

The Apollo 13 Mission

Compiled by Daniel R. Adamo



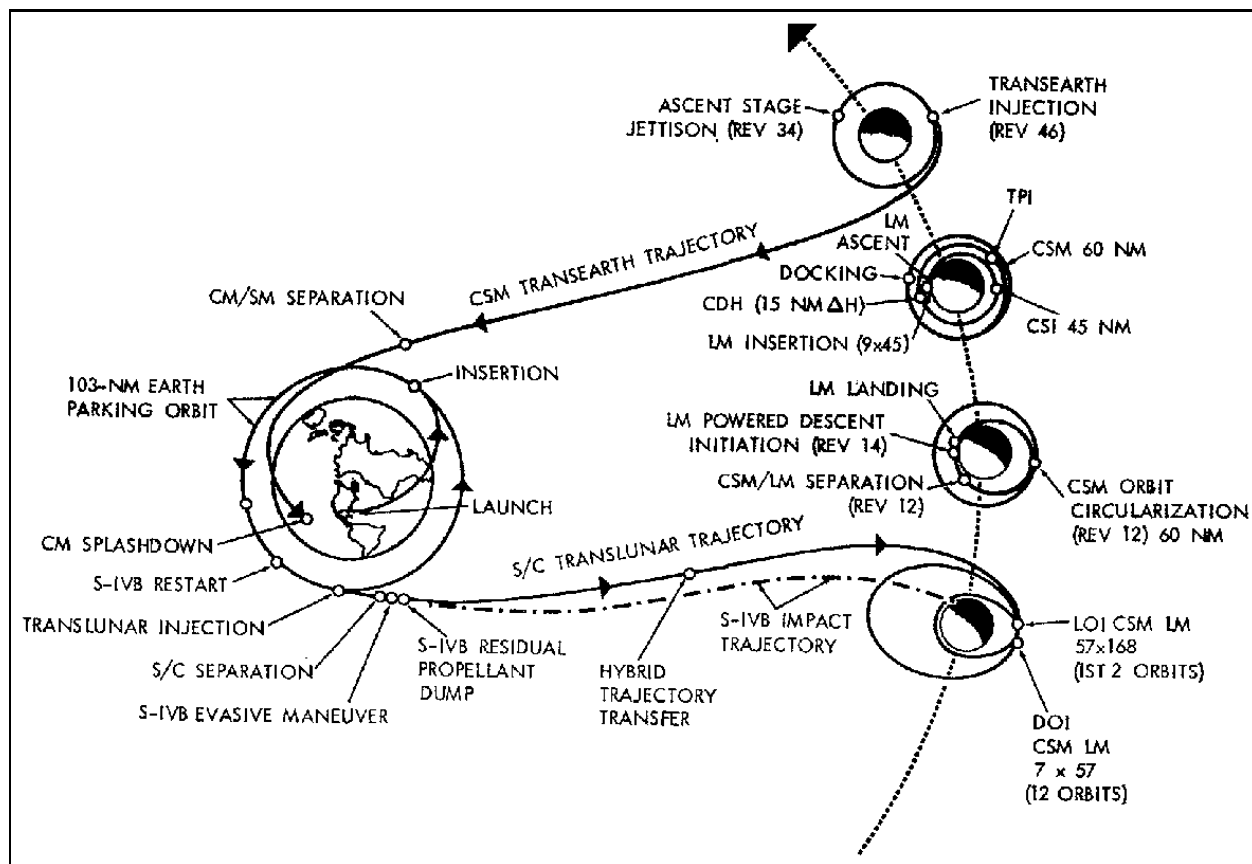
Crew

<u>Mission Commander</u>	James Arthur Lovell
<u>Command Module Pilot</u>	John Leonard Swigert
<u>Lunar Module Pilot</u>	Fred Wallace Haise

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Acknowledgments & Notes

- 1) All illustrations are published by NASA unless otherwise credited.
- 2) Supplemental information is obtained from Apollo By The Numbers, © 1996, Richard W. Orloff at URL
<http://www.floridatoday.com/space/explore/manspace/apollo/orloff.htm>.
- 3) All distances are measured in statute miles (mi) units.
- 4) All speeds are measured in statute miles per hour (mph) units.
- 5) "Height" is distance from the earth's (assumed by default) or moon's center, minus the pertinent equatorial radius. "Altitude" is distance above an ellipsoid approximating earth's figure at mean sea level or distance above the lunar landing site.
- 6) Apogee/perigee and apocynthion/pericynthion are maximum/minimum heights with respect to the earth and moon, respectively. Maximum/minimum heights for a spacecraft launched from the moon are related by apolune/perilune values.
- 7) "Speed" is magnitude of inertial velocity with respect to the earth's (assumed by default) or moon's center.
- 8) "Flight path angle" and "heading" pertain to inertial velocity referenced to true north in a local horizontal plane whose normal points from the earth's (assumed by default) or moon's center.



Planned Mission Profile

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13 June 1969

Saturn IVB stage #508 arrives at KSC.

16 June 1969

Saturn IC stage #8 arrives at KSC.

26 June 1969

CSM #109 *Odyssey* arrives at KSC.

28 June 1969

LM #7 *Aquarius* delivery completed to KSC.

29 June 1969

Saturn II stage #8 arrives at KSC.

10 December 1969

Spacecraft mating to launch vehicle is complete.

15 December 1969

MLP #3 transports launch vehicle and spacecraft from the VAB to LC-39A.

16 March 1970

Saturn IC RP-1 kerosene fueling is complete.

10 April 1970 EST

12:00 M	<u>T-028:00</u>	terminal countdown begins.
00:30 AM	<u>T-027:30</u>	launch vehicle flight batteries installation is initiated.
05:00 AM	<u>T-023:00</u>	launch vehicle flight batteries installation is complete.
05:30 AM	<u>T-022:30</u>	LM super critical helium toloff begins.
07:30 AM	<u>T-020:30</u>	LM super critical helium toloff is complete.
08:30 AM	<u>T-019:30</u>	LM super critical helium thermal shield installation begins.
09:00 AM	<u>T-019:00</u>	CSM crew stowage is initiated.
12:00 N	<u>T-016:00</u>	launch vehicle range safety checks begin.
12:30 PM	<u>T-015:30</u>	LM super critical helium thermal shield installation is complete.
01:00 PM	<u>T-015:00</u>	launch vehicle range safety checks are complete.
03:30 PM	<u>T-012:30</u>	CSM crew stowage is complete.
04:30 PM	<u>T-011:30</u>	connection of launch vehicle safe and arm devices and CSM pre-ingress operations are initiated.
05:15 PM	<u>T-010:45</u>	launch vehicle safe and arm devices are connected.

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05:45 PM T-010:15 MSS begins move from LC-39A.



MSS Prelaunch Rollback

07:00 PM T-009:00 countdown is suspended for a built-in hold.

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04:13 AM T-009:00 countdown resumes. Pad A is cleared for launch vehicle cryogenic propellant loading.
05:08 AM T-008:05 launch vehicle cryogenic propellant loading is initiated.
07:43 AM T-005:30 MCC updates SPS thrust = 21302 lbs, flow rate = 67.934 lbs/sec.
08:56 AM T-004:17 flight crew begins prelaunch preparations.
09:35 AM T-003:38 launch vehicle cryogenic propellant loading is complete.
09:43 AM T-003:30 countdown is suspended for a built-in hold.
10:43 AM T-003:30 countdown resumes.
11:06 AM T-003:07 flight crew enters transfer van at the MSOB.

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11:18 AM T-002:55 flight crew arrives at Pad A.
 11:28 AM T-002:45 MCC updates APS thrust = 3515.9 lbs, flow rate = 11.368 lbs/sec.
 11:33 AM T-002:40 flight crew begins CM ingress.
 12:13 PM T-002:00 MCC conducts spacecraft command checks.
 12:18 PM T-001:55 abort advisory system checks are performed.
 12:22 PM T-001:51 space vehicle EDS test is performed.
 01:13 PM T-001:00 final systems checks begin.
 01:30 PM T-000:43 320-ft-level walkway is partially retracted.
 01:31 PM T-000:42 LES is armed.
 01:33 PM T-000:40 final launch vehicle range safety checks commence.
 01:38 PM T-000:35 final launch vehicle range safety checks are complete.
 01:43 PM T-000:30 launch vehicle power transfer test is performed. LM is placed on internal power.
 01:53 PM T-000:20 LM operational instrumentation powerdown begins.
 01:58 PM T-000:15 CSM is placed on internal power.
 02:03 PM T-000:10 LM operational instrumentation powerdown is complete.
 02:07 PM T-000:06 space vehicle final status checks are performed.
 02:07:30 PM T-000:05:30 destruct system is armed.
 02:08 PM T-000:05 320-ft-level walkway is fully retracted.
 02:09:53 PM T-000:03:07 Launch Director activates the automatic sequencer.
 02:11 PM T-000:02 launch vehicle propellant tanks begin pressurization.
 02:11:40 PM T-000:01:20 Saturn IVB propellant tanks are fully pressurized.
 02:12:10 PM T-000:00:50 launch vehicle is transferred to internal power.
 02:12:43 PM T-000:00:16.961 launch vehicle is placed on internal guidance.
 02:12:51 PM T-000:00:08.9 Saturn IC ignition sequence begins.
 02:12:53 PM T-000:00:06.7 Saturn IC center engine ignition.
 02:12:58 PM T-000:00:01.4 all Saturn IC F1 engines running.
 02:13:00 PM T+000:00:00.3 hold-down arms are released.
 T+000:00:00.61 latitude = 28.4470°N, longitude = 80.604133°W, altitude = 0.0371 mi, flight path angle = 0.04° heading = 90° speed = 914.1 mph. Soft release mechanism is deactivated. Saturn V liftoff.
 02:13:02 PM T+000:00:02.3 tower clearance yaw maneuver is initiated.
 02:13:10 PM T+000:00:10.0 tower clearance yaw maneuver is complete.
 02:13:12 PM T+000:00:12.6 Saturn IC engines clear LC-39A tower. Control is switched from KSC to MSC. Launch vehicle begins pitch maneuver and roll from 90°azimuth.
 02:13:32 PM T+000:00:32.1 altitude = 0.5 mi. Launch vehicle attains flight azimuth = 72.043°. Roll maneuver is complete.
 02:13:40 PM T+000:00:40 altitude = 1.288 mi.
 02:13:45 PM T+000:00:45 altitude = 1.4 mi.
 02:14:08 PM T+000:01:08.4 altitude = 5.056 mi, range = 1.508 mi, speed = 1423.3 mph. Launch vehicle attains local sonic speed.
 02:14:21 PM T+000:01:21.3 altitude = 7.742 mi, range = 3.256 mi, speed = 1749.7 mph. Maximum dynamic pressure = 651.63 lbs/ft² encountered.
 02:15:15 PM T+000:02:15.18 altitude = 27.002 mi, range = 27.925 mi, speed = 4314.7 mph. Saturn IC center engine shutdown.

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02:15:43 PM T+000:02:43.3 pitch maneuver complete.
02:15:43 PM T+000:02:43.60 altitude = 41.879 mi, range = 58.679 mi, speed = 6138.1 mph. Saturn IC outboard engines shutdown.
02:15:44 PM T+000:02:44.3 altitude = 42.278 mi, range = 59.628 mi, speed = 6161.1 mph. Saturn IC jettison.
02:15:46 PM T+000:02:46.0 Saturn II ignition.
02:16:14 PM T+000:03:14.3 Saturn II aft interstage jettison.
02:16:21 PM T+000:03:21.0 LES jettison.
02:16:24 PM T+000:03:24.5 IGM is initiated.
02:17:00 PM T+000:04:00 altitude = 74.9 mi, speed = 7113 mph.
02:17:31 PM T+000:04:31.7 altitude = 72.6 mi, range = 202.5 mi. Maximum Saturn IC altitude.
02:17:50 PM T+000:04:50 altitude = 88.9 mi, speed = 7887 mph.
02:18:10 PM T+000:05:10 altitude = 93 mi, range = 288 mi.
02:18:30 PM T+000:05:30.64 altitude = 99.177 mi, range = 343.047 mi, speed = 8767.9 mph. Excessive vibrations force Saturn II center engine shutdown 2 min 12.36 sec earlier than planned.
02:20:12 PM T+000:07:12 Saturn IVB achieves earth orbit insertion capability.
02:20:20 PM T+000:07:20 altitude = 110 mi, range = 627 mi.
02:21:17 PM T+000:08:17 speed = 12300 mph.
02:21:40 PM T+000:08:40 altitude = 114 mi, speed = 14327 mph.
02:22:06 PM T+000:09:06.9 latitude = 30.177°N, longitude = 74.0650°W, range = 408.9 mi. Estimated Saturn IC splashdown.
02:22:52 PM T+000:09:52.64 altitude = 117.509 mi, range = 1010.017 mi, speed = 15416.5 mph. Saturn II outboard engines shutdown 34.53 sec later than planned.
02:22:53 PM T+000:09:53.50 altitude = 117.552 mi, range = 1113.385 mi, speed = 15425.8 mph. Saturn II jettison.
02:22:56 PM T+000:09:56.9 Saturn IVB ignition.
02:23:05 PM T+000:10:05.4 Saturn IVB ullage case jettison.
02:23:30 PM T+000:10:30 altitude = 119 mi, speed = 16387 mph.
02:23:32 PM T+000:10:32.2 altitude = 118.5 mi, range = 1264.5 mi. Maximum Saturn II altitude.
02:25:29 PM T+000:12:29.83 altitude = 119.070 mi, range = 1764.802 mi, speed = 17427.5 mph. Saturn IVB shutdown 9 sec later than planned.
02:25:39 PM T+000:12:39.83 latitude = 32.5249°N, longitude = 50.4902°W, altitude = 119.074 mi, range = 1809.371 mi, flight path angle = 0.005° heading = 90.148° speed = 17431.4 mph, apogee = 115.4 mi, perigee = 114.3 mi, period = 88.19 min. Earth parking orbit insertion at 32.547° inclination.
02:25:50 PM T+000:12:50.1 maneuver to local horizontal attitude is initiated.
02:33:58 PM T+000:20:58.1 latitude = 31.320°N, longitude = 33.289°W, range = 2822.4 mi. Estimated Saturn II splashdown.
03:50 PM T+001:37 6-min telecast from CM begins.
04:48:46 PM T+002:35:46.30 altitude = 120.208 mi, speed = 17436.3 mph, lunar distance = 246524 mi. Saturn IVB ignition for a 5 min 50.85 sec TLI burn.

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04:54:37 PM T+002:41:37.15 altitude = 201.305 mi, speed = 24247.2 mph, inclination = 31.818° Saturn IVB shutdown.

04:54:47 PM T+002:41:47.15 latitude = 3.8635°S, longitude = 167.2074°E, height = 209.954 mi, flight path angle = 7.635° heading = 59.318° speed = 24230.7 mph. TLI into an earth free-return trajectory within CSM RCS DV capability.

04:57:08 PM T+002:44:08 Saturn IVB initiates LVLH attitude hold.

05:09:38 PM T+002:56:38.3 Saturn IVB initiates maneuver to transposition and docking attitude.

05:19:38 PM T+003:06:38.9 height = 4348.315 mi, speed = 17065.4 mph. CSM separates from the SLA.

05:22 PM T+003:09 1 hr 11 min telecast from CM begins.

05:32:08 PM T+003:19:08.8 height = 6829.76 mi, speed = 14919.1 mph. CSM docks with LM.

06:14:00 PM T+004:01:00.8 latitude = 31.95°N, longitude = 105.3°W, height = 14333.91 mi, flight path angle = 61.092° heading = 91.491° speed = 11331.1 mph. Docked spacecraft is ejected from Saturn IVB.

06:22 PM T+004:09 Saturn IVB initiates maneuver to evasive burn attitude.

06:31:00 PM T+004:18:00.6 Saturn IVB APS ignition for a 1 min 20.2 sec evasive burn.

06:40:40 PM T+004:27:40.0 Saturn IVB initiates maneuver to propellant dump attitude.

06:47:39 PM T+004:34:39.4 Saturn IVB propellant dumps begin.

06:53:07 PM T+004:40:07.4 Saturn IVB propellant dumps are complete.

07:01:07 PM T+005:48:07.8 Saturn IVB initiates maneuver to lunar impact burn attitude.

07:12:59 PM T+005:59:59.5 Saturn IVB APS ignition for a 3 min 37.2 sec lunar impact burn.

08:13 PM T+007:00 MCC updates CSM weight = 63734 lbs.

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03:13 AM T+013:00 crew begins a 10-hr rest period.

03:42 AM T+013:29 MCC updates CSM weight = 63660 lbs.

04:22 AM T+014:09 MCC predicts pericynthion = 293 mi.

07:37 AM T+017:24 MCC predicts pericynthion = 292.5 mi.

09:13 AM T+019:00 height = 90000 mi, speed = 4200 mph.

09:56 AM T+019:43 MCC predicts pericynthion = 292.71 mi.

11:59 AM T+021:46 MCC predicts pericynthion = 292.60 mi.

02:38 PM T+024:25 MCC predicts pericynthion = 292.39 mi.

04:21 PM T+026:08 MCC updates CSM weight = 63634 lbs.

05:33:49 PM T+027:20:49 height = 128968 mi, speed = 3402 mph, lunar speed = 2868 mph. Spacecraft reaches equidistant point in its translunar trajectory.

05:42 PM T+027:29 MCC predicts pericynthion = 292.59 mi.

T+028:27 MCC predicts pericynthion = 294.4 mi.

08:26 PM T+030:13 49-min telecast from CM begins.

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08:53:49 PM T+030:40:49.65 height = 139683.83 mi, speed = 3192.6 mph. SPS ignition for a 3.49-sec MCC-2 HCI burn, imparting DV = 15.8 mph and lowering pericynthion to 74.65 mi for LOI. Latitude after burn = 22.80°N, longitude 101.86°W, height = 139687.86 mi, flight path angle = 77.743° heading = 112.751° speed = 3194.7 mph.

11:46 PM T+033:33 MCC predicts pericynthion = 71.35 mi.

13 April 1970 EST

12:18 AM T+034:05 MCC updates CSM weight = 63367 lbs.

02:37 AM T+036:24 MCC predicts pericynthion = 71.54 mi.

03:13 AM T+037:00 crew begins a 10-hr rest period.

04:28 AM T+038:15 MCC predicts pericynthion = 71.60 mi.

04:56:06 AM T+038:43:06.2 height = 163139 mi, speed = 2794 mph, lunar height = 98603 mi, speed = 2575 mph. Assuming a nominal LOI at T+077:26:12.4, spacecraft reaches halfway point in its translunar trajectory.

06:52 AM T+040:39 MCC predicts pericynthion = 73.40 mi.

09:43 AM T+043:30 MCC predicts pericynthion = 70.06 mi.

12:08 PM T+045:55 MCC predicts pericynthion = 69.02 mi.

02:58 PM T+048:45 MCC predicts pericynthion = 69.02 mi.

05:07 PM T+050:54 MCC predicts pericynthion = 69.05 mi.

06:13 PM T+052:00 height = 195000 mi.

08:32 PM T+054:19 MCC predicts pericynthion = 69.10 mi.

08:33 PM T+054:20 Haise and Lovell enter the LM for systems checks.

09:27 PM T+055:14 32-min telecast from CM and LM begins.

10:03 PM T+055:50 after Lovell and Haise return to the CM, tunnel hatch to LM is closed.

10:06:18 PM T+055:53:18 at MCC's request, Swigert initiates routine SM cryogenic storage tank destratification by activating O₂ Tank 1 fans.

10:06:20 PM T+055:53:20 Swigert activates O₂ Tank 2 fans. A power transient is indicated.

10:06:22 PM T+055:53:22.718 an electrical short is indicated in O₂ Tank 2.

10:07:52 PM T+055:54:52.763 last O₂ Tank 2 telemetry indicates pressure = 995.7 psi.

10:07:52 PM T+055:54:53.542 CM accelerometers register 1.49 Gs.

T+055:54:53.555 Master Caution and Warning alarm is triggered by a DC Main B Bus undervoltage. Crew hears a loud bang from the SM as an exterior panel is blown off by O₂ Tank 2's explosion. The departing panel grazes the SM high gain antenna, and communications with Mission Control are interrupted for 1.8 sec.

10:08:20 PM T+055:55:20 Haise remarks, "OK, Houston. We've had a problem here."

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MCC In Crisis

10:11 PM T+055:58 altitude = 205000 mi, speed = 2400 mph. SM power system fails, aborting the mission and requiring emergency utilization of LM power, communication, propulsion, and life support systems.

10:46:49 PM T+056:33:49 emergency CSM powerdown is initiated.

11:56 PM T+057:43 Lovell and Haise enter the LM.

14 April 1970 EST

12:23 AM T+058:10 CM GNC systems are powered down after data transfer to LM GNC is complete.

12:53 AM T+058:40 CSM deactivation and LM activation are complete.

03:42:43 AM T+061:29:43.49 height = 216773.91 mi, speed = 2090.3 mph. LM DPS ignition for a 34.23-sec Free Return Injection burn, imparting DV = 25.8 mph, raising pericynthion from 69 mi to 157.37 mi, and establishing EI flight path angle = -6.53° Latitude after burn = 20.74°N , longitude = 159.56°E , height = 216799.01 mi, flight path angle = 79.934° heading = 116.54° speed = 2109.0 mph.

04:52 AM T+062:39 MCC updates CSM weight = 62207 lbs, LM weight = 33576 lbs.

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05:02 AM T+062:49 height = 219469 mi, speed = 2062 mph, lunar height = 38921 mi, speed = 2482 mph. Spacecraft enters lunar gravitational sphere of influence.

05:03 AM T+062:50 LM partial deactivation is achieved to conserve battery power.

05:43 AM T+063:30 MCC predicts maximum LM lifetime = 75 hrs.

04:38 PM T+074:25 MCC predicts pericynthion = 158.31 mi.

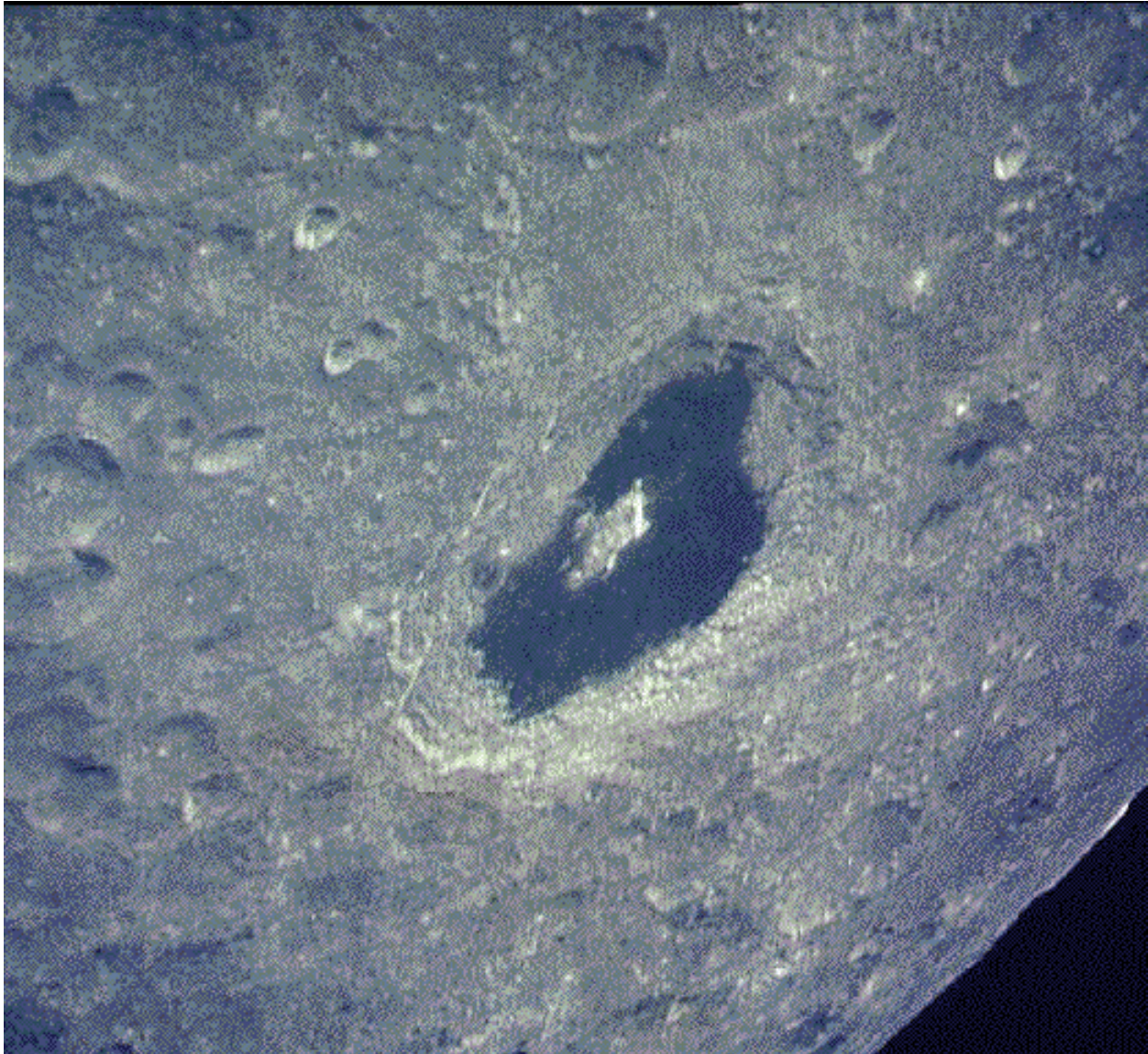
06:58 PM T+076:45 spacecraft enters the lunar shadow.

07:17 PM T+077:04 lunar height = 605 mi, speed = 4856 mph.

07:21 PM T+077:08 lunar height = 484 mi.

07:21:35 PM T+077:08:35 lunar occultation LOS.

07:40:40 PM T+077:27:40 height = 246000 mi, lunar height = 156 mi. Pericynthion.



Tsiolkovsky and the Lunar Farside

07:46:10 PM T+077:33:10 lunar occultation AOS.

07:51 PM T+077:38 lunar height = 651 mi, speed = 4815 mph.

07:53 PM T+077:40 lunar height = 725 mi.

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08:09:39 PM T+077:56:39.7 lunar latitude = 2.75°S , longitude = 27.86°W , speed = 5769 mph. Saturn IVB lunar impact. Shock waves are registered by Apollo 12's ALSEP seismometer.

08:13 PM T+078:00 LM systems are powered up for TEI burn.

08:23 PM T+078:10 LM AGS is aligned to its primary guidance system.

08:30 PM T+078:17 lunar height = 2600 mi, speed = 3700 mph.

09:23 PM T+079:10 lunar height = 5429 mi, speed = 3187 mph.

09:31 PM T+079:18 lunar height = 5800 mi, speed = 3147 mph.

09:36 PM T+079:23 lunar height = 6058 mi, speed = 3121 mph.

09:38 PM T+079:25 lunar height = 6157 mi, speed = 3112 mph.

09:39 PM T+079:26 lunar height = 6196 mi, speed = 3109 mph.

09:40 PM T+079:27 lunar height = 6245 mi, speed = 3104 mph.

09:40:39 PM T+079:27:38.95 lunar height = 6289.31 mi, speed = 3100.7 mph. LM DPS ignition for a 4 min 23.82 sec TEI burn, imparting DV = 586.7 mph and reducing time to splashdown by 10 hours. Splashdown location is also shifted from a secondary location in the Indian Ocean to the prime recovery area in the Pacific Ocean. Lunar latitude after burn = 3.62°N , longitude = 64.77°E , height = 6511.89 mi, flight path angle = 64.784° heading = 242.114° speed = 3422.9 mph.

09:46 PM T+079:33 lunar height = 6569 mi.

09:53 PM T+079:40 lunar height = 6909 mi, speed = 3395 mph.

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12:23 AM T+082:10 LM powerdown is completed.

01:36 AM T+083:23 height = 234204 mi.

02:17 AM T+084:04 MCC estimates LM RCS DV capability = 22 mph.

03:47 AM T+085:34 MCC predicts perigee = 90.8 mi.

08:33 AM T+090:20 MCC predicts perigee = 95.1 mi.

08:37:03 AM T+090:24:03 spacecraft exits lunar gravitational sphere of influence.

01:23 PM T+095:10 MCC predicts perigee = 99.7 mi.

03:00 PM T+096:47 height = 200000 mi.

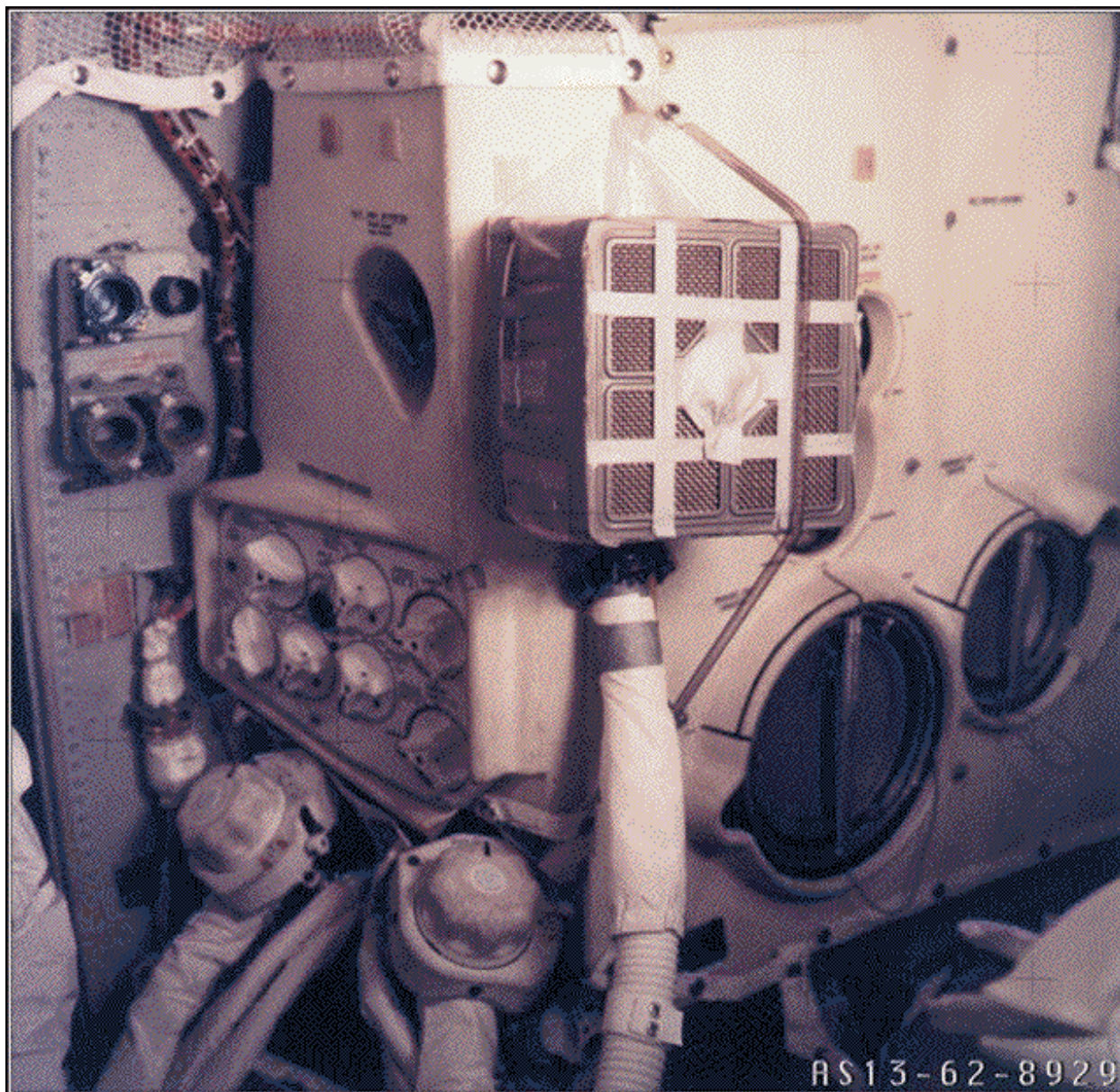
04:13 PM T+098:00 MCC predicts perigee = 99.4 mi.

06:30 PM T+100:17 height = 189689 mi.

06:42 PM T+100:29 MCC predicts perigee = 100.6 mi.

07:24 PM T+101:11 MCC predicts perigee = 100.5 mi.

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CM LiOH Canister Adapted for LM Use

07:33 PM T+101:20 CSM is configured to transmit telemetry.
08:06 PM T+101:53 CM powerup on internal batteries completed.
09:11 PM T+102:58 MCC predicts perigee = 100.1 mi.
11:03 PM T+104:50 LM powerup completed.
11:31:28 PM T+105:18:28.0 height = 175176.62 mi, speed = 3039.4 mph. DPS
ignition for a 14.0-sec MCC-5 burn, imparting DV = 5.3 mph and targeting
EI flight path angle = -6.52° Latitude after burn = 19.50°N , longitude =
 136.90°W , height = 175166.49 mi, flight path angle = -79.765° heading
= 114.242° speed = 3038.6 mph.

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12:03 AM T+105:50 LM powerdown completed.
12:21 AM T+106:08 MCC updates LM weight = 25272 lbs.

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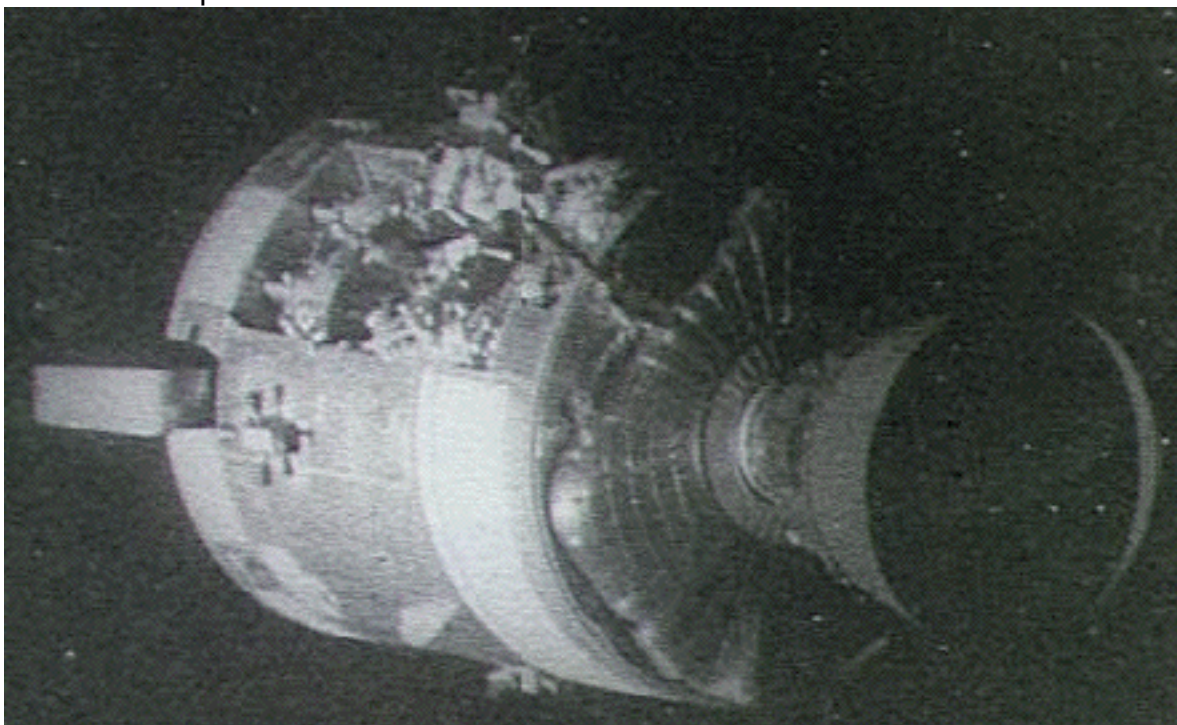
12:48 AM T+106:35 MCC updates CSM weight = 62468 lbs.
02:00 AM T+107:47 height = 167669 mi.
03:07:30 AM T+108:54:30 LM super critical He pressure relief disk bursts, imparting angular rates in excess of 300/sec to the spacecraft before they are damped.
03:51 AM T+109:38 MCC predicts EI flight path angle = -6.240
06:18 AM T+112:05 LM power transfer to CM is established.
06:33 AM T+112:20 CM Battery A charging is initiated.
03:35 PM T+121:22 MCC predicts EI flight path angle = -5.990 at 142:40:53 GET, perigee = 30.8 mi.
06:22 PM T+124:09 MCC predicts EI flight path angle = -5.930 at 142:40:55 GET, perigee = 31.6 mi.
08:00 PM T+125:47 speed = 4000 mph.
08:23 PM T+126:10 CM Battery A charging is terminated, and Battery B charging is initiated.
08:39 PM T+126:26 MCC predicts EI flight path angle = -6.050 at 142:40:51 GET, perigee = 29.9 mi.
10:23 PM T+128:10 CM Battery B charging is terminated.
10:48 PM T+128:35 MCC predicts EI flight path angle = -6.030 perigee = 30.3 mi.

17 April 1970 EST

12:34 AM T+130:21 MCC predicts EI flight path angle = -6.030 perigee = 30.2 mi.
01:01 AM T+130:48 MCC updates LM weight = 25181 lbs.
02:33 AM T+132:20 MCC predicts EI flight path angle = -6.030 perigee = 30.3 mi.
03:42 AM T+133:29 MCC predicts EI flight path angle = -5.940
03:48 AM T+133:35 LM powerup completed.
04:53 AM T+134:40 LM inertial platform is aligned.
06:10 AM T+135:57 Swigert enters the CM for preliminary checkout.
06:24 AM T+136:11 Swigert initiates CM powerup.
07:00 AM T+136:47 height = 48000 mi, speed = 6000 mph.
07:52:51 AM T+137:39:51.5 height = 43509.34 mi, speed = 6892.6 mph. LM RCS ignition for a 21.5-sec MCC-7 burn, imparting DV = 2.2 mph and changing EI flight path angle from -6.20 to -6.50 Latitude after burn = 11.340N, longitude = 113.320E, height = 43471.90 mi, flight path angle = -72.3730 heading = 118.6600 speed = 6896.3 mph.
08:00 AM T+137:47 height = 43275 mi, speed = 7000 mph.

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08:14:48 AM T+138:01:48.0 height = 41076.99 mi, speed = 7094.9 mph. CM and LM separate from SM.

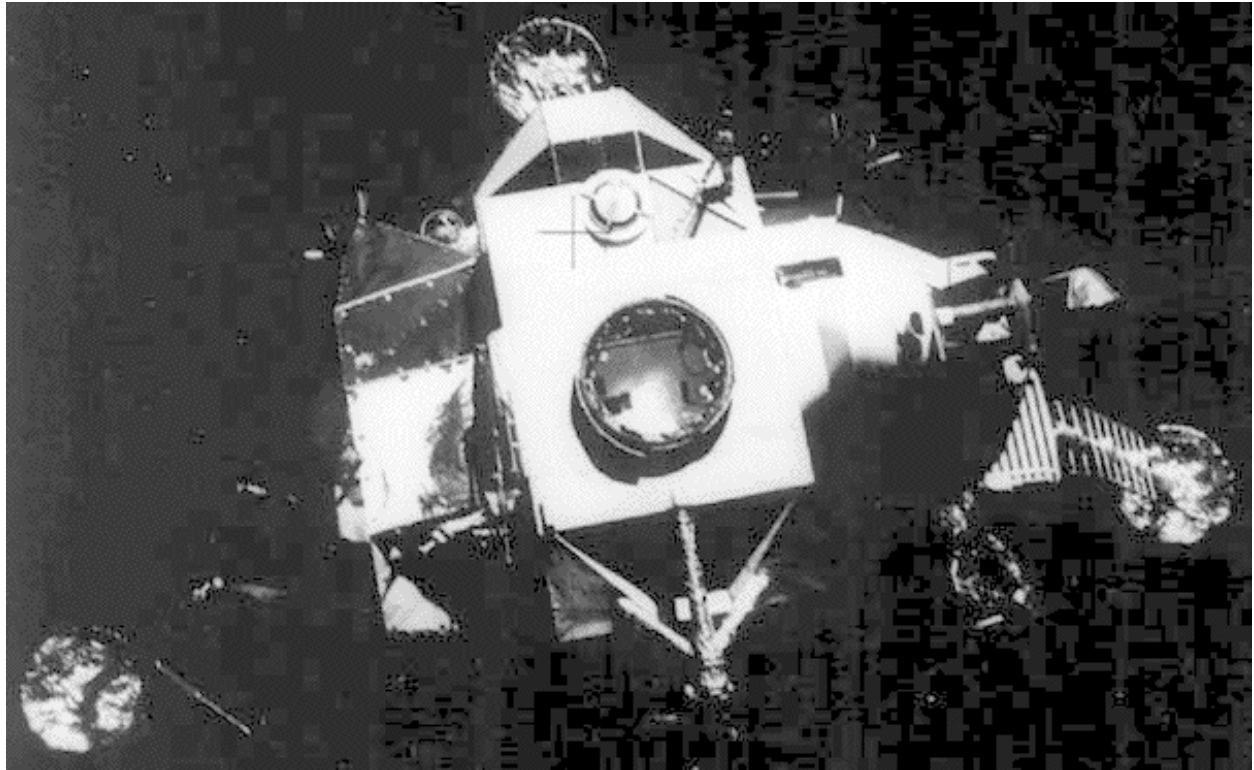


Damaged SM Following Jettison

08:28 AM	<u>T+138:15</u>	height = 39514 mi, speed = 7232 mph.
09:00 AM	<u>T+138:47</u>	height = 36000 mi, speed = 7700 mph.
09:30 AM	<u>T+139:17</u>	height = 33000 mi.
10:00 AM	<u>T+139:47</u>	height = 28200 mi, speed = 8900 mph.
10:06 AM	<u>T+139:53</u>	height = 27490 mi.
10:23 AM	<u>T+140:10</u>	full CM powerup is complete.
10:36 AM	<u>T+140:23</u>	height = 23326 mi, speed = 9288 mph.
10:51 AM	<u>T+140:38</u>	speed = 9800 mph.
10:53 AM	<u>T+140:40</u>	LM inertial platform is aligned.
11:03 AM	<u>T+140:50</u>	LM maneuvers to CM undocking attitude.
11:21 AM	<u>T+141:08</u>	height = 16660 mi.
11:29 AM	<u>T+141:16</u>	height = 15295 mi, speed = 11148 mph.
11:35 AM	<u>T+141:22</u>	height = 14364 mi, speed = 11428 mph.
11:37 AM	<u>T+141:24</u>	height = 13892 mi, speed = 11583 mph.
11:41 AM	<u>T+141:28</u>	height = 13346 mi.

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11:43:00 AM T+141:30:00.2 height = 12954.88 mi, speed = 11908.6 mph. CM undocks from LM. Docking tunnel depressurization imparts DV such that MCC predicts CM will be 0.9 mi ahead, 0.3 mi below, and 0.7 mi right of LM at EI.



LM Following CM Undocking

11:48 AM	<u>T+141:35</u>	recovery communications aircraft are deployed.
11:53 AM	<u>T+141:40</u>	speed = 12616 mph.
11:57 AM	<u>T+141:44</u>	height = 10485 mi, speed = 12922 mph.
12:09 PM	<u>T+141:56</u>	height = 8161 mi, speed = 14161 mph.
12:13 AM	<u>T+142:00</u>	recovery helicopters are deployed from the USS <i>Iwo Jima</i> .
12:17 PM	<u>T+142:04</u>	height = 6753 mi, speed = 15058 mph.
12:34 PM	<u>T+142:21</u>	height = 3750 mi, speed = 17890 mph.
12:36 PM	<u>T+142:23</u>	height = 2973 mi.
12:37 PM	<u>T+142:24</u>	speed = 18786 mph.
12:39 PM	<u>T+142:26</u>	range from splashdown = 5741 mi, speed = 19882 mph.
12:41 PM	<u>T+142:28</u>	range = 5395 mi, speed = 20532 mph.
12:43 PM	<u>T+142:30</u>	range = 4990 mi.
12:44:46 PM	<u>T+142:31:46</u>	range = 4515 mi, speed = 21950 mph.
12:46:46 PM	<u>T+142:33:46</u>	speed = 22761 mph.
12:47:46 PM	<u>T+142:34:46</u>	range = 3768 mi.
12:48:46 PM	<u>T+142:35:46</u>	range = 3365 mi, speed = 23410 mph.
12:49:46 PM	<u>T+142:36:46</u>	range = 3024 mi, speed = 23729 mph.
12:50:46 PM	<u>T+142:37:46</u>	range = 2651 mi, speed = 24031 mph.
12:51:16 PM	<u>T+142:38:16</u>	moonset.
12:51:46 PM	<u>T+142:38:46</u>	range = 2259 mi, speed = 24304 mph.
12:52:40 PM	<u>T+142:39:40</u>	range = 2063 mi, speed = 24434 mph.

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12:53:45 PM T+142:40:45.7 latitude = 28.23°S, longitude = 173.44°E, altitude = 400000 ft, range = 1438 mi, flight path angle = -6.269° heading = 77.210° speed = 24689.0 mph, sensed acceleration = 0.05 G. EI.

12:54:05 PM T+142:41:05 altitude = 300000 ft. CM enters S and C-band radio blackout. Entry Roll phase is initiated.

12:55:18 PM T+142:42:18 altitude = 190000 ft, exterior temperature = 5000°F, acceleration = 5.2 Gs. Entry Steering phase is initiated.

12:57:24 PM T+142:44:24 altitude = 216500 ft. CM exits S and C-band radio blackout.

12:58:54 PM T+142:45:54 recovery aircraft establish radio contact with the CM.

01:02 PM T+142:49 recovery helicopters visually acquire the CM.

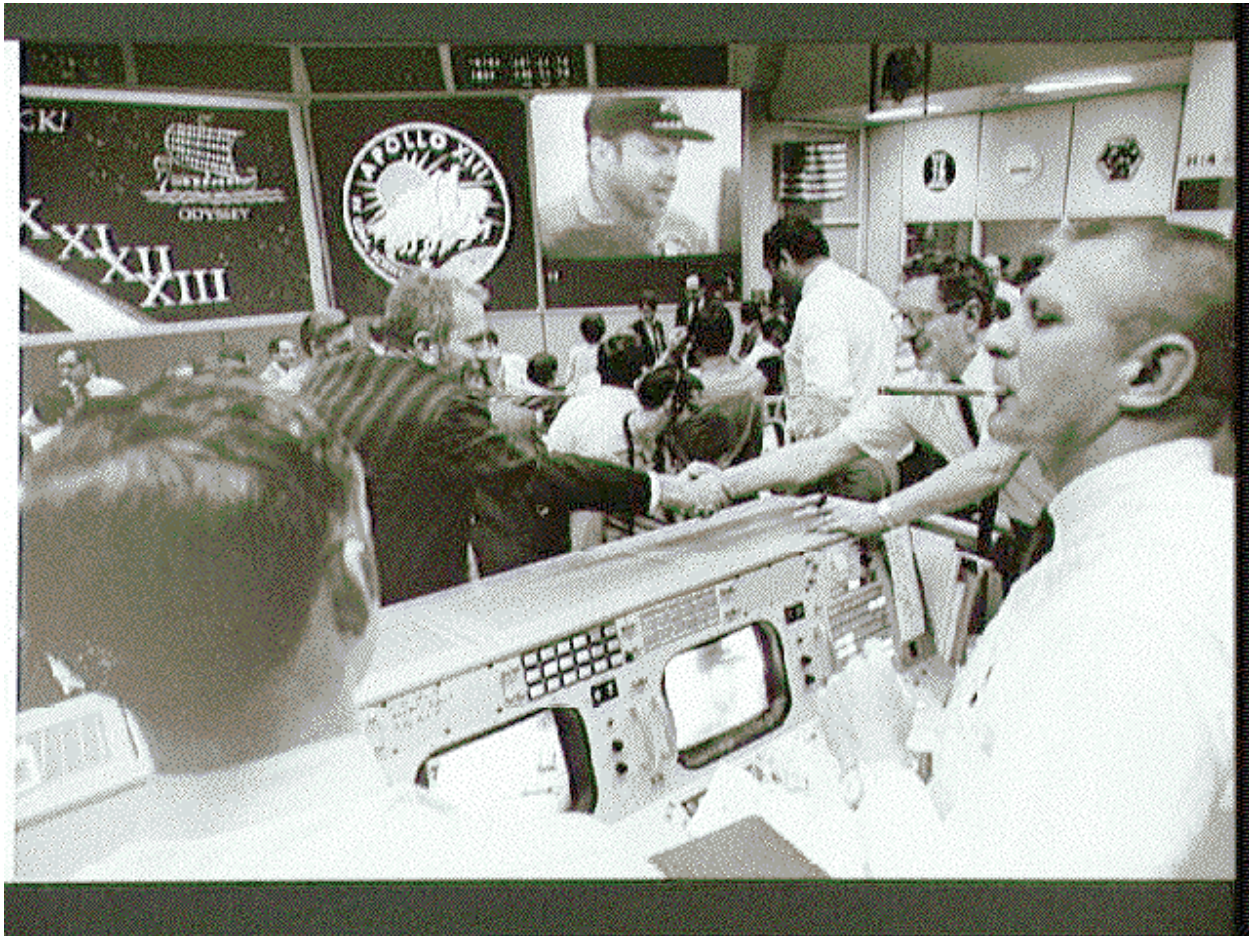
01:02:45 PM T+142:49:45 altitude = 23300 ft. Drogue parachutes are deployed and unreefed.

01:03:32 PM T+142:50:32 altitude 10500 ft. Drogue parachutes are released. Pilot and main parachutes are deployed and unreefed.

01:03:36 PM T+142:50:36 USS *Iwo Jima* visually acquires the CM.

01:07:18 PM T+142:54:18 altitude = 1000 ft.

01:07:41 PM T+142:54:41 latitude = 21.63°S, longitude = 165.37°W. Splashdown 5 mi from the USS *Iwo Jima* and 0.5 mi from the prime landing site. CM retains Stable 1.



Splashdown Celebration In MCC

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01:53 PM T+143:40 crew arrives aboard USS *Iwo Jima* in Helicopter 66.



Crew On *Iwo Jima*'s Flight Deck

4441056

DATE		INVENTORY #		QUANTITY		UNIT PRICE		TOTAL	
DATE		INVENTORY #		QUANTITY		UNIT PRICE		TOTAL	
1.	400,001	NI	Tooling, \$4.00 first mile, \$1.00 each additional mile Tireless call, fast service Battery Charge (road call + \$.05 JAW) Engineer's junior cables						\$ 400,000.00
2.	1	NI	Engineer's junior cables						1.00
3.	200	\$	Engineer's junior cables						500.00
4.	2		Sleeping accommodations for 2, no TV, air-conditioned, with radio, modified American plan, with view Additional guest in room at \$8.00/night. (2) Check out no later than noon Fri. 4/17/70, accommodations not guaranteed beyond that time.						Prepaid
5.									32.00
6.			Water						No charge
7.			Personalized "trip-kit", including all transfers, baggage handling and protection						No charge
				Sub-Total					\$ 400,500.00
				20% commercial discount + 2% cash discount (not 30 days)				(-)	\$ 80,100.00
				Total					\$ 312,400.00
				No taxes applicable (government contract)					

STUDY 5

PODCAST: <http://www.fox.com/podcast> 5/2/04

20 February 2000

The Apollo 13 Mission Acronym List: Compiled by Daniel R. Adamo

AGS: Abort Guidance System
ALSEP: Apollo Lunar Surface Experiments Package
AOS: Acquisition Of Signal
APS: Auxiliary Propulsion System (Saturn IVB); Ascent Propulsion System (LM)
AS: Apollo-Saturn
CM: Command Module
CSM: Command-Service Module
DPS: Descent Propulsion System
EDS: Emergency Detection System
EST: Eastern Standard Time
GET: Ground Elapsed Time
GNC: Guidance Navigation and Control
HCI: Hybrid Course Insertion
IGM: Iterative Guidance Mode
KSC: Kennedy Space Center
LC: Launch Complex
LES: Launch Escape System
LM: Lunar Module
LOI: Lunar Orbit Insertion
LOS: Loss Of Signal
LVLH: Local Vertical Local Horizontal
MCC: Mission Control Center; Mid-Course Correction
MLP: Mobile Launch Platform
MSC: Manned Spacecraft Center
MSOB: Manned Spacecraft Operations Building
MSS: Mobile Service Structure
NASA: National Aeronautics and Space Administration
RCS: Reaction Control System
SM: Service Module
SLA: Spacecraft Lm Adapter
SPS: Service Propulsion System
TEI: Trans-Earth Injection
TLI: Trans-Lunar Injection
USS: United States Ship
VAB: Vehicle Assembly Building