-FEAT Test - INSTR

Subsystem:

Instrumentation

Test Objectives:

a. To turn-on the LM Instrumentation Subsystem and to provide minimal verification of the adequate operation of the PCMTEA.

b. To test the logic of those CWEA data channels available at the SCEA GSE connectors.

Vehicle Configuration:

1. Planned - Electrically connected stages (Ascent and Descent)
2. Minimum - Ascent Stage with staging interconnections shorted to simulate attached Descent Stage

Location:

Integrated Test Stand, Plant 5 CEF

Hazardous Conditions:

Not Applicable

Equipment Under Test:

PCMTEA
SCEA #1
SCEA #2
CWEA
Selected Transducers

Test Descriptions:

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.

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

Test Description: (Cont)

Seq. 004: CWEA Stimuli Generator Test

a. CES AC Warining

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

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)
Lighting Control Assembly (LCA)
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 4.2.2.2.2.C2)

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 & Seq. 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

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.

Test Description (Cont)

Seq. 08
&
Seq. 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 contractor 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 and k)

2. Response to simulated over-current condition.
(Para. 4.2.2.2.3.2 a,b,c and 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 LMP'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 LMP'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 sub-assembly, of: (Para. 4.2.2.2.2 a2)

1. Battery high voltage main feeder contractor operation

2. Battery low voltage main feeder contractor 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

Test Description: (Cont)

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. 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. 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. 31: Redundant EPS CB Verification

a. Verification of Commander's and LMP'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)

Seq. 32: DC Bus Isolation

a. Verification of isolation between Commander's DC bus and LMP'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 ECS power contactors.

Seq. 36 & Seq. 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 de-energized LMP's bus shorted to ground (bus tie circuit breakers open)

2. Energizing LMP's bus with de-energized Commander's bus shorted to ground (bus tie circuit breakers open)

Test Description: (Cont)

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 Commander's DC bus then the LMP's DC bus.

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 overcurrent. (Para. 4.2.2.2.3 P/O b)

Seq. 49: Descent ECG Low Voltage Taps On

a. Preparation of descent battery taps for following sequences (Para. 4.2.2.2.2 P/O a)

Test Description: (Cont)

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)

Seq. 59: Configuration for EPS Support

a. Verification that EPS Subsystem is secured and prepared to support other subsystem testing.

Seq. 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73 74: Lighting Tests (Para. 4.2.2.2.5 a)

a. Verification of power failure indicator (PFI) lights using Lighting Test Set (LTS)

b. Verification of integral lighting and override control using LTS.

Test Description: (Cont)

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 GSE 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 subsystems.

k. Verification of numeric lighting outputs from LCA.

l. Provision for demating Lighting Test Set.

m. Verification of numeric 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)

o. Verification of annunciator light 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)

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: ED Resistance Measurements

a. Establish RRA and RTS resistance measurements for system A and system B.

b. Verification of correct panel and relay configuration and operation.

Test Description: (Cont)

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

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

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 circuitry and panel controls and displays.

b. Mating of ED battery to 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 b 1)

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 b 1)

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 b 1)

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 b 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 b 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)

Test Title:

LM Combined Subsystem Pre-FEAT Test -G&N

Subsystem:

Guidance and Navigation

Test Objectives:

a. To verify normal operation of the Guidance and Navigation power supplies and IMU temperature control circuitry.

b. To operationally check the LM Guidance Computer and DSKY.

c. To verify accuracy of the LGC clock.

d. To verify operation of the computer control and reticle dimmer assembly.

e. To verify dynamic operation of each Gimbal stabilization loop.

f. To verify operation of each Gimbal torquing loop.

g. To verify proper operation of turn-on and shutdown procedures.

h. To verify that the G and N subsystem is operationally ready to support further vehicle integrated testing.

i. To verify all stimuli and response between ACE-S/C and G and N subsystem.

j. To verify proper operation of the LGC at high and low operating levels of the LGC +4 and +14 VDC power supplies.

k. To verify PIPA and IRIG operation during IMU operational test.

l. To verify IMU CDU moding, CDU repeating accuracy, CDU command accuracy, CDU command rate, and FDAI linearity test.

m. To verify signal conditioning assembly/PCM interface.

n. To obtain and verify IRIG scale factor error for each IRIG.

o. To obtain and verify PIPA bias and scale factor error for each PIPA.

p. To obtain and verify stable member normal bias drifts about the input axes of the IRIG's (NBDX, NBDY, NBDZ).

q. 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)

r. 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).

s. 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.

t. 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.

Min 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 and Heater Current Test

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.

Test Description: (Cont)

1. High + 14VDC High + 4VDC

2. High + 14VDC Low + 4VDC

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 computated 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 Power Turn-On

a. Application of IMU Operate Power.

b. Verification of G&N ACE-S/C Measurements.

Seq. 11: Temperature Control Verification Test

a. 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 Operational Test

a. 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

a. Verifies the IMU, CDU repeating accuracy, CDU command accuracy, CDU command rate, FDAI and Gasta commands.

Test Description: (Cont)

Seq. 15, 16, 17: IMU Gimbal Friction Test

a. Determination of IMU Gimbal friction levels of the outer, inner and middle gimbal by means of gimbal torquing through positive and negative angles.

Seq. 18, 19, 21: IMU Gimbal Step Response Test

a. 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

a. 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 ± X, ± Y, ± 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).

Test Description: (Cont)

d. Comparison of results with last three sets of lab determined parameters.

Seq. 25,
and 26:

a. Provision in OCP for performance of two additional runs of IMU Performance Test if out of tolerance conditions are shown by the comparison.

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. Aximuth scales set to zero.

Seq. 28: AOT Functional 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 manufacturer's 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 true azimuth and elevation of optical targets.

Test Description: (Cont)

c) Measurement of optical target shaft and trunnion angles by AOT.

d) Entry into 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

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

a. The transfer of G&N system from the operate to standby mode, for support of related OCP.

Test Description: (Cont)

Seq. 33: G&N Standby Mode to G&N Operate Mode

a. 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/C 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 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))

b. Recording of APS pressure 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)

Test Description: (Cont)

c. Recording of 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. 4.2.2.9.1 (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. 4.2.2.12.2.1 (a) and (b))

c. Venting of 'He Tank No. 1' to blanket pressure and Channel ID of Tank No. 1 Temp Transducer by:

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) and (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:

. 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) and (b))

c. Venting of 'He Tank No. 2' by blanket pressure and channel ID of tank No. 1 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) and (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))

Test Description: (Cont)

b. Verification of APS Fuel Tank Ullage Press and Fuel Isol Valve Inlet Press Transducers and Fuel Tank Transducer end-to-end checks by:

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 pressure

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 Fuel 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 output 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 individual 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) and (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) and (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 and b))

Test Description: (Cont)

6. Application of heat to Fuel Tank #2 transducer only

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 and 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 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 transudcer 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 and 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 and 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 #1 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) (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 and b))

Seq. 16: PQGS Sensor Test Dry

a. Verification of the PQGS Dry Sensor Test by:

Test Description: (Cont)

1. Application of a known voltage stimuli (contact closure) to the control unit (PQGS) (Para. 4.2.2.8.3.3 (n) (b1))

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 'PRPLNT 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 and 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 and 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. Application of vehicle power to the low level sensor.

   2. Recording of the Prop Lqd Level Low sensor warning indications at the proper ACE display. (Para. 4.2.2.12.2.1 (b))

   3. 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))

Test Description: (Cont)

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 and b))

b. Channel ID of the No. 1 Tank Fuel and Oxid sensors versus the No.2 sensors by:

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 a 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. 4.2.2.9.1 (a and b))

4. Reversal of the known voltage stimuli to Tanks No. 1 and 2.

5. Recording of the complete known reversal of the sensor outputs between Tanks No. 1 and 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 and 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 Engine 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.

Test Description: (Cont)

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.

c. 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 stimuli 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 "Blowdown" 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:

Test Description: (Cont)

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.

3. Repeat of same procedural steps of item b1 thru b6, 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.

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 be 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.

Test Description: (Cont)

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.

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

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)

Test Description: (Cont)

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. 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 attentuation. (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)

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)

Test Description: (Cont)

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. (Par. 4.2.2.11.1.2 f)

Seq. 09: VOX Sensitivity Test LMP

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)

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)

Test Description: (Cont)

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 Sequence 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 sta.

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)
(Para. 4.2.2.11.1.5.2 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)

Test Description: (Cont)

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)
(Para. 4.2.2.11.5.2 e)

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 EVA 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)

Test Description: (Cont)

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.

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

Test Description: (Cont)

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. 3.1.3.10.5)

Seq. 46: Communications Shutdown

a. Normal procedure for placing vehicle equipment ERA's into dormant state.

b. CTS and support test equipment power-down.

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.)

d. Verification of POWER ON/LGC MODE discrete

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

Test Description: (Cont)

a. Verification of acquisition time.
(Para. 4.2.2.5.7.5)

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 Trunion 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 angles.
(Para. 4.2.2.5.7.6.1)

b. Check of the dynamic nulling characteristics.

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)

Test Description: (Cont)

Seq. 17: LR Self-Test Verification

a. Initiation of In-Flight Self-Test by means of cabin switch.

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)

Test Description: (Cont)

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.

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

Test Description: (Cont)

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.

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.

Crossfeed valves.

Equipment Under Test: (Cont)

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) Δ P 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) Δ P 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 activiation 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 veification 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. 4.2.2.74 (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, vis 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.

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 Description: (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 Ass'y Pulse Mode Checkout. IPara. 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.

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 IMP TEST TONE switch to test LUNAR CONTACT lights. Verification of manual reset of Lunar Contact lights.

c. Verification of operation of Lunar Contact lights via each redundant circuit, ATCA, and ENG CONT.

d. 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 (Controlled by LGC test program).

Seq. 16: PGNS ACA Checkout. (Para. 4.2.2.5.3(f), 4.2.2.5.13)

a. Verification of DES Rate switch of +1 FPS and -1 FPS command inputs to LGC.

Test Description: (Cont)

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 Card.

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 Ass'y Logic Checkout. (Auto Engine On/Off)

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.

Test Description: (Cont)

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.

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. 4.2.2.5.1.4(a))

a. Verification of FDAI's total attitude displays initiated by LGC Profile.

Test Description: (Cont)

Seq. 26: PGNS Automatic Descent. (Para. 4.2.2.5.9.1(a), 4.2.2.5.9.2, 4.2.2.5.9.3(a), (b), (c), 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 a 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.

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 a 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 for the following conditions:

1. Long fail malfunctions.

2. Short fail malfunctions.

3. Opposing jets malfunctions.

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.

Test Description: (Cont)

d. AEA internal power supply voltages.

e. AGS timing pulses.

Seq. 30: Data Entry and Display Ass'y (DEDA) Verification. (Para. 4.2.2.6.5.2, 4.2.2.6.5.3)

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)

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.

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.

Verification of AEA capability to drive FDAI's attitude error displays at minimum deadband, in response to AEA test program.

Test Description: (Cont)

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.

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.

Test Description: (Cont)

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.

e. Verification of AGS/PGNS alignment, utilizing DEDA and DSKY readouts.

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.

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.

Test Description: (Cont)

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 b 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.

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. Vertification (via AGS Program) of ATCA ascent limiter in yaw, pitch, and roll control loops. AEA test program is utilized to generate attitude error signals.

Test Description: (Cont)

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.
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.

Test Description: (Cont)

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 Objectives:

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

Communications Subsystem

Electrical Power Subsystem

Equipment Under Test: (Cont)

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:

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:

Pneumatic pressure in excess of 300 psig.

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 460 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 the 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.

END ITEM	NOMENCLATURE	3250	3913	3914		26007	26008	26022	26040	26041	27005	27006	27014	27015	27027	31030	31033	31034	32014	33030	36015	36527	61015	62000-ECS	62000-INST	62000-EPS	62000-EDS	62000-G&N	62000-PROP	62000-COMM	62000-RAD	62000-RCS	62000-FCS	70010
LDW 410-1110	Cable Set, Intercom																					x											
LDW 410-1210	Boxes, Breakout		x	x													x				x	x	x		x	x	x						x	
LDW 410-3240	GSE Signal Conditioner																					x								x				
LDW 410-6019	Panel Set, Ascent, Plug-In										x		x	x																				
LDW 410-6040	Control Station, RCS												x		x	x																		
LDW 410-6230	CAEC CF Wiring					x	x		x	x	x		x	x	x	x		x																
LDW 410-6045	Panel Set, Plug-In, Descent								x	x																								
LDW 410-6555	Test Cond. Pnl Assy									x						x																		
LDW 410-6640	Pneumatic Control Station					x		x	x	x	x			x	x					x														
LDW 410-6660	Cont Sta. Descent S/S					x	x	x	x	x	x	x	x	x	x																			
LDW 410-6700	Cont Sta. Ascent S/S						x			x	x	x	x	x	x																			
LDW 410-8510	Inverter Simulator																						x											
LDW 410-8800	Load Bank Electrical																									x								
LDW 410-11090	Cable Set GAEC Prod Test																		x		x	x	x	x	x	x	x	x		x	x		x	x
LDW 410-11270	Power Supply DC ACE-S/C																					x	x	x	x	x	x	x	x	x	x	x	x	x
LDW 410-11390	Cable Set, ASC/DES STG			x																														
LDW 410-11930	Console, ACE Carry-on																				x	x	x	x	x	x	x	x	x	x	x	x	x	x
LDW 410-12070	Test Set, Explosive Dev S/S	x																					x				x							
LDW 410-22040	Test Sta. RR/T & LR Maint.																		x				x								x			
LDW 410-31030	Adapter, RR & LR Microwave																						x								x			
LDW 410-32000	Fault Isolation Demod Unit																						x							x				
LDW 410-32030	Simulation Adapter Unit																													x				
LDW 410-32060	Adapt Assy VHF Inflt Ant																		x				x							x				
LDW 410-32150	Rack,Signal Patch &Switch																		x				x							x				
LDW 410-32200	Adapt Assy,S-Band Antenna																		x				x							x				
LDW 410-32280	Console, S-Band & COMM.																		x				x							x				
LDW 410-32520	Test Sta. RR/T & LR Maint.																						x								x			
LDW 410-62850	Station, C/O Prop, S/S																	x																
LDW 410-72021	Power Supply 10V, PCMTEA																				x	x	x		x									x
LDW 410-80031	GPI Monitor																									x								
LDW 410-81001	Interlock, VEH GNDPWR																		x				x			x								x
LDW 410-81060	Interface Unit EPS Checkout																		x			x	x			x								x
LDW 410-81070	Transformer, Power, 400 CP																		x							x								x
LDW 410-82090	Controller, EPS C/O																						x			x								
LDW 410-82140	Ground Power Supply, Vehicle																		x				x			x								x
LSC 410-9470	Intercom, Rack Mounted																		x															
LSC 410-11990	Ground Station, ACE-S/C																				x	x	x	x	x	x	x	x	x	x	x	x	x	
LSC 410-31020	Adapter, LR Antenna C/O																						x								x			
LSC 410-31058	Controller, Temp Initial																						x					x						
LSC 410-31080	Module PSA Adapt.																						x					x						
LSC 410-31120	Abort Sen Assy Port.																						x										x	
LSC 410-31180	AGS Line Driver																						x										x	

FOLDOUT FRAME A

FOLDOUT FRAME B

END ITEM	NOMENCLATURE	3103	3215	3326	3356	3357	3358	26007	26022	26040	26041	27005	27014	27020	27027	31030	31032	31033	31034	32014	32016	32020	33020	33024	33030	33067	36015	36527	61015	62000-ECS	62000-INST	62000-EPS	62000-EDS	62000-G & N	62000-PROP	62000-COMM	62000-RAD	62000-RCS	62000-FCS	70010
LSC 410-31210	Hat Coupler Landing Radar																												x								x			
LSC 410-32100	Test Assy, Digital Command																												x							x				
LSC 410-32120	Test Assy, Ranging																												x							x				
LSC 410-51190	Control Unit, ECS																												x	x										
LSC 410-82970	Test Set, Initiator Simul.																												x				x							
LSC 410-92232	Data Interleaving Sys.																										x	x	x		x									x
LSW 410-1097	D.C. Distribution Box																										x	x	x	x	x	x	x	x	x	x	x	x	x	x
LSW 410-1340	C&WEA Stimuli Gen.																											x			x									
LSW 410-2021	Station,Cont Unit,Test							x	x	x	x		x	x																										
LSW 410-2022	Base Control Supercritical He									x	x																													
LSW 410-3030	R/R Field, Test Bench																			x																				
LSW 410-3770	Ant.F/Space RAD																												x							x				
LSW 410-7900	Test Station, ISG																																							x
LDW 420-1100	Stand Bell Diffus. Atmos																									x														
LDW 420-1250	Kit, Transportation																						x		x															
LDW 420-6611	Kit, Pyro & ECI Reset Tool		x																																					
LDW 420-11000	Adapter Forward Hatch																							x																
LDW 420-11006	Fix, Umb Lines, Guillotine		x																																					
LDW 420-11010	Enclosure Cabin Clness																							x																
LDW 420-11262	Cover, Protective Floor																							x																
LDW 420-11430	Door, Docking Hatch																							x										x						
LDW 420-13360	Fix, Optical Align																																	x						
LDW 420-13371	Set, AOT Optical Target																																	x						
LDW 420-13390	Workstand Integrd LEM																																x							
LDW 420-13550	Dolly, Handling D/S									x																														
LDW 420-31040	Work Pltfrm Polarity Chkr.																												x											
LDW 420-41003	Tool Test LM Crew Comp.																												x	x	x	x	x	x	x	x	x	x	x	
LDW 420-42041	Booster Cartrge Inst Kit		x																																					
LDW 420-63120	Kit, Plug & Support A/S Eng.													x																										
LDW 420-63420	Adapter, Set D/S Hardmount									x																									x					
LDW 420-83112	Elec Con. Inststge Assy		x																																					
LSC 420-13440	Kit, Vertical Jacking													x																										
LSW 420-1207	Plat.Supt.Cbn,Clean Encls																							x																
LSW 420-2060	Set,Workstand,Cold Flow																							x																
LSW 420-6000	ECS Valve Remote Actuator																						x																	
LDW 430-1000	Cabin Air Supply Unit			x																				x		x														
LDW 430-1060	GN_2 Regulator Unit RCS	x						x				x				x		x	x			x																x		
LDW 430-1150	Cart RCS Vac Test Fuel							x	x		x	x	x		x	x		x							x					x										
LDW 430-2210	Fluid Distb Sys GCRM	x		x	x	x																							x	x										x
LDW 430-4100	Console, Cont,SP ,Suit																			x																				
LDW 430-4130	EMU Preflight C/O Assy																				x																			
LDW 430-5011	WaterGlycol Hose Set																												x	x										x

FOLDOUT FRAME

A.

FOLDOUT FRAME

B

APPENDIX 1 - GSE USAGE (Continued)

END ITEM	NOMENCLATURE	3103	3314	3326	3356	3357	3358	26007	26008	26019	26022	26040	26041	27005	27006	27012	27014	27015	27020	27027	27028	31008
LDW 430-5013	Hose Set Refrigeration Unit																					
LDW 430-5014	Hose Set Cabin Leak TS Unit																					
LDW 430-5020	FLU DIS SYS RCS PL 2 GCRM																					
LDW 430-5031	Cabin DNP, REL VLV Tester													x								
LDW 430-5510	Simulator, Internal Envir																					
LDW 430-6014	Eng Solenoid C/O Unit																		x			
LDW 430-6090	Ascent Engine Simulator													x				x		x		
LDW 430-6100	Unit-Calib Weight Tank							x						x								
LDW 430-6150	Descent Engine Simulator							x					x									
LDW 430-6201	TS Gage Unit Propulsion							x														
LDW 430-6320	Stand Stor Trans Sub Fuel							x			x		x	x				x		x		
LDW 430-6330	Stand Stor Trans Sub Oxid							x	x				x	x	x			x		x		
LDW 430-6440	Cart, Stor & Tran Sub Pro				x	x	x															
LDW 430-6580	Cart, Nitrogen Conditioning	x			x	x	x		x			x			x							
LDW 430-6582	Sfty Relf Unit BK Press												x									
LDW 430-6770	Distrib Sys Fluid Cold Flow							x				x	x		x							
LDW 430-6819	Sight Gauge Unit, Live Prop							x	x		x		x	x	x			x		x		
LDW 430-6860	Cart Freon Flush RCS	x																				
LDW 430-6940	Fluid Dist Sys													x	x		x			x		
LDW 430-6990	Syst Cont. Cell Press												x									
LDW 430-31220	Cooling Unit Lndg Radar																					
LDW 430-42020	Waste Mgt Syst Leak Test																					
LDW 430-51100	Accum H_2O Separator Disch																					
LDW 430-52000	Leak Detector Mass Spectr	x								x		x	x			x	x			x	x	x
LDW 430-52[illegible]00	ECS C/O Adapter Kit			x																		
LDW 430-54400	Unit, Cabin Leak Test			x																		
LDW 430-54700	Basic H_2O-GL Trim CTL Assy				x	x	x															
LDW 430-54720	H_2O GLY INTRSTG Jump Assy				x																	
LDW 430-62110	Test Stand, He Component																					
LDW 430-62160	Cart, Ullage Simu A/D										x	x						x				
LDW 430-62170	A/D Prop Section C/O Assy									x		x				x			x		x	
LDW 430-62180	Cart, Checkout, Prop Sys										x	x			x		x	x		x		
LDW 430-62190	Test Set SHe Checkout											x	x									
LDW 430-62230	Hose Kit Prop Sys C/O							x			x	x	x			x	x			x		x
LDW 430-62369	Flow Meter RCS Thrusters																					
LDW 430-64200	SHe Cond Unit											x	x									
LDW 430-64260	Dewar He Storage Trans											x	x									
LDW 430-64570	Dist. Assy, Press. He																					
LDW 430-82720	Detector, Leak		x																			
LSC 430-6599	Leak Meter Displacement	x						x		x	x	x	x			x	x	x	x	x	x	x
LSC 430-62010	Sensor Unit Inj Flow RCS																					
LSW 430-5004	Gas Entrapment Indicator				x		x															
LSW 430-6295	Pressure Test Assy	x																				
LSW 430-6442	Cold Flow LN_2 Mobile Unit											x	x									

END ITEM	NOMENCLATURE	31030	31032	31033	31034	32014	33001	33013	33020	33022	33024	33030	33066	33067	33068	34000	61012	61015	62000-ECS	62000-FCS	62000-PROP	62000-RAD	70010
LDW 430-5013	Hose Set Refrigeration Unit																	x	x				x
LDW 430-5014	Hose Set Cabin Leak TS Unit										x												
LDW 430-5020	FLU DIS SYS RCS PL 2 GCRM		x																				
LDW 430-5031	Cabin DNP, REL VLV Tester										x												
LDW 430-5510	Simulator, Internal Envir																	x	x				x
LDW 430-6014	Eng Solenoid C/O Unit																	x		x			
LDW 430-6090	Ascent Engine Simulator																						
LDW 430-6100	Unit-Calib Weight Tank																						
LDW 430-6150	Descent Engine Simulator																						
LDW 430-6201	TS Gage Unit Propulsion	x		x	x																		
LDW 430-6320	Stand Stor Trans Sub Fuel																						
LDW 430-6330	Stand Stor Trans Sub Oxid																						
LDW 430-6440	Cart, Stor & Tran Sub Pro																						
LDW 430-6580	Cart, Nitrogen Conditioning									x													
LDW 430-6582	Sfty Relf Unit BK Press																						
LDW 430-6770	Distrib Sys Fluid Cold Flow																						
LDW 430-6819	Sight Gauge Unit, Live Prop																						
LDW 430-6860	Cart Freon Flush RCS																						
LDW 430-6940	Fluid Dist Sys																						
LDW 430-6990	Syst Cont. Cell Press																						
LDW 430-31220	Cooling Unit Lndg Radar																	x				x	
LDW 430-42020	Waste Mgt Syst Leak Test															x							
LDW 430-51100	Accum H_2O Separator Disch																	x	x				
LDW 430-52000	Leak Detector Mass Spectr	x		x	x		x	x	x	x		x	x		x								
LDW 430-52[illegible]00	ECS C/O Adapter Kit							x	x	x	x	x				x		x	x				
LDW 430-54400	Unit, Cabin Leak Test										x												
LDW 430-54700	Basic H_2O-GL Trim CTL Assy					x												x	x				x
LDW 430-54720	H_2O GLY INTRSTG Jump Assy						x								x								
LDW 430-62110	Test Stand, He Component		x																				
LDW 430-62160	Cart, Ullage Simu A/D																						
LDW 430-62170	A/D Prop Section C/O Assy																				x		
LDW 430-62180	Cart, Checkout, Prop Sys											x											
LDW 430-62190	Test Set SHe Checkout																						
LDW 430-62230	Hose Kit Prop Sys C/O	x			x												x						
LDW 430-62369	Flow Meter RCS Thrusters	x		x																			
LDW 430-64200	SHe Cond Unit																						
LDW 430-64260	Dewar He Storage Trans																						
LDW 430-64570	Dist. Assy, Press. He																	x					
LDW 430-82720	Detector, Leak																						
LSC 430-6599	Leak Meter Displacement	x	x	x	x		x		x		x					x	x				x		
LSC 430-62010	Sensor Unit Inj Flow RCS				x																		
LSW 430-5004	Gas Entrapment Indicator																						
LSW 430-6295	Pressure Test Assy																						
LSW 430-6442	Cold Flow LN_2 Mobile Unit																						

FOLDOUT FRAME

A

FOLDOUT FRAME

B

APPENDIX 1 - GSE USAGE (Continued)

END ITEM	NOMENCLATURE	3103	3215	26007	26008	26040	27005	27006	27014	27015	27027	31008	31030	31032	31033	33022	33024	61015
LDW 450-66100	Sub Prop Press Meas Unit			x			x											
LSW 450-9370	Cabling, Interface			x	x	x	x	x	x	x	x		x				x	
LTT 460-20751	Test Tool,Cold Flow Fac	x										x		x	x			
LTT 460-20752	Test Tool,Pl.5, Final Ass'y Area	x										x		x		x		
LTT 460-20757	Test Tool,Pl.5, Final Ass'y Area																	x
LTT 460-20762	Test Tool, Pl.5,Final Ass'y Area		x															

FOLDOUT FRAME A

FOLDOUT FRAME B.

APPENDIX 2 - 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 61015 FEAT, PLUGS-IN		X
OCP 61018 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.

	3103	3310	3314	3356	3357	3358	26007	26008	26019	26022	26040	26041	27005	27006	27012	27014	27015	27020	27027	27028	30032
R.F. ENERGY																					
1. S-Band																					
2. LDG RDR																					
3. RNDZ RDR																					
ENVIRONMENT																					
1. Suspension of vehicle																					X
2. X-Ray																					
3. Tracking light																					
4. Alcohol flush	X	X		X	X	X															
HIGH PRESSURE GAS																					
1. HTS A/S																					
D/S																					
2. ECS A/S			X																		
D/S																					
3. OCPS A/S																					
D/S																					
4. WMS A/S																					
D/S																					
5. ARS																					
6. APS													X	X	X	X	X	X	X	X	
7. DPS							X	X	X	X	X	X									
8. RCS	X																				X

	31003	31008	31030	31031	31032	31033	31034	32020	33001	33013	33020	33022	33030	33066	33067	33068	61012	62000 COMM	62000 ECS	62000 EPS	62000 PROP	62000 RAD	62000 RCS
R.F. ENERGY																							
1. S-Band																		X					
2. LDG RDR																						X	
3. RNDZ RDR																						X	
ENVIRONMENT																							
1. Suspension of vehicle																							
2. X-Ray								X															
3. Tracking light																				X			
4. Alcohol flush																							
HIGH PRESSURE GAS																							
1. HTS A/S									X	X													
D/S																X							
2. ECS A/S										X										X			
D/S													X						X				
3. OCPS A/S										X	X								X				
D/S													X						X				
4. WMS A/S													X		X								
D/S														X									
5. ARS											X												
6. APS																						X	
7. DPS																		X				X	
8. RCS	X	X	X	X	X	X	X																

FOLDOUT FRAME A

FOLDOUT FRAME B

GRUMMAN AIRCRAFT ENGINEERING CORPORATION

BETHPAGE • LONG ISLAND • NEW YORK