



FRA MAURO LANDING

APOLLO 14

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

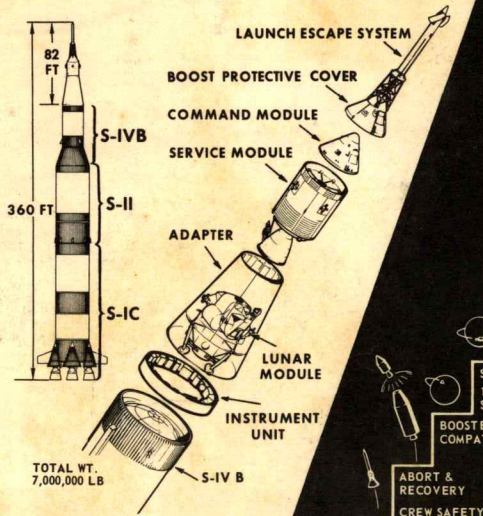


DELCO ELECTRONICS

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

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	Schirra-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-Swigert-Haise	April 11, '70	142:54:44	6262:40:59
Apollo 14 Saturn V	Shepard-Roosa-Mitchell	Jan. 31, '71		

APOLLO 14 MISSION DESCRIPTION

- 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.

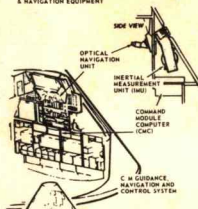
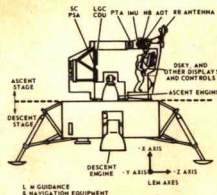


LM GUIDANCE and NAVIGATION EQUIPMENT.....

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 discretes 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.

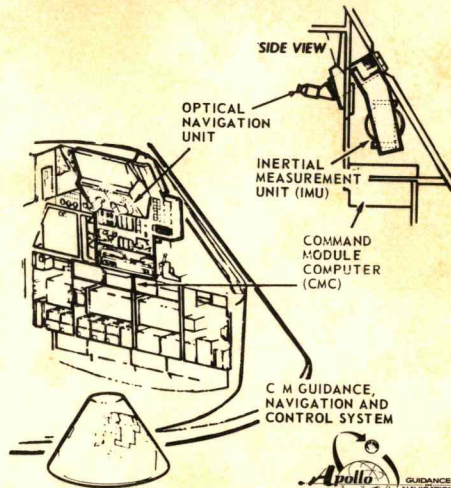
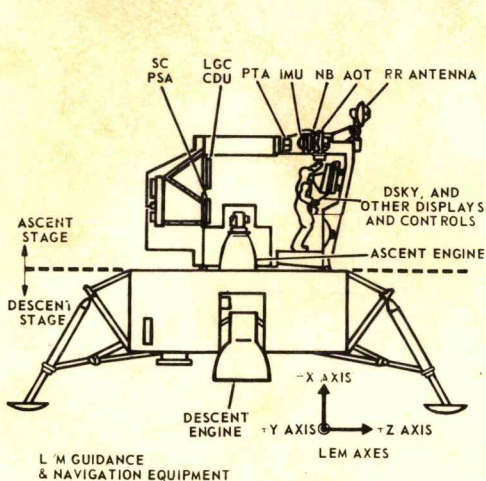
NAVIGATION BASE (NAV BASE) - Provides an accurate mounting base for the Alignment Optical Telescope (AOT) and the Inertial Measurement Unit.

LM GUIDANCE COMPUTER (LGC) - Performs four major functions: (A) Calculates steering signals and engine discretes 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.

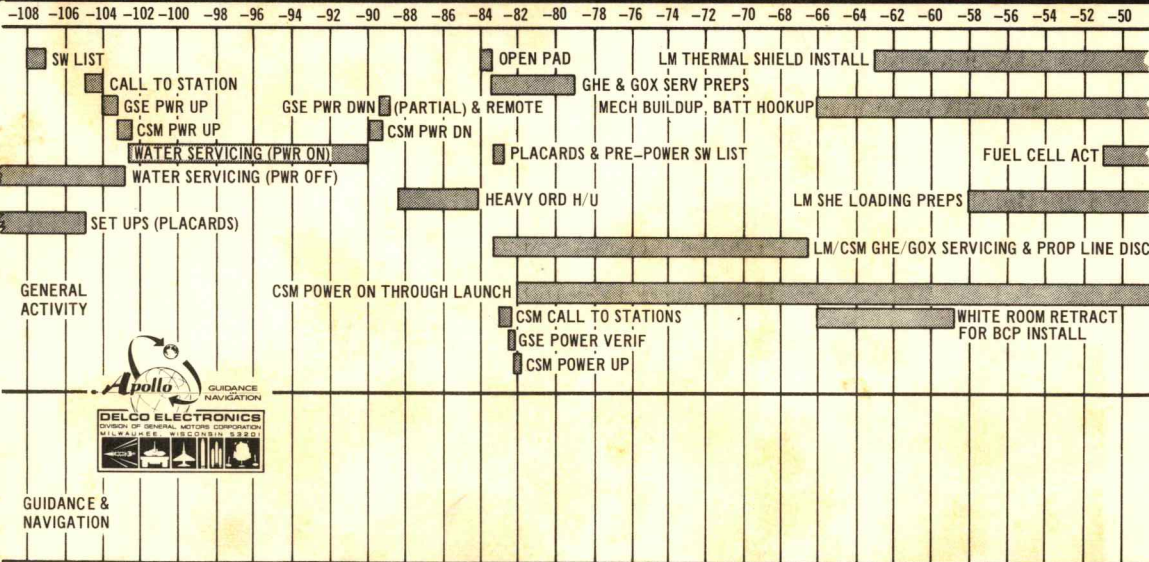
GUIDANCE & NAVIGATION EQUIPMENT LOCATION



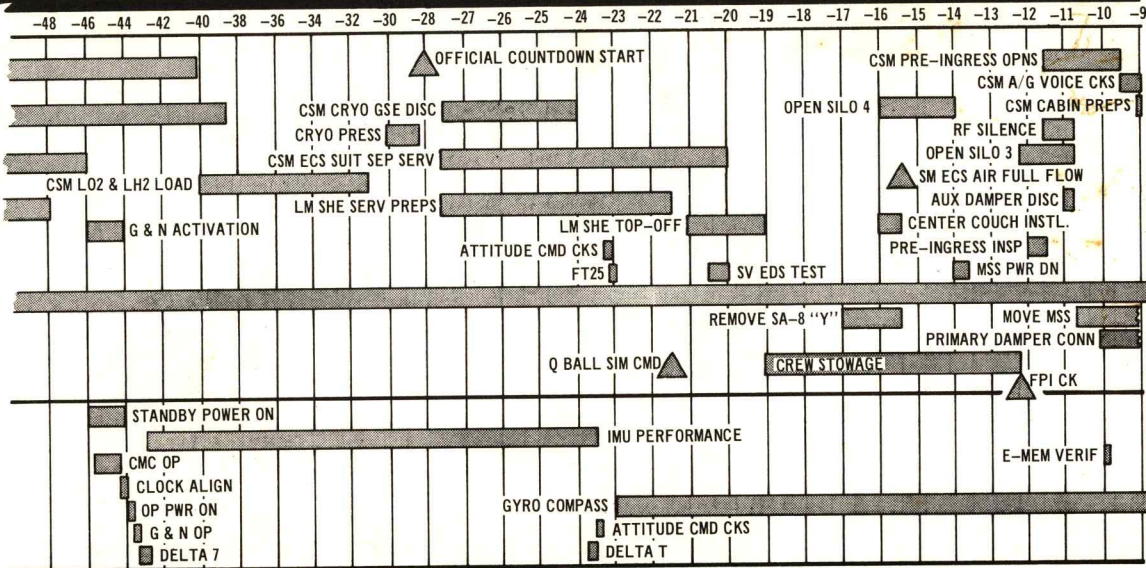
APOLLO 14 LAUNCH COUNTDOWN

PRECOUNT

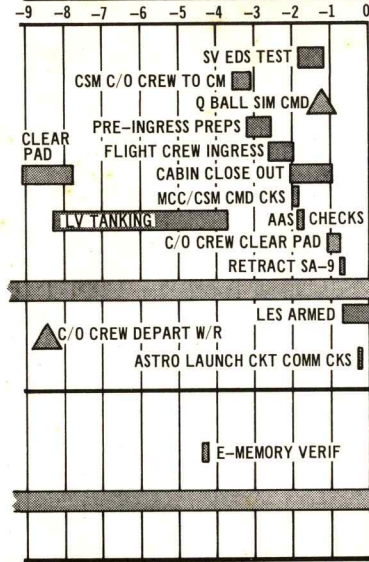
MIDCOUNT



COUNTDOWN



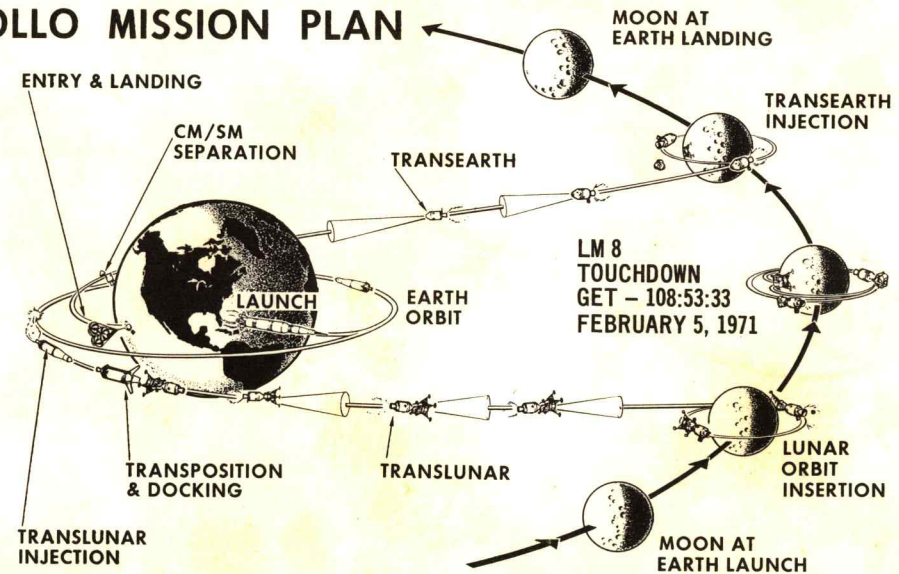
SIX (6) HOUR BUILT-IN HOLD



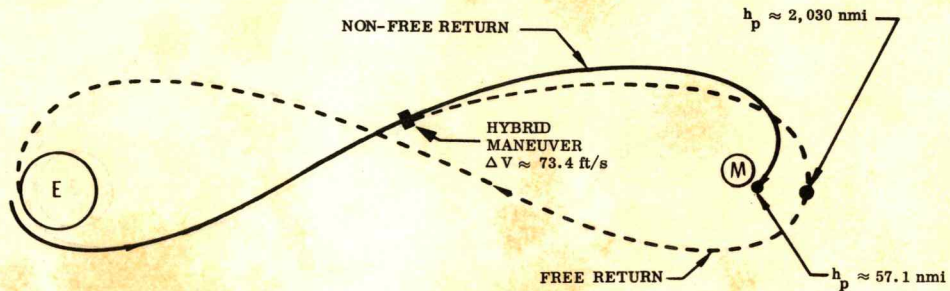
SEQUENCE OF MAJOR EVENTS

EVENT	TIME HR:MIN:SEC G.E.T.	TIME HR:MIN:SEC C.S.T.	BURN TIME SEC
LAUNCH		Jan. 31, 1971	
Earth Orbit Insertion	00:00:00	14:23:00	
Translunar Injection	00:11:39	14:34:39	
S-IVB Separation	02:30:38	16:53:38	5 min 55 sec
Docking	03:01:00	17:24:00	
	03:11:06	17:34:06	
		Feb. 4, 1971	
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
		Feb. 5, 1971	
CSM Circularization	105:46:48	00:09:48	
DESCENT			
PDI	108:42:01	03:05:01	11 min 58 sec
Landing	108:53:32	03:16:32	
ASCENT		Feb. 6, 1971	
LM Lift-Off	142:24:29	12:47:29	
LM Insertion	142:31:39	12:54:39	7 min 10 sec
RENDEZVOUS			
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	
Transearth Injection	149:14:50	19:37:50	2 min 27 sec
		Feb. 9, 1971	
Entry Interface	216:26:58	14:49:58	Lat. - 27.241
Splashdown	216:40:53	15:03:53	Long. - 171.53

APOLLO MISSION PLAN



APOLLO 14 HYBRID MISSION PROFILE



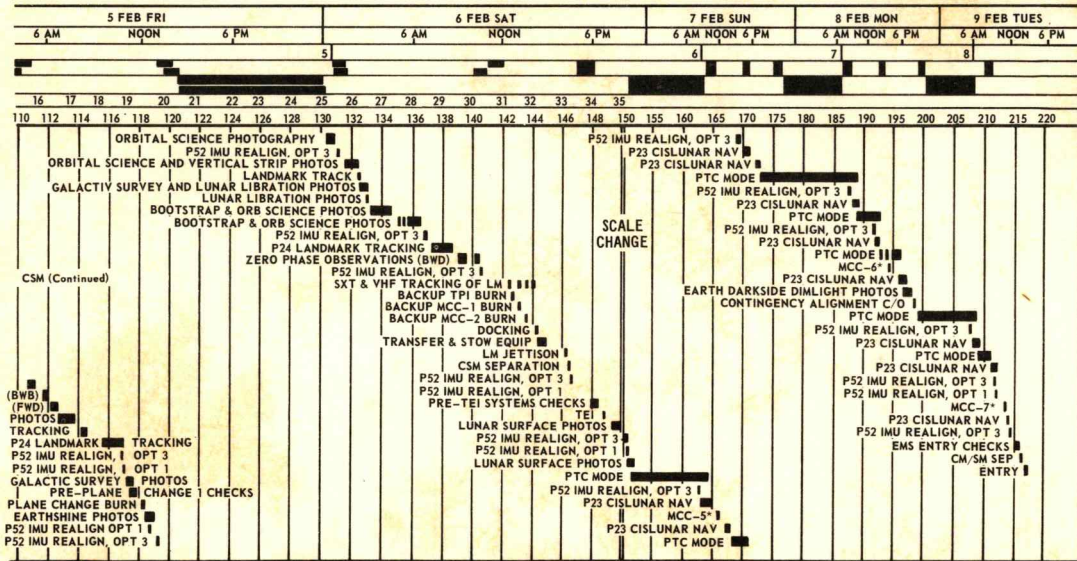
DELCO ELECTRONICS

DIVISION OF GENERAL MOTORS CORPORATION
MILWAUKEE, WISCONSIN 53201

DAY/DTE	31 JAN				1 FEB MON				2 FEB TUES				3 FEB WED				4 FEB THURS																							
CST	6 PM		6 AM NOON 6 PM		6 AM NOON 6 PM		6 AM NOON 6 PM		6 AM NOON 6 PM		6 AM NOON 6 PM		6 AM NOON 6 PM		6 AM NOON 6 PM		6 PM																							
ACTIVITY/DAY	LAUNCH DAY				1				2				3				LOI DAY				4				1ST EVA DAY															
EAT PERIODS																																								
REST PERIODS																																								
LUNAR REV.																																								
G.E.T.	5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110																																							
CSM	EARTH ORBIT AND SYSTEMS CHECKOUT																				BAILOUT BURN (IF REQ'D)																			
	P52 IMU REALIGN, OPT 3																				P24 ORB NAV (NO MARKS)																			
	TLI																				P52 IMU REALIGN, OPT 3																			
	TRANSPONITION DOCKING, AND EJECTION																				PHOTO DESCARTES																			
	MONITOR S-IVB APS EVASIVE BURN																				P52 IMU REALIGN, OPT 3																			
	P52 IMU REALIGN, OPT 3																				P52 IMU REALIGN, OPT 1																			
	P52 IMU REALIGN, OPT 1																				REMOVE & STOW PROBE AND DROGUE																			
	PTC MODE																				DON HELMET & GLOVES																			
	P23 Cislunar NAV																				INSTALL DROGUE & PROBE																			
	P52 IMU REALIGN, OPT 3																				RR XPNDR ACT & SELF-TEST																			
	MCC-1*																				UNDocking & SEPARATION																			
	PTC MODE																				P24 LANDMARK TRACKING																			
	LAUNCH VEHICLE SYSTEMS DEBRIEFING																				P52 IMU REALIGN, OPT 3																			
	P52 IMU REALIGN, OPT 3																				PRE-CIRC BURN CHECKS																			
	P23 Cislunar NAV																				CIRC BURN																			
	MCC-2																				P24 LANDMARK TRACKING																			
	DIM LIGHT PHOTOGRAPHY																				P52 IMU REALIGN, OPT 3																			
	PTC MODE																				P52 IMU REALIGN, (COAS CALIB)																			
	P52 IMU REALIGN, OPT 3																				TOPO PHOTOS OF LM LANDING																			
	P52 IMU REALIGN, OPT 3																				P52 IMU REALIGN, OPT 3																			
P52 IMU REALIGN, OPT 3																				P24 LANDMARK TRACKING																				
MCC-3*																				GEGENSCHIEIN PHOTOS																				
PTC MODE																				ZERO PHASE OBSERVATIONS																				
P52 IMU REALIGN, OPT 3																				ZERO PHASE OBSERVATIONS																				
MCC-4*																				ZODIACAL LIGHT																				
P52 IMU REALIGN, OPT 3																				P24 LANDMARK																				
P52 IMU REALIGN, OPT 3																																								
PRE-LOI SYSTEMS CHECK																																								
LOI																																								
P52 IMU REALIGN, OPT 3																																								
P24 LANDMARK TRACKING-MOSTING A																																								
PRE-DOI SYSTEMS CHECKS																																								
P52 IMU REALIGN, OPT 3																																								
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*MAY NOT BE REQUIRED

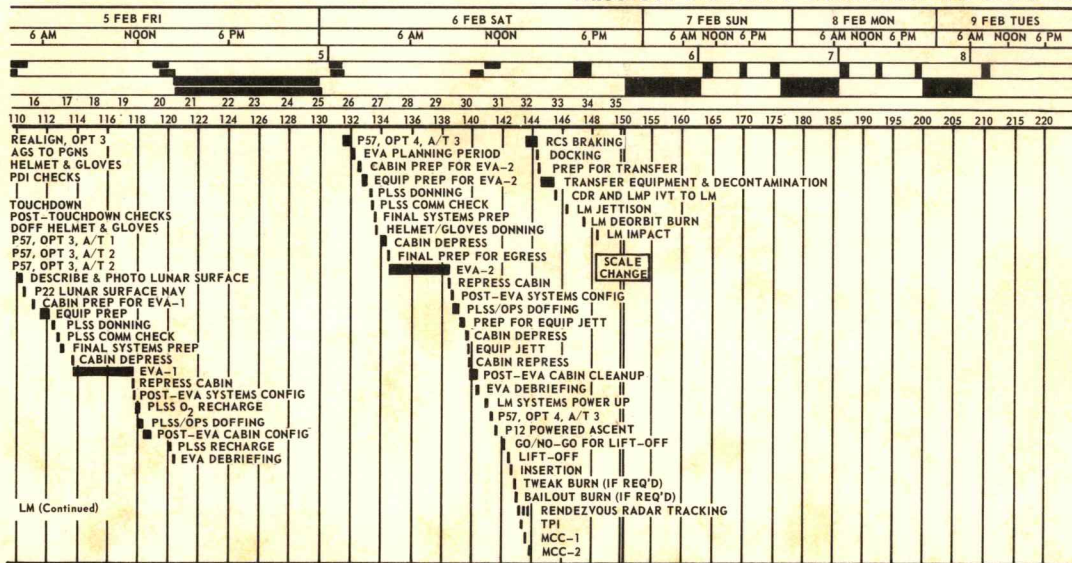
MISSION ACTIVITY SUMMARY APOLLO 14



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*MAY NOT BE REQUIRED

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	GEGENSCHIEIN PHOTOGRAPHY	186:45:00	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			192:35:00	P23 CISLUNAR NAV
53:10:00	P52 REFS	113:15:00	ZODIACAL LIGHT PHOTOGRAPHY	194:26:59	MCC6
59:45:00	P52 REFS	114:10:00	P24 LM VISUAL TRACK	196:30:00	P23 CISLUNAR NAV
60:20:00	P40/P41 SPS/RCS THRUST	117:00:00	P52	208:10:00	P52 REFS
60:38:14	MCC3	117:10:00	GALACTIC SURVEY PHOTOGRAPHY	208:40:00	P23 CISLUNAR NAV
61:45:00	TV TO 62:30	118:09:40	PLANE CHANGE 1, B.T. 18.4 SEC	212:00:00	P52 REFS
62:05:00	LMP & CDR IVT TO LM FOR HOUSEKEEPING	118:27:00	P52	212:10:00	P52 PREF
64:00:00	LMP & CDR IVT TO CSM	118:45:00	EARTHSHINE PHOTOGRAPHY	213:26:59	MCC7
76:50:00	P52 REFS	119:15:00	P52 (LIFT-OFF ORIENT)	214:00:00	P23 CISLUNAR NAV
77:22:00	P40/41 SPS/RCS THRUST	130:20:00	ORBIT SCIENCE PHOTOGRAPHY	214:50:00	P52 REFS
77:38:14	MCC4	131:17:00	P52	216:12:00	CM/SM SEPARATION
79:25:00	P52 REFS (PTC ORIENT)	131:45:00	ORBITAL SCIENCE PHOTOGRAPHY	216:25:00	P63 ENTRY INITIATE
79:35:00	P52 PREF (LDG SITE ORIENT)	132:55:00	GALACTIC SURVEY PHOTOGRAPHY	216:26:59	EI - 400 KFT
82:05:00	P40 SPS THRUST	133:20:00	LUNAR LIBRATION PHOTOGRAPHY	216:27:29	P64
82:38:14	LOI B.T. 6 MIN 06.6 SEC	133:40:00	ORBITAL SCIENCE PHOTOGRAPHY	216:29:09	P64 TO P67
84:05:00	P52 REFS (LDG SITE ORIENT)	137:00:00	P52	216:34:15	GUIDANCE TERMINATION
86:10:00	P52 REFS (LDG SITE ORIENT)	137:30:00	P24 LDMK TRACKING	216:35:16	DROGUE DEPLOYMENT
86:24:00	P40 SPS THRUSTING	139:40:00	ZERO PHASE OBSERVATIONS	216:36:03	MAIN DEPLOYMENT
86:56:57	DOI B.T. 21.38 SEC ORBIT 58.4 - 9.8 NM	140:38:00	P52	216:40:53	SPLASHDOWN
87:50:00	P24 ORB NAV	140:49:00	P52 COAS CALIB		
		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 NMVR	GETI BURN TIME	VT 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 NOW ZERO
MCC-1	11:36:33 30:36:07			PTC		
MCC-2	11:08 SEC	73.40	NOT REQ'D	PTC		SPS BURN
MCC-3	60:38:14			PTC		NOW ZERO
MCC-4	77:38:14			PTC		NOW 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	199.0	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 63.51 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 57.41	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 27.4 SEC	3449.55	4 JET 12 SEC	TEI		SPS BURN
MCC-5	186:14:50			PTC		NOW ZERO
MCC-6	194:26:59			PTC		NOW ZERO
MCC-7	213:26:59			ENTRY		

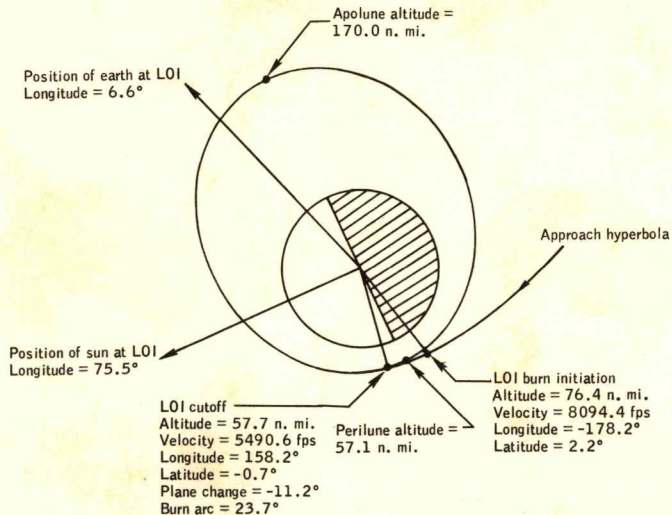
NOTES: 1. HA & HP ARE HEIGHTS ABOVE LANDING SITE RADIUS (937.73488 NM).
2. BURN TIME DOES NOT INCLUDE ULLAGE OR TAILOFF BT.

LM BURN SCHEDULE

BURN NMVR	GETI BURN TIME	VT FPS	ULLAGE V, FPS	REFSMAT	RESULTANT HA & HP	REMARKS
PDI	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.

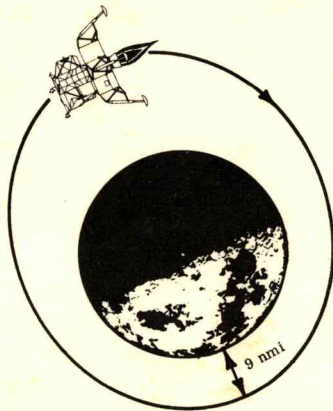
LOI GEOMETRY



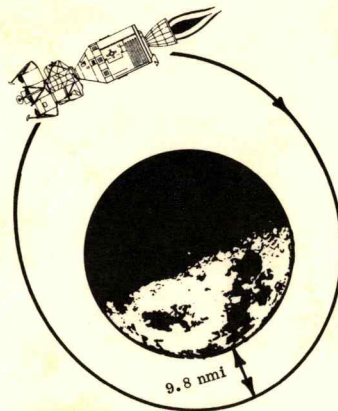
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MILWAUKEE, WISCONSIN 53201

DOI ON LOI DAY



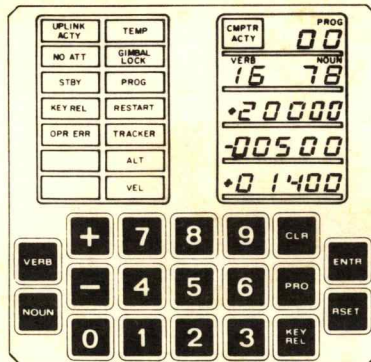
APOLLO 11 AND 12 - DOI ON REVOLUTION 14
60/60 nmi TO 60/9 nmi
28 s DPS BURN
 $\Delta V = 72.1 \text{ ft/s}$ RETROGRADE
THRUST ACCELERATION $\approx 4 \text{ ft/s}^2$



APOLLO 14 - DOI ON REVOLUTION 3
57/170 nmi TO 58/9.8 nmi
21 s SPS BURN
 $\Delta V = 207 \text{ ft/s}$ RETROGRADE
THRUST ACCELERATION $\approx 9 \text{ ft/s}^2$

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

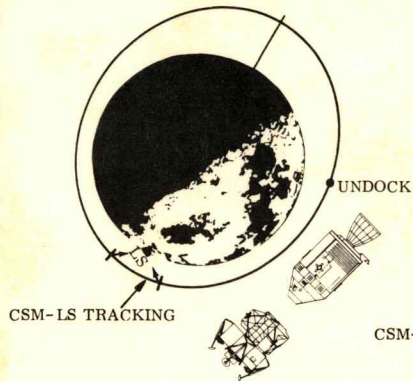


TYPICAL LUNAR LANDING DSKY ENTRIES
PROGRAMS 64 AND 66

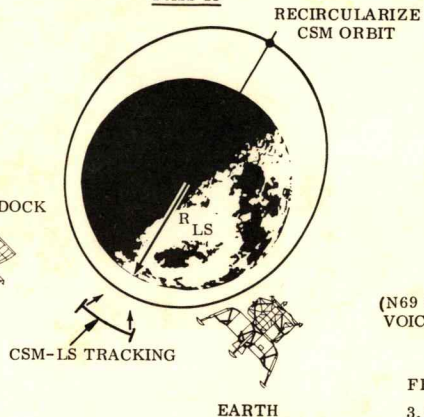
F V06 N64 TIME TO GO AND LPD ANGLE
H DOT
H
PROCEED (USE LPD)
V06 N64
REDESIGNATE LANDING SITE
PGNS MODE TO ATTITUDE HOLD
ACTUATE ROD SWITCH
PROGRAM 66 DISPLAYED
V06 N60 HORIZONTAL VELOCITY
H DOT
H
INPUT ROD AS DESIRED
LUNAR CONTACT LIGHT - ON
ENGINE STOP - PUSH
STAY/NO STAY DECISION
V37E N68E LANDING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

APOLLO 14 NAVIGATION PLAN FOR LANDING

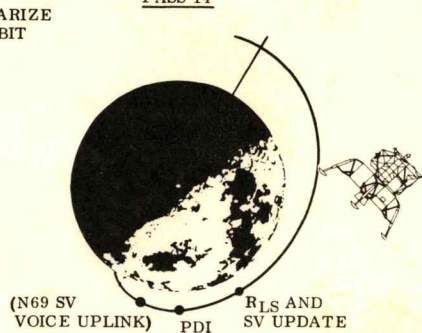
PASS 12



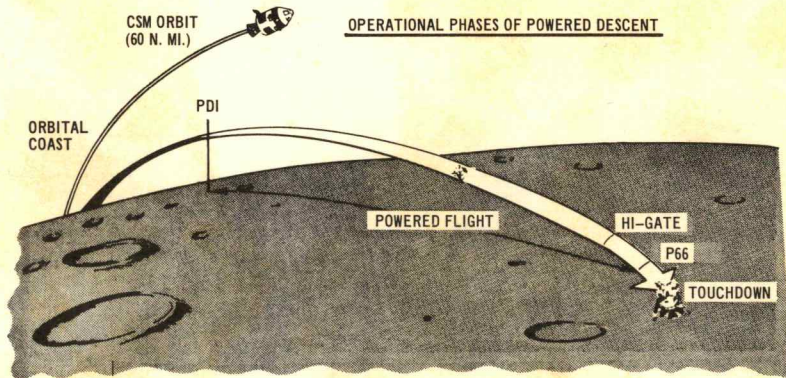
PASS 13



PASS 14



FRA MAURO LANDING SITE
3.67 DEG SOUTH LAT.
17.5 DEG WEST LONG.

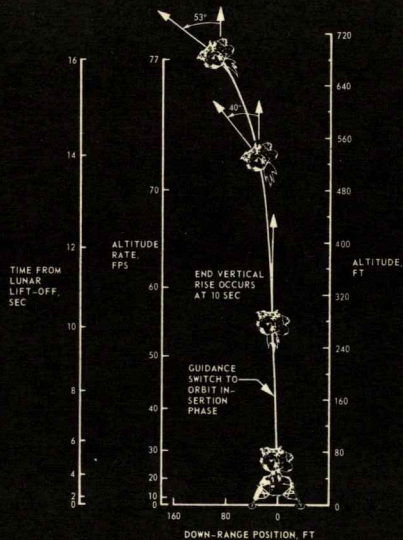
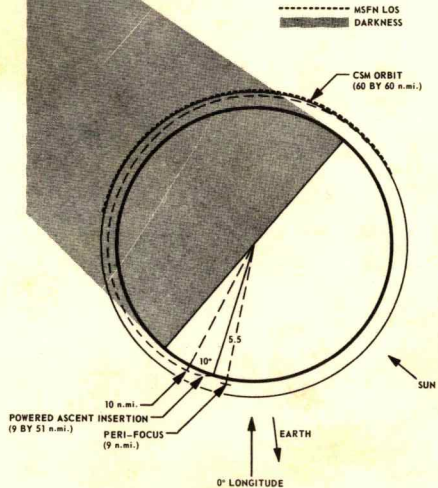


- P63-BRAKING PHASE (PDI TO HI-GATE)
- P64-VISIBILITY PHASE (HI-GATE TO CREW SELECTION OF P66)
- P66-LANDING PHASE (P66 TO TOUCHDOWN)

DESCENT EVENTS

EVENT	TIME HR:MIN:SEC G.E.T.	TIME HR:MIN:SEC C.S.T.	DATA SUMMARY
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



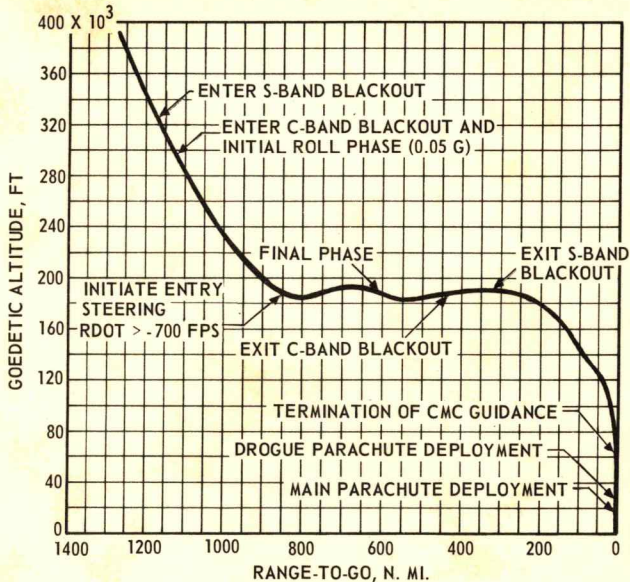
ASCENT EVENTS

EVENT	TIME HR:MIN:SEC G.E.T.	TIME HR:MIN:SEC C.S.T.	DATA SUMMARY
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

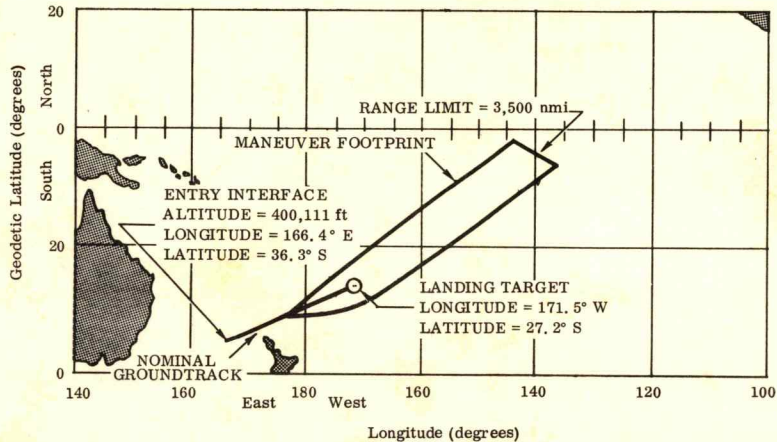
EVENT	TIME HR:MIN:SEC G.E.T.	TIME HR:MIN:SEC C.S.T.	DATA SUMMARY
Docking	144:10:00.0	14:33:00.0	
LM Jettison	146:23:30.5	16:46:30.5	Selenographic Latitude, deg -3.3 Selenographic Longitude, deg -21.1
CSM/LM SEPARATION			
Burn Initiation	146:28:30.6	16:51:30.6	
Burn Termination	146:28:36.5	16:51:36.5	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



DELCO ELECTRONICS
DIVISION OF GENERAL MOTORS CORPORATION
MILWAUKEE, WISCONSIN 53201

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
Pre-thrusting	24	P-24 LDMK Tracking
	27	CMC Update
	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
Pre-Thrusting Other Vehicle	65	Entry-Up Control
	66	Entry-Ballistic
	67	Entry-Final Phase
	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 DIIPHIDA	31 ARCTURUS
03 NAVI	32 ALPHECCA
04 ACHERNAR	33 ANTARES
05 POLARIS	34 ATRIA
06 ACAMAR	35 RASALHAGUE
07 MENKAR	36 VEGA
10 MIRFAK	37 NUNKI
11 ALDEIBARAN	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 DENEbola	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
 00112 MK REJECT BEFORE MKS ACCEPTED
 00113 NO INBITS (CH 16)
 00114 MORE MKS THAN DESIRED
 00115 V4IN9I WITH OPTICS NOT IN CMC
 00116 OPTICS SW MOVED BEFORE 15 SEC
 00117 V4IN9I BUT OPTICS NOT READY
 00120 ZERO OPTICS FIRST
 00121 CDUS BAD DURING MK-REPEAT
 00122 MK NOT CALLED FOR
 00205 PIPA SATURATED
 00206 CANNOT ZERO ICDU-WITH ALARMS
 00207 NEED 90 SEC FOR ISS TURN ON
 00210 IMU NOT OPERATING
 00211 COARSE ALIGN ERROR > 2 DEG
 00212 PIPA FAIL BUT PIPA NOT IN USE
 00213 IMU NOT ON-TURN ON IMU
 00214 PROGRAM USING IMU BUT IMU OFF
 00217 COARSE ALIGN/TORQUING PROBLEM
 00220 IMU NOT ALIGNED/NO REFSMMAT
 00401 DESIRED MGA TOO LARGE
 00404 * TGT OUT OF VIEW (TRUN > 90 DEG)
 00405 STAR PAIR NOT AVAILABLE
 00406 P20 NOT OPERATING
 00421 W MATRIX OVERFLOW
 00600 NO SOLUTION ON 1ST ITERATION
 00601 HP < 5.8 NM AFTER CSI

00602 HP < 5.8 NM AFTER CDH
 00603 CSI TIG TO CDH TIG ΔT < 10 MIN
 00604 CDH TIG TO TPI TIG ΔT < 10 MIN
 00605 TOO MANY ITERATIONS
 00606 CSI ΔV > 1000 LAST 2 ITERATIONS
 00611 NO TIG FOR ELEV ANGLE GIVEN
 00612 WRONG SPHERE OF INFL AT TIG
 00613 REENTRY ANGLE OUT OF LIMITS
 00777 ISS WARNING-PIPA FAIL
 01102 CMC SELF TEST ERROR
 01105 DOWNLINK TOO FAST
 01106 UPLINK TOO FAST
 01107 PHASE TABLE FAIL-ERASABLE BAD
 01301 ARCSIN/ARCCOS INPUT > ONE
 01407 VG INCREASING
 01426 IMU UNSATISFACTORY
 01427 IMU POLARITY REVERSED
 01520 V37 NOT PERMITTED NOW
 01600 OVERFLOW DURING DRIFT TEST
 01601 BAD IMU TORQUE
 01602 BAD OPTICS IN VERIFICATION
 01703 INSUF TIME TO INTEG-TIG SLIP
 03777 ISS WARNING-ICDU FAIL
 04777 ISS WARNING-ICDU & PIPA FAIL
 07777 ISS WARNING-IMU FAIL
 10777 ISS WARNING-IMU & PIPA FAIL
 13777 ISS WARNING-IMU & ICDU FAIL

14777 ISS WARN-IMU/ICDU & PIPA FAIL
 20430 ORBITAL INTEGRATION STOPPED
 20607 NO CONIC SOLUTION
 20610 ALTITUDE < 400K AT TIG (P37)
 21103 UNUSED CCS BRANCH EXECUTED
 21204 NEG OR ZERO WAITLIST CALL
 21206 TWO DISPLAYS ATTEMPTED AT ONCE
 21210 TWO PROGRAMS USING AT ONCE
 21302 SQRT CALLED WITH NEG ARGUMENT
 21501 DSKY ALARM DURING INTERNAL USE
 21502 ILLEGAL FLASHING DISPLAY
 21521 KEYED POI/V92 AFTER LIFTOFF
 31104 DELAY ROUTINE IS BUSY
 31201 EXEC OVERFLOW-NO VAC AREAS
 31202 EXEC OVERFLOW-NO CORE SETS
 31203 WAITLIST OVERFLOW-MANY TASKS
 31207 NO VAC AREA FOR MKS
 31211 CANNOT INTERRUPT EXTENDED VERB

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)

S E R V I C E C E N T E R S

CAPE KENNEDY

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NASA - Recorded Information	784 2380
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HOUSTON

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Escape Velocity Press Club - King's Inn	488 0220

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(Milwaukee)	Private Line: 762 1748
	Home: 962 2012
David Hudgens (Houston)	King's Inn: 488 0220

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Bob Weiss (Syosset, N. Y.)	(516) 921 4300
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RAYTHEON COMPANY (Computer Subsystems)

John Severance (Lexington, Mass.)	(617) 862 6600
(Houston) Holiday Inn	591 2500

T R A N S P O R T A T I O N

AIR

	Cape Area (305)	Houston (713)
National	784 1653	224 9011
Eastern	773 1270	621 8000
Delta	636 3144	623 6000
Braniff		621 3111
American		222 9873
Continental		524 4711
Houston Metro (STOL)		524 9121

GROUND

Avis	783 3643	443 8870
Hertz	783 7771	443 0800
National	723 3035	443 8850
Limousine	783 1400	223 6426

M O T E L S

	Cape Area (305)		Houston (713)
Cape Kennedy Hilton	783 0361	Airport Inn	644 1261
Caravelle	783 1300	Holiday Inn (Alvin)	331 4624
Holiday Inn	783 2271	Holiday Inn (NASA)	591 2500
Howard Johnson	783 9481	King's Inn	488 0220
Imperial 400	783 0500	Nassau Bay Motor Inn	591 3000
Quality Courts	783 9430	Ramada Inn	932 4541
Ramada Inn	783 9441		
Sheraton Cape Colony	783 2252		



Delco Electronics

