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LUMINARY MEMO # 250

TO: Distribution
FROM: Luminary Test Group
DATE: 20 October 1972
SUBJECT: Luminary Level 6 Test Results for Mission 17

Reference: LUMINARY MEMO #247 "Level 6 Test Description for Mission 17 (PRELIMINARY)" Dated 1 September 1972

This memo summarized the results of the LUMINARY level 6 digital testing effort conducted at M.I.T. The tests fall into the following general categories:

6.1.0 ASCENT AND RENDEZVOUS
6.2.0 ABORT FROM DESCENT
6.3.0 LUNAR SURFACE OPERATION
6.4.0 LUNAR LANDING
6.5.0 ERASABLE MEMORY PROGRAMS
6.6.0 SPECIAL TESTS

The test initialization listed below apply to all the tests and any special initial conditions will be indicated in the particular test.

(1) 1 σ IMU, Radar, State Vector Errors
(2) Normal Astronaut Interface from Apollo 17 Data File
(3) Apollo 17 Operation Trajectory
(4) Apollo 17 Erasable Load
(5) 71/72 Ephemeris
(6) 10% TLOSS
(7) LM-11 Vehicle
(8) Apollo 17 terrain

Typical 1σ initialization errors are given on page 3. An index for the test results is provided on the following page.

INDEX

TYPICAL 1 SIGMA INITIALIZATION ERRORS

IMU ERRORS

	X	Y	Z
Misalignment (milliradians)	1.0	1.0	1.0
Bias Drift (MERU)	2.00	2.00	2.00
Input Axis Drift (MERU/G)	8.00	-8.00	8.00
Spin Axis Drift (MERU/G)	-5.00	5.00	-5.00
PIPA Bias (CM/SEC^2)	.20	.20	.20
PIPA Scale Factor (PPM)	-116	-116	-116

STATE VECTOR ERRORS AT PDI IGNITION - 10 MIN

	ALTITUDE	CROSS-RANGE	DOWN-TRACK
POSITION (ft.)	-383	123	545
VELOCITY (fps.)	-1.76	-2.0	-5.52

RENDEZVOUS RADAR ERRORS

	BIAS	RANDOM
RANGE (ft.)	800 if $R > 50.8$ N.M. 80 if $R \leq 50.8$ N.M.	.3% R
RANGE-RATE (fps)	.3	.4% R (MINIMUM .0044 fps)
SHAFT/TRUNNION (Mr.)	15.0	1.0

LANDING RADAR ERRORS

	RANDOM	MINIMUM
ALTITUDE (ft.)	.5%	5
VX (fps)	.5%	.8
VY (fps)	.7%	.8
VZ (fps)	1.0%	.8

3.1.0 ASCENT AND RENDEZVOUS

The following applies to all tests in this section unless stated otherwise in the test description.

a) The SLOSH environment is not simulated.
b) The FAST IMU environment is used.

6.1.1 ASCENT AND RENDEZVOUS

I. Test Objective

Demonstrate LM Aseent from the lunar surfaee and LM aetive short Rendezvous.

II. Test Deseription

The LM is tilted approximately 10^{o} on the Lunar Surface.

Program Sequenee

P57	AT-3 to Landing Site
P00	
V48	DAP Data Load
V41N72	Position RR
P12	Aseent
V64	S-Band Antenna
V82	Orbital Parameter Display (R30)
P00	
V48	DAP Data Load
P20	Rendezvous Navigation
V80	Enable LM State Veetor Update
P34	Transfer Phase Initiation (TPI)
V83	Rendezvous Parameter Display (R31)
N52	Display LM Central Angle
N59	Display Delta LOS Vel.
V48	DAP Data Load
P42	APS
V82	Orbital Parameter Display (R30)
P35	Transfer Phase Mideoarse (TPM)
V67	W-Matrix Display
V48	DAP Data Load
V83	Rendezvous Parameter Display (R31)

P41	RCS
V82	Orbital Parameter Display
P35	Transfer Phase Midcourse (TPM)
V93	Enable W-Matrix Initialization
P41	RCS
V82	Orbital Parameter Display
P00	
V48	DAP Data Load
P47	Thrust Monitor
P00	

TEST 6.1.1 DATA SUMMARY

P57 AT-3 to Landing Site

NOUN 04=9.89
(LM tilted approximately 10 degrees on Lunar Surface)
Sighting: Starcode=223, Sighting err. =.00 (deg.)
NOUN 05=-.01
NOUN 93= -.058, .030, .049
True misalignment after torquing
OIM= .001, -.003, -.009

P12 Ascent Insertion Data

	ENV	LGC	TARGETED
Ha (nm)	52.83	55.7	
Hp (nm)	9.22	9.2	
Y (ft)	-1580	-617.8	-613.7
H (ft)	59463	60384	60000
HDOT (fps)	28.0	32.7	32.0
FORVEL (fps)	5547.2	5550.1	5550.0
YAW (deg)	-0.24	0.09	
PITCH (deg)	-4.31	-5.16	
VGX (fps)		-.07	0
VGY (fps)		-.18	0
VGZ (fps)		.07	0

P20 Navigation Data Summary

State Vector errors.

	Time (sec)	No. Marks	Position (m)	Velocity (m/s)
TPI	678415	0	2956	3.87
	679753	18	257	0.21

	Time (sec)	No. Marks	Position (m)	Velocity (m/s)
MCCI	680503	0	346	.27
	680950	7	26	.19
MCC2	681231	0	64	.32
	681828	9	82	.14

Noun 49 Summary

Marktime	RMAG(ft)	VMAG(ft/sec)	MEAS.
678415	2907	3.45	Range Rate
678415	6352	5.26	Shaft
678415	3064	0.05	Trunnion
678507	0	2.99	Range Rate
678507	2658	6.15	Shaft
678596	2421	3.76	Shaft
678754	3268	4.00	Shaft

TARGETING AND BURN PERFORMANCE

The targeting and burn performance data summary is shown in Tables I and II.

TABLE I

EVENT	TIG SEC	TPI SLIP SEC	DELTA ALT NM	DELTA V (LOCAL VERT)-FPS X	Y	Z	MAG	BURN RESIDUAL-FPS X	Y	Z	ENV CPA TIME SEC	RANGE M
TPI		- 0.00		+ 80.0	- 2.6	+ 57.7	+ 98.6					
	680252.30	- 0.00		+ 80.1	- 2.2	+ 56.2	+ 97.9					
TPI		+ 0.00		+ 80.0	- 2.6	+ 57.7	+ 98.6				682789.26	363.7
	680252.30	- 0.00		+ 79.9	- 2.7	+ 58.2	+ 98.9	+ 0.1	- 0.2	+ 0.0		
MCC1				- 0.5	- 0.1	+ 0.4	+ 0.7				682789.44	357.9
	681160.23			- 0.0	+ 0.0	+ 0.0	+ 0.0	+ 0.1	- 0.2	+ 0.2		
MCC2				+ 0.3	+ 0.0	+ 2.4	+ 2.4				682808.32	168.9
	682062.85			+ 0.5	+ 0.5	+ 1.5	+ 1.6	+ 0.2	+ 0.3	+ 0.1		

TABLE II

BURN PERFORMANCE

TEST EVENT	BURN UNCERTAINTY (FPS) RANGE	TRACK	ALT	MAG	DELTA V MAG (FPS)	MISS (METERS)
CSI	+ 0.0	+ 0.0	+ 0.0	+ 0.1	0.0	
CDH	+ 0.0	+ 0.0	+ 0.0	+ 0.1	0.0	
TPI	- 0.0	- 0.1	+ 0.5	+ 0.6	98.9	363
MCC1	+ 0.5	+ 0.2	- 0.3	+ 0.7	0.0	357
MCC2	+ 0.2	+ 0.4	- 0.9	+ 1.1	1.6	168

TPI SLIPPAGE - 0.00 SEC

6.2.0 ABORTS FROM DESCENT

The following applies to all tests in this seetion unless indieated differently in test deseription.

a) The LM is yawed left 70 degrees at PDI- 10 mins.
The LM is yawed to 20 degrees left at PDI + 4 mins. This maneuver is done in the AUTO mode.

b) The AUTO throttle and ABORT baek up diseretes are set.

c) The abort switeh is failed ON.

d) The SLOSH environment model is not simulated.

e) The environmental FAST IMU is used.

f) Abort sequenee:
Switch to ATTHOLD
Full Throttle
ABORT or ABORT STAGE
V22N46 ENTER ENTER
Switch to AUTO

g) Terrain slope error of -1 degree.

TEST 6.2.1 ABORT AT 33 K. FT.

I. Test Objective

Demonstrate DPS Abort from descent.

II. Test Description

Program Sequence

P00	
V48	DAP Data Load
V64	S-Band Antenna Routine (R05)
P63	Braking Phase Program
V57	LR Update (R12)

ABORT sequence at 33 K ft. altitude.

P70	DPS Abort Program
N76	Monitor Desired HVEL, RVEL, Crossrange
N77	Monitor TTOGO, VGY, ABVEL
N85	Monitor VG
P00	LGC Idle Program
V64	S-Band Antenna Routine (R05)
V82	Orbital Parameter Display Routine (R30)
V83	Rendezvous Parameter Display Routine (R31)
P20	Rendezvous Navigation Program
P32	Coelliptic Sequence Initiation Program

6.2.1 ABORT at 33000 ft

	Environment	LGC	Target
Apolune (n. mi.)	105.25	106.0	106.1
Perilune (n. mi.)	9.46	9.8	
Out of Plane (ft)		-.6	0
Altitude (ft)	58010*	60068	60000
Alt rate (fps)	15.6	19.8	19.5
Downrange Speed (fps)	5618.5*	5617.8	5617.8
Pitch Angle(°)	-10.83	-9.81	
VGX Body (fps)		+.4	0
VGY Body (fps)		-.7	0
VGZ Body (fps)		+1.2	0
Theta(Phase angle) (at cutoff) (°)		+0.3	

Discussion of Results:

The 2600 ft altitude error at abort actually decreases to 2060 ft at insertion. This should produce an apolune error of +1.3 n. mi. The slight underspeed of -.7 fps concels most of that out, leaving apolune very close to the targeted value.

*Computed from R and V (sm); Alt and Forvel not comparable to AGC data.

TEST 6.2.2 ABORT AT 7 K. FT.

I. Test Objectives

Demonstrate DPS and APS Abort from descent.

II. Test Description

The abort switch is failed OPEN requiring the astronaut to select P70 via DSKY.

Program Sequence

P00	
V48	DAP data load
V64	S-Band Antenna Routine (R05)
P63	Braking Phase
V57	LR Update (R12)
P64	Approach Phase
	ATTHOLD at 7 K ft.
	Full throttle
	V22N46 EE
P70	DPS Abort select by Astronaut
	AUTO mode
ABORT STAGE at DPS depletion	
P71	APS Abort
N76	Monitor Desired Horizontal, Radial Vel, Crossrange
N77	Monitor TTOGO, VGY, ABVEL
N85	Monitor VG
P00	
V64	S-Band Antenna Routine (R05)
V82	Orbital Parameter Display (R30)
V83	Rendezvous Parameter Display (R31)
P20	Rendezvous Navigation
P32	Coelliptic Sequence Initiation

6.2.2 ABORT at 7000 ft.

	Environment	LGC	Target
Apolune (n. mi.)	49.70	52.1	51.5
Perilune (n. mi.)	10.58	10.8	
Out of Plane (ft)		9.4	0
Altitude (ft)	65020*	67285	60000
Alt. Rate (fps)	12.2	20.4	19.5
Downrange Speed (fps)	5539.4*	5540.8	5540.7
Pitch Angle (α)	-3.97	-6.28	
VGX Body (fps)		+0.1	0
VGY Body (fps)		-0.8	0
VGZ Body (fps)		+1.4	0
Theta(Phase angle) (at cutoff)		+15.6	

Discussion of Results:

This abort from low altitude starts with small (+300 ft and +1fps) altitude and altitude rate errors, due to the effect of landing radar measurements. These initial errors combine with the IMU errors to cause the AGC to overestimate altitude by 2260ft and altitude rate by 8.2fps. The actural insertion tolerances. The down range speed, the critical phasing parameter, is within 1.4 fps of the AGC value.

*Computed from R and V (sm); Alt and Forvel not comparable to LGC data.

TEST 6.2.3 ABORT AFTER TOUCHDOWN

I. Test Objcctive

Demonstratc APS (T1) Abort

II. Test Description

The Auto Throttlc is failcd off.

Program Sequencc

P00	
V48	DAP Data Load
V64	S-Band Antenna Routine (R05)
P63	Braking Phase
V57	LR Update Enable
P64	Approach Phase
P66	Vertical Phase

ABORT Sequence at Lunar Surface Touchdown

P71	APS Abort
P00	
V64	S-Band Antenna Routine (R05)
V82	Orbital Parameter Display (R30)
V83	Rendezvous Parameter Display (R31)
P20	Rendezvous Navigation
P32	Coelliptic Sequence Initiation

6.2.3 ABORT at Touchdown

	Environment	LGC	Target
Apolune (n. mi.)	57.58	59.6	59.3
Penrilunc (n. mi.)	9.59	9.7	
Out of Plane (ft)		1.0	0
Altitude (ft)	58970*	60375	60000
Alt. Rate (fps)	12.5	20.1	19.5
Downrange			
Speed (fps)	5554.6	5556.2	5555.8
Pitch Angle (°)	-4.15	-5.97	
VGX Body (fps)		-.4	0
VGY Body (fps)		+.4	0
VGZ Body (fps)		+.6	0
Theta (phase angle);			
(at cutoff) (°)		+24.6	

Discussion of Results:

The abort from touchdown as would be expected is very simular to a normal liftoff, with the exceptions of higher downrange speed and lower radial rate. The IMU errors cause the AGC to overestimate altitude by 1400 ft. and radial rate by 7.6 fps. Thc resulting insertion values are within acceptable tolerances. The downrange speed is within 1.6 fps of thc AGC value.

*Computed from R and V (sm); Alt and Forvel not comparable to AGC data.

6.3.0 LUNAR SURFACE OPERATION AND ALIGNMENTS

TEST 6.3.1 LUNAR SURFACE OPERATIONS

I. Test Objective

Demonstrate LM IMU Lunar Surface alignments and operations.

II. Test Description

The LM is tilted approximately 10^{o} on the Lunar Surface.

Program Sequence

P68	Lunar Surface Confirmation Program
P00	
P12	Ascent Program
P57	AT-3 Lunar Surface Alignment to REFSMMAT
	Recycle Gravity Determination
V47	AGS Initialization
V41N20	Park IMU
	Coarse align IMU to parking gimbal angles
P06	LGC Power Down Program
	LGC Power Up
P57	AT-3 Lunar Surface Alignment to Landing Site
	4 Star sightings
V63	RR Self test
P22	Lunar Surface Navigation (No Update Mode)
P57	AT-3 Lunar Surface Alignment to Landing Site
V47	AGS Initialization
V48	DAP Data Load
V82	Orbital Parameter Display
P12	Ascent Program to TIG
P00	

TEST 6.3.1 DATA SUMMARY

P68

NOUN 43

Lat. =20.16, Long.=30.75

(This agrees within .00 degs. of actural landing site)

P57 AT-3 to REFSMMAT

NOUN 04=.00

Recycle

NOUN 04=.00

Sighting: starcode 220, sighting err.=.00

NOUN 05=.00

NOUN 93=.007,-.008, -.010

True misalignment after torquing

OIM=-.007, .000 , .000

P57 AT-3 to Landing Site

NOUN 04=.01

1st sighting: starcode 220, sighting err. -.00

NOUN 05=.00

NOUN 93=.032, .005, .001

Recycle

2nd sighting: starcode 124, sighting err. =.01

NOUN 05=.01

NOUN 93=.004, .005,.000

Recycle

3rd sighting: starcode 220, sighting err.=.00

NOUN 05=.00

NOUN 93=.020, .003, -.002

Recycle

4th sighting: starcode 625, sighting err.=.00

NOUN 05=.00

NOUN 93=.016, .000, -.003

True misalignment after torquing

OIM=-.003,.002, .002

P57 AT-3 to Landing Site

NOUN 04=.00

Sighting: starcode 625, sighting err. =.01

NOUN 05=.00

NOUN 93=-.009, +.015, -.011

True misalignment after torquing

OIM=-.016, .008, .012

Verb 82 (Orbital Parameter Display)

LGC NOUN 44	70.2	54.6	(n.m.)
ENV	70.11	54.49	(n.m.)

The OPERATOR ERROR LITE was turned on at 113 hrs 55 min. 29 sec. because of bad procedure ie, an extraneous 00 ENTR was keyed in. The LITE went out when P12 was selected.

6.4.0 LUNAR LANDING

The following applies to all tests in this section unless indicated differently in test description.

a) The LM is yawed left 70 degrees at PDI - 10 mins.
The LM is yawed to 20 degrees left at PDI+4 mins. This maneuver is done in the AUTO mode.

b) The AUTO throttle and ABORT back up discretes are set.

c) The abort switch is failed ON and the auto throttle failed OFF.

d) The SLOSH mode is not simulated.

e) The environmental FAST IMU is simulated.

f) Terrain slope error -1 degree

Test results for the Lunar Landing simulations are on page 25.

TEST 6.4.1 LUNAR LANDING - AUTO (ERROR FREE)

I. Test Objective

Demonstrate LM automatic landing.

II. Test Description

This test contains no initialization errors.

Program Sequence

P00	
V48	DAP data Load
V64	S-Band Antenna Routine (R05)
P63	Braking Phase
V57	LR Update Enable
N68	Monitor Range, TGO, Velocity
N92	Monitor THROTTLE CMD, HDOT, H
P64	Approach Phase
P66	Vertical Phase
P68	Lunar Surface Confirmation
P00	

TEST 6.4.2 LUNAR LANDING - AUTO

I. Test Objective

Demonstrate LM automatic landing.

II Test Description

This is the same as TEST 6.4.1 (ERROR FREE) except that it contains a -1 degree terrain slope error.

TEST 6.4.3 LUNAR LANDING - NOMINAL

I. Test Objection

Demonstrate LM automatic landing.

II. Test Description

This test exercises landing site redesignation option at PDI -10 mins. to correct propagated state vectors errors; at PDI +5 mins. to correct IMU errors and at PDI +8 mins. to correct altitude errors.

Test Scquence

P00	
N69	Landing Site Redesignation at PDI -10 mins.
	Downtrack
	Crosstrack
V48	DAP Data Load
V64	S-Band Antenna Routine (R05)
P63	Braking Phase
V57	LR Update Enable
N69	Landing Site Redesignation at PDI +5 mins.
	Downtrack
	Crosstrack
N69	Landing Site Redesignation at PDI +8 mins.
	Altitude
P64	Approach Phase
	LPD ACA: AZ, EL
P66	Vertical Phase
P68	Lunar Surface Confirmation
P00	

TEST 6.4.4 LUNAR LANDING - MAX DOWNRANGE N69

I. Test Objective

Demonstrate LM nominal landing to offset landing site.

II. Test Description

This test exercises the landing site redesignation option N69 at PDI +2 and LPD during P64. The N69 redesignation offsets the actual landing site.

Program Sequence

P00	
V48	DAP Data Load
P63	Braking Phase
N69	Landing Site Redesignation at PDI +2 mins.
	Downtrack = 20K ft
	Crosstrack = 20K ft
P64	Approach Phase
	LPD ACA: AZ, EL
P66	Vertical Phase
	Entered manually at 700 ft.
P68	Lunar Surface Confirmation
P00	

Units are feet and feet/second, except for Range, which is given in nautical miles.

	6.4.1	6.4.2	6.4.3	6.4.4
	No errors	-1^0slope	N69's	Max N69
Marsrot#	27320492	27518540	28314584	28217373
Downupts	3	1	9	2
Ignition	406177.7	406177.7	406179.3	406178.3
Atitude				
P	-178	-178	-178	-178
Y	-68	- 68	- 71	- 71
R	- 1	- 1	1	0
V57:Time	406559	406577	406582	406594
Alt	29650	27919	27606	28235
ΔH	-1029	2175	2221	1059
Throttledown	406623	406623	406631	406610
TTF	-174 AGC/ENV	-175 AGC/ENV	-164 AGC/ENV	-205 AGC/ENV
Altitude	23624/19621	25197/20971	23332/18246	26421/23190
Alt -rate	-82.4/-82.1	-97.0/-97.0	-103.0/-102.6	-67.0/-65.9
Forvel	1145.7/1138.0	1139.9/1132.2	1059.1/1052.2	1334.3/1328.0
Range	-16.4	-16.5	-14.5	-22.5
Highgate	406738 AGC/ENV	406739 AGC/ENV	406736 AGC/ENV	406755 AGC/ENV
Altitude	7655/7720	7275/7325	7166/7013	5889/5574
Alt-rate	-164.7/-166.7	-152.2/-153.7	-157.3/-159.0	-128.8/-127.6
Forvel	289.1/285.1	292.5/288.8	284.4/280.4	291.2/287.9
Range	-2.5	-2.5	-2.5	-2.5
500'time	406832 AGC/ENV	406828 AGC/ENV	406813 AGC/ENV	
Altitude	519/511	505/497	505/484	
Alt-rate	-18.3/-17.0	-16.8/-15.5	-19.6/-17.9	
Forvel	50.5/49.8	57.9/57.3	69.3/68.3	
Range	-.1	-.1	-.1	

Units are feet and feet/second, except for Range, which is given in nautical miles.

	6.4.1	6.4.2	6.4.3	6.4.4
	No errors	-1^0slope	N69's	Max N69
Marsrot#	27320492	27518540	28314584	28217373
Low-gate	406862 AGC/ENV	406863 AGC/ENV	406852 AGC/ENV	406827 AGC/ENV
Altitude	184/195	176/187	179/177	638/660
Alt-rate	-3.8/-3.9	-2.3/-2.5	-.6/-1.1	-20.1/-20.5
Forvel	5.6/5.3	5.3/4.9	5.7/6.1	75.6/73.9
Range	0.0	0.0	0.0	-.2
Touchdown	406904 AGC/ENV	406926 AGC/ENV	406986 AGC/ENV	406936 AGC/ENV
Alt-rate	-4.0/-4.4	-2.3/-2.6	-.5/-1.2	-4.0/-4.4
Forvel	.1/.4	-.1/.2	0/0	-.1/-.1
Nav. errors				
Rx	-4.58	-7.5	-38.3	-468.56
4	-21.40	-20.5	-30.4	-75.26
z	-10.35	-28.56	+779.3	782.74
Vx	.10	+.06	+.28	.14
y	-.06	-.12	+.19	.14
z	-.12	-.12	+.03	-.01
Fuel:RCS	67.3	62.5	80.6	84.4
DPS	18153	18373	18996	18374
Ground track coords				
CR	740	745	5072	+25097
DR	-107	-53	1817	+22994

6.5.0 ERASABLE MEMORY PROGRAMS

Only those EMPs specified in the flight plan for a nominal mission will be reported on.

EMP 99 LM DEORBIT TEST 6.5.1

TEST 6.5.1 LM DEORBIT

I Test Objective

Demonstrate LM deorbit using Erasable Memory Program 99.

II Test Description

Test Sequence

P00

Load EMP 99

V48 DAP Data Load

V47 AGS Initialization

P30 External Delta-V

Verify Noun 26

V62 Display Total Attitude Errors

V30 Activate EMP 99

Test 6.5.1 Data Summary

	MIT/CSDL	NASA/MSC
TIG (hr:min:sec)	195:39:13	195:39:13
ΔV X	-219.4	-219.4
(fps) Y	-56.0	-56.0
Z	167.8	167.8
Magnitude	281.8	281.8
Ha(from P30)	67.6	---
Hp	-90.0	---
(n. mi.)		
Burn Time (min:sec)	120.5	116.4
Impact Time (hr:min:sec)	195:58:28	195:58:25
Impact Point		
Latitude	19.97	19.93
Longitude	30.40	30.54
Ha (after burn)	67.5	66.5
Hp	-89.6	-90.2

Discussion of results:

The test results agree closely with the NASA/MSC results for the deorbit burn. The differences that do exist are attributable to differences in simulation models and computational accuracy.

6.6.0 SPECIAL TESTS

The following applies to all tests in this section unless otherwise indicated in the test description.

a) The SLOSH environment is not simulated.
b) The FAST IMU environment is used.

6. 6. 1A DOI2 - ERROR FREE

I. Test Objectives

Demonstrate the DOI2 burn with no initialization errors.

II. Test Description

The LM is yawed left 70 degrees after DOI2.
The simulation is terminated at throttle up in P63.

Program Sequence

P00	
V48	DAP data load
V82	Orbited Parameter Display (R30)
P30	External Delta V targetting
P41	RCS Burn
V82	R30
V64	S-Band Antenna Routine (R05)
V48	DAP data load
P27	SV Update
P63	Braking Phase

Test results for the DOI2 simulations are on page 34.

6.6.1B DOI2

I. Test Objective

Demonstrate the DOI2 burn with 1σ errors.

II. Test Description

This is the same as TEST 6.6.1A except that it is initialized with 1σ errors.

Initial State Vector Errors at DOI2 - 3 HRS 16 MIN

	X	Y	Z
Position	1484.5 ft	2668.8 ft	1272.3 ft
Velocity	-.537 fps	6.12 fps	-1.20 fps

State Vectors Errors at DOI2

	X	Y	Z
Position	1848 ft	-7456 ft	-53018 ft
Velocity	44 fps	-.18 fps	-9.3 fps

6. 6. 1C DOI2

I. Test Objective

Demonstrate the DOI2 burn with 1σ errors.

II. Test Description

This is the same as TEST 6. 6. 1B except that the 1σ state vector errors are reversed.

	DOI2A	DOI2B	DOI2C
P30 EXTERNAL DELTAV - 111:56:14			
N33	112:00:33.7	112:00:33.7	112:00:33.7
N81 (fps)			
Vx	-9.4	-9.4	-9.4
Vy	0.0	0.0	0.0
Vz	.8	.8	.8
N42 (nm)			
Apo	60.0	58.9	61.1
Peri	7 2	7.1	7.2
P41 RCS THRUST PROGRAM			
IGN (sec)	403233.7	403233.7	403233.7
Burn time (sec)	42.1	37.1	37.1
N85 (fps)			
Vx	-.1	.1	.1
Vy	.3	-.2	.0
Vz	-.3	.1	.0
V82 ORBITAL PARAMETER DISPLAY AT PDI- 48 MIN.			
N44 (nm)	AGC/ENV	AGC/ENV	AGC/ENV
Apo	60/59.9	58.9/59.9	61.1/59.9
Peri	6.8/6.8	7.2/7.5	7.2/7.5
V82 AT PDI - 46 MIN.			
N44 (nm)			
Apo	60/59.9	58 9/59.9	61.1/59.9
Peri	6.8/6.8	7.1/7.5	7.2/7.5
V82 PDI-30 MIN.			
N44 (nm)			
Apo	60.2/60.2	59.1/60.2	61.4/60.2
Peri	6.6/6.6	7.0/7.3	7.0/7.3
V82 PDI-13 MIN.			
N44 (nm)			
Apo	60.2/60.2	59.1/60.2	61.4/60.2
Peri	6,2/6.2	6.5/6.9	6.6/6.9
P63 POWERED DESCENT-BRAKING PHASE 112:40:7.3			
IGN (sec)	406177.1 (nominal)	406165.6 (12 sec early)	406189.2 (12 sec late)
State Vector errors at PDI			
x (meters)	-35	6320	-6320
y	-64	4041	-4041
z	74	22916	-22916
Vx (m/s)	.02	-21.45	21.45
Vy	.06	.39	-.39
Vz	.03	6.64	-6.64

6.6.3 TEI Using DPS

I. Test Objective

Demonstrate the TEI burn using the LM DPS.

II. Test Description

Program Sequence

P00	
V48	DAP Data Load
V82	Orbital Parameter Display (R30)
P30	External Delta V Targeting
P40	DPS Burn
V82	R30

Test results to be determined

6.6.4 LOI Using DPS

I. Test Objective

Demonstrate the LOI burn using the LM DPS.

II. Test Description

Program Sequence

P00	
V48	DAP Data Load
V82	Orbital Parameter Display (R30)
P30	External Delta V targetting
P40	DPS Burn
V82	R30

Test results to be determined