



FRA MAURO LANDING

APOLLO 14

AS509 S/C110 LM8
G&N 214 G&N 611

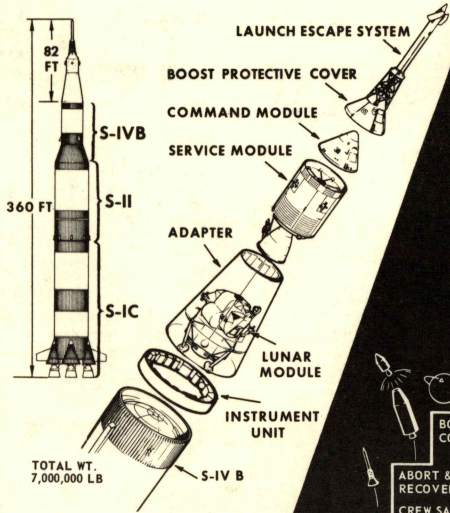


DELCO ELECTRONICS

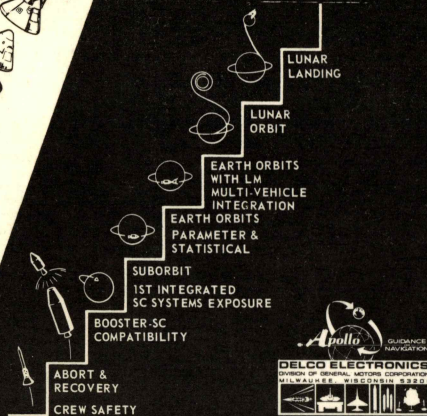
DIVISION OF GENERAL MOTORS CORPORATION
MILWAUKEE, WISCONSIN 53201



APOLLO SPACECRAFT



SPACECRAFT DEVELOPMENT FLIGHT CATEGORIES



- APOLLO 14 AS509 S/C 110 LM8 LUNAR LANDING ()
- APOLLO 13 AS508 S/C 109 LM7 LUNAR LANDING (6 DAYS ABORTED)
- APOLLO 12 AS507 S/C 108 LM6 LUNAR LANDING (10 DAYS)
- APOLLO 11 AS506 S/C 107 LM5 LUNAR LANDING (8 DAYS)
- APOLLO 10 AS505 S/C 106 LM4 LUNAR ORBIT W/LM (8 DAYS)
- APOLLO 9 AS504 S/C 104 LM3 EARTH ORBIT W/LM (10 DAYS)
- APOLLO 8 AS503 S/C 103 LUNAR ORBIT (6 DAYS)
- APOLLO 7 AS205 S/C 101 EARTH ORBIT (10 DAYS)
- APOLLO 6 AS502 S/C 020 EARTH ORBIT (3 REV)
- APOLLO 5 AS204 LM1 EARTH ORBIT (4 REV)
- APOLLO 4 AS501 S/C 17 EARTH ORBIT (3 REV)
- AS202 S/C 11 SUBORBITAL
- SC 009 SUBORBITAL
- SC 002 TUMBLING ABORT
- BP 23A PAD ABORT
- BP 23 HI Q ABORT
- BP 22 HI ALTITUDE ABORT
- BP 15 BOOSTER
- BP 13 BOOSTER
- BP 12 TRANSONIC ABORT
- BP 6 PAD ABORT

U.S. SPACE FLIGHT LOG

APOLLO 14 MISSION DESCRIPTION

MISSION	ASTRONAUTS	LAUNCH DATE	ELAPSED TIME HR:MIN:SEC	TOTAL U.S. MANNED HOURS IN SPACE
Mercury-Redstone 3	Shepard	May 5, '61	00:15:22	00:15:22
Mercury-Redstone 4	Grissom	July 21, '61	00:15:37	00:30:59
Mercury-Atlas 6	Glenn	Feb. 20, '62	04:55:23	05:26:22
Mercury-Atlas 7	Carpenter	May 24, '62	04:56:05	10:22:27
Mercury-Atlas 8	Schirra	Oct. 3, '62	09:13:11	19:35:38
Mercury-Atlas 9	Cooper	May 15, '63	34:19:49	53:55:27
Gemini-Titan III	Grissom-Young	Mar. 23, '65	04:53:00	63:41:27
Gemini-Titan IV	McDivitt-White	June 3, '65	97:56:11	259:33:49
Gemini-Titan V	Cooper-Conrad	Aug. 21, '65	190:55:14	641:24:17
Gemini-Titan VII	Borman-Lovell	Dec. 4, '65	330:35:31	1302:35:19
Gemini-Titan VI-A	Schirra-Stafford	Dec. 15, '65	25:51:24	1354:18:07
Gemini-Titan VIII	Armstrong-Scott	Mar. 16, '66	10:41:26	1375:40:59
Gemini-Titan IX-A	Stafford-Cernan	June 3, '66	72:21:00	1520:22:59
Gemini-Titan X	Young-Collins	July 18, '66	70:46:39	1661:56:17
Gemini-Titan XI	Conrad-Gordon	Sept. 12, '66	71:17:08	1804:30:33
Gemini-Titan XII	Lovell-Aldrin	Nov. 11, '66	94:34:31	1993:39:35
Apollo 7 Saturn 1B	Shirra-Eisele-Cunningham	Oct. 11, '67	260:06:18	2773:58:29
Apollo 8 Saturn V	Borman-Lovell-Anders	Dec. 21, '68	147:00:11	3214:59:02
Apollo 9 Saturn V	McDivitt-Scott-Schweickart	Mar. 3, '69	241:00:53	3938:01:41
Apollo 10 Saturn V	Stafford-Young-Cernan	May 18, '69	192:03:23	4514:11:50
Apollo 11 Saturn V	Armstrong-Aldrin-Collins	July 16, '69	195:18:35	5100:07:35
Apollo 12 Saturn V	Conrad-Gordon-Bean	Nov. 14, '69	244:36:24	5833:56:47
Apollo 13 Saturn V	Lovell-Swiger-Haise	April 11, '70	142:54:44	6262:40:59
Apollo 14 Saturn V	Shepard-Roosa-Mitchell	Jan. 31, '71		

- Manned: Prime Crew Back-up Crew
 Alan B. Shepard (CDR) Eugene A. Cernan (CDR)
 Stuart A. Roosa (CMP) Ronald E. Evans (CMP)
 Edgar D. Mitchell (LMP) Joe Henry Engle (LMP)
- Seventh Manned Saturn V Mission
- Fourth Lunar Landing Mission
- Planned Duration of Apollo 14 - 216 hours 41 minutes
- Booster - Saturn V Booster = 509
- Spacecraft - CSM = 110 and LM = 8
- Block II G & N System = 214 - LM G & N System = 611

The Apollo 14 Mission will be approximately 9 days duration. Lunar surface activities will be conducted up to 34 hours and will include (2) two EVA periods for surface exploration and experiment deployment. The primary objectives of this mission include the following:

- Provide a contingency sample for postflight scientific investigation.
- Deploy ALSEP consistent with a seismic net.
- Collect geologic core tube soil samples from the lunar subsurface.
- Develop man's capability to work in the lunar environment.

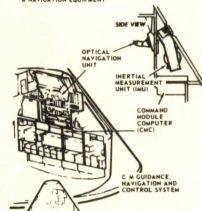
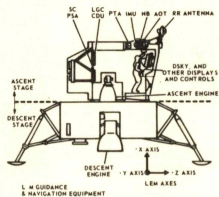


LM GUIDANCE and NAVIGATION EQUIPMENT.....

CM GUIDANCE, NAVIGATION and CONTROL SYSTEM

THE APOLLO GUIDANCE AND NAVIGATION SYSTEM IS COMPOSED OF THREE BASIC SUBSYSTEMS: INERTIAL, OPTICAL AND COMPUTER.

1. The inertial guidance subsystem is composed of inertial measurement unit (IMU) and associated equipment. This subsystem performs three major functions: (A) Measures changes in spacecraft attitude; (B) Measures spacecraft velocity due to thrust; and (C) Assists in generating steering signals.
2. The optical navigation subsystem is composed of a space sextant and a scanning telescope. Sightings on celestial bodies and landmarks on the moon and earth are used by the computer subsystem to determine the spacecraft's position and velocity and to align the inertial reference within the IMU.
3. The command module computer (CMC) provides five major functions: (A) Calculates steering signals and engine discharges necessary to keep the spacecraft on the required trajectory; (B) Positions the stable member in the IMU to a coordinate system defined by precise optical measurements; (C) Positions the optical unit to celestial objects; (D) Conducts limited malfunction isolation of the G&N system by monitoring the level and rate of system signals; and (E) Supplies pertinent spacecraft condition information to the display and control panel.



INERTIAL MEASUREMENT UNIT (IMU) and associated equipment performs three major functions; (A) Measures changes in LM attitude, (B) Assists in generating steering commands, and (C) Measures LM velocity changes due to thrust.

ALIGNMENT OPTICAL TELESCOPE (AOT) - Provides star sighting data which is manually inserted into the LM Guidance Computer for establishing the inertial reference.

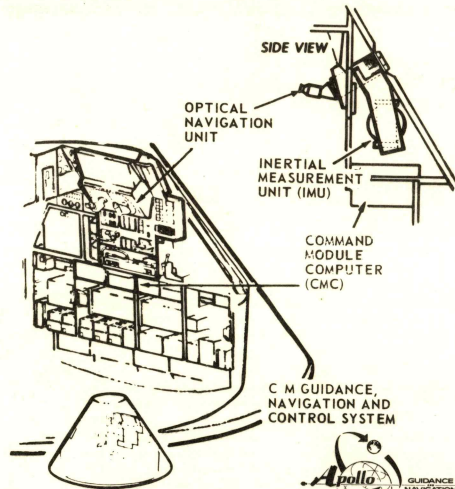
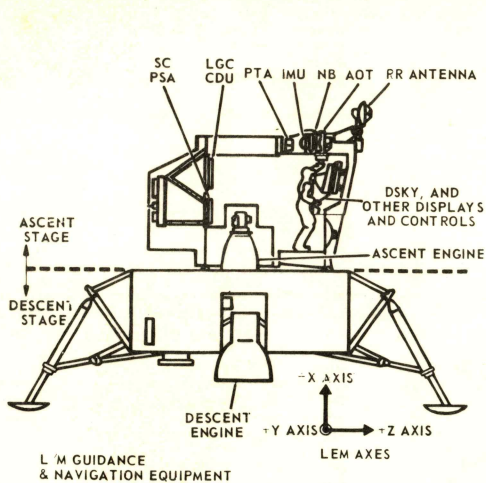
NAVIGATION BASE (NAV BASE) - Provides an accurate mounting base for the Alignment Optical Telescope (AOT) and the Inertial Measurement Unit.

LM GUIDANCE COMPUTER (LGC) - Performs four major functions: (A) Calculates steering signals and engine discharges necessary to keep the LM on the required trajectory, (B) Positions the stable member in the IMU to a coordinate system defined by precise optical measurements, (C) Conducts limited malfunction isolation of the PGNCS by monitoring the level and rate of system signals and (D) Supplies pertinent LM condition information to the display and control panels.

DISPLAY AND KEYBOARD (DSKY) - Provides a two-way communication link between the operator and the LGC and the following functions may be performed: (A) Loading of data into the LGC and (B) Display of data and system configuration to the operator.

COUPLING DATA UNIT (CDU) - The CDU, an all-electronic device, is used as an interface element between the following: (A) The inertial subsystem and computer subsystem and (B) The computer subsystem and the controls: This unit functions primarily as an analog to digital or digital to analog converter.

GUIDANCE & NAVIGATION EQUIPMENT LOCATION

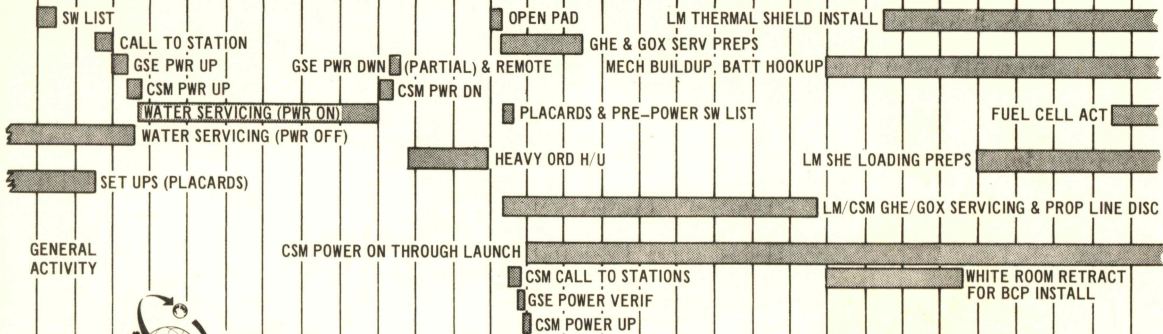


APOLLO 14 LAUNCH COUNTDOWN

PRECOUNT

MIDCOUNT

-108 -106 -104 -102 -100 -98 -96 -94 -92 -90 -88 -86 -84 -82 -80 -78 -76 -74 -72 -70 -68 -66 -64 -62 -60 -58 -56 -54 -52 -50

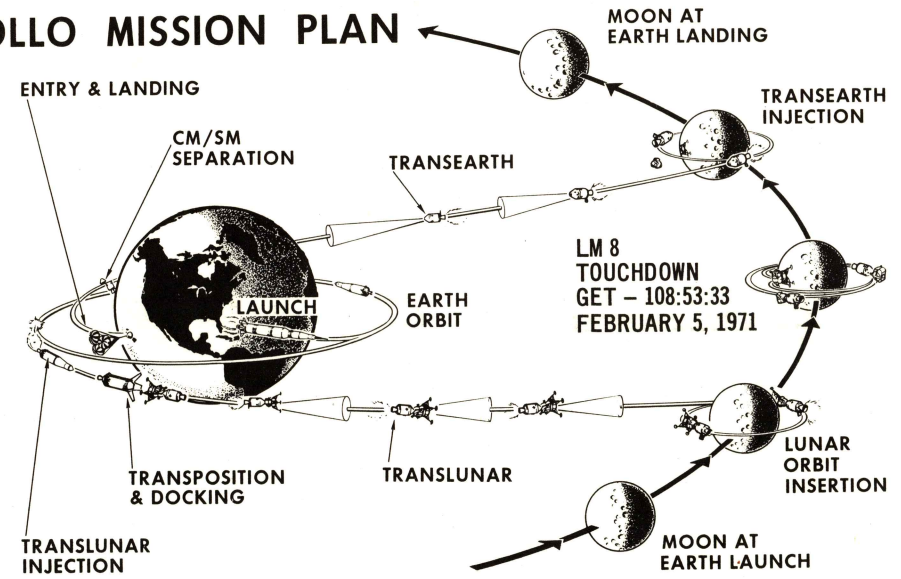


GENERAL ACTIVITY

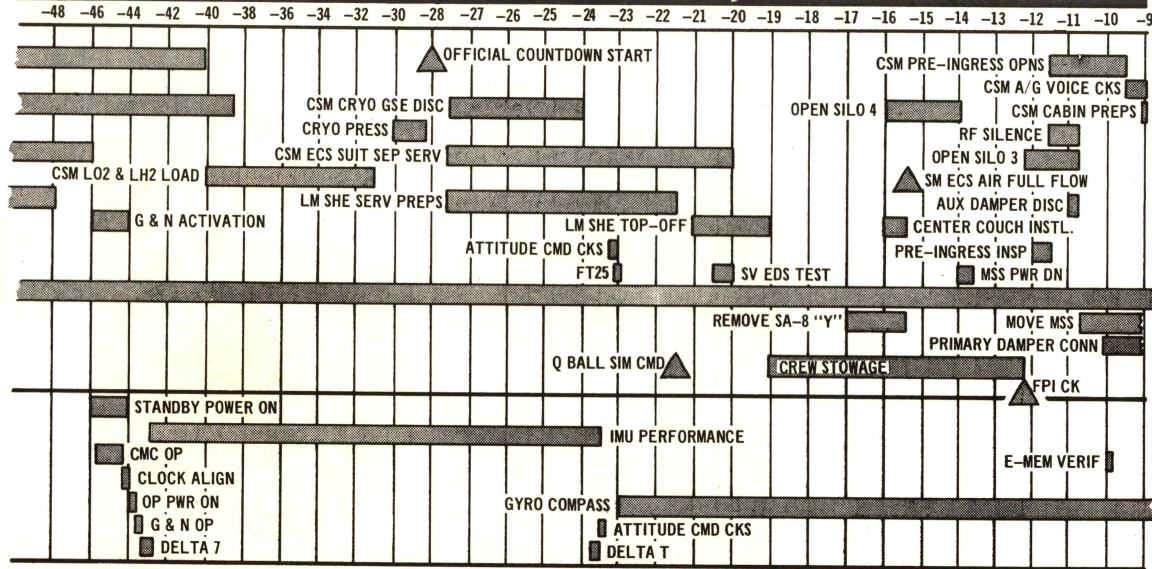


GUIDANCE & NAVIGATION

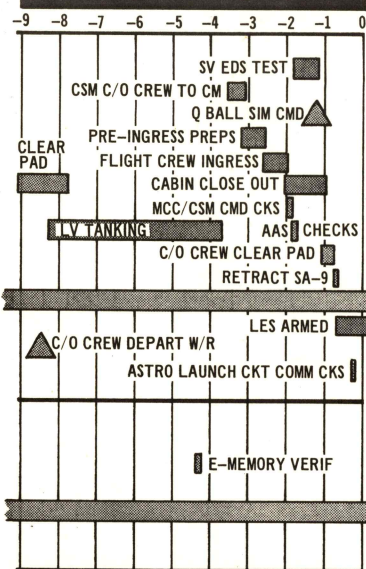
APOLLO MISSION PLAN



COUNTDOWN



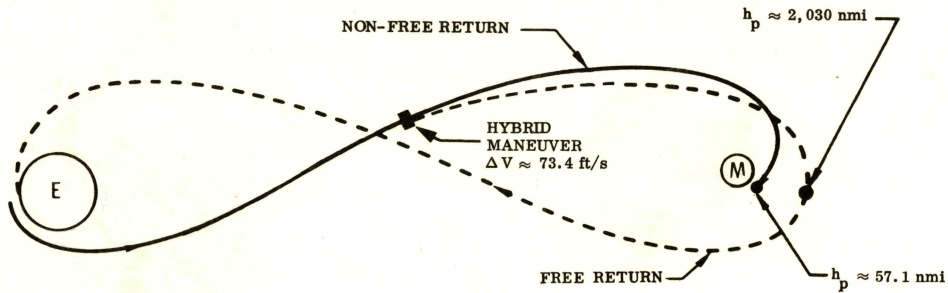
SIX (6) HOUR BUILT-IN HOLD



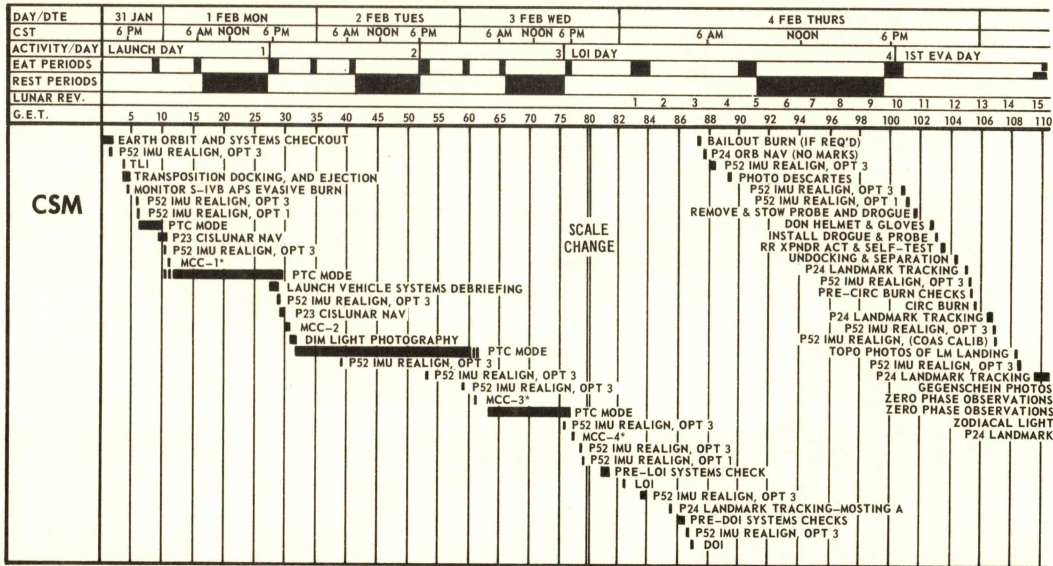
SEQUENCE OF MAJOR EVENTS

EVENT	TIME	TIME	BURN TIME SEC	
	HR:MIN:SEC G.E.T.	HR:MIN:SEC C.S.T.		
LAUNCH		Jan. 31, 1971		
	Earth Orbit Insertion	00:00:00	14:23:00	
	Translunar Injection	00:11:39	14:34:39	5 min 55 sec
	S-IVB Separation	02:30:38	16:53:38	
DESCENT	Docking	03:01:00	17:24:00	
		03:11:06	17:34:06	
	Lunar Orbit Insertion	82:38:13	01:01:13	6 min 6 sec
	Descent Orbit Insertion	86:56:57	05:19:57	20.5 sec
ASCENT	CSM Circularization	105:46:48	00:09:48	
RENDEZVOUS	PDI	108:42:01	03:05:01	11 min 58 sec
	Landing	108:53:32	03:16:32	
RENDZVOUS				
	LM Lift-Off	142:24:29	12:47:29	7 min 10 sec
	LM Insertion	142:31:39	12:54:39	
RENDZVOUS	TPI	143:09:39	13:32:39	4 sec
	Braking	143:50:32	14:13:32	
	Docking	144:10:00	14:33:00	
	LM Jettison	146:23:30	16:46:30	
RENDZVOUS	Transearth Injection	149:14:50	19:37:50	2 min 27 sec
RENDZVOUS	Entry Interface	216:26:58	14:49:58	Lat. - 27.241
	Splashdown	216:40:53	15:03:53	Long. - 171.53

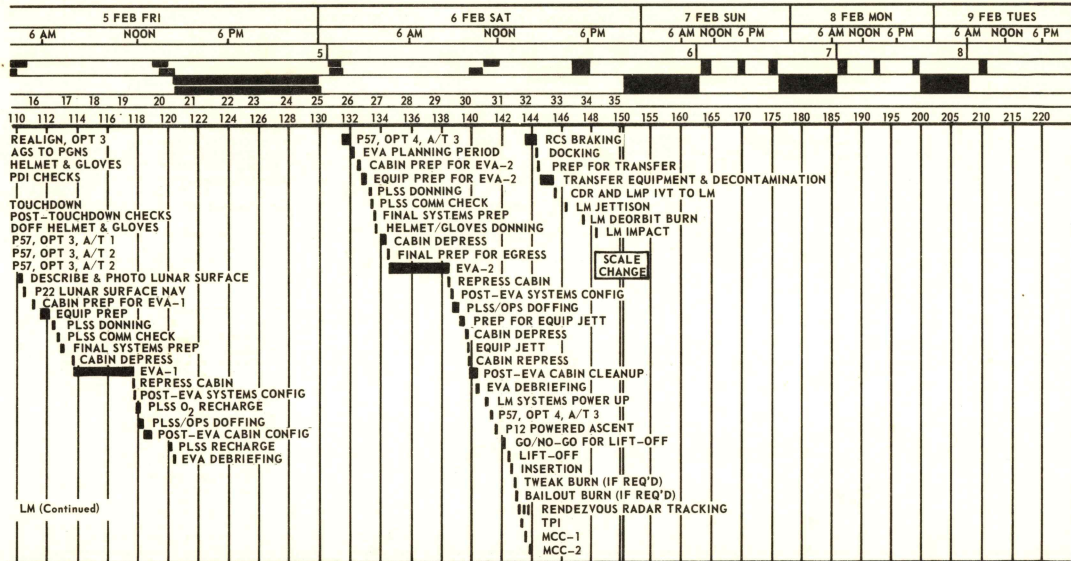
APOLLO 14 HYBRID MISSION PROFILE



MISSION ACTIVITY SUMMARY APOLLO 14



MISSION ACTIVITY SUMMARY APOLLO 14



APOLLO 14 MISSION EVENTS (CSM)

G.E.T. HR:MIN:SEC	EVENT	G.E.T. HR:MIN:SEC	EVENT	G.E.T. HR:MIN:SEC	EVENT
	LAUNCH 3:23 P.M. EST JANUARY 31, 1971 2:23 P.M. CST	88:05:00	P52 REFS (LDG SITE ORIENT)	144:06:00	TV TO 144:11 (DOCKING)
00:11:39.6	EARTH ORBIT INSERTION	101:00:00	TV TO 101:14	144:10:00	DOCKING
00:40:00	P52 REFS	101:17:00	P52	145:55:00	CDR & LMP IVT TO CSM
02:30:38	TLI B.T. 5 MIN 55.6 SEC	101:22:00	P52	146:23:31	LM JETTISON
03:01:00	CSM/SIVB SEP	101:50:00	LMP IVT TO LM	146:28:31	CSM SEPARATION
03:05:00	TV TO 03:30	102:05:00	CDR IVT TO LM	146:40:00	P52
03:11:00	DOCKING	102:40:00	LM DOCKED IMU COARSE ALIGN	149:05:00	P40 SPS THRUST
03:56:00	CSM/LM EJECTION B.T. 3 SEC	103:10:00	LM DOCKED IMU FINE ALIGN	149:14:50	TEI B.T. 2 MIN 27.4 SEC
04:19:00	SIVB EVASIVE MNVR	104:27:31	UNDOCKING & SEP B.T. 3.07 SEC	150:00:00	P52 REFS (TEI ORIENT), PREF (PTC ORIENT)
05:25:00	P52 REFS	105:05:00	P52	163:45:00	P52 REFS
09:05:00	P52 REFS	105:46:48	CSM CIRCULARIZATION B.T. 3.79 SEC	164:15:00	P23 CISLUNAR NAV
09:35:00	P23 CISLUNAR NAV	107:12:00	P52	166:14:50	MCC5
11:23:00	P40/41 SPS/RCS THRUST	107:17:00	COAS CALIB	166:25:00	P23 CISLUNAR NAV
11:36:33	MCC1	109:05:00	P52	172:30:00	TV TO 173:00
28:15:00	P52 REFS	109:50:00	P24 LDMK TRACKING	173:05:00	P23 CISLUNAR NAV
28:50:00	P23 CISLUNAR NAV	111:20:00	GEGENSCHN PHOTOGRAPHY	178:45:00	P52 REFS
30:10:00	P40 SPS THRUST	111:55:00	ZERO PHASE OBSERVATIONS - BACKWARD LOOKING	188:30:00	P23 CISLUNAR NAV
30:36:07	MCC2 B.T. 11.08 SEC	112:30:00	ZERO PHASE OBSERVATIONS - FORWARD LOOKING	192:10:00	P52 REFS
39:50:00	P52 REFS		ZODIACAL LIGHT PHOTOGRAPHY	192:35:00	P23 CISLUNAR NAV
53:10:00	P52 REFS	113:15:00	P24 LM VISUAL TRACK	194:26:59	MCC6
59:45:00	P52 REFS	114:10:00	P52	196:30:00	P23 CISLUNAR NAV
60:20:00	P40/P41 SPS/RCS THRUST	117:00:00	GALACTIC SURVEY PHOTOGRAPHY	208:10:00	P52 REFS
60:38:14	MCC3	117:10:00	PLANE CHANGE 1, B.T. 18.4 SEC	208:40:00	P23 CISLUNAR NAV
61:45:00	TV TO 62:30	118:09:40	P52	212:00:00	P52 REFS
62:05:00	LMP & CDR IVT TO LM FOR HOUSEKEEPING	118:27:00	EARTHSHINE PHOTOGRAPHY	212:10:00	P52 PREF
64:00:00	LMP & CDR IVT TO CSM	118:45:00	P52 (LIFT-OFF ORIENT)	213:26:59	MCC7
76:50:00	P52 REFS	119:15:00	ORBIT SCIENCE PHOTOGRAPHY	214:00:00	P23 CISLUNAR NAV
77:22:00	P40/41 SPS/RCS THRUST	130:20:00	P52	214:50:00	P52 REFS
77:38:14	MCC4	131:17:00	ORBITAL SCIENCE PHOTOGRAPHY	216:12:00	CM/SM SEPARATION
79:25:00	P52 REFS (PTC ORIENT)	131:45:00	GALACTIC SURVEY PHOTOGRAPHY	216:25:00	P63 ENTRY INITIATE
79:35:00	P52 PREF (LDG SITE ORIENT)	132:55:00	LUNAR LIBRATION PHOTOGRAPHY	216:26:59	EI = 400 KFT
82:05:00	P40 SPS THRUST	133:20:00	ORBITAL SCIENCE PHOTOGRAPHY	216:27:29	P64
82:38:14	LOI B.T. 6 MIN 06.6 SEC	133:40:00	P52	216:29:09	P64 TO P67
84:05:00	P52 REFS (LDG SITE ORIENT)	137:00:00	P24 LDMK TRACKING	216:34:15	GUIDANCE TERMINATION
86:10:00	P52 REFS (LDG SITE ORIENT)	137:30:00	ZERO PHASE OBSERVATIONS	216:35:16	DROGUE DEPLOYMENT
86:24:00	P40 SPS THRUSTING	139:40:00	P52	216:36:03	MAIN DEPLOYMENT
86:56:57	DOI B.T. 21.38 SEC ORBIT 58.4 x 9.8 NM	140:38:00	P52 COAS CALIB	216:40:53	SPLASHDOWN
87:50:00	P24 ORB NAV	143:51:00	TV TO 143:57 (RENDEZVOUS)		

APOLLO 14 MISSION EVENTS (LM)

G.E.T. HR:MIN:SEC	EVENT	G.E.T. HR:MIN:SEC	EVENT
62:05:00	LMP & CDR IVT TO LM HOUSE-KEEPING & LM CHECKOUT	134:35:00	LMP EGRESS
64:00:00	LMP & CDR IVT TO CSM	138:15:00	LMP INGRESS - EVA TERMINATION
101:50:00	LMP IVT TO LM	138:25:00	CDR INGRESS - EVA TERMINATION
102:05:00	CDR IVT TO LM	141:20:00	AGS TO PGNS ALIGNMENT
102:20:00	PGNS TURN-ON	141:40:00	P57 LUNAR SURFACE ALIGN
102:40:00	DOCKED IMU COARSE ALIGN	141:50:00	P12 POWERED ASCENT
103:10:00	DOCKED IMU FINE ALIGN	142:24:29	LM ASCENT STAGE LIFTOFF B.T. 7 MIN 10.7 SEC ORBIT: 50.96 x 9.14 NM
104:27:31	UNDOCKING & SEPARATION	142:31:40	LUNAR ORBIT INSERTION
105:15:00	P52 REFS (LDG SITE ORIENT)	142:34:40	TWEAK BURN - IF REQ'D
106:26:00	LANDING RADAR CHECKOUT	142:36:40	BAILOUT BURN - IF REQ'D
107:00:00	P52 REFS	142:38:00	P20, P34
107:45:00	P63	143:05:00	P42 APS THRUSTING
108:42:01	PDI B.T. 11 MIN 31.5 SEC	143:09:40	TPI B.T. 4.0 SEC ORBIT: 61 x 44.6 NM
108:53:33	TOUCHDOWN	143:24:40	MCC1 - RCS
109:15:00	P57 REFS	143:39:40	MCC2 - RCS
109:30:00	P57 LUNAR SURFACE ALIGN	143:48:44	TO 143:54:44 BRAKING GATES, ORBIT: 60.2 x 58.1 NM
110:43:00	P22 LUNAR SURFACE NAV	144:10:00	DOCKING
112:20:00	IMU, LGC TO STANDBY	145:55:00	CDR & LMP IVT TO CSM
112:30:00	PREP FOR EVA 1	146:23:31	LM JETTISON
113:40:00	TV TO 117:40 CDR EGRESS	146:28:31	CSM SEPARATION
113:50:00	LMP EGRESS	147:52:58.9	LM DEORBIT BURN-LM RCS B.T. 77 SEC
117:30:00	EVA TERMINATION - LMP & CDR INGRESS LM	148:20:58	LM LUNAR IMPACT LAT 3.5° S, LONG 19.29° W
131:45:00	P57 LUNAR SURFACE ALIGN		
132:00:00	PREP FOR EVA-2		
133:31:00	TV TO 141:14		
134:25:00	CDR EGRESS		

CSM BURN SCHEDULE

BURN NNVR	GETI BURN TIME	V.T. FPS	ULLAGE V. FPS	REFSMAT	RESULTANT HA & HP	REMARKS
TLI	02:30:38 5 MIN 55.6 SEC	10353.1		PAD		S-IVB BURN
CSM LM EJECTION	03:56 3.0 SEC	0.4		PAD		RCS BURN
MCC-1	11:36:33 30:36:07			PTC		NOM ZERO
MCC-2	11:08:58 30:36:07	73.40	NOT REQ'D	PTC		SPS BURN
MCC-3	69:38:14			PTC		NOM ZERO
MCC-4	77:38:14			PTC		NOM ZERO
LOI	82:38:15 6 MIN 06.6 SEC	2986.0	NOT REQ'D	LDG SITE	HA 170.00 HP 57.14	SPS BURN
DOI	86:56:57 21:38 SEC	206.6	4 JET 14.0 SEC	LDG SITE	HA 58.44 HP 9.77	SPS BURN
BAILOUT BURN	87:27:31 10:17 SEC	100.0	4 JET 14.0 SEC	LDG SITE		SPS BURN
UNDOCK SEP	104:27:31 3:07 SEC	1.00		LDG SITE	HA 59.48 HP 8.23	RCS BURN
CIRC BURN	105:46:48 3:79 SEC	72.46	4 JET 11.0 SEC	LDG SITE	HA 53.51 HP 56.04	SPS BURN
PC-1	118:09:40 18.4 SEC	360.70	4 JET 11.0 SEC	PLANE CHANGE	HA 61.71 HP 57.61	SPS BURN
CSM SEP BURN	146:28:31	1.00		LIFT-OFF	HA 58.26 HP 60.24	3 AXIS RCS BURN
TEI	149:14:50 2 MIN 27.8 SEC	3149.55	4 JET 12 SEC	TEI		SPS BURN
MCC-5	166:13:50			PTC		NOM ZERO
MCC-6	193:26:59			PTC		NOM ZERO
MCC-7	213:26:59			ENTRY		

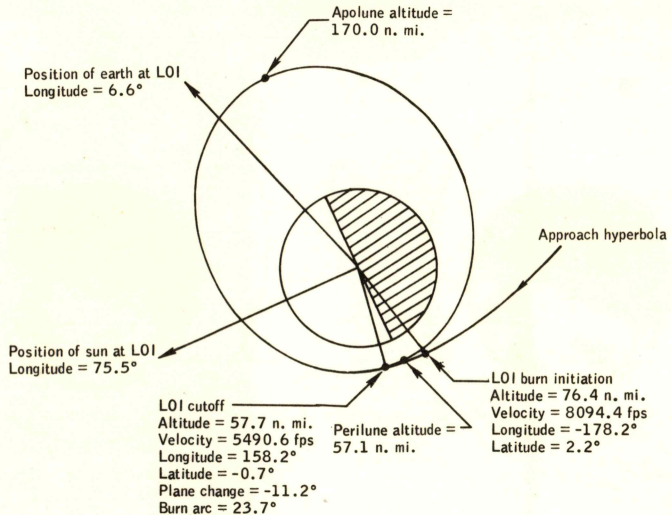
NOTES: 1. HA & HP ARE HEIGHTS ABOVE LANDING SITE RADIUS (937.73488 NM).
2. BURN TIME DOES NOT INCLUDE ULLAGE OR TAILOFF BT.

LM BURN SCHEDULE

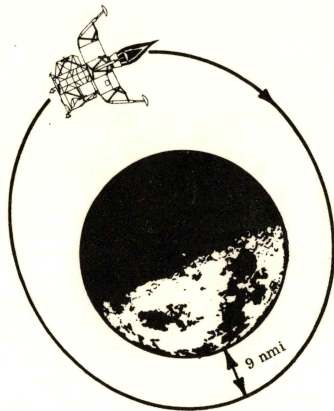
BURN NNVR	GETI BURN TIME	V.T. FPS	ULLAGE V. FPS	REFSMAT	RESULTANT HA & HP	REMARKS
POI	108:42:01 11 MIN 31.5 SEC	6637.7	2 JET 7.5 SEC	LDG SITE		DPS BURN
ASCENT	142:24:29 7 MIN 10.7 SEC	6053.4	NONE	LIFT-OFF	HA 50.96 HP 9.14	APS BURN
TPI	143:09:40 4.0 SEC	92.2	2 JET 13 SEC	LIFT-OFF	HA 61.0 HP 44.6	APS BURN
LM DEORBIT	147:52:58.9 1 MIN 17 SEC	183.7		LIFT-OFF	N/A	RCS BURN

NOTES: 1. HA & HP ARE HEIGHTS ABOVE LANDING SITE RADIUS (937.73488 NM).
2. BURN TIME DOES NOT INCLUDE ULLAGE OR TAILOFF BT.

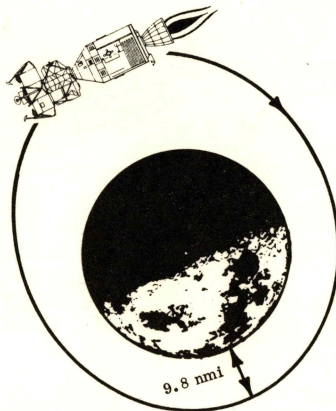
LOI GEOMETRY



DOI ON LOI DAY



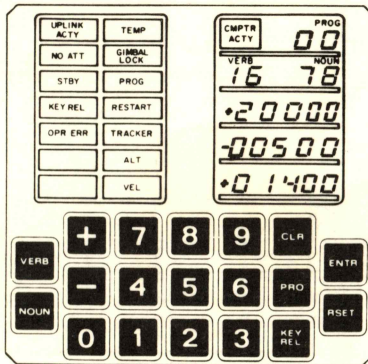
APOLLO 11 AND 12 - DOI ON REVOLUTION 14
60/60 nmi TO 60/9 nmi
28 s DPS BURN
 $\Delta V = 72.1$ ft/s RETROGRADE
THRUST ACCELERATION ≈ 4 ft/s²



APOLLO 14 - DOI ON REVOLUTION 3
57/170 nmi TO 58/9.8 nmi
21 s SPS BURN
 $\Delta V = 207$ ft/s RETROGRADE
THRUST ACCELERATION ≈ 9 ft/s²

TYPICAL LUNAR LANDING DSKY ENTRIES
PROGRAM 63

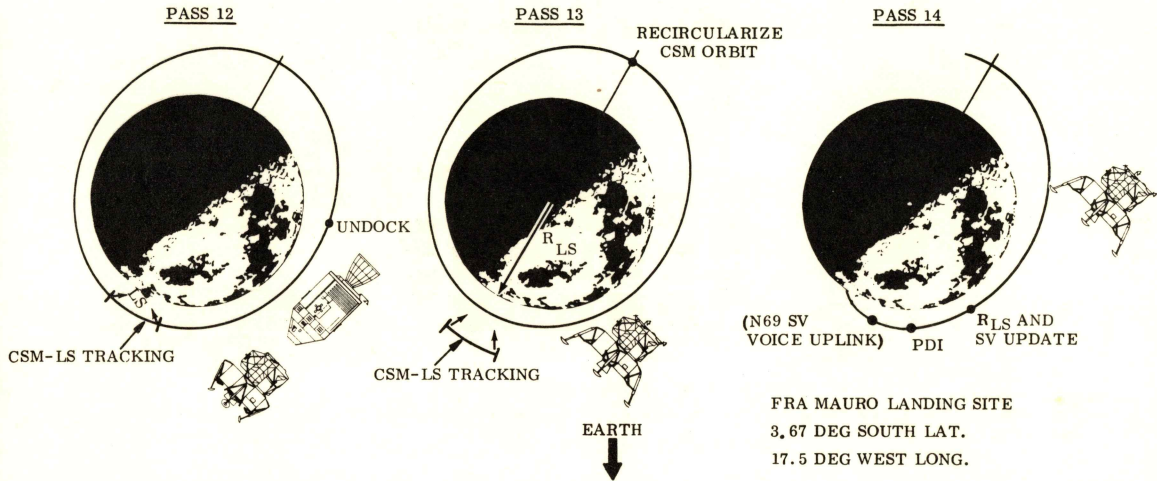
- V37E 63E
F V06 N61 TIME TO GO
TIME FROM IGNITION
CROSSRANGE DISTANCE
N33E
F V06 N33 TIME OF IGNITION
PROCEED
F V50 N18 ROLL, PITCH, YAW FOR PDI
PROCEED
V06 N62 TIME FROM IGNITION
DSKY BLANKS (TIG - 35 SECONDS)
ENGINE ARM TO - (DESCENT)
V06 N62 COUNTDOWN CONTINUES (TIG-30)
ULLAGE
F V99 N62 ENGINE ON ENABLE (TIG-5)
PROCEED
IGNITION
V06 N63 INERTIAL VELOCITY
H DOT (ALTITUDE RATE)
H (ALTITUDE)
V21 N69E LANDING SITE CORRECTIONS
V57 E PERMIT LR UPDATE
THROTTLE DOWN (6 min + XX s)
PROGRAM 64 DISPLAYED
F V06 N64

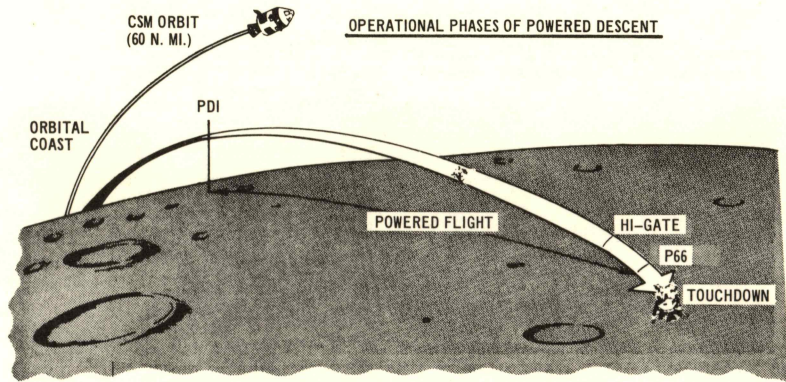


TYPICAL LUNAR LANDING DSKY ENTRIES
PROGRAMS 64 AND 66

- F V06 N64 TIME TO GO AND LPD ANGLE
H DOT
H
PROCEED (USE LPD)
V06 N64
REDESIGNATE LANDING SITE
PGNS MODE TO ATTITUDE HOLD
ACTUATE ROD SWITCH
PROGRAM 66 DISPLAYED
V06 N60 HORIZONTAL VELOCITY
H DOT
H
INPUT ROD AS DESIRED
LUNAR CONTACT LIGHT - ON
ENGINE STOP - PUSH
STAY/NO STAY DECISION
V37E N68E LANDING CONFIRMATION
PROGRAM

APOLLO 14 NAVIGATION PLAN FOR LANDING



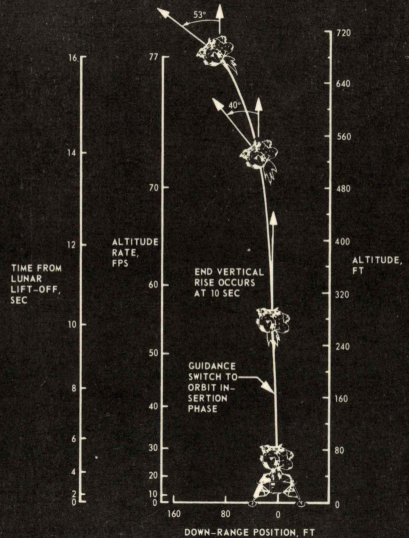
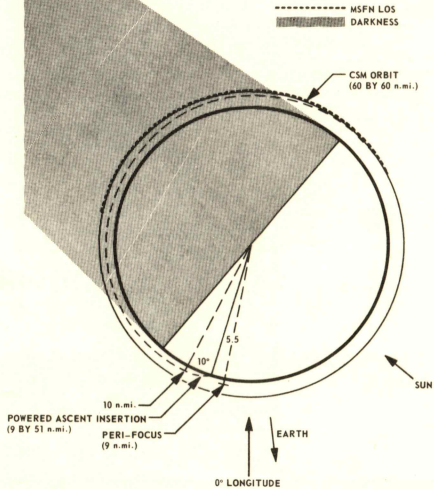


- P63-BRAKING PHASE (PDI TO HI-GATE)
- P64-VISIBILITY PHASE (HI-GATE TO CREW SELECTION OF P66)
- P66-LANDING PHASE (P66 TO TOUCHDOWN)

DESCENT EVENTS

EVENT	TIME		DATA SUMMARY
	HR:MIN:SEC G.E.T.	HR:MIN:SEC C.S.T.	
DESCENT		Feb. 4, 1971	
CSM/LM Undock and SEP	104:27:30.7	22:50:30.7	Revolution Number 12
CIRCULARIZATION (CSM)		Feb. 5, 1971	
Burn Initiation	105:46:48.5	00:09:48.5	Mass, lb 35 937.7
			Selenographic Latitude, deg 9.7
			Selenographic Longitude, deg -168.2
			Selenographic Inclination, deg 14.2
			Altitude Above LLS, nmi 58.6
			Perilune Altitude Above LLS, nmi 8.8
			Velocity, fps 5280.1
			Revolution Number 12
Burn Termination	105:46:52.3	00:09:52.3	ΔV , fps 72.5
			Burn Duration, sec 3.8
			Altitude Above LLS, nmi 58.6
			Perilune Altitude Above LLS, nmi 56.0
			Apolune Altitude Above LLS, nmi 63.5
			Velocity, fps 5351.0
			SPS Propellant Consumed, lb 257.2
			Burn Arc, deg 0.2
			Period, hr:min:sec 01:58:45.2
PDI (DPS Ignition Time)	108:42:01.1	03:05:01.1	Altitude Above LLS, ft 50 026.6
			Velocity, fps 5574.5
			Revolution Number 14
High Gate (P63 to P64)	108:50:35.1	03:13:35.1	Altitude Above LLS, ft 7496.3
			Velocity, fps 464.0
Low Gate	108:52:13.1	03:15:13.1	Altitude Above LLS, ft 682.8
			Velocity, fps 84.5
Vertical Descent	108:53:01.1	03:16:01.1	Altitude Above LLS, ft 125.1
			Velocity, fps 6.7
LM Landing	108:53:32.6	03:16:32.6	ΔV , fps 6637.6
			Burn Duration, min:sec 11:31.5
			DPS Propellant Consumed, lb 16 801.2
			Revolution Number 14

LM ASCENT



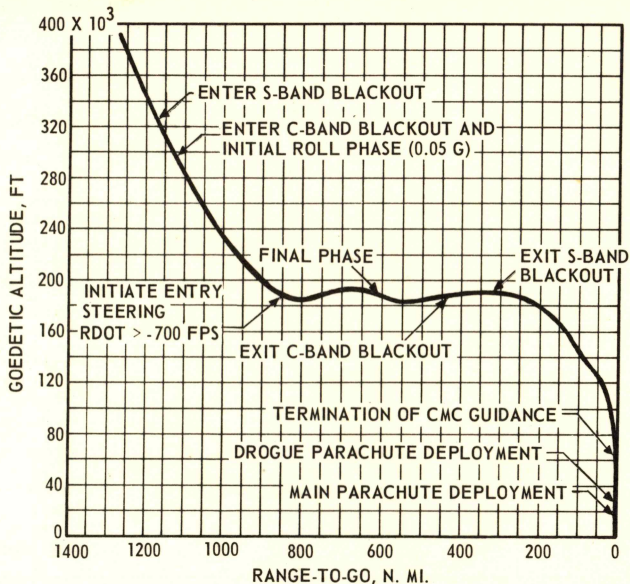
ASCENT EVENTS

EVENT	TIME	TIME	DATA SUMMARY
	HR:MIN:SEC G.E.T.	HR:MIN:SEC C.S.T.	
ASCENT			
	Feb. 6, 1971		
LM Lift-Off	142:24:29.2	12:47:29.2	Mass, lb 10 747.0 Selenographic Latitude, deg -3.7 Selenographic Longitude, deg -17.5 Revolution Number 31
LM Insertion	142:31:39.9	12:54:39.9	Mass, lb 5831.5 ΔV , fps 6053.4 Burn Duration, sec 430.7 Latitude, deg -1.6 Longitude, deg -27.3 Altitude Above LLS, ft 59 932.7 Perilune Altitude Above LLS, ft 55 511.9 Apolune Altitude Above LLS, ft 309 656.4
RENDEZVOUS			
TPI	143:09:39.9	13:32:39.9	Burn Duration, sec 4.0 ΔV , fps 77.8 Propellant Used, lb 45.3 Resultant h_a/h_p , nmi 61.0/44.6 Range at Cutoff, nmi 32.5 Range Rate at Cutoff, fps -134.3 Propulsion System APS Revolution Number 31
Braking	143:50:32.8	14:13:32.8	Burn Duration, sec 29.2 ΔV , fps 32.6 Propellant Used, lb 20.8 Range at Final Braking, nmi 0.02 Range Rate at Final Braking, fps -0.23 h_a/h_p at Final Braking, nmi 60.3/58.7 Propulsion System LM/RCS Revolution Number 32

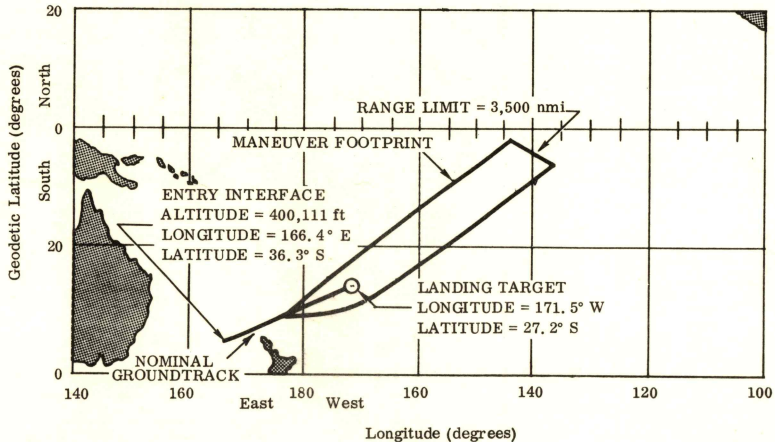
EVENT	TIME	TIME	DATA SUMMARY
	HR:MIN:SEC G.E.T.	HR:MIN:SEC C.S.T.	
Docking	144:10:00.0	14:33:00.0	
LM Jettison	146:23:30.5	16:46:30.5	Selenographic Latitude, deg -3.3 Selenographic Longitude, deg -21.1
CSM/LM SEPARATION			
Burn Initiation	146:28:30.6	16:51:30.6	
Burn Termination	146:28:36.5	16:51:36.5	Mass, lb 34 570.7 ΔV , fps 1.0 Burn Duration, sec 5.9 Selenographic Latitude, deg -0.1 Selenographic Longitude, deg -36.3 Altitude Above LLS, nmi 59 559.5 Perilune Altitude Above LLS, nmi 58.3 Apolune Altitude Above LLS, nmi 60.2 Plane Change, deg 0.0 Selenographic inclination, deg 12.2 Velocity, fps 5344.7 Revolution Number 33
LM Deorbit	147:52:58.9	18:15:58.9	Mass, lb 5277.2 ΔV , fps 183.7 Burn Duration, sec 77.0 Selenographic Latitude, deg -11.8 Selenographic Longitude, deg 67.4
LM Impact	148:20:58.1	18:43:58.1	Mass, lb 5171.1 Selenographic Latitude, deg -3.5 Selenographic Longitude, deg -19.3 Velocity, fps 5505.9 CSM Revolution Number 34

TYPICAL ENTRY SEQUENCE

EVENT	TIME FROM 400 000 FT MIN:SEC
400,000 FT (GET 216: 26:59)	00:00
ENTER S-BAND BLACKOUT	00:18
0.05g LOAD FACTOR	00:30
KA - INITIATE CONSTANT DRAG	00:52
RDOT = 700 FPS	01:18
PEAK G	02:06
SUBCIRCULAR VELOCITY	02:06
P64 - P67	02:10
EXIT S-BAND BLACKOUT	03:32
GUIDANCE TERMINATION	07:16
DROUGE DEPLOYMENT	08:17
MAIN DEPLOYMENT	09:04
SPLASHDOWN	13:54



MANEUVER FOOTPRINT AND NOMINAL GROUNDTRACK



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LGC PROGRAMS

NUMBER	TITLE
SERVICE	
P00	LGC Idling
P06	PGNCS Power
P07	Systems Test (Non-flight)
ASCENT	
P12	Powered Ascent Guidance
COAST	
P20	Rendezvous Navigation
P21	Ground Track Determination
P22	RR Lunar Surface Navigation
P25	Preferred Tracking Attitude
P27	LGC Update
PRETHRUSTING	
P30	External Delta V
P32	Co-elliptic Sequence Initiation (CSI)
P33	Constant Delta Altitude (CDH)
P34	Transfer Phase Initiation (TPI)
P35	Transfer Phase Midcourse (TPM)

NUMBER	TITLE
THRUST	
P40	DPS Thrusting
P41	RCS Thrusting
P42	APS Thrusting
P47	Thrust Monitor
ALIGNMENTS	
P51	IMU Orientation Determination
P52	IMU Realign
P57	Lunar Surface Alignment
DESCENT & LANDING	
P63	Landing Maneuver Braking Phase
P64	Landing Maneuver: Approach Phase
P66	Rate of Descent Landing (Rod)
P68	Landing Confirmation
ABORTS & BACKUPS	
P70	DPS Abort
P71	APS Abort
P72	CSM Co-elliptic Sequence Initiation (CSI) Targeting
P73	CSM Constant Delta Altitude (CDH) Targeting
P74	CSM Transfer Phase Initiation (TPI) Targeting;
P75	CSM Transfer Phase Midcourse (TPM) Targeting
P76	Target Delta V

CM COMPUTER PROGRAMS

PHASE	PROGRAM NUMBER	PROGRAM TITLE	
Pre-launch and Service	00	CMC Idling	
	01	Prelaunch or Service-Initialization	
	02	Prelaunch or Service-Gyro Compassing	
	03	Prelaunch or Service-Optical Verification of Gyro Compassing	
Boost	06	GNCS Power Down	
	07	Systems Test	
	11	Earth Orbit Insertion Monitor (EOI)	
Coast	15	Saturn Time Base 6 Initiation	
	20	Rendezvous Navigation	
	21	Ground Track Determination	
	22	Orbital Navigation	
	23	Cislunar Midcourse Navigation	
	24	P-24 LDMK Tracking	
	27	CMC Update	
	Pre-thrusting	30	External Delta V
		31	Lambert Aimpoint Maneuver
		32	Co-elliptic Sequence Initiation (CSI)
33		Constant Delta Altitude (CDH)	
34		Transfer Phase Initiation (TPI)	
35		Transfer Phase (Midcourse)	
37		Return to Earth (RTE)	

PHASE	PROGRAM NUMBER	PROGRAM TITLE	
Thrusting	38	Stable Orbit Rendezvous (SOR)	
	39	Stable Orbit Midcourse (SOM)	
	40	SPS	
	41	RCS	
Alignment	47	Thrust Monitor	
	51	IMU Orientation Determination	
	52	IMU Realign	
	53	Back-up IMU Orientation Determination	
Entry	54	Back-up IMU Realign	
	61	Entry-Preparation	
	62	Entry-CM/SM Separation and Pre-entry Maneuver	
	63	Entry Initialization	
	64	Entry-Post 0.05G	
	65	Entry-Up Control	
	66	Entry-Ballistic	
	67	Entry-Final Phase	
	Pre-Thrusting Other Vehicle	72	LM Co-elliptic Sequence Initiation (CSI) Targeting
		73	LM Constant Delta Altitude (CDH) Targeting
74		LM Transfer Phase Initiation (TPI) Targeting	
75		LM Transfer Phase (Midcourse) Targeting	
	76	LM Target Delta V	

NOUN 70 CODES

R1: CELESTIAL BODY CODE 000DE

P22 R2: LANDMARK DATA

00	PLANET	27	ALKAID
01	ALPHERATZ	30	MENKENT
02	DIPHDA	31	ARCTURUS
03	NAVI	32	ALPHECCA
04	ACHERNAR	33	ANTARES
05	POLARIS	34	ATRIA
06	AGAMAR	35	RASALHAGUE
07	MENKAR	36	VEGA
10	MIRFAK	37	NUNKI
11	ALDEBARAN	40	ALTAIR
12	RIGEL		
13	CAPELLA		
14	CANOPUS		
15	SIRIUS		
16	PROCYON		
17	REGOR	41	DABIH
20	DNOCES	42	PEACOCK
21	ALPHARD	43	DENEIB
22	REGULUS	44	ENIF
23	DENEIBOLA	45	FOMALHAUT
24	GIENAH	46	SUN
25	ACRUX	47	EARTH
26	SPICA	50	MOON

LANDING SITE	10001
KNOWN SITE	10000
UNKNOWN SITE	20000

P23 R1: 000DE STAR ID

R2: 00000
 C=0 HORIZON
 C=1 EARTH LDMK
 C=2 LUNAR LDMK

R3: 00000 HORIZ ID
 C=1 EARTH, 2 LUNAR
 D=1 NEAR, 2 FAR

NOUN 99 CODES

R3:
 00001 = RDZV
 00002 = ORBITAL
 00003 = CISLUNAR
 00000 = NO REINITIALIZATION

ALARM CODES (V05N09)

00110	MK REJECT ENTERED & IGNORED	00602	HP < 5.8 NM AFTER CDH	14777	ISS WARN-IMU,ICDU & PIPA FAIL
00112	MK REJECT BEFORE MKS ACCEPTED	00603	CSI TIG TO CDH TIG $\Delta T < 10$ MIN	20430	ORBITAL INTEGRATION STOPPED
00113	NO INBITS (CH 16)	00604	CDH TIG TO TPI TIG $\Delta T < 10$ MIN	20607	NO CONIC SOLUTION
00114	MORE MKS THAN DESIRED	00605	TOO MANY ITERATIONS	20610	ALTITUDE < 400K AT TIG (P37)
00115	V41N91 WITH OPTICS NOT IN CMC	00606	CSI $\Delta V > 1000$ LAST 2 ITERATIONS	21103	UNUSED CCS BRANCH EXECUTED
00116	OPTICS SW MOVED BEFORE 15 SEC	00611	NO TIG FOR ELEV ANGLE GIVEN	21204	NEG OR ZERO WAITLIST CALL
00117	V41N91 BUT OPTICS NOT READY	00612	WRONG SPHERE OF INFL AT TIG	21206	TWO DISPLAYS ATTEMPTED AT ONCE
00120	ZERO OPTICS FIRST	00613	REENTRY ANGLE OUT OF LIMITS	21210	TWO PROGRAMS USING AT ONCE
00121	CDUS BAD DURING MK-REPEAT	00777	ISS WARNING-PIPA FAIL	21302	SQRT CALLED WITH NEG ARGUMENT
00122	MK NOT CALLED FOR	01102	CMC SELF TEST ERROR	21501	DSKY ALARM DURING INTERNAL USE
00205	PIPA SATURATED	01105	DOWNLINK TOO FAST	21502	ILLEGAL FLASHING DISPLAY
00206	CANNOT ZERO ICDU-WITH ALARMS	01106	UPLINK TOO FAST	21521	KEYED PO1/V92 AFTER LIFTOFF
00207	NEED 90 SEC FOR ISS TURN ON	01107	PHASE TABLE FAIL-ERASABLE BAD	31104	DELAY ROUTINE IS BUSY
00210	IMU NOT OPERATING	01301	ARCSIN/ARCCOS INPUT > ONE	31201	EXEC OVERFLOW-NO VAC AREAS
00211	COARSE ALIGN ERROR > 2 DEG	01407	VG INCREASING	31202	EXEC OVERFLOW-NO CORE SETS
00212	PIPA FAIL BUT PIPA NOT IN USE	01426	IMU UNSATISFACTORY	31203	WAITLIST OVERFLOW-MANY TASKS
00213	IMU NOT ON-TURN ON IMU	01427	IMU POLARITY REVERSED	31207	NO VAC AREA FOR MKS
00214	PROGRAM USING IMU BUT IMU OFF	01520	V37 NOT PERMITTED NOW	31211	CANNOT INTERRUPT EXTENDED VERB
00217	COARSE ALIGN/TORQUING PROBLEM	01600	OVERFLOW DURING DRIFT TEST		
00220	IMU NOT ALIGNED/NO REFSMMAT	01601	BAD IMU TORQUE		
00401	DESIRED MGA TOO LARGE	01602	BAD OPTICS IN VERIFICATION		
00404 *	TGT OUT OF VIEW (TRUN > 90 DEG)	01703	INSUF TIME TO INTEG-TIG SLIP		
00405	STAR PAIR NOT AVAILABLE	03777	ISS WARNING-ICDU FAIL		
00406	P20 NOT OPERATING	04777	ISS WARNING-ICDU & PIPA FAIL		
00421	W MATRIX OVERFLOW	07777	ISS WARNING-IMU FAIL		
00600	NO SOLUTION ON 1ST ITERATION	10777	ISS WARNING-IMU & PIPA FAIL		
00601	HP < 5.8 NM AFTER CSI	13777	ISS WARNING-IMU & ICDU FAIL		

NOTE :

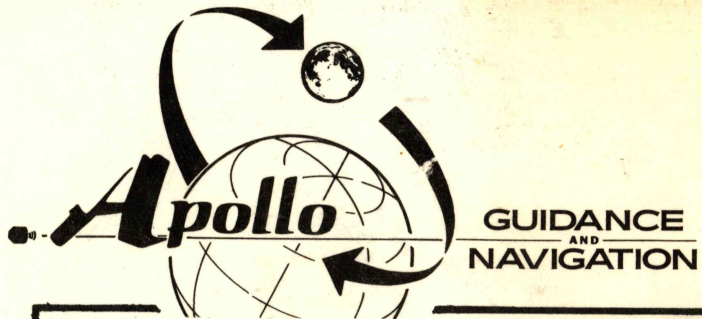
00404 * IS A PRIORITY ALARM
 2XXXX POODOO-NO RESTART LT-F37
 (AVE G ON-ACTS AS BAILOUT)
 3XXXX BAILOUT-NO RESTART LT-
 PROGRAM CONTINUES

ABBREVIATIONS

ACN	ASCENSION TRACKING STATION
AGS	ABORT GUIDANCE SYSTEM
ANG	ANTIGUA TRACKING STATION
AOS	ACQUISITION OF SIGNAL
APS	ASCENT PROPULSION SYSTEM
BDA	BERMUDA TRACKING STATION
BT	BURN TIME
CAL	CALIFORNIA TRACKING STATION
CDH	CONSTANT DIFFERENTIAL HEIGHT
CDR	COMMANDER
CES	CONTROL ELECTRONICS SYSTEM
CMC	COMMAND MODULE COMPUTER
CRO	CARNARVON TRACKING STATION
CSI	CONCENTRIC SEQUENCE INITIATION
CSM	COMMAND AND SERVICE MODULES
CYI	GRAND CANARY ISLAND
DAP	DIGITAL AUTOPILOT
DOI	DESCENT ORBIT INSERTION
DPS	DESCENT PROPULSION SYSTEM
EI	ENTRY INTERFACE
EMU	EXTRAVEHICULAR MOBILITY UNIT
EOI	EARTH ORBIT INSERTION
EPO	EARTH PARKING ORBIT
EVA	EXTRAVEHICULAR ACTIVITY
EVT	EXTRAVEHICULAR TRANSFER
FTP	FIXED THROTTLE POINT
GBM	GRAND BAHAMA TRACKING STATION
GDS	GOLDSTONE TRACKING STATION
g.e.t.	GROUND ELAPSED TIME
G.m.t.	GREENWICH MEAN TIME
G&N	GUIDANCE AND NAVIGATION
GYM	GUAYMAS TRACKING STATION
H _a	APOGEE ALTITUDE
HAW	HAWAII TRACKING STATION
H _p	PERIGEE ALTITUDE
IVC	INTERVEHICLE COMMUNICATIONS
IVT	INTRAVEHICULAR TRANSFER
LGC	LM GUIDANCE COMPUTER
LLM	LUNAR LANDING MISSION
LLS	LUNAR LANDING SITE
LM	LUNAR MODULE
LMP	LUNAR MODULE PILOT
LOI	LUNAR ORBIT INSERTION
LOS	LOSS OF SIGNAL
LPO	LUNAR PARKING ORBIT

ABBREVIATIONS

LR	LANDING RADAR
MC	LM MIDCOURSE CORRECTION
MCC	MIDCOURSE CORRECTION
MER	MERCURY TRACKING SHIP
MGA	MIDDLE GIMBAL ANGLE
MIL	MERRITT ISLAND TRACKING STATION
MSFN	MANNED SPACE FLIGHT NETWORK
OGA	OUTER GIMBAL ANGLE
OPS	OXYGEN PURGE SYSTEM
PC	PLANE CHANGE
PDI	POWER DESCENT INITIATION
PGA	PRESSURE GARMENT ASSEMBLY
PGNCS	PRIMARY GUIDANCE & NAVIGATION CONTROL SUBSYSTEM
PLSS	PORTABLE LIFE SUPPORT SYSTEM
PRE	PRETORIA TRACKING STATION
PTC	PASSIVE THERMO CONTROL
RCS	REACTION CONTROL SUBSYSTEM
RDG	POSITION TARGET FOR LM DESCENT
RR	RENDEZVOUS RADAR
SECO	SIVB ENGINE CUT-OFF
SLA	SPACECRAFT LM ADAPTER
SPS	SERVICE PROPULSION SYSTEM
S-IC	SATURN IC, LV FIRST STAGE
S-II	SATURN II, LV SECOND STAGE
S-IVB	SATURN IVB, LV THIRD STAGE
TAN	TANANARIVE TRACKING STATION
TEC	TRANSEARTH COAST
TD&E	TRANSPPOSITION & DOCKING & EXTRACTION
TEI	TRANSEARTH INSERTION
TEX	CORPUS CHRISTI TRACKING STATION
TLC	TRANSLUNAR COAST
TLI	TRANSLUNAR INJECTION
TPF	TERMINAL PHASE FINALIZATION
TPI	TERMINAL PHASE INITIALIZATION
TPM	TERMINAL PHASE MIDCOURSE
TVC	THRUST VECTOR CONTROL
VAN	VANGUARD TRACKING SHIP
ΔV	VELOCITY CHANGE (DIFFERENTIAL)
ΔVC	VELOCITY CHANGE AT ENGINE CUT-OFF
ΔR	POSITION CHANGE (DIFFERENTIAL)



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MILWAUKEE, WISCONSIN 53201

