APOLLO BY THE NUMBERS

A statistical reference for the manned phase of Project Apollo

by

Richard W. Orloff

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Introduction

The purpose of this work is to provide researchers, students, and space enthusiasts with a comprehensive reference for facts about Project Apollo, America's effort to put men on the moon.

Research for this work started in 1988, when the author discovered that, despite the number of excellent books that focused on the drama of events that highlighted Apollo, there were none that focused on the drama of the numbers.

It may be impossible to produce the perfect Apollo fact book. For a program of the magnitude of Apollo, many NASA centers and contractors maintained data files for each mission. As a result, the same types of measurements from different sources vary, sometimes significantly. In addition, there are notable errors and conflicts even within official NASA and contractor documents. In order to minimize conflicts, the author sought original documents to create this work. Some documents were previously unavailable to the public, and were released only following the author's petitions through the Freedom of Information Act.

Trivia buffs will have a field day with the data published here, and it's a sure bet that a few readers will disagree with some of it. However, it is a start. Enjoy!

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Comments and documented potential corrections are welcomed, and should be addressed to the author via Internet e-mail at orloff@injersey.com

Richard W. Orloff
June, 1996

Acknowledgments

The information contained in the mission summaries in this work was derived primarily from uncopyrighted NASA and contractor mission reports, and, in some cases, is quoted verbatim from the original text without attribution. Readers interested in specific sources will find them listed in the bibliographies which appear at the end of each mission summary. In a few cases, it was necessary to include information from other copyrighted works, and the author acknowledges those cases as follows:

The source for some of the astronaut biographical data is *Who's Who In Space: The International Space Year Edition*, by Michael Cassutt, although most information was derived from NASA biographies.

The primary source for descriptions of the mission emblems is the official NASA text that accompanied each emblem. However, additional information has been used from *Space Patches From Mercury to the Space Shuttle*, written by Judith Kaplan and Robert Muniz. Another source is Dick Lattimer's unpublished draft of *Astronaut Mission Patches and Spacecraft Callsigns,* available at Rice University's Fondren Library.

The source for the COSPAR designations for the various Apollo spacecraft and launch vehicle stages once on orbit is the *R. A. E. Table of Earth Satellites 1957-1986*.

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Notes

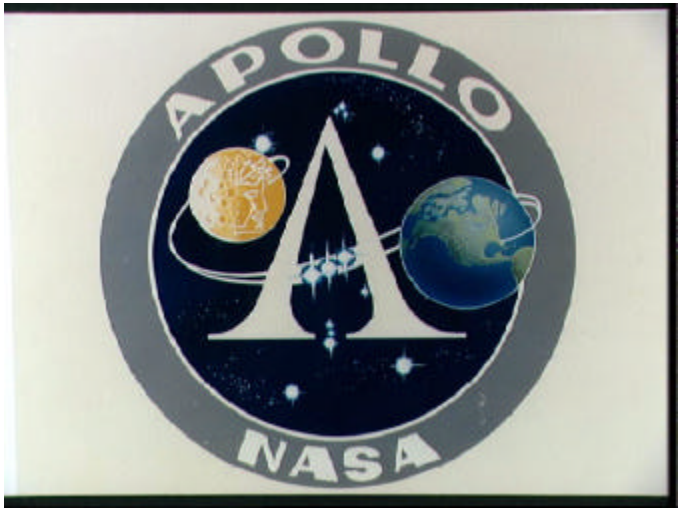
For the convenience of the reader, event times are expressed mostly as GMT (Greenwich Mean Time) and GET (Ground Elapsed Time). Local U.S. Eastern time, in which all missions were launched, is also included only for significant events. In regular usage, GMT does not use a colon between the hours and minutes; however for the convenience of readers of this work, most of whom are in the United States, where time is expressed as “00:00”, the colon is included.

The term “GET” (Ground Elapsed Time), used for manned U.S. spaceflights prior to the space shuttle, was referenced to “Range Zero,” the last integral second before liftoff. With the first launch of the shuttle, NASA began using the term “MET” (Mission Elapsed Time), which begins at the moment of solid rocket booster ignition. The format for GET used here is hhh:mm:ss.sss (e.g., hours:minutes:seconds). Example: 208:23:45.343, with “GET” excluded and assumed in order to avoid confusion with GMT.

Some other abbreviations used frequently in this work include:

B. S.: Bachelor of Science degree
CM: Command Module
CSM: Command and Service Module(s) (combined structure)
GH_2: Gaseous Hydrogen
LH_2: Liquid Hydrogen
LM: Lunar Module
LOX: Liquid Oxygen
LRV: Lunar Rover Vehicle (used on Apollos 15, 16, and 17)
M. S.: Master of Science degree
MET: Modular Equipment Transport (used only on Apollo 14)
NASA: National Aeronautics and Space Administration
Ph. D.: Doctor of Philosophy degree
Sc. D.: Doctor of Science degree
S-IB: Saturn IB launch vehicle
S-IVB: Saturn IV-B launch vehicle
SM: Service Module

APOLLO BY THE NUMBERS



Statistical Tables

General Background[1]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Mission Information											
Mission Type	C	C prime	D	F	G	H-1	H-2	H-3	J-1	J-2	J-3
Purpose	Command and service module manned flight demonstration.	Command and service module manned flight demonstration.	Lunar module manned flight demonstration.	Lunar module manned flight demonstration.	Manned lunar landing demonstration.	Precision manned lunar landing demonstration and systematic lunar exploration.	Precision manned lunar landing demonstration and systematic lunar exploration.	Precision manned lunar landing demonstration and systematic lunar exploration.	Extensive scientific investigation of moon on lunar surface and from lunar orbit.	Extensive scientific investigation of moon on lunar surface and from lunar orbit.	Extensive scientific investigation of moon on lunar surface and from lunar orbit.
Trajectory Type	Earth Orbital	Lunar Orbital	Earth Orbital	Lunar Orbital	Lunar Landing	Lunar Landing	Lunar Landing	Lunar Landing	Lunar Landing	Lunar Landing	Lunar Landing
Payload Description	Block II command and service module, adapter, and launch escape system.	Block II command and service module, lunar module, adapter, and launch escape system.	Block II command and service module, lunar module, adapter, and launch escape system.	Block II command and service module, lunar module, adapter, and launch escape system.	Block II command and service module, lunar module, adapter, and launch escape system.	Block II command and service module, lunar module, adapter, and launch escape system.	Block II command and service module, lunar module, adapter, and launch escape system.	Block II command and service module, lunar module, adapter, and launch escape system.	Block II command and service module, lunar module, adapter, and launch escape system.	Block II command and service module, lunar module, adapter, and launch escape system.	Block II command and service module, lunar module, adapter, and launch escape system.
Launch Information											
Launch Site	Cape Kennedy	Kennedy Space Ctr	Kennedy Space Ctr	Kennedy Space Ctr	Kennedy Space Ctr	Kennedy Space Ctr	Kennedy Space Ctr	Kennedy Space Ctr	Kennedy Space Ctr	Kennedy Space Ctr	Kennedy Space Ctr
Launch Complex	Complex 34	Complex 39A	Complex 39A	Complex 39B	Complex 39A	Complex 39A	Complex 39A	Complex 39A	Complex 39A	Complex 39A	Complex 39A
Geodetic Latitude (deg N)	28.521963	28.608422	28.608422	28.627306	28.608422	28.608422	28.608422	28.608422	28.608422	28.608422	28.608422
Geocentric Latitude (deg N)	28.3608	28.4470	28.4470	24.4658	28.4470	28.4470	28.4470	28.4470	28.4470	28.4470	28.4470
Longitude (deg E)	-80.561141	-80.604133	-80.604133	-80.620869	-80.604133	-80.604133	-80.604133	-80.604133	-80.604133	-80.604133	-80.604133
Range Zero[2]											
KSC Date	11-Oct-68	21-Dec-68	03-Mar-69	18-May-69	16-Jul-69	14-Nov-69	11-Apr-70	31-Jan-71	26-Jul-71	16-Apr-72	07-Dec-72
KSC Time	11:02:45 AM	07:51:00 AM	11:00:00 AM	12:49:00 PM	09:32:00 AM	11:22:00 AM	02:13:00 PM	04:03:02 PM	09:34:00 AM	12:54:00 PM	12:33:00 AM
KSC Time Zone	EDT	EST	EST	EDT	EDT	EST	EST	EST	EDT	EST	EST
GMT Date	11-Oct-68	21-Dec-68	03-Mar-69	18-May-69	16-Jul-69	14-Nov-69	11-Apr-70	31-Jan-71	26-Jul-71	16-Apr-72	07-Dec-72
GMT Time	15:02:45	12:51:00	16:00:00	16:49:00	13:32:00	16:22:00	19:13:00	21:03:02	13:34:00	17:54:00	05:33:00
Actual GMT Liftoff Time	15:02:45.36	12:51:00.67	16:00:00.67	16:49:00.58	13:32:00.63	16:22:00.68	19:13:00.61	21:03:02.57	13:34:00.58	17:54:00.59	05:33:00.63
Selected Durations											
Ascent to Orbit (sec)	626.76	694.98	674.66	713.76	709.33	703.91	759.83	710.56	704.67	716.21	712.65
Earth Orbit	259:42:59	002:44:30.53	240:32:55.5	002:27:26.82	002:38:23.70	002:41:30.03	002:28:07.32	002:22:42.68	002:44:18.94	002:27:32.21	003:06:44.99
Revolutions	163.0	1.5	151.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.0
Translunar Coast	---	066:16:21.8	---	073:22:29.5	073:05:34.87	080:38:01.67	---	079:28:18.30	075:42:21.45	071:55:14.35	083:02:18.12
Time on Lunar Surface	---	---	---	---	021:36:21	031:31:12	---	033:30:31	066:54:54	071:02:13	074:59:39
Lunar Orbit	---	020:10:13.0	---	061:43:23.6	059:30:25.79	088:58:11.52	---	066:35:39.99	145:12:41.68	125:49:32.59	147:43:37.11
Revolutions	---	10	---	31	30	45	---	34	74	64	75
CSM/LM Undocked	---	---	006:22:50	008:10:05	027:51:00.0	037:42:17.9	---	039:45:08.9	072:57:09.3	081:27:47	079:49:19
Transearth Coast	---	057:23:32.5	---	054:09:40.8	059:36:52.0	071:52:51.96	---	067:09:13.8	071:07:48	065:13:16	067:34:05
Earth Entry (sec)	937.0	869.2	1,004	869	929	846	835	853	778	814	801
Mission Duration	260:09:03	147:00:42.0	241:00:54	192:03:23	195:18:35	244:36:25	142:54:41	216:01:58.1	295:11:53.0	265:51:05	301:51:59

[1]Compiled from mission reports, launch vehicle reports, and other sources.

[2]Range Zero was the integral second before liftoff.

Crew Information - Earth Orbit and Lunar Orbit Missions[3]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10
Commander	Walter Marty Schirra, Jr.	Frank Frederick Borman, II	James Alton McDivitt	Thomas Patten Stafford
Date of Birth	12-Mar-23	14-Mar-28	10-Jun-29	17-Sep-30
Place of Birth	Hackensack, NJ	Gary, IN	Chicago, IL	Weatherford, OK
Age On Launch Date	45	40	39	38
Status	Captain	Colonel	Colonel	Colonel
	USN	USAF	USAF	USAF
Year Selected Astronaut	1959	1962	1962	1962
Prior Space Flights	MA-8, GT-6A	GT-7	GT-4	GT-6A, GT-9A
Backup	Thomas Patten Stafford	Neil Alden Armstrong	Charles Conrad, Jr.	Leroy Gordon Cooper, Jr.
Status	Colonel	Civilian	Commander	Colonel
	USAF	NASA	USN	USAF
Command Module Pilot	Donn Fulton Eisele	James Arthur Lovell, Jr.	David Randolph Scott	John Watts Young
Date of Birth	23-Jun-30	25-Mar-28	06-Jun-32	24-Sep-30
Place of Birth	Columbus, OH	Cleveland, OH	San Antonio, TX	San Francisco, CA
Date of Death	01-Dec-87	---	---	---
Place of Death	Tokyo, Japan	---	---	---
Age On Launch Date	38	40	36	38
Status	Major	Captain	Colonel	Commander
	USAF	USN	USAF	USN
Year Selected Astronaut	1963	1962	1963	1962
Prior Space Flights	None	GT-7, GT-12	GT-8	GT-3, GT-10
Backup	John Watts Young	Edwin Eugene Aldrin, Jr.	Richard Francis Gordon, Jr.	Donn Fulton Eisele
Status	Commander	Colonel	Commander	Lt. Colonel
	USN	USAF	USN	USAF
Lunar Module Pilot	Ronnie Walter Cunningham	William Alison Anders	Russell Louis Schweickart	Eugene Andrew Cernan
Date of Birth	16-Mar-32	17-Oct-33	25-Oct-35	14-Mar-34
Place of Birth	Creston, IA	Hong Kong	Neptune, NJ	Chicago, IL
Age On Launch Date	36	35	33	35
Status	Civilian	Major	Civilian	Commander
	---	USAF	---	USN
Year Selected Astronaut	1963	1963	1963	1963
Prior Space Flights	None	None	None	GT-9A
Backup	Eugene Andrew Cernan	Fred Wallace Haise, Jr.	Alan LaVern Bean	Edgar Dean Mitchell
Status	Commander	Civilian	Commander	Commander
	USN	NASA	USN	USN

[3]Compiled from press kits and mission reports, and *Who's Who in Space* (Cassutt).

Crew Information - Lunar Landing Missions[4]

	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Commander	Neil Alden Armstrong	Charles Conrad, Jr.	James Arthur Lovell, Jr.	Alan Bartlett Shepard, Jr.	David Randolph Scott	John Watts Young	Eugene Andrew Cernan
Date of Birth	05-Aug-30	02-Jun-30	25-Mar-28	18-Nov-23	06-Jun-32	24-Sep-30	14-Mar-34
Place of Birth	Wapakoneta, OH	Philadelphia, PA	Cleveland, OH	East Derry, NH	San Antonio, TX	San Francisco, CA	Chicago, IL
Age On Launch Date	38	39	42	47	39	41	38
Status	Civilian	Commander	Captain	Captain	Colonel	Captain	Captain
	---	USN	USN	USN	USAF	USN	USN
Year Selected Astronaut	1962	1962	1962	1959	1963	1962	1963
Prior Space Flights	GT-8	GT-5, GT-11	GT-7, GT-12, Apollo 8	MR-3	GT-8, Apollo 9	GT-3, GT-10, Apollo 10	GT-9A, Apollo 10
Backup	James Arthur Lovell, Jr.	David Randolph Scott	John Watts Young	Eugene Andrew Cernan	Richard Francis Gordon, Jr.	Fred Wallace Haise, Jr.	John Watts Young
Status	Captain	Colonel	Commander	Captain	Captain	Civilian	Captain
	USN	USAF	USN	USN	USN	NASA	USN
Command Module Pilot	Michael Collins	Richard Francis Gordon, Jr.	John Leonard Swigert, Jr.	Stuart Allen Roosa	Alfred Merrill Worden	Thomas Kenneth Mattingly, II	Ronald Ellwin Evans
Date of Birth	31-Oct-30	05-Oct-29	30-Aug-31	16-Aug-33	07-Feb-32	17-Mar-36	10-Nov-33
Place of Birth	Rome, Italy	Seattle, WA	Denver, CO	Durango, CO	Jackson, MI	Chicago, IL	St Francis, KS
Date of Death	---	---	27-Dec-82	12-Dec-95	---	---	07-Apr-90
Place of Death	---	---	Washington, DC	Washington, DC	---	---	Scottsdale, AZ
Age On Launch Date	38	40	38	37	39	36	39
Status	Lt. Colonel	Commander	Civilian	Major	Major	Lt. Commander	Commander
	USAF	USN	---	USAF	USAF	USN	USN
Year Selected Astronaut	1963	1963	1966	1966	1966	1966	1966
Prior Space Flights	GT-10	GT-11	None	None	None	None	None
Backup	William Alison Anders	Alfred Merrill Worden	Thomas Kenneth Mattingly, II	Ronald Ellwin Evans	Vance DeVoe Brand	Stuart Allen Roosa	Stuart Allen Roosa
Status	Lt. Colonel	Major	Lt. Commander	Commander	Civilian	Lt. Colonel	Lt. Colonel
	USAF	USAF	USN	USN	NASA	USAF	USAF
Lunar Module Pilot	Edwin Eugene Aldrin, Jr.	Alan LaVern Bean	Fred Wallace Haise, Jr.	Edgar Dean Mitchell	James Benson Irwin	Charles Moss Duke, Jr.	Harrison Hagan Schmitt
Date of Birth	20-Jan-30	15-Mar-32	14-Nov-33	17-Sep-30	17-Mar-30	03-Oct-35	03-Jul-35
Place of Birth	Montclair, NJ	Wheeler, TX	Biloxi, MS	Hereford, TX	Pittsburgh, PA	Charlotte, NC	Santa Rita, NM
Date of Death	---	---	---	---	08-Aug-91	---	---
Place of Death	---	---	---	---	Glenwood Springs, CO	---	---
Age On Launch Date	39	37	36	40	41	36	37
Status	Colonel, Sc. D.	Commander	Civilian	Commander, Sc. D.	Lt. Colonel	Lt. Colonel	Civilian, Ph. D.
	USAF	USN	---	USN	USAF	USAF	---
Year Selected Astronaut	1963	1963	1966	1966	1966	1966	1965
Prior Space Flights	GT-12I	None	None	None	None	None	None
Backup	Fred Wallace Haise, Jr.	James Benson Irwin	Charles Moss Duke, Jr.	Joe Henry Engle	Harrison Hagan Schmitt	Edgar Dean Mitchell	Charles Moss Duke, Jr.
Status	Civilian	Lt. Colonel	Major	Lt. Colonel	Civilian	Captain	Colonel
	NASA	USAF	USAF	USAF	NASA	USN	USAF

[4]Compiled from press kits and mission reports, and *"Who's Who in Space"* (Cassutt).

Apportionment of Training According to Mission Type[5]

Training Category	Missions Before 1st Lunar Landing (Apollo 7 - 10)		Early Lunar Landing Missions (Apollo 11 - 14)		Final Lunar Landing Missions (Apollo 15 - 17)	
	Hours	**% of Total**	**Hours**	**% of Total**	**Hours**	**% of Total**
Simulators	11,511	36	15,029	56	11,413	45
Special Purpose	4,023	13	5,379	220	9,246	36
Procedures	7,924	25	2,084	8	1,265	5
Briefings	5,894	18	3.070	11	2,142	9
Spacecraft Tests	2,576	8	1,260	5	1,255	5
Total	31,928	100	26,822	100	25,321	100

Apollo Training Exercises[6]

Exercise	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Lunar Surface Activity Simulations (Sessions)	---	---	---	---							
Surface Operations	---	---	---	---	20	31	42	43	91	47	341
Operations Before/After EVA	---	---	---	---	10	4	11	18	20	20	93
Total Per Mission	---	---	---	---	30	35	53	61	111	67	434
Geology Field Trips[7]	---	---	---	---	1	4	7	7	12	18	13
Integrated Crew/Ground Mission Simulations (Days)											
Command Module Simulator	18	14	---	---	6 (1)	10	13	12 (3)	13 (6)	16 (5)	13 (2)
Lunar Module Simulator	0	0	---	---	4	3	5	5 (2)	5	7 (1)	6
Command Module and Lunar Module Simulators	0	0	---	---	7	12	9	12 (1)	7	10	9
Total Per Mission	18	14	---	---	17 (1)	25	27	29 (6)	25 (6)	33 (6)	28 (2)

[5] *Apollo Program Summary Report* (JSC-09423), pps. 6-20 to 6-23. Includes participation of Mission Control Center personnel. Numbers in parentheses indicate simulations accomplished by follow-on or support crewmen.

[6] ibid.

[7] Each field trip lasted from one to seven days.

Capsule Communicators (Capcoms)[8]

Apollo 7

Col. Thomas Patten Stafford, USAF
Lt. Cdr. Ronald Ellwin Evans, USN
Maj. William Reid Pogue, USAF
John Leonard Swigert, Jr.
Cdr. John Watts Young, USN
Cdr. Eugene Andrew Cernan, USN

Apollo 8

Lt. Col. Michael Collins, USAF
Lt. Cdr. Thomas Kenneth Mattingly, II, USN
Maj. Gerald Paul Carr, USMC
Neil Alden Armstrong
Col. Edwin Eugene Aldrin, USAF/Sc. D.
Vance DeVoe Brand
Fred Wallace Haise, Jr.

Apollo 9

Maj. Stuart Allen Roosa, USAF
Lt. Cdr. Ronald Ellwin Evans, USN
Maj. Alfred Merrill Worden, USAF
Cdr. Charles Conrad, Jr., USN
Cdr. Richard Francis Gordon, Jr., USN
Cdr. Alan LaVern Bean, USN

Apollo 10

Maj. Charles Moss Duke, Jr., USAF
Maj. Joe Henry Engle, USAF
Maj. Jack Robert Lousma, USMC
Lt. Cdr. Bruce McCandless, II, USN

Apollo 11

Maj. Charles Moss Duke, Jr., USAF
Lt. Cdr. Ronald Ellwin Evans, USN
Lt. Cdr. Bruce McCandless, II, USN
Capt. James Arthur Lovell, Jr., USN
Lt. Col. William Alison Anders, USAF
Lt. Cdr. Thomas Kenneth Mattingly, II, USN
Fred Wallace Haise, Jr.
Don Leslie Lind, Ph. D.
Owen Kay Garriott, Jr., Ph. D.
Harrison Hagan Schmitt, Ph. D.

Apollo 12

Lt. Col. Gerald Paul Carr, USMC
Edward George Gibson, Ph. D.
Cdr. Paul Joseph Weitz, USN
Don Leslie Lind, Ph. D.
Col. David Randolph Scott, USAF
Maj. Alfred Merrill Worden, USAF
Lt. Col. James Benson Irwin, USAF

Civilian Backup Capcoms
Dickie K. Warren
James O. Rippey
James L. Lewis
Michael R. Wash

Apollo 13

Cdr. Joseph Peter Kerwin, USN/MD/MC
Vance DeVoe Brand
Maj. Jack Robert Lousma, USMC
Cdr. John Watts Young, USN
Lt. Cdr. Thomas Kenneth Mattingly, II, USN

Apollo 14

Maj. Charles Gordon Fullerton, USAF
Lt. Cdr. Bruce McCandless, II, USN
Fred Wallace Haise, Jr.
Lt. Cdr. Ronald Ellwin Evans, USN

Apollo 15

Joseph Percival Allen, IV, Ph. D.
Maj. Charles Gordon Fullerton, USAF
Karl Gordon Henize, Ph. D.
Cdr. Edgar Dean Mitchell, USN/Sc. D.
Robert Alan Ridley Parker, Ph. D.
Harrison Hagan Schmitt, Ph. D.
Capt. Alan Bartlett Shepard, Jr., USN
Capt. Richard Francis Gordon, Jr., USN
Vance DeVoe Brand

Apollo 16

Maj. Donald Herod Peterson, USAF
Maj. Charles Gordon Fullerton, USAF
Col. James Benson Irwin, USAF
Fred Wallace Haise, Jr.
Lt. Col. Stuart Allen Roosa, USAF
Cdr. Edgar Dean Mitchell, USN
Maj. Henry Warren Hartsfield, Jr., USAF
Anthony Wayne England, Ph. D.
Lt. Col. Robert Franklyn Overmyer, USMC

Apollo 17

Maj. Charles Gordon Fullerton, USAF
Lt. Col. Robert Franklyn Overmyer
Robert Alan Ridley Parker, Ph. D.
Joseph Percival Allen, IV, Ph. D.
Capt. Alan Bartlett Shepard, Jr., USN
Cdr. Thomas Kenneth Mattingly, II, USN
Col. Charles Moss Duke, Jr., USAF
Lt. Col. Stuart Allen Roosa, USAF
Capt. John Watts Young, USN

[8]Derived from various documents and memoranda in Rice University archives. Military ranks for astronauts who are not also backups are implied from available information and B. Hello (Rockwell) memo, Dec. 10, 1969.

Support Crews[9]

Apollo 7
Lt. Cdr. Ronald Ellwin Evans, USN
Maj. William Reid Pogue, USAF
John Leonard Swigert, Jr.

Apollo 8
Vance DeVoe Brand
Lt. Cdr. Thomas Kenneth Mattingly, II, USN
Maj. Gerald Paul Carr, USMC

Apollo 9
Maj. Jack Robert Lousma, USMC
Lt. Cdr. Edgar Dean Mitchell, USN/Sc. D.
Maj. Alfred Merrill Worden, USAF

Apollo 10
Maj. Charles Moss Duke, Jr., USAF
Maj. Joe Henry Engle, USAF
Lt. Col. James Benson Irwin, USAF

Apollo 11
Lt. Cdr. Thomas Kenneth Mattingly, II, USN
Lt. Cdr. Ronald Ellwin Evans, USN
Maj. William Reid Pogue, USAF
John Leonard Swigert, Jr.

Apollo 12
Maj. Gerald Paul Carr, USMC
Cdr. Paul Joseph Weitz, USN
Edward George Gibson, Ph. D.

Apollo 13
Maj. Jack Robert Lousma, USMC
Vance DeVoe Brand
Maj. William Reid Pogue, USAF

Apollo 14
Lt. Cdr. Bruce McCandless, II, USN
Lt. Col. William Reid Pogue, USAF
Maj. Charles Gordon Fullerton, USAF
Phillip Kenyon Chapman, Sc. D.

Apollo 15
Karl Gordon Henize, Ph. D.
Joseph Percival Allen, IV, Ph. D.
Robert Alan Ridley Parker, Ph. D.

Apollo 16
Maj. Donald Herod Peterson, USAF
Anthony Wayne England, Ph. D.
Maj. Henry Warren Hartsfield, Jr., USAF
Philip Kenyon Chapman, Sc. D.

Apollo 17
Lt. Col. Robert Franklyn Overmyer, USMC
Robert Alan Ridley Parker, Ph. D.
Maj. Charles Gordon Fullerton, USAF

[9]Compiled from various documents and memoranda in the Rice University archives. For Apollo 7, Bill Pogue replaced Maj. Edward Galen Givens, Jr., USAF, who was killed in an automobile accident in Pearland, TX on June 6, 1967. Military ranks are implied from available information and B. Hello (Rockwell) memo, Dec. 10, 1969.

Flight Directors[10]

Apollo 7	Director
Shift #1	Glynn S. Lunney
Shift #2	Eugene F. Kranz
Shift #3	Gerald D. Griffin

Apollo 8	Director
Shift #1	Clifford E. Charlesworth
Shift #2	Glynn S. Lunney
Shift #3	Milton L. Windler

Apollo 9	Director
Shift #1	Eugene F. Kranz
Shift #2	Gerald D. Griffin
Shift #3	M. P. "Pete" Frank

Apollo 10	Director
Shift #1	Glynn S. Lunney
	Gerald D. Griffin
Shift #2	Milton L. Windler
Shift #3	M. P. "Pete" Frank

Apollo 11	Director
Shift #1	Clifford E. Charlesworth
	Gerald D. Griffin
Shift #2	Eugene F. Kranz
Shift #3	Glynn S. Lunney

Apollo 12	Director
Shift #1	Gerald D. Griffin
Shift #2	M. P. "Pete" Frank
Shift #3	Clifford E. Charlesworth
Shift #4	Milton L. Windler

Apollo 13	Director
Shift #1	Milton L. Windler
Shift #2	Gerald D. Griffin
Shift #3	Eugene F. Kranz
Shift #4	Glynn S. Lunney

Apollo 14	Director
Shift #1	M. P. "Pete" Frank
	Glynn S. Lunney
Shift #2	Milton L. Windler
Shift #3	Gerald D. Griffin
Shift #4	Glynn S. Lunney

Apollo 15	Director
Shift #1	Gerald D. Griffin
Shift #2	Milton L. Windler
Shift #3	Glynn S. Lunney
	Eugene F. Kranz

Apollo 16	Director
Shift #1	M. P. "Pete" Frank
	Philip C. Shaffer
Shift #2	Eugene F. Kranz
	Donald R. Puddy
Shift #3	Gerald D. Griffin
	Neil B. Hutchinson
	Charles R. Lewis

Apollo 17	Director
Shift #1	Gerald D. Griffin
Shift #2	Eugene F. Kranz
	Neil B. Hutchinson
Shift #3	M. P. "Pete" Frank
	Charles R. Lewis

[10] Compiled from various documents and memoranda in the Rice University archives.

Apollo Space Vehicle Configuration

S-IB (Apollo 7)

- Reached 1.640 million pounds of thrust at liftoff
- Accelerated total space vehicle to ~7,620 fps (inertial/space-fixed)
- Reached ~33 nautical miles in ~ 2.5 minutes

S-IC

- Reached to 7.650 million pounds of thrust at liftoff
- Accelerated total space vehicle to ~7,880 fps (inertial/space-fixed)
- Reached ~58 nautical miles in ~ 2.5 minutes

S-II interstage

- Interfaced first and second stages
- Housed second stage engines
- Provided ullage for S-II engine start

S-II

- Accelerated vehicle from ~7,880 fps to ~ 22,850 fps in ~370 sec.
- Achieved altitude of ~101 nautical miles
- Housed S-II retro-rocket mounting

S-IVB Interstage

- Provided structural transition from diameter of S-II to S~IVB
- Housed S-IVB engine
- Had attitude control about 3 axed and +X ullage with APS, up to 505 seconds of burn time

S-IVB

- Increased inertial/space-fixed velocity from 7,620 fps to 25,553 fps in 470 sec to accomplish orbit (Apollo 7)
- Increased inertial/space-fixed velocity from 22,850 fps to 25,568 fps in 154 sec to accomplish orbit (all other flights)
- Accelerated space vehicle to ~35,500 fps for TLI (all except Apollo 7)

Instrument Unit

- Provided launch vehicle guidance; navigation; control signals; telemetry; command communications; tracking; EDS rates and display activation timing and stage functional sequencing

Spacecraft/Lunar Module Adapter

- Housed and supported the LM, aerodynamically enclosed, supported LM
- Provided the structural electrical interface between spacecraft and launch vehicle
- Provided diameter transition from S-IVB to CSM
- Allowed LM extraction

Lunar Module Descent Stage

- Provided velocity change for lunar deorbit and lunar landing (throttleable)
- Protected ascent stage from landing damage
- Provided ascent stage /descent stage staging
- Provided LM ascent stage launch pad
- Stowed lunar scientific equipment

Lunar Module Ascent Stage

- Provided mission life support for 2 crewmen
- Contained secondary command control and communications
- Computed and performed lunar landing abort, launch, rendezvous and docking with CSM
- Facilitated CM, LM ingress/egress inter- and extra-vehicular activities
- Maneuvered about and along 3 axed in the near-lunar environment

Service Module

- Provided velocity change for course correction, lunar orbit insertion, transearth injection and CSM aborts
- Provided attitude control and translation
- Supplemented environmental, electrical power and reaction control requirements of CM

Command Module

- Provided mission life support for 3 crewmen
- Provided inertial/space-fixed navigation
- Provided command control and communication center
- Provided attitude control about 3 axes
- Acted as a limited lifting body
- Provided CM-LM ingress/egress for inter- and extra-vehicular activity

Launch Escape System

- Transported CM away from space vehicle (and mainland) during launch abort
- Oriented CM attitude for launch abort descent
- Jettisoned safely as required
- Sensed flight dynamics
- Provided CM thermal protection

Designations[11]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Call-Signs											
Command Module	Apollo 7	Apollo 8	Gumdrop	Charlie Brown	Columbia	Yankee Clipper	Odyssey	Kitty Hawk	Endeavor	Casper	America
Lunar Module	---	---	Spider	Snoopy	Eagle	Intrepid	Aquarius	Antares	Falcon	Orion	Challenger
NASA/Contractor Designations											
Space Vehicle	AS-205	AS-503	AS-504	AS-505	AS-506	AS-507	AS-508	AS-509	AS-510	AS-511	AS-512
Launch Vehicle	SA-205	SA-503	SA-504	SA-505	SA-506	SA-507	SA-508	SA-509	SA-510	SA-511	SA-512
Launch Vehicle Type	Saturn IB	Saturn V	Saturn V	Saturn V	Saturn V	Saturn V	Saturn V	Saturn V	Saturn V	Saturn V	Saturn V
Launch Vehicle 1st Stage	S-IB-5	S-IC-3	S-IC-4	S-IC-5	S-IC-6	S-IC-7	S-IC-8	S-IC-9	S-IC-10	S-IC-11	S-IC-12
Launch Vehicle 2nd Stage	S-IVB-205	S-II-3	S-II-4	S-II-5	S-II-6	S-II-7	S-II-8	S-II-9	S-II-10	S-II-11	S-II-12
Launch Vehicle 3rd Stage	---	S-IVB-503	S-IVB-504	S-IVB-505	S-IVB-506	S-IVB-507	S-IVB-508	S-IVB-509	S-IVB-510	S-IVB-511	S-IVB-512
Instrument Unit	S-IU-205	S-IU-503	S-IU-504	S-IU-505	S-IU-506	S-IU-507	S-IU-508	S-IU-509	S-IU-510	S-IU-511	S-IU-512
Spacecraft/LM Adapter	SLA-10	SLA-11	SLA-12	SLA-13	SLA-14	SLA-15	SLA-16	SLA-17	SLA-19	SLA-20	SLA-21
Command Module	CM-101	CM-103	CM-104	CM-106	CM-107	CM-108	CM-109	CM-110	CM-112	CM-113	CM-114
Service Module	SM-101	SM-103	SM-104	SM-106	SM-107	SM-108	SM-109	SM-110	SM-112	SM-113	SM-114
Lunar Module	---	Lunar Module Test Article (LTA-B)	LM-3	LM-4	LM-5	LM-6	LM-7	LM-8	LM-10	LM-11	LM-12
Lunar Roving Vehicle	---	---	---	---	---	---	---	---	LRV-1	LRV-2	LRV-3
VAB High Bay	---	1	3	2	1	3	1	3	3	3	3
Firing Room	---	1	2	3	1	2	1	2	1	1	1
Mobile Launcher Platform	---	MLP-1	MLP-2	MLP-3	MLP-1	MLP-2	MLP-3	MLP-2	MLP-3	MLP-3	MLP-3
Computer Programs		Colossus	Colossus, Sundance	Colossus 2, Luminary 1	Colossus 2A, Luminary 1A	Colossus 2C, Luminary 1B	Colossus 2D, Luminary 1C	Colossus 2E, Luminary 1D	Colossus 3, Luminary 1E	Colossus 3, Luminary 1F	Colossus 3, Luminary 1G
Eastern Test Range Number	66	170	9025	920	5307	2793	3381	7194	7744	1601	1701
International Designations											
CSM	1968-089A	1968-118A	1969-018A	1969-043A	1969-059A	1969-099A	1970-029A	1971-008A	1971-063A	1972-031A	1972-096A
S-IVB Stage	1968-089B	1968-118B	1969-018B	1969-043B	1969-059B	1969-099B	1970-029B	1971-008B	1971-063B	1972-031B	1972-096B
LM Ascent Stage [12]	---	---	1969-018C	1969-043D	1969-059C	1969-099C	1970-029C	1971-008C	1971-063C	1972-031C	1972-096C
LM Descent Stage	---	---	1969-018D	1969-043C	1969-059D	1969-099D	1970-029C	1971-008D	1971-063E	1972-031E	1972-096D
Lunar Subsatellite	---	---	---	---	---	---	---	---	1971-063D	1972-031D	---
NORAD Designations											
CSM	03486	03626	03769	03941	04039	04225	04371	04900	05351	06000	06300
S-IVB Stage	03487	03627	03770	03943	04040	04226	04372	04904	05352	06001	06301
LM Ascent Stage	---	---	03771	03949	04041	04246	---	04905	05366	06005	06307
LM Descent Stage	---	---	03780	03948	---	---	---	---	---	---	---
Lunar Subsatellite	---	---	---	---	---	---	---	---	05377	06009	---

[11]Compiled from *RAE Table of Earth Satellites 1957-1986*; press kits; mission implementation plans; Saturn V flight evaluation reports; *Apollo Program Summary Report*; *Stages to Saturn: A Technological History of the Apollo/Saturn Launch Vehicles;* and other sources.

[12]Ascent and descent stages for Apollo 13 remained as one piece until Earth entry.

Launch Vehicle/Spacecraft Key Facts[13]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
First Stage (S-IB)											
Contractor	Chrysler	---	---	---	---	---	---	---	---	---	---
Diameter, base, ft	21.500	---	---	---	---	---	---	---	---	---	---
Diameter, top, ft	21.667	---	---	---	---	---	---	---	---	---	---
Height, ft	80.200	---	---	---	---	---	---	---	---	---	---
Engines, type/number	H-1/8	---	---	---	---	---	---	---	---	---	---
Fuel	RP-1	---	---	---	---	---	---	---	---	---	---
Oxidizer	LO_2										
Rated thrust each engine, lbf	200.000	---	---	---	---	---	---	---	---	---	---
Rated thrust total, lbf	1,600,000	---	---	---	---	---	---	---	---	---	---
Thrust at 35 to 38 sec, lbf	1,744,400	---	---	---	---	---	---	---	---	---	---
First Stage (S-IC)											
Contractor	---	Boeing	Boeing	Boeing	Boeing	Boeing	Boeing	Boeing	Boeing	Boeing	Boeing
Diameter, base, ft	---	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000
Diameter, top, ft	---	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000
Height, ft	---	138.030	138.030	138.030	138.030	138.030	138.030	138.030	138.030	138.030	138.030
Engines, type/number	---	F-1/5	F-1/5	F-1/5	F-1/5	F-1/5	F-1/5	F-1/5	F-1/5	F-1/5	F-1/5
Fuel	---	RP-1	RP-1	RP-1	RP-1	RP-1	RP-1	RP-1	RP-1	RP-1	RP-1
Oxidizer	---	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2
Rated thrust each engine, lbf	---	1,500,000	1,522,000	1,522,000	1,522,000	1,522,000	1,522,000	1,522,000	1,522,000	1,522,000	1,522,000
Rated thrust total, lbf	---	7,500,000	7,610,000	7,610,000	7,610,000	7,610,000	7,610,000	7,610,000	7,610,000	7,610,000	7,610,000
Thrust at 35 to 38 sec, lbf	---	7,560,000	7,576,000	7,536,000	7,552,000	7,594,000	7,560,000	7,504,000	7,558,000	7,620,000	7,599,000
Second Stage (S-II)											
Contractor	---	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell
Diameter, ft	---	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000
Height, ft	---	81.500	81.500	81.500	81.500	81.500	81.500	81.500	81.500	81.500	81.500
Engines, type/number	---	J-2/5	J-2/5	J-2/5	J-2/5	J-2/5	J-2/5	J-2/5	J-2/5	J-2/5	J-2/5
Fuel	---	LH_2	LH_2	LH_2	LH_2	LH_2	LH_2	LH_2	LH_2	LH_2	LH_2
Oxidizer	---	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2
Rated thrust each engine, lbf	---	225,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000
Rated thrust total, lbf	---	1,125,000	1,150,000	1,150,000	1,150,000	1,150,000	1,150,000	1,150,000	1,150,000	1,150,000	1,150,000
Thrust, ESC+61 sec, lbf	---	1,143,578	1,155,611	1,159,477	1,155,859	1,161,534	1,160,767	1,164,464	1,169,662	1,163,534	1,156,694
Thrust, OECO, lbf	---	865,302	730,000	642,068	625,751	611,266	635,725	580,478	548,783	787,380	787,009

[13]Compiled from Saturn launch vehicle flight evaluation reports. Thrust for S-IC stage is at sea level and for the S-II and S-IVB stages is at altitude. Thrust listed at “35 to 38 sec”, “Engine Start Command (ESC) + 61 seconds”, and at Outboard Engine Cutoff (OECO) is actual thrust as flown.

Launch Vehicle/Spacecraft Key Facts

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Third Stage (S-IVB)											
Contractor	McDonnell Douglas	McDonnell Douglas	McDonnell Douglas	McDonnell Douglas	McDonnell Douglas	McDonnell Douglas	McDonnell Douglas	McDonnell Douglas	McDonnell Douglas	McDonnell Douglas	McDonnell Douglas
Diameter, ft (base)	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000
Diameter, ft (top)	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667
Height, ft	58.400	58.630	58.630	58.630	58.630	58.630	58.630	58.630	58.630	58.630	58.630
Engines, type/number	J-2/1	J-2/1	J-2/1	J-2/1	J-2/1	J-2/1	J-2/1	J-2/1	J-2/1	J-2/1	J-2/1
Fuel	---	LH_2	LH_2	LH_2	LH_2	LH_2	LH_2	LH_2	LH_2	LH_2	LH_2
Oxidizer	---	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2	LO_2
Rated thrust total, lbf	200,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000	230,000
Thrust, lbf - 1st burn	207,802	202,678	232,366	204,965	202,603	206,956	199,577	201,572	202,965	206,439	205,797
Thrust, lbf - 2nd burn	---	201,777	203,568	204,712	201,061	207,688	198,536	201,738	203,111	206,807	205,608
Thrust, lbf - 3rd burn	---	---	199,516	---	---	---	---	---	---	---	---
Instrument Unit (IU)											
Contractor	IBM	IBM	IBM	IBM	IBM	IBM	IBM	IBM	IBM	IBM	IBM
Diameter, ft	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667
Height, ft	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
Service Module (SM)											
Contractor	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell
Diameter, ft	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833
Height (with engine bell), ft	24.583	24.583	24.583	24.583	24.583	24.583	24.583	24.583	24.583	24.583	24.583
Height (engine bell), ft	9.750	9.750	9.750	9.750	9.750	9.750	9.750	9.750	9.750	9.750	9.750
Fairing, ft	24.583	24.583	24.583	24.583	24.583	24.583	24.583	24.583	24.583	24.583	24.583
Main structure, ft	1.917	1.917	1.917	1.917	1.917	1.917	1.917	1.917	1.917	1.917	1.917
SPS nozzle structure	12.917	12.917	12.917	12.917	12.917	12.917	12.917	12.917	12.917	12.917	12.917
Weight, lb	19,730	51,258	36,159	51,371	51,243	51,105	51,105	51,744	54,063	54,044	54,044
Weight, dry, lb									13,470	13,450	13,450
Propellant, lb									40,593	40,594	40,594
Rated Thrust, SPS engine, lbf	20,500	20,500	20,500	20,500	20,500	20,500	20,500	20,500	20,500	20,500	20,500
Spacecraft/LM Adapter											
Contractor	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman
Minimum diameter, ft	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833
Maximum diameter, ft	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667	21.667
Height, ft	28.000	27.999	27.999	27.999	27.999	27.999	27.999	27.999	27.999	27.999	27.999
Upper jettisonable panels, ft	21.129	21.208	21.208	21.208	21.208	21.208	21.208	21.208	21.208	21.208	21.208
Lower fixed panels, ft	6.871	6.791	6.791	6.791	6.791	6.791	6.791	6.791	6.791	6.791	6.791
Lunar Module (LM)											
Contractor	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman	Grumman
Overall											
Width, ft	---	---	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
Height, ft	---	---	22.917	22.917	22.917	22.917	22.917	22.917	22.917	22.917	22.917
Footpad diameter, ft	---	---	3.083	3.083	3.083	3.083	3.083	3.083	3.083	3.083	3.083
Sensing probe length, ft	---	---	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667
Weight (lb)	---	(LTA) 19,900	32,034	30,735	33,278	33,562	33,493	33,685	36,238	36,237	36,262

Launch Vehicle/Spacecraft Key Facts

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
LM Descent Stage	---	---									
Diameter, ft	---	---	14.083	14.083	14.083	14.083	14.083	14.083	14.083	14.083	14.083
Height, ft	---	---	10.583	10.583	10.583	10.583	10.583	10.583	10.583	10.583	10.583
Weight, dry, lb[14]	---	---	4,265	4,703	4,483	4,875	4,650	4,716	6,179	6,083	6,155
Maximum rated thrust, lb	---	---	9,870	9,870	9,870	9,870	9,870	9,870	9,870	9,870	9,870
LM Ascent Stage	---	---									
Diameter, ft	---	---	14.083	14.083	14.083	14.083	14.083	14.083	14.083	14.083	14.083
Height, ft	---	---	12.333	12.333	12.333	12.333	12.333	12.333	12.333	12.333	12.333
Cabin volume, cu ft	---	---	235	235	235	235	235	235	235	235	235
Habitable volume, cu ft	---	---	160	160	160	160	160	160	160	160	160
Crew compartment height, ft	---	---	7.667	7.667	7.667	7.667	7.667	7.667	7.833	7.833	7.833
Crew compartment depth, ft	---	---	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
Weight, dry, lb	---	---	5,071	4,781	4,804	4,760	4,668	4,691	4,690	4,704	4,729
Maximum rated thrust, lb	---	---	2,524	1,650	3,218	3,224	N/A	3,218.2	3,225.6	3,224.7	3,234.8
Lunar Roving Vehicle (LRV)											
Contractor	---	---	---	---	---	---	---	---	Boeing	Boeing	Boeing
Length, ft	---	---	---	---	---	---	---	---	10.167	10.167	10.167
Width, ft	---	---	---	---	---	---	---	---	6.000	6.000	6.000
Wheel base, ft	---	---	---	---	---	---	---	---	7.500	7.500	7.500
Weight, lb	---	---	---	---	---	---	---	---	462	462	462
Payload capacity, lb	---	---	---	---	---	---	---	---	1,080	1,080	1,080
Command Module (CM)											
Contractor	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell
Diameter, ft	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833	12.833
Height, ft	11.417	11.417	11.417	11.417	11.417	11.417	11.417	11.417	11.417	11.417	11.417
Docking probe cone, ft	2.583	2.583	2.583	2.583	2.583	2.583	2.583	2.583	2.583	2.583	2.583
Main structure, ft	6.750	6.750	6.750	6.750	6.750	6.750	6.750	6.750	6.750	6.750	6.750
Aft/heat shield, ft	2.083	2.083	2.083	2.083	2.083	2.083	2.083	2.083	2.083	2.083	2.083
Weight, lb	12,659	12,392	12,405	12,277	12,250	12,365	12,365	12,831	12,831	12,874	12,874
Habitable volume, cu ft	210	210	210	210	210	210	210	210	210	210	210
Launch Escape System (LES)											
Contractor	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell	North American Rockwell
Diameter, ft	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Height, ft	33.460	33.460	33.460	33.460	33.460	33.460	33.460	33.460	33.460	33.460	33.460
Rocket motors (1 each)											
Thrust, LES, lb	155,000	147,000	147,000	147,000	147,000	147,000	147,000	147,000	147,000	147,000	147,000
Thrust, pitch control motor, lb	3,000	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
Thrust tower jettison motor, lb	33,000	31,500	31,500	31,500	31,500	31,500	31,500	31,500	31,500	31,500	31,500
Total Vehicle											
Height (ft)	223.488	363.013	363.013	363.013	363.013	363.013	363.013	363.013	363.013	363.013	363.013

[14]LM ascent and descent stages, LRV and CM dry weights are as published in mission press kits. All other weights are actual "as flown."

Launch Windows[15]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Launch Window Opening											
KSC Date	11-Oct-68	21-Dec-68	03-Mar-69	18-May-69	16-Jul-69	14-Nov-69	11-Apr-70	31-Jan-71	26-Jul-71	16-Apr-72	06-Dec-72
KSC Time	11:00:00 AM	07:50:22 AM	11:00:00 AM	12:49:00 PM	09:32:00 AM	11:22:00 AM	02:13:00 PM	03:23:00 PM	09:34:00 AM	12:54:00 PM	09:53:00 PM
Time Zone	EST	EST	EST	EDT	EDT	EST	EST	EST	EDT	EST	EST
GMT Date	11-Oct-68	21-Dec-68	03-Mar-69	18-May-69	16-Jul-69	14-Nov-69	11-Apr-70	31-Jan-71	26-Jul-71	16-Apr-72	07-Dec-72
GMT Time	16:00:00	12:50:22	16:00:00	16:49:00	13:32:00	16:22:00	19:13:00	20:23:00	13:34:00	17:54:00	02:53:00
Launch Window Closing											
KSC Date	11-Oct-68	21-Dec-68	03-Mar-69	18-May-69	16-Jul-69	14-Nov-69	11-Apr-70	31-Jan-71	26-Jul-71	16-Apr-72	07-Dec-72
KSC Time	03:00:00 PM	12:31:40 PM	02:15:00 PM	05:09:00 PM	01:54:00 PM	02:28:00 PM	05:36:00 PM	07:12:00 PM	12:11:00 PM	04:43:00 PM	01:31:00 AM
Time Zone	EST	EST	EST	EDT	EDT	EST	EST	EST	EDT	EST	EST
GMT Date	11-Oct-68	21-Dec-68	03-Mar-69	18-May-69	16-Jul-69	14-Nov-69	11-Apr-70	01-Feb-71	26-Jul-71	16-Apr-72	07-Dec-72
GMT Time	20:00:00	17:31:40	19:15:00	21:09:00	17:54:00	19:28:00	22:36:00	00:12:00	16:11:00	21:43:00	06:31:00
Window Duration											
H:MM:SS	4:00:00	4:41:18	3:15:00	4:20:00	4:22:00	3:06:00	3:23:00	3:49:00	3:37:00	3:49:00	3:38:00
Minutes	240	281	195	260	262	186	203	229	217	229	218
Targeted Lunar Sun Elevation Angle (deg)	---	6.74	---	11.0	10.8	5.1	10.0	10.3	12.0	11.9	13.3

[15]Compiled from press kits, mission implementation plans, and mission reports.

Launch Weather[16]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Surface Observations											
Pressure (lb/in²)	14.765	14.804	14.642	14.779	14.798	14.621	14.676	14.652	14.788	14.769	14.795
Temperature (°F)	82.9	59.0	67.3	80.1	84.9	68.0	75.9	71.1	85.6	88.2	70.0
Relative Humidity	65%	88%	61%	75%	73%	92%	57%	86%	68%	44%	93%
Dew Point (°F)	70	56	53	72	75	65	60	67	74	62.6	68.0
Visibility (s mi)	11.5	9.9	9.9	11.2	9.9	3.7	9.9	9.9	9.9	9.9	6.8
Surface Wind Conditions											
1st Level Wind Site (ft)	64.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
1st Level Wind Speed (ft/sec)	33.5	18.7	22.6	32.2	10.8	22.3	20.7	16.4	16.7	20.7	13.5
1st Level Wind Direction (deg)	090	348	160	142	175	280	105	255	156	269	005
2nd Level Wind Site (ft)	N/R	N/R	N/R	N/R	N/R	N/R	N/R	530.0	530.0	530.0	530.0
2nd Level Wind Speed (ft/sec)	N/R[17]	N/R	N/R	N/R	N/R	N/R	N/R	27.9	17.7	16.7	17.7
2nd Level Wind Direction (deg)	N/R	N/R	N/R	N/R	N/R	N/R	N/R	275	158	256	335
Cloud Coverage											
1st Level Cover	30%	40%	70%	40%	10%	100%/rain	40%	70%	70%	20%	20%
1st Level Type	Cumulonimbus	Cirrus	Stratocumulus	Cumulus	Cumulus	Stratocumulus	Altocumulus	Cumulus	Cirrus	Cumulus	Stratocumulus
1st Level Altitude (ft)	2,100	N/R	3,500	2,200	2,400	2,100	19,000	4,000	25,000	3,000	26,000
2nd Level Cover	---	---	100%	20%	20%	---	100%	20%	---	---	50%
2nd Level Type	---	---	Altostratus	Altocumulus	Altocumulus	---	Cirrostratus	Altocumulus	---	---	Cirrus
2nd Level Altitude (ft)	---	---	9,000	11,000	15,000	---	26,000	8,000	---	---	26,000
3rd Level Cover	---	---	---	100%	90%	---	---	---	---	---	---
3rd Level Type	---	---	---	Cirrus	Cirrostratus	---	---	---	---	---	---
3rd Level Altitude (ft)	---	---	---	Unknown	Unknown	---	---	---	---	---	---
Maximum Wind Speed/Ascent											
Speed (ft/sec)	136.2	150.9	250.0	154	203	256	246	207	249.3	85.6	252.6
Altitude (ft)	172,000	108,300	38,480	295,276	183,727	180,446	256,562	193,570	182,900	38,880	145,996
Maximum Dynamic Pressure											
Ground Elapsed Time (sec)	75.5	78.9	85.5	82.6	83.0	81.1	81.3	81.0	82.0	86.0	82.5
Max q (lb/ft²)	665.60	776.938	630.73	694.232	735.17	682.95	651.63	655.8	768.58	726.81	701.75
Altitude (ft)	39,903	44,062	45,138	43,366	44,512	42,133	40,876	40,398	44,971	47,122	42,847

[16]Compiled from Saturn launch vehicle reports, trajectory reconstruction reports, and *Summary of Atmospheric Data Observations For 155 Flights of MSFC/ABMA Related Aerospace Vehicles*.

[17]This measurement not used or not recorded at launch time.

Launch Weather[18]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Maximum Wind Conditions in the High Dynamic Pressure Region											
Altitude (ft)	44,500	49,900	38,480	46,520	37,400	46,670	44,540	43,270	45,110	38,880	39,945
Wind Speed (ft/sec)	51.1	114.1	250.0	139.4	31.6	156.1	182.5	173.2	61.1	85.6	147.9
Wind Direction (deg)	309	284	264	270	297	245	252	255	063	257	311
Maximum Wind Components											
Pitch Plane - Pitch (ft/sec)	51.8	102.4	244.4	133.9	24.9	154.9	182.4	173.2	-58.4	85.3	114.2
Pitch Plane - Altitude (ft)	36,800	49,500	38,390	45,280	36,680	46,670	44,540	43,720	45,030	38,880	39,945
Yaw Plane - Yaw (ft/sec)	51.5	74.1	71.2	61.4	23.3	-64.0	49.2	81.7	24.0	41.0	95.8
Yaw Plane - Altitude (ft)	47,500	51,800	37,500	48,720	39,530	44,780	42,750	33,460	44,040	50,850	37,237
Maximum Shear Values (D h=1000 m)											
Pitch Plane Shear (sec -1)	0.0113	0.0103	0.0248	0.0203	0.0077	0.0183	0.0166	0.0201	0.0110	0.0095	0.0177
Pitch Plane Altitude (ft)	48,100	52,500	49,700	50,200	48,490	46,750	50,610	43,720	36,830	44,780	26,164
Yaw Plane Shear (sec -1)	0.0085	0.0157	0.0254	0.0125	0.0056	0.0178	0.0178	0.0251	0.0071	0.0114	0.0148
Yaw Plane Altitude (ft)	46,500	57,800	48,160	50,950	33,790	47,820	45,850	38,880	47,330	50,850	34,940
Maximum % Density Deviations											
Negative Deviation From PRA63[19]	-0.1	-0.7	-6.1	-1.0	-0.2	-7.6	-2.8	-5.0	None	-0.8	-0.0
Altitude (n mi)	4.32	4.32	7.56	4.32	4.45	8.50	7.69	7.69	None	4.86	0.00
Positive Deviation from PRA63	+1.3	+3.3	None	+3.3	+4.4	+1.2	+0.5	None	+4.2	+4.0	+1.7
Altitude (n mi)	5.80	8.50	None	7.56	7.69	5.67	8.64	None	7.56	8.64	7.02

[18]Compiled from Saturn launch vehicle reports, trajectory reconstruction reports, and *Summary of Atmospheric Data Observations For 155 Flights of MSFC/ABMA Related Aerospace Vehicles*.

[19]Patrick Air Force Base Reference Atmosphere, 1963.

Apollo Program Budget Appropriations ($000) [20]

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	Program Total
Advanced Technical Development Studies	$100	$1,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,100
Orbital Flight Tests	$0	$0	$63,900	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$63,900
Biomedical Flight Tests	$0	$0	$16,550	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$16,550
High-Speed Reentry Tests	$0	$0	$27,550	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$27,550
Spacecraft Development	$0	$0	$52,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$52,000
Instrumentation & Scientific Equipment	$0	$0	$0	$11,500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$11,500
Operational Support	$0	$0	$0	$2,500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,500
Little Joe II Development	$0	$0	$0	$8,800	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$8,800
Supporting Development	$0	$0	$0	$3,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,000
Command and Service Modules	$0	$0	$0	$345,000	$545,874	$577,834	$615,000	$560,400	$455,300	$346,000	$282,821	$0	$0	$0	$3,728,229
Lunar Module	$0	$0	$0	$123,100	$135,000	$242,600	$310,800	$472,500	$399,600	$326,000	$231,433	$0	$0	$0	$2,241,033
Guidance & Navigation	$0	$0	$0	$32,400	$91,499	$81,038	$115,000	$76,654	$113,000	$43,900	$33,866	$0	$0	$0	$587,357
Integration, Reliability, & Checkout	$0	$0	$0	$0	$60,699	$24,763	$34,400	$29,975	$66,600	$65,100	$0	$0	$0	$0	$281,537
Spacecraft Support	$0	$0	$0	$0	$43,503	$83,663	$95,400	$110,771	$60,500	$121,800	$170,764	$0	$0	$0	$686,401
Saturn C-1	$0	$0	$0	$90,864	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$90,864
Saturn I	$0	$0	$0	$0	$187,077	$40,265	$800	$0	$0	$0	$0	$0	$0	$0	$228,142
Saturn IB	$0	$0	$0	$0	$146,817	$262,690	$274,185	$236,600	$146,600	$41,347	$0	$0	$0	$0	$1,108,239
Saturn V	$0	$0	$0	$0	$763,382	$964,924	$1,177,320	$1,135,600	$998,900	$534,453	$484,439	$189,059	$142,458	$26,300	$6,416,835
Engine Development	$0	$0	$0	$0	$166,000	$166,300	$134,095	$49,800	$18,700	$0	$0	$0	$0	$0	$534,895
Apollo Mission Support	$0	$0	$0	$0	$133,101	$170,542	$210,385	$243,900	$296,800	$0	$0	$0	$0	$0	$1,054,728
Manned Space Flight Operations	$0	$0	$0	$0	$0	$0	$0	$0	$0	$546,400	$422,728	$314,963	$307,450	$0	$1,591,541
Advanced Development	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$11,500	$12,500	$0	$24,000
Flight Modules	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$245,542	$55,033	$0	$300,575
Science Payloads	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$60,094	$106,194	$52,100	$0	$218,388
Ground Support	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$46,411	$31,659	$0	$78,070
Spacecraft	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,400	$50,400
Apollo Program	**$100**	**$1,000**	**$160,000**	**$617,164**	**$2,272,952**	**$2,614,619**	**$2,967,385**	**$2,916,200**	**$2,556,000**	**$2,025,000**	**$1,686,145**	**$913,669**	**$601,200**	**$76,700**	**$19,408,134**
NASA Total	**$523,375**	**$964,000**	**$16,717,500**	**$3,674,115**	**$3,974,979**	**$4,270,695**	**$4,511,644**	**$4,175,100**	**$3,970,000**	**$3,193,559**	**$3,113,765**	**$2,555,000**	**$2,507,700**	**$2,509,900**	**$56,661,332**
Apollo Share of Total Budget	**>1%**	**>1%**	**1%**	**17%**	**57%**	**61%**	**66%**	**70%**	**64%**	**63%**	**54%**	**36%**	**24%**	**3%**	**34%**

[20] *The Apollo Spacecraft: A Chronology*, volumes I through IV.

Call Signs[21]

Mission	Command Module	Lunar Module
Apollo 7	“Apollo 7”.	None.
Apollo 8	“Apollo 8”.	None.
Apollo 9	"Gumdrop". Derived from the appearance of the spacecraft when transported on Earth. During shipment, it was wrapped in blue wrappings giving appearance of a wrapped gumdrop.	“Spider”, derived from its bug-like configuration.
Apollo 10	“Charlie Brown”, from a character in comic strip *Peanuts*© drawn by Charles L. Schulz. As in the comic, the CM “Charlie Brown” would be the guardian of the LM “Snoopy.”	“Snoopy,” after the beagle dog character in the same comic strip. The name referred to the fact that the LM would be “snooping” around the lunar surface in low orbit. Also, at the Manned Spacecraft Center, Snoopy was symbol of quality performance. Employees who did outstanding work were awarded a silver Snoopy pin.
Apollo 11	“Columbia”, after Jules Verne’s mythical moonship, “Columbiad,” and the close relationship of the word to our nation’s origins.	“Eagle,” after the eagle selected for the mission insignia.
Apollo 12	“Yankee Clipper”, selected from names submitted by employees of the command module prime contractor.	“Intrepid”, selected from names submitted by employees of the lunar module prime contractor.
Apollo 13	“Odyssey,” reminiscent of the long voyage of Odysseus of Greek mythology.	"Aquarius," after the Egyptian god Acquarius, the water carrier. Acquarius brought fertility and therefore life and knowledge to the Nile Valley, as the Apollo 13 crew hoped to bring knowledge from the moon.
Apollo 14	“Kitty Hawk”, the site of the Wright brothers’ first flight.	“Antares”, for the star on which the LM oriented itself for lunar landing.
Apollo 15	“Endeavor,” for the ship which carried Captain James Cook on his 18th-century scientific voyages.	"Falcon," named for the USAF Academy mascot by Apollo 15’s all-Air Force crew.
Apollo 16	“Casper”, named for a cartoon character, “Casper the Friendly Ghost,” because the white Teflon suits worn by the crew looked shapeless on television screens.	"Orion," for a constellation, because the crew would depend on star sightings to navigate in cislunar space.
Apollo 17	“America”, as a tribute and a symbol of thanks to the American people who made the Apollo program possible.	"Challenger," indicative of the challenges of the future, beyond the Apollo program.

[21]Excerpted and reworked from *Astronaut Mission Patches and Spacecraft Callsigns*, by Dick Lattimer, unpublished draft in JSC History Office; *Space Patches From Mercury to the Space Shuttle*; and various NASA documents.

Mission Insignias[22]

Apollo 7

Symbolizing the Earth-orbital nature of the mission, a command and service module combination circled the globe, trailing an ellipse of orange flame. The background was dark navy-blue, symbolizing the depth of space. In the center was the Earth, with the North and South American continents appearing against light blue oceans. The crew's names appeared in an arc at the bottom. A Roman numeral VII appeared in the Pacific region of the globe.

Apollo 8

The shape of the insignia symbolized the Apollo command module. The red figure 8 circled the Earth and moon, representing not only the number of the mission but the translunar and transearth trajectories.

Apollo 9

Orbiting near the command module, the lunar module symbolized the first manned flight of the spacecraft that would take man to the lunar surface on future flights. A Saturn V launch vehicle was depicted at the left. The crew names appeared around the top edge of the insignia, and the mission name, Apollo IX, appeared along the bottom. The 'D' in McDivitt had a red interior, identifying Apollo 9 as the "D" mission in the Apollo series.

Apollo 10

Shaped like a shield, the design of the insignia was based more on mechanics than on mission goals. The large Roman numeral X identified the mission, and was three-dimensional to give the effect of sitting on the moon. The command module circled the moon as the LM fired the descent engine for its low pass over the surface. The Earth appeared in the background. Although Apollo 10 did not land, the prominence of the X indicated the mission would make a significant contribution to the Apollo program.

Apollo 11

The American eagle, symbolic of the United States, was about to land on the moon. In its talons, an olive branch indicated that the crew "came in peace for all mankind." The Earth, the place from which the crew came and would return safely in order to fulfill President John F. Kennedy's challenge to the nation, rested on a field of black, representing the vast unknown of space.

Apollo 12

An American clipper ship and the blue-and-gold motif signified that the crew was all-Navy and symbolically related the era of the clipper ship to the era of space flight. As the clipper ship brought foreign shores closer to the United States, and marked the increased utilization of the seas by this nation, spacecraft have opened the way to the other planets and Apollo 12 marked the increased utilization of space-based on knowledge gained in earlier missions. The portion of the moon shown represented the Ocean of Storms area in which Apollo would land. The four stars represented the crew and C. C. Williams, who would have been the lunar module pilot had he not died in an aircraft accident.

Apollo 13

Apollo, the sun god of Greek mythology, was represented as the sun, with three horses driving his chariot across the surface of the moon, symbolizing how the Apollo flights have extended the light of knowledge to all mankind. The Latin phrase "Ex Luna, Scientia" means "From the Moon, Knowledge."

Apollo 14

The Apollo 14 insignia featured the astronaut insignia approaching the moon and leaving a comet trail from the liftoff point on Earth. The mission name and crew name appeared in the border

Apollo 15

Three stylized birds, or symbols of flight, representing the Apollo 15 crew, were superimposed over an artist's concept of the landing site, next to the Hadley Rille at the foot of the Lunar Apennines. Beneath the symbols, a formation on the lunar surface formed a "XV", signifying the mission number. Two of the birds flew closer to the surface, representing the two crewmen who actually landed.

Apollo 16

Resting on a gray field representing the lunar surface, the American eagle and red, white and blue striped shield paid tribute to the people of the United States. Crossing the shield while orbiting the moon was a gold NASA vector. Sixteen stars, representing the mission number, and the crew names, appeared on a blue border, outlined in gold.

Apollo 17

The insignia was dominated by the image of the Greek sun god Apollo. Suspended in space behind the head of Apollo was an American eagle. The red bars of the eagle's wing represented the bars in the U.S. flag. The three white stars symbolized the crewmen. The background was deep blue space. Within it were the moon, Saturn and a spiral galaxy. The moon was partially overlaid by the eagle's wing suggesting it is a celestial body man has visited and conquered. The thrust of the eagle and the gaze of Apollo to the right toward Saturn and the galaxy implied that man's goals in space will someday include the planets and perhaps the stars. The colors of the insignia were red, white, and blue, the colors of our flag, with the addition of gold to symbolize the golden age of space flight.

[22]Excerpted and reworked from *Astronaut Mission Patches and Spacecraft Callsigns*, by Dick Lattimer, unpublished draft in JSC History Office; *Space Patches From Mercury to the Space Shuttle*; and various NASA documents.

Ground Ignition Weights[23]

Weights In Pounds Mass	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Ground Ignition Time Relative to Range Zero (sec)	**-2.988**	**-6.585**	**-6.3**	**-6.4**	**-6.4**	**-6.5**	**-6.7**	**-6.5**	**-6.5**	**-6.7**	**-6.9**
S-IB stage, dry	84,530	---	---	---	---	---	---	---	---	---	---
S-IB stage, fuel	276,900	---	---	---	---	---	---	---	---	---	---
S-IB stage, oxidizer	631,300	---	---	---	---	---	---	---	---	---	---
S-IB stage, other	1,182	---	---	---	---	---	---	---	---	---	---
S-IB stage, total	**993,912**	---	---	---	---	---	---	---	---	---	---
S-IB/S-IVB interstage, dry	5,543	---	---	---	---	---	---	---	---	---	---
Retromotor Propellant	1,061	---	---	---	---	---	---	---	---	---	---
S-IC stage, dry	---	305,232	294,468	293,974	287,531	287,898	287,899	287,310	286,208	287,855	287,356
S-IC stage, fuel	---	1,357,634	1,431,678	1,423,254	1,424,889	1,424,287	1,431,384	1,428,561	1,410,798	1,439,894	1,431,921
S-IC stage, oxidizer	---	3,128,034	3,301,203	3,302,827	3,305,786	3,310,199	3,304,734	3,312,769	3,312,030	3,311,226	3,314,388
S-IC stage, other	---	6,226	5,508	5,491	5,442	5,442	5,401	5,194	4,283	5,396	5,395
S-IC stage, total	**---**	**4,797,126**	**5,032,857**	**5,025,546**	**5,023,648**	**5,027,826**	**5,029,418**	**5,033,834**	**5,013,319**	**5,044,371**	**5,039,060**
S-IC/S-II interstage, dry	**---**	**12,436**	**11,591**	**11,585**	**11,477**	**11,509**	**11,454**	**11,400**	**9,083**	**10,091**	**9,975**
S-II stage, dry	---	88,500	84,312	84,273	79,714	80,236	77,947	78,120	78,908	80,362	80,423
S-II stage, fuel	---	793,795	821,504	823,325	819,050	825,406	836,741	837,484	837,991	846,157	844,094
S-II stage, oxidizer	---	154,907	158,663	158,541	158,116	157,986	159,931	159,232	158,966	160,551	160,451
S-II stage, other	---	1,426	1,188	1,250	1,260	1,250	1,114	1,051	1,082	991	934
S-II stage, total	**---**	**1,038,628**	**1,065,667**	**1,067,389**	**1,058,140**	**1,064,878**	**1,075,733**	**1,075,887**	**1,076,947**	**1,088,061**	**1,085,902**
S-II/S-IVB interstage, dry	**---**	**8,731**	**7,998**	**8,045**	**8,076**	**8,021**	**8,081**	**8,060**	**8,029**	**8,055**	**8,019**
S-IVB stage, dry	21,852	25,926	25,089	25,680	24,852	25,064	25,097	25,030	25,198	25,099	25,040
S-IVB stage, fuel	39,909	43,395	43,709	43,388	43,608	43,663	43,657	43,546	43,674	43,727	43,752
S-IVB stage, oxidizer	193,330	192,840	189,686	192,089	192,497	190,587	191,890	190,473	195,788	195,372	195,636
S-IVB stage, other	1,432	1,626	1,667	1,684	1,656	1,873	1,673	1,687	1,655	1,643	1,658
S-IVB stage, total	**256,523**	**263,787**	**260,151**	**262,841**	**262,613**	**261,187**	**262,317**	**260,736**	**266,315**	**265,841**	**266,086**
Total Instrument Unit	**4,263**	**4,842**	**4,281**	**4,267**	**4,275**	**4,277**	**4,502**	**4,505**	**4,487**	**4,502**	**4,470**
Spacecraft/Lunar Module Adapter	3,943	3,951	4,012	3,969	3,951	3,960	3,947	3,962	3,964	3,961	3,961
LM (LTA Apollo 8)	---	19,900	32,034	30,735	33,278	33,562	33,493	33,685	36,238	36,237	36,262
Command and Service Module	32,495	63,531	59,116	63,560	63,507	63,559	63,795	64,448	66,925	66,949	66,942
Total Launch Escape System	8,874	8,890	8,869	8,936	8,910	8,963	8,991	9,027	9,108	9,167	9,104
Total Spacecraft (CSM)	**45,312**	**96,272**	**104,031**	**107,200**	**109,646**	**110,044**	**110,226**	**111,122**	**116,235**	**116,314**	**116,269**
Total Vehicle	**1,306,614**	**6,221,823**	**6,486,577**	**6,486,873**	**6,477,875**	**6,487,742**	**6,501,733**	**6,505,548**	**6,494,415**	**6,537,238**	**6,529,784**

[23]Actual weights at S-IC stage ignition, compiled from Saturn launch vehicle flight evaluation reports. Weights to do not add to vehicle totals due to truncated data in report.

Ascent Data[24]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Pre-Staging											
Pad Azimuth (deg East of North)	100	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0
Flight Azimuth (deg East of North)	72	72.124	72.0	72.028	72.058	72.029	72.043	75.558	80.088	72.034	91.503
Mach 1 - GET (sec)	62.15	61.48	68.2	66.8	66.3	66.1	68.4	68.0	65.0	67.5	67.5
Mach 1 Altitude (ft)	25,034	24,128	25,781	25,788	25,736	25,610	26,697	26,355	25,663	26,019	26,221
Maximum Bending Moment - GET (sec)	73.1	74.7	79.4	84.6	91.5	77.5	76	76	80.1	86.5	79
Maximum Bending Moment (lbf-in)	7,546,000	60,000,000	86,000,000	88,000,000	33,200,000	37,000,000	69,000,000	116,000,000	80,000,000	71,000,000	96,000,000
Maximum q - GET (sec)	75.5	78.90	85.5	82.6	83.0	81.1	81.3	81.0	82.0	86.0	82.5
Maximum q Altitude (ft)	39,903	44,062	45,138	43,366	44,512	42,133	40,876	40,398	44,971	47,122	42,847
Maximum q (lb/ft^2)	665.60	776.938	630.73	694.232	735.17	682.95	651.63	655.8	768.58	726.81	701.75
S-IC Stage Burn (S-IB Apollo 7)											
Duration (sec)	147.31	160.41	169.06	168.03	168.03	168.2	170.3	170.6	166.1	168.5	168.1
Maximum Total Inertial Acceleration - GET (sec)	140.10	153.92	162.84	161.71	161.71	161.82	163.70	164.18	159.56	161.78	161.20
Maximum Total Inertial Acceleration - (ft/sec^2)	137.76	127.46	123.75	126.21	126.67	125.79	123.36	122.90	127.85	122.90	124.51
Maximum Total Inertial Acceleration - (g)	4.28	3.96	3.85	3.92	3.94	3.91	3.83	3.82	3.97	3.82	3.87
Maximum Earth-Fixed Velocity - GET (sec)	144.6	154.47	163.45	161.96	162.30	162.18	164.10	164.59	160.00	162.5	162.0
Maximum Earth-Fixed Velocity (ft/sec)	6,490.1	7,727.36	7,837.89	7,835.76	7,882.9	7,852.0	7,820.9	7,774.9	7,387.6	7,779.5	7,790.0
Apex - GET (sec)	259.4	266.54	266.03	266.87	269.1	275.6	271.7	271.8	277.562	270.973	273.689
Apex - Altitude (n mi)	64.4	64.69	59.23	60.61	62.1	66.4	63.1	62.9	68.8	63.1	64.9
Apex - Range (n mi)	132.6	175.70	172.37	172.90	176.8	181.4	176.0	174.5	182.9	174.8	177.2
S-II Stage Burn											
Duration (sec)	---	367.85	371.06	388.59	384.22	389.14	426.64	392.55	386.06	394.34	395.06
Maximum Total Inertial Acceleration - GET (sec)	---	524.14	536.31	460.69	460.70	460.83	537.00	463.17	459.56	461.77	461.21
Maximum Total Inertial Acceleration - (ft/sec^2)	---	59.71	64.34	58.46	58.53	58.79	53.31	58.10	57.58	56.00	56.00
Maximum Total Inertial Acceleration - (g)	---	1.86	2.00	1.82	1.82	1.83	1.66	1.81	1.79	1.74	1.74
Maximum Earth-Fixed Velocity GET (sec)	---	524.90	536.45	553.50	549.00	553.20	593.50	560.07	550.00	560.0	560.6
Maximum Earth-Fixed Velocity (ft/sec)	---	21,068.14	21,441.11	21,317.81	21,377.0	21,517.8	21,301.6	21,574.5	21,601.4	21,550.9	21,567.6
Apex - GET (sec)	---	560.34	593.58	597.21	587.0	581.7	632.2	600.2	553.225	584.122	574.527
Apex - Altitude (n mi)	---	104.21	102.50	102.31	101.9	103.2	103.0	102.4	95.2	93.7	93.3
Apex - Range (n mi)	---	934.06	1,026.36	1,035.06	1,005.9	985.3	1,098.8	1,032.2	888.9	978.7	946.2
S-IVB First Burn											
Duration (sec)	469.79	156.69	123.84	146.95	147.13	137.31	152.93	137.16	141.47	142.61	138.85
Maximum Total Inertial Acceleration - GET (sec)	616.9	685.08	664.74	703.84	699.41	693.99	750.00	700.66	694.67	706.21	702.65
Maximum Total Inertial Acceleration (ft/sec^2)	82.22	23.10	25.72	22.60	22.08	22.21	21.85	21.62	21.00	21.59	21.46
Maximum Total Inertial Acceleration (g)	2.56	0.72	0.80	0.70	0.69	0.69	0.68	0.67	0.65	0.67	0.67
Maximum Earth-Fixed Velocity - GET (sec)	619.3	685.50	674.66	703.84	709.33	703.91	750.50	710.56	704.67	716.21	712.70
Maximum Earth-Fixed Velocity (ft/sec)	24,208.4	24,244.26	24,246.39	24,240.09	24,243.8	24,242.3	24,243.1	24,221.8	24,242.4	24,286.1	24,231.0
S-IVB Second Burn											
Duration (sec)	---	317.72	62.06	343.06	346.83	341.14	350.85	350.84	350.71	341.92	351.04
Maximum Total Inertial Acceleration - GET[25]	---	002:55:55.61	004:46:57.68	002:39:10.66	002:50:03.11	002:53:04.02	002:41:37.23	002:34:23.34	002:55:53.61	002:39:18:42	003:18:27.64
Maximum Total Inertial Acceleration (ft/sec^2)	---	49.77	39.90	47.90	46.65	47.74	46.23	46.56	45.01	45.64	45.44
Maximum Total Inertial Acceleration (g)	---	1.55	1.24	1.49	1.45	1.48	1.44	1.45	1.40	1.42	1.41
Maximum Earth-Fixed Velocity - GET	---	002:55:56.00	004:46:58.20	002:39:11.30	002:50:03.50	002:53:04.32	002:41:37.80	002:34:23.67	002:55:54.00	002:39:20.0	003:18:28.5
Maximum Earth-Fixed Velocity (ft/sec)	---	34,178.74	26,432.58	34,251.67	34,230.3	34,063.0	34,231.0	34,194.9	34,236.9	34,269.0	34,202.4
S-IVB Third Burn											
Duration (sec)	---	---	242.06	---	---	---	---	---	---	---	---
Maximum Total Inertial Acceleration - GET	---	---	006:08:53.00	---	---	---	---	---	---	---	---
Maximum Total Inertial Acceleration (ft/sec^2)	---	---	54.40	---	---	---	---	---	---	---	---
Maximum Total Inertial Acceleration (g)	---	---	1.69	---	---	---	---	---	---	---	---
Maximum Earth-Fixed Velocity - GET	---	---	006:11:23.50	---	---	---	---	---	---	---	---
Maximum Earth-Fixed Velocity (ft/sec)	---	---	29,923.49	---	---	---	---	---	---	---	---

[24]Compiled from Saturn V launch vehicle flight evaluation reports, Apollo/Saturn V postflight trajectory reports, and mission reports. Segments do not add to totals due to rounding in the Saturn reports.

[25]GET is expressed as hours:minutes:seconds (hhh:mm:ss) for the S-IVB second and third burns.

Earth Orbit Data[26]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Earth Orbit Insertion											
Insertion - GET (sec)	626.76	694.98	674.66	713.76	709.33	703.91	759.83	710.56	704.67	716.21	712.65
Altitude (ft)	748,439	627,819	626,777	627,869	626,909	626,360	628,710	626,364	566,387	567,371	559,348
Surface Range (n mi)	1,121.743	1,430.363	1,335.515	1,469.790	1,460.697	1,438.608	1,572.300	1,444.989	1,445.652	1,469.052	1,456.314
Earth Fixed Velocity (ft/sec)	24,208.5	24,242.9	24,246.39	24,244.3	24,243.9	24,242.3	24,242.1	24,221.6	24,242.4	24,286.1	24,230.9
Space-Fixed Velocity (ft/sec)	25,553.2	25,567.06	25,569.78	25,567.88	25,567.9	25,565.9	25,566.1	25,565.8	25,602.6	25,605.0	25,603.9
Geocentric Latitude (deg N)	31.4091	32.4741	32.4599	32.5303	32.5027	31.5128	32.5249	31.0806	29.2052	32.5262	24.5384
Geodetic Latitude (deg N)	31.58	32.6487	32.629	32.700	32.672	32.6823	32.6945	31.2460	29.3650	32.6963	24.6805
Longitude (deg E)	-61.2293	-53.2923	-55.1658	-52.5260	-52.6941	-53.1311	-50.4902	-52.9826	-53.0807	-52.5300	-53.8107
Space-Fixed Flight Path Angle (deg)	0.005	0.0006	-0.0058	-0.0049	0.012	-0.014	0.005	-0.003	0.015	0.001	0.003
Space-Fixed Heading Angle (deg E of N)	86.32	88.532	87.412	89.933	88.848	88.580	90.148	91.656	95.531	88.932	105.021
Apogee (n mi)	152.34	99.99	100.74	100.32	100.4	100.1	100.3	100.1	91.5	91.3	90.3
Perigee (n mi)	123.03	99.57	99.68	99.71	98.9	97.8	99.3	98.9	89.6	90.0	90.0
Period (mins)	89.55	88.19	88.20	88.20	88.18	88.16	88.19	88.18	87.84	87.85	87.83
Inclination (deg)	31.608	32.509	32.552	32.546	32.521	32.540	32.547	31.120	29.679	32.542	28.526
Descending Node (deg)		42.415	45.538	123.132	123.088	123.126	123.084	117.455	109.314	123.123	86.978
Eccentricity	0.0045	0.00006	0.000149	0.000086	0.00021	0.00032	0.0001	0.0002	0.0003	0.0002	0.0000
Earth Orbit - Revolutions	163.0	1.5	151.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.0
Earth Orbit Duration	259:42:59.24	002:44:30.53	240:32:55.54	002:27:26.82	002:38:23.70	002:41:30.03	002:28:27.32	002:22:42.68	002:44:18.94	002:27:32.21	003:06:44.99

[26]Compiled from Saturn V launch vehicle flight evaluation reports, Apollo/Saturn V postflight trajectory reports and mission reports.

Saturn Stage Earth Impact[27]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
S-IB Impact											
GET (sec)	560.2	---	---	---	---	---	---	---	---	---	---
Surface Range (n mi)	265.002	---	---	---	---	---	---	---	---	---	---
Geodetic Latitude (deg N)	29.7605	---	---	---	---	---	---	---	---	---	---
Longitude (deg E)	-75.7183	---	---	---	---	---	---	---	---	---	---
S-IC Impact											
GET (sec)	---	540.410	536.436	539.12	543.7	554.5	546.9	546.2	560.389	547.136	551.708
Surface Range (n mi)	---	353.462	346.635	348.800	357.1	365.200	355.300	351.700	368.800	351.600	356.6
Geodetic Latitude (deg N)	---	30.2040	30.1830	30.188	30.212	30.273	30.177	29.835	29.4200	30.207	28.219
Longitude (deg E)	---	-74.1090	-74.238	-74.207	-74.038	-73.895	-74.0650	-74.0420	-73.6530	-74.147	-73.8780
S-II Impact											
GET (sec)	---	1,145.106	1,205.346	1,217.89	1,213.7	1,221.6	1,258.1	1,246.3	1,143.912	1,202.390	1,146.947
Surface Range (n mi)	---	2,245.913	2,413.198	2,389.290	2,371.8	2,404.4	2,452.600	2,462.100	2,261.3	2,312.000	2292.800
Geodetic Latitude (deg N)	---	31.8338	31.4618	31.522	31.535	31.465	31.320	29.049	26.975	31.726	20.056
Longitude (deg E)	---	-37.2774	-34.0408	-34.512	-34.844	-34.214	-33.2890	-33.567	-37.924	-35.990	-39.6040
S-IVB Earth Impact											
GET	162:27:15	---	---	---	---	---	---	---	---	---	---
KSC Date	18-Oct-68	---	---	---	---	---	---	---	---	---	---
GMT Date	18-Oct-68	---	---	---	---	---	---	---	---	---	---
KSC Time	05:30 AM	---	---	---	---	---	---	---	---	---	---
Time Zone	EDT	---	---	---	---	---	---	---	---	---	---
GMT Time	09:30 GMT	---	---	---	---	---	---	---	---	---	---
Latitude (deg N)	-8.90	---	---	---	---	---	---	---	---	---	---
Longitude (deg E)	081.6	---	---	---	---	---	---	---	---	---	---

[27]Theoretical impacts compiled from Saturn V launch vehicle flight evaluation reports, and Apollo/Saturn V postflight trajectory reports. Impact date is same as launch date except for S-IVB stage, as indicated.

Launch Vehicle Propellant Usage[28]

	Apollo 7	Apollo 7	Apollo 7	Apollo 7	Apollo 8	Apollo 8	Apollo 8	Apollo 8	Apollo 9	Apollo 9	Apollo 9	Apollo 9	Apollo 10	Apollo 10	Apollo 10	Apollo 10
	Burn Start	**Burn End**	**Change**	**Burn Rate Lb/Sec**	**Burn Start**	**Burn End**	**Change**	**Burn Rate Lb/Sec**	**Burn Start**	**Burn End**	**Change**	**Burn Rate Lb/Sec**	**Burn Start**	**Burn End**	**Change**	**Burn Rate Lb/Sec**
S-IB Burn (sec)	-2.988	144.32	147.31	---	---	---	---	---	---	---	---	---	---	---	---	---
Oxidizer (LOX), lb	631,300	3,231	628,069	4,263.6	---	---	---	---	---	---	---	---	---	---	---	---
Fuel (RP-1), lb	276,900	4,728	272,172	1,847.6	---	---	---	---	---	---	---	---	---	---	---	---
Total, lb	908,200	7,959	900,241	6,111.3	---	---	---	---	---	---	---	---	---	---	---	---
S-IC Burn (sec)	---	---	---	---	-6.585	153.82	160.41	---	-6.3	162.76	169.06	---	-6.4	161.63	168.03	---
Oxidizer (LOX), lb	---	---	---	---	3,128,034	46,065	3,081,969	19,213.7	3,301,203	45,230	3,255,973	19,259.3	3,302,827	40,592	3,262,235	19,414.6
Fuel (RP-1)	---	---	---	---	1,357,634	26,622	1,331,012	8,297.8	1,431,678	42,390	1,389,288	8,217.7	1,423,254	28,537	1,394,717	8,300.4
Total, lb	---	---	---	---	4,485,668	72,687	4,412,981	27,511.5	4,732,881	87,620	4,645,261	27,477.0	4,726,081	69,129	4,656,952	27,715.0
S-II Burn (sec)	---	---	---	---	156.19	524.04	367.85	---	165.16	536.22	371.06	---	164.05	552.64	388.59	388.59
Oxidizer (LOX), lb	---	---	---	---	793,795	5,169	788,626	2,143.9	821,504	3,230	818,274	2,205.2	823,325	3,536	819,789	2,109.7
Fuel (LH_2), lb	---	---	---	---	154,907	4,514	150,393	408.8	158,663	3,381	155,282	418.5	158,541	4,622	153,919	396.1
Total, lb	---	---	---	---	948,702	9,683	939,019	2,552.7	980,167	6,611	973,556	2,623.7	981,866	8,158	973,708	2,505.7
S-IVB 1st Burn (sec)	146.97	616.76	469.79		528.29	684.98	156.69	---	540.82	664.66	123.84	---	556.81	703.76	146.95	---
Oxidizer (LOX), lb	193,330	1,671	191,659	408.0	192,840	132,220	60,620	386.9	189,686	133,421	56,265	454.3	192,089	133,883	58,206	396.1
Fuel (LH_2), lb	39,909	2,502	37,407	79.6	43,395	30,678	12,717	81.2	43,709	32,999	10,710	86.5	43,388	31,564	11,824	80.5
Total, lb	233,239	4,173	229,066	487.6	236,235	162,898	73,337	468.0	233,395	166,420	66,975	540.8	235,477	165,447	70,030	476.6
S-IVB 2nd Burn (sec)	---	---	---	---	10,237.79	10,555.51	317.72	---	17,155.54	17,217.60	62.06	---	9,207.52	9,550.58	343.06	343.06
Oxidizer (LOX), lb	---	---	---	---	131,975	8,064	123,911	390.0	132,988	109,298	23,690	381.7	133,471	5,274	128,197	373.7
Fuel (LH_2), lb	---	---	---	---	28,358	2,759	25,599	80.6	29,369	24,476	4,893	78.8	29,116	2,177	26,939	78.5
Total, lb	---	---	---	---	160,333	10,823	149,510	470.6	162,357	133,774	28,583	460.6	162,587	7,451	155,136	452.2
S-IVB 3rd Burn (sec)	---	---	---	---	---	---	---	---	22,039.26	22,281.32	242.06	---	---	---	---	---
Oxidizer (LOX), lb	---	---	---	---	---	---	---	---	108,927	34,051	74,876	309.3	---	---	---	---
Fuel (LH_2), lb	---	---	---	---	---	---	---	---	23,520	8,951	14,569	60.2	---	---	---	---
Total, lb	---	---	---	---	---	---	---	---	132,447	43,002	89,445	369.5	---	---	---	---
Oxidizer-Fuel Ratio																
S-IB Stage	2.280	---	2.308	---	---	---	---	---	---	---	---	---	---	---	---	---
S-IC Stage	---	---	---	---	2.304	---	2.316	---	2.306	---	2.344	---	2.321	---	2.339	---
S-II Stage	---	---	---	---	5.124	---	5.244	---	5.178	---	5.270	---	5.193	---	5.326	---
S-IVB Stage 1st burn	4.844	---	5.124	---	4.444	---	4.767	---	4.340	---	5.254	---	4.427	---	4.923	---
S-IVB Stage 2nd burn	---	---	---	---	4.654	---	4.840	---	4.528	---	4.842	---	4.584	---	4.759	---
S-IVB Stage 3rd burn	---	---	---	---	---	---	---	---	4.631	---	5.139	---	---	---	---	---

[28]All times are referenced to Range Zero; all other values represent actual usage, in pounds mass. Sources are the Saturn V launch vehicle flight evaluation reports and *Results of the Fifth Saturn IB Vehicle Test Flight (Apollo 7).*

Launch Vehicle Propellant Usage[29]

	Apollo 11	Apollo 11	Apollo 11	Apollo 11	Apollo 12	Apollo 12	Apollo 12	Apollo 12	Apollo 13	Apollo 13	Apollo 13	Apollo 13	Apollo 14	Apollo 14	Apollo 14	Apollo 14
	Burn Start	Burn End	Change	Burn Rate Lb/Sec	Burn Start	Burn End	Change	Burn Rate Lb/Sec	Burn Start	Burn End	Change	Burn Rate Lb/Sec	Burn Start	Burn End	Change	Burn Rate Lb/Sec
S-IC Burn (sec)	-6.4	161.63	168.03	---	-6.5	161.74	168.24	---	-6.7	163.60	170.30	---	-6.5	164.10	170.60	---
Oxidizer (LOX), lb	3,305,786	39,772	3,266,014	19,437.1	3,310,199	42,093	3,268,106	19,425.3	3,304,734	38,921	3,265,813	19,176.8	3,312,769	42,570	3,270,199	19,168.8
Fuel (RP-1)	1,424,889	30,763	1,394,126	8,296.9	1,424,287	36,309	1,387,978	8,250.0	1,431,384	27,573	1,403,811	8,243.2	1,428,561	32,312	1,396,249	8,184.3
Total, lb	4,730,675	70,535	4,660,140	27,734.0	4,734,486	78,402	4,656,084	27,675.2	4,736,118	66,494	4,669,624	27,420.0	4,741,330	74,882	4,666,448	27,353.2
S-II Burn (sec)	164.00	548.22	384.22	---	163.20	552.34	389.14	---	166.00	592.64	426.64	---	166.50	559.05	392.55	---
Oxidizer (LOX), lb	819,050	3,536	815,514	2,122.5	825,406	3,536	821,870	2,112.0	836,741	3,533	833,208	1,953.0	837,484	2,949	834,535	2,125.9
Fuel (LH_2), lb	158,116	10,818	147,298	383.4	157,986	4,610	153,376	394.1	159,931	4,532	155,399	364.2	159,232	3,232	156,000	397.4
Total, lb	977,166	14,354	962,812	2,505.9	983,392	8,146	975,246	2,506.2	996,672	8,065	988,607	2,317.2	996,716	6,181	990,535	2,523.3
S-IVB 1st Burn (sec)	552.20	699.33	147.13	---	556.60	693.91	137.31	---	596.90	749.83	152.93	---	563.40	700.56	137.16	---
Oxidizer (LOX), lb	192,497	135,144	57,353	389.8	190,587	135,909	54,678	398.2	191,890	132,768	59,122	386.6	190,473	136,815	53,658	391.2
Fuel (LH_2), lb	43,608	31,736	11,872	80.7	43,663	32,346	11,317	82.4	43,657	31,455	12,202	79.8	43,546	32,605	10,941	79.8
Total, lb	236,105	166,880	69,225	470.5	234,250	168,255	65,995	480.6	235,547	164,223	71,324	466.4	234,019	169,420	64,599	471.0
S-IVB 2nd Burn (sec)	9,856.20	10,203.03	346.83	---	10,042.80	10,383.94	341.14	---	9,346.30	9,697.15	350.85	---	8,912.40	9,263.24	350.84	---
Oxidizer (LOX), lb	134,817	5,350	129,467	373.3	135,617	4,659	130,958	383.9	132,525	3,832	128,693	366.8	136,551	5,812	130,739	372.6
Fuel (LH_2), lb	29,324	2,112	27,212	78.5	29,804	2,109	27,695	81.2	29,367	1,963	27,404	78.1	30,428	2,672	27,756	79.1
Total, lb	164,141	7,462	156,679	451.7	165,421	6,768	158,653	465.1	161,892	5,795	156,097	444.9	166,979	8,484	158,495	451.8
Oxidizer-Fuel Ratio																
S-IB Stage	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-IC Stage	2.320	---	2.343	---	2.324	---	2.355	---	2.309	---	2.326	---	2.319	---	2.342	---
S-II Stage	5.180	---	5.536	---	5.225	---	5.359	---	5.232	---	5.362	---	5.260	---	5.350	---
S-IVB Stage 1st burn	4.414	---	4.831	---	4.365	---	4.831	---	4.395	---	4.845	---	4.374	---	4.904	---
S-IVB Stage 2nd burn	4.597	---	4.758	---	4.550	---	4.729	---	4.513	---	4.696	---	4.488	---	4.710	---
S-IVB Stage 3rd burn	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

[29] All times are referenced to Range Zero; all other values represent actual usage, in pounds mass. Sources are the Saturn V launch vehicle flight evaluation reports.

Launch Vehicle Propellant Usage[30]

	Apollo 15	Apollo 15	Apollo 15	Apollo 15	Apollo 16	Apollo 16	Apollo 16	Apollo 16	Apollo 17	Apollo 17	Apollo 17	Apollo 17	Program Totals	Program Totals	Program Totals	Program Totals
	Burn Start	**Burn End**	**Change**	**Burn Rate Lb/Sec**	**Burn Start**	**Burn End**	**Change**	**Burn Rate Lb/Sec**	**Burn Start**	**Burn End**	**Change**	**Burn Rate Lb/Sec**	**Burn Start**	**Burn End**	**Change**	**Burn Rate Lb/Sec**
S-IC Burn (sec)	-6.5	159.56	166.06	---	-6.7	161.78	168.48	---	-6.9	161.20	168.10	---	---	---	1,677.31	---
Oxidizer (LOX), lb	3,312,030	31,135	3,280,895	19,757.3	3,311,226	34,028	3,277,198	19,451.6	3,314,388	36,479	3,277,909	19,499.8	32,903,196	396,885	32,506,311	19,380.1
Fuel (RP-1)	1,410,798	27,142	1,383,656	8,332.3	1,439,894	31,601	1,408,293	8,358.8	1,431,921	26,305	1,405,616	8,361.8	14,204,300	309,554	13,894,746	8,284.0
Total, lb	4,722,828	58,277	4,664,551	28,089.6	4,751,120	65,629	4,685,491	27,810.4	4,746,309	62,784	4,683,525	27,861.5	47,107,496	706,439	46,401,057	27,664.1
S-II Burn (sec)	163.00	549.06	386.06	---	165.20	559.54	394.34	---	164.60	559.66	395.06	---	---	---	3,895.51	---
Oxidizer (LOX), lb	837,991	3,109	834,882	2,162.6	846,157	3,141	843,016	2,137.8	844,094	3,137	840,957	2,128.7	8,285,547	34,876	8,250,671	2,118.0
Fuel (LH_2), lb	158,966	4,022	154,944	401.3	160,551	2,884	157,667	399.8	160,451	3,024	157,427	398.5	1,587,344	45,639	1,541,705	395.8
Total, lb	996,957	7,131	989,826	2,563.9	1,006,708	6,025	1,000,683	2,537.6	1,004,545	6,161	998,384	2,527.2	9,872,891	80,515	9,792,376	2,513.8
S-IVB 1st Burn (sec)	553.20	694.67	141.47	---	563.60	706.21	142.61	---	563.80	702.65	138.85	---	---	---	1,424.94	---
Oxidizer (LOX), lb	195,788	140,293	55,495	392.3	195,372	138,937	56,435	395.7	195,636	140,047	55,589	400.4	1,926,858	1,359,437	567,421	398.2
Fuel (LH_2), lb	43,674	32,416	11,258	79.6	43,727	32,081	11,646	81.7	43,752	32,685	11,067	79.7	436,119	320,565	115,554	81.1
Total, lb	239,462	172,709	66,753	471.9	239,099	171,018	68,081	477.4	239,388	172,732	66,656	480.1	2,362,977	1,680,002	682,975	479.3
S-IVB 2nd Burn (sec)	10,202.90	10,553.61	350.71	---	9,216.50	9,558.42	341.92	---	11,556.60	11,907.64	351.04	---	---	---	3,156.17	---
Oxidizer (LOX), lb	139,665	4,273	135,392	386.1	138,532	3,869	134,663	393.8	139,879	4,219	135,660	386.5	1,356,020	154,650	1,201,370	380.6
Fuel (LH_2), lb	29,799	1,722	28,077	80.1	29,968	2,190	27,778	81.2	30,050	2,212	27,838	79.3	295,583	44,392	251,191	79.6
Total, lb	169,464	5,995	163,469	466.1	168,500	6,059	162,441	475.1	169,929	6,431	163,498	465.8	1,651,603	199,042	1,452,561	460.2
Oxidizer-Fuel Ratio																
S-IB Stage	---	---	---	---	---	---	---	---	---	---	---	---	2.280	---	2.308	---
S-IC Stage	2.348	---	2.371	---	2.300	---	2.327	---	2.315	---	2.332	---	2.316	---	2.339	---
S-II Stage	5.272	---	5.388	---	5.270	---	5.347	---	5.261	---	5.342	---	5.220	---	5.352	---
S-IVB Stage 1st burn	4.483	---	4.929	---	4.468	---	4.846	---	4.471	---	5.023	---	4.418	---	4.910	---
S-IVB Stage 2nd burn	4.687	---	4.822	---	4.623	---	4.848	---	4.655	---	4.873	---	4.588	---	4.783	---
S-IVB Stage 3rd burn	---	---	---	---	---	---	---	---	---	---	---	---	4.631	---	5.139	---

[30] All times are referenced to Range Zero; all other values represent actual usage, in pounds mass. Sources are the Saturn V launch vehicle flight evaluation reports.

Translunar Injection[31]

	Apollo 8	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
GET	002:56:05.51	002:39:20.58	002:50:13.03	002:53:13.94	002:41:47.15	002:34:33.24	002:56:03.61	002:39:28.42	003:18:37.64
KSC Date	21-Dec-68	18-May-69	16-Jul-69	14-Nov-69	11-Apr-70	31-Jan-71	26-Jul-71	16-Apr-72	07-Dec-72
GMT Date	21-Dec-68	18-May-69	16-Jul-69	14-Nov-69	11-Apr-70	31-Jan-71	26-Jul-71	16-Apr-72	07-Dec-72
KSC Time	10:47:05 AM	03:28:20 PM	12:22:13 PM	02:15:13 PM	04:54:47 PM	06:37:35 PM	12:30:03 PM	03:33:28 PM	03:51:37 AM
Time Zone	EST	EDT	EDT	EST	EST	EST	EDT	EST	EST
GMT Time	15:47:05	19:28:20	16:22:13	19:15:13	21:54:47	23:37:35	16:30:03	20:33:28	08:51:37
Altitude (ft)	1,137,577	1,093,217	1,097,229	1,209,284	1,108,555	1,090,930	1,055,296	1,040,493	1,029,299
Altitude (n mi)	187.221	179.920	180.581	199.023	182.445	179.544	173.679	171.243	169.401
Earth Fixed Velocity (ft/sec)	34,140.1	34,217.2	34,195.6	34,020.5	34,195.3	34,151.5	34,202.2	34,236.6	34,168.3
Space-Fixed Velocity (ft/sec)	35,505.41	35,562.96	35,545.6	35,389.8	35,538.4	35,511.6	35,579.1	35,566.1	35,555.3
Geocentric Latitude (deg N)	21.3460	-13.5435	9.9204	16.0791	-3.8635	-19.4388	24.8341	-11.9117	4.6824
Geodetic Latitude (deg N)	21.477	-13.627	9.983	16.176	-3.8602	-19.554	24.9700	-11.9881	4.7100
Longitude (deg E)	-143.9242	159.9201	-164.8373	-154.2798	167.2074	141.7312	-142.1295	162.4820	-53.1190
Flight Path Angle (deg)[32]	7.897	7.379	7.367	8.584	7.635	7.480	7.430	7.461	7.379
Heading Angle (deg E of N)	67.494	61.065	60.073	63.902	59.318	65.583	73.173	59.524	118.110
Inclination (deg)	30.636	31.698	31.383	30.555	31.817	30.834	29.696	32.511	28.466
Descending Node (deg)	38.983	123.515	121.847	120.388	122.997	117.394	108.439	122.463	86.042
Eccentricity	0.97553	0.97834	0.97696	0.96966	0.9772	0.9722	0.9760	0.9741	0.9722
C3 (ft^2/sec^2)	-15,918,930	-14,084,265	-14,979,133	-19,745,586	-14,814,090	-18,096,135	-15,643,934	-16,881,439	-18,152,226

[31] Compiled from Saturn V launch vehicle flight evaluation reports and mission reports.

[32] Flight path angle and heading angle are 'space-fixed' for these measurements.

S-IVB Solar Trajectory[33]

	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12
S-IVB Closest Approach To Moon					
GET	069:58:55.2	---	078:51:03.6	078:42	085:48
KSC Date	24-Dec-68	---	21-May-69	19-Jul-69	18-Nov-69
GMT Date	24-Dec-68	---	21-May-69	19-Jul-69	18-Nov-69
KSC Time	05:49:55 AM	---	07:40 PM	04:14 PM	01:10 AM
KSC Time Zone	EST	---	EDT	EDT	EST
GMT Time	10:49:55	---	23:40	20:14	06:10
Lunar Radius (n mi)	1,620	---	2,619	2,763	4,020
Altitude Above Lunar Surface (n mi)	681	---	1,680	1,825	3,082
Velocity Increase Due To Lunar Gravity (n mi/sec)	0.79	---	0.459	0.367	0.296
S-IVB Solar Orbit Conditions					
Semi-Major Axis (n mi)	77,130,000	74,848,893	77,740,000	77,260,000	---
Eccentricity	---	0.07256	---	---	---
Aphelion (n mi)	79,770,000	80,280,052	82,160,000	82,000,000	---
Perihelion (n mi)	74,490,000	69,417,732	73,330,000	72,520,000	---
Inclination (deg)	23.47	24,390	23.46	0.3836	---
Period (days)	340.8	325.8	344.88	342	---

[33]Compiled from Saturn V launch vehicle flight evaluation reports.

S-IVB Lunar Impact[34]

	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
S-IVB Lunar Impact					
GET	077:56:39.7	082:37:52.17	079:24:41.55	075:08:04.0	086:59:40.99
KSC Date	14-Apr-70	04-Feb-71	29-Jul-71	19-Apr-72	10-Dec-72
GMT Date	15-Apr-70	04-Feb-71	29-Jul-71	19-Apr-72	10-Dec-72
KSC Time	08:09:39 PM	02:40:54 AM	04:58:41 PM	04:02:04 PM	03:42:40 PM
Time Zone	EST	EST	EDT	EST	EST
GMT Time	01:09:39	07:40:54	20:58:41	21:02:04	20:32:40
Weight (lbm)	29,599	30,836	30,880	30,805	30,712
Velocity (ft/sec)	8,461	8,343	8,455	8,711	8,346
Energy (ergs)	4.63E-17	4.52E-17	4.61E-17		
Angle From Vertical (deg)	13.2	21.8	27.83	16.6	35.0
Heading Angle (deg N to W)	100.6	75.7	83.46	104.7	83
S-IVB Lunar Impact -Tumble Rate (deg/sec)	12	1	1	---	---
Selenographic Latitude (deg N)	-2.75	-8.09	-1.51	1.3	-4.21
Selenographic Longitude (deg E)	-27.86	-26.02	-11.81	-23.8	-12.31
Crater Diameter (calculated) (ft)	134.8	133.9	134.8		
Crater Diameter (measured) (ft)	135.0	129.6	---		
Distance To Target (n mi)	35.4	159	83	173	84
Distance To Seismic Stations (n mi)					
Apollo 12	73	93	192	71	183
Apollo 14	---	---	99	131	85
Apollo 15	---	---	---	593	557
Apollo 16	---	---	---	---	459
Azimuth To Seismic Stations (deg)					
Apollo 12	274	207	083	355	096
Apollo 14	---	---	069	308	096
Apollo 15	---	---	---	231	209
Apollo 16	---	---	---	---	278

[34]Compiled from Saturn V launch vehicle flight evaluation reports, preliminary science reports, and mission reports.

LM Lunar Landing[35]

	Apollo 10[36]	Apollo 11	Apollo 12	Apollo 13[37]	Apollo 14	Apollo 15	Apollo 16	Apollo 17
LM Lunar Landing Conditions								
PDI Burn Duration (sec)	---	756.39	717.0	---	764.61	739.2	734	721
Hover Time Remaining (sec)	---	45	103	---	68	103	102	117
Landing Site	Sea of Tranquillity	Sea of Tranquillity	Ocean of Storms	Fra Mauro	Fra Mauro	Hadley-Apennine	Plain of Descartes	Taurus-Littrow
Targeted Latitude (deg N)	0.7333°	0.6833°	2.9833°	-3.6167°	-3.6719°	26.0816°	-9.0002°	20.1639°
Targeted Longitude (deg E)	23.6500°	23.7167°	-23.4000°	-17.5500°	17.4627	3.6583°	15.5164°	30.7495°
Actual Landing Latitude (deg N)	---	0.6875°	-3.1975°	---	-3.6733°	26.1008°	-8.9914°	20.1653°
Actual Landing Longitude (deg E)	---	23.4333°	-23.3856°	---	-17.4653°	3.6528°	15.5144°	30.7658°
GET	---	102:45:39.9	110:32:36.2	---	108:15:11.40	104:42:31.1	104:29:35	110:21:58
KSC Date	---	20-Jul-69	19-Nov-69	---	05-Feb-71	30-Jul-71	20-Apr-72	11-Dec-72
GMT Date	---	20-Jul-69	19-Nov-69	---	05-Feb-71	30-Jul-71	21-Apr-72	11-Dec-72
KSC Time	---	04:17:39 PM	01:54:36 AM	---	04:18:13 AM	06:16:29 PM	09:23:35 PM	02:54:58 PM
Time Zone	---	EDT	EST	---	EST	EDT	EST	EST
GMT Time	---	20:17:39	06:54:36	---	09:18:13	22:16:29	02:23:35	19:54:58
Sun Angle (deg)	11.0	10.8	5.1	18.5	10.3	12.2	11.9	13.0
LM Surface Angle (deg)	---	4.5° tilt east; yaw 13° south	3° pitch up, 3.8° roll left	---	1° pitch down; 6.9° roll right; 1.4° yaw left	6.9° pitch up; 8.6° roll left resulting in tilt of 11° from horizontal	0° roll, 2.5° pitch up, slight yaw south	4 to 5° pitch up, 0° roll, near 0° yaw
LM Distance To Target (ft)		22,500 ft W of landing ellipse center	535 ft NW of Surveyor III	---	55 ft N; 165 ft E	1,800 ft NW	668 ft N; 197 ft W	656 ft
Distance To Seismic Stations (n mi)								
Apollo 12		---	---	---	98	641	641	
Apollo 14		---	98	---	---	591	544	
Apollo 15		---	641	---	591	---	604	
Apollo 16		---	641	---	544	604	---	
Azimuth To Seismic Stations (deg)								
Apollo 12		---	---	---	96	40	100	
Apollo 14		---	276	---	---	33	101	
Apollo 15		---	226	---	218	---	160	
Apollo 16		---	276	---	277	342	---	

[35]Compiled from mission reports and summary science reports.

[36]Although not planned as a lunar landing mission, Apollo 10 flew over the area to be targeted by the first lunar landing mission.

[37]Data is for intended landing site; mission aborted.

LM Descent Stage Propellant Status[38]

Weight (lbm)	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Loaded									
Fuel	6,977	7,009.5	6,975	7,079	7,083.6	7,072.8	7,537.6	7,530.4	7,521.7
Oxidizer	11,063	11,209.2	11,209	11,350	11,350.9	11,344.4	12,023.9	12,028.9	12,042.5
Total	18,040	18,218.7	18,184	18,429	18,434.5	18,417.2	19,561.5	19,559.3	19,564.2
Consumed									
Fuel	4,127	295.0	6,724	6,658	3,225.5	6,812.8	7,058.3	7,105.4	7,041.3
Oxidizer	6,524	470.0	10,690	10,596	5,117.4	10,810.4	11,315.0	11,221.9	11,207.6
Total	10,651	765.0	17,414	17,254	8,342.9	17,623.2	18,373.3	18,327.3	18,248.9
Remaining at Cutoff									
Fuel	---	---	251	421	---	260.0	479	425	480.0
Oxidizer	---	---	519	754	---	534.0	709	807	835.0
Total	---	---	770	1,175	---	794.0	1,188	1,232	1,315.0
Usable at Cutoff									
Fuel	---	---	216	386	---	228.0	433	396	455.0
Oxidizer	---	---	458	693	---	400.0	622	732	770.0
Total	---	---	674	1,079	---	628.0	1,055	1,128	1,225.0
Remaining at Cutoff (No Landing)									
Fuel	2,850	6,714.5	---	---	3,858.1	---	---	---	---
Oxidizer	4,539	10,739.2	---	---	6,233.5	---	---	---	---
Total	7,389	17,453.7	---	---	10,091.6	---	---	---	---

[38]Compiled from mission reports.

LM Ascent Stage Propellant Status[39]

Weight (lbm)	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Loaded								
Fuel	1,626	981	2,020	2,012	2,007.0	2,011.4	2,017.8	2,026.9
Oxidizer	2,524	1,650	3,218	3,224	3,218.2	3,225.6	3,224.7	3,234.8
Total	4,150	2,631	5,238	5,236	5,225.2	5,237.0	5,242.5	5,261.7
Transferred from RCS								
Fuel	---	---	---	---	---	---	16.0	---
Oxidizer	---	---	---	---	---	---	44.0	---
Total	---	---	---	---	---	---	60.0	---
Consumed by RCS								
Fuel	22	13.9	23	31	---	---	---	---
Oxidizer	44	28.0	46	62	---	---	---	---
Total	66	41.9	69	93	---	---	---	---
Consumed by APS Prior to Jettison								
Fuel	31	67	1,833	1,831	---	---	---	---
Oxidizer	59	108	2,934	2,943	---	---	---	---
Total	90	175	4,767	4,774	---	---	---	---
Remaining at Jettison								
Fuel	---	---	164	150	128.0	118.0	164.0	108.9
Oxidizer	---	---	238	219	204.2	173.0	257.7	175.6
Total	---	---	402	369	332.2	291.0	421.7	284.5
Consumed at Fuel Depletion								
Fuel	---	13	---	---	---	---	---	---
Oxidizer	---	106	---	---	---	---	---	---
Total	---	119	---	---	---	---	---	---
Consumed at Oxidizer Depletion								
Fuel	68	---	---	---	---	---	---	---
Oxidizer	0	---	---	---	---	---	---	---
Total	68	---	---	---	---	---	---	---
Total Consumed								
Fuel	1,558	887	1,856	1,862	1,879.0	1,893.4	1,869.8	1,918.0
Oxidizer	2,524	1,408	2,980	3,005	3,014.0	3,052.6	3,011.0	3,059.2
Total	4,082	2,295	4,836	4,867	4,893.0	4,946.0	4,880.8	4,977.2

[39]Compiled from mission reports.

LM Ascent and Ascent Stage Lunar Impact[40]

	Apollo 11	Apollo 12	Apollo 14	Apollo 15	Apollo 16[41]	Apollo 17
LM Ascent						
GET	124:22:00.79	142:03:47.78	141:45:40	171:37:23.2	175:31:47.9	185:21:37
KSC Date	21-Jul-69	20-Nov-69	06-Feb-71	02-Aug-71	23-Apr-72	14-Dec-72
GMT Date	21-Jul-69	20-Nov-69	06-Feb-71	02-Aug-71	24-Apr-72	14-Dec-72
KSC Time	01:54:00 PM	09:25:47 AM	01:48:42 PM	01:11:23 PM	08:25:47 PM	05:54:37 PM
KSC Time Zone	EDT	EST	EST	EDT	EST	EST
GMT Time	17:54:00	14:25:47	18:48:42	17:11:23	01:25:47	22:54:37
LM Ascent Stage Lunar Impact						
GET	---	149:55:16.4	147:42:23.4	181:29:35.8	---	193:17:21
KSC Date	---	20-Nov-69	06-Feb-71	02-Aug-71	---	15-Dec-72
GMT Date	---	20-Nov-69	07-Feb-71	03-Aug-71	---	15-Dec-72
KSC Time	---	05:17:16 PM	07:45:25 PM	11:03:35	---	01:50:21 AM
Time Zone	---	EST	EST	EDT	---	EST
GMT Time	---	22:17:16	00:45:25	03:03:35	---	06:50:21
Selenocentric Latitude (deg N)	---	-3.94000	-3.42000	26.35583	---	19.96611
Selenocentric Longitude (deg E)	---	-21.20000	-19.67000	0.25000	---	30.48972
Selenocentric Latitude	---	3° 56' 24" S	3° 25' 12" S	26° 21' 21" N	---	19° 57' 58" N
Selenocentric Longitude	---	21° 12' 00" W	19° 40' 01" W	0° 15' 00" E	---	30° 29' 23" E
Velocity (ft/sec)	---	5,512	5,512	5,577	---	5,479
Mass (lbm)	---	5,254	5,077	5,258	---	4,982
LM Ascent Stage Lunar Impact Energy (ergs)	---	3.36E-16	3.25E-16	3.43E-16	---	3.15E-16
Angle From Horizontal (deg)	---	-3.7	-3.6	-3.2	---	
Heading Angle (deg)	---	305.85	282	284	---	283
Crater Diameter (calculated) (n mi)	---	9.8	9.7	9.9	---	[Not found]
Crater Diameter (measured) (n mi)	---	---	---	---	---	[Not found]
Distance To Target (n mi)	---	35	7	12	---	0.7
Distance to LM Descent Stage Landing Site (n mi)	---	41.0	36	50	---	4.7
Distance to Apollo 17 Landing Site (n mi)	---	---	---	---	---	4.7
Distance to Seismic Stations (n mi)						
Apollo 12	---	39	62	610	---	945
Apollo 14	---	---	36	566	---	863
Apollo 15	---	---	---	50	---	416
Apollo 16	---	---	---	---	---	532
Azimuth to Seismic Stations (deg)						
Apollo 12	---	112	096	036	---	064
Apollo 14	---	---	276	029	---	061
Apollo 15	---	---	---	276	---	098
Apollo 16	---	---	---	---	---	027

[40]Compiled from Saturn V launch vehicle flight evaluation report and mission report for each flight.

[41]Deorbit maneuver was not possible and LM ascent stage remained in lunar orbit for about one year. No impact information is available.

Extravehicular Activity[42]

		Apollo 9	Apollo 11	Apollo 12	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Earth Orbit EVA	1st EVA Participant	Scott	---	---	---	---	---	---
	1st EVA Duration	01:01	---	---	---	---	---	---
	2nd EVA Participant	Schweickart	---	---	---	---	---	---
	2nd EVA Duration	01:07:00	---	---	---	---	---	---
	2nd EVA Duration Outside LM	00:47:01	---	---	---	---	---	---
LM Stand-Up EVA	Participant					Scott		
	Duration					00:33:07		
First Surface EVA	Duration	---	02:31:40	03:56:03	04:47:50	06:32:42	07:11:02	07:11:53
	Total Distance Traveled (n mi)	---	0.5	0.5	0.5	5.6	2.3	1.8
	LRV Ride Time	---	---	---	---	01:02	00:43	00:33
	LRV Park Time	---	---	---	---	01:14	03:39	---
	Total LRV Time	---	---	---	---	02:16	04:22	---
	Samples Collected (lbm)[43]	---	47.51	36.82	45.19	31.97	65.92	31.53
Second Surface EVA	Duration	---	---	03:49:15	04:34:41	07:12:14	07:23:09	07:36:56
	Total Distance Traveled (n mi)	---	---	0.7	1.6	6.7	6.1	11.0
	LRV Ride Time	---	---	---	---	01:23	01:31	02:25
	LRV Park Time	---	---	---	---	02:34	03:56	---
	Total LRV Time	---	---	---	---	03:57	05:27	---
	Samples Collected (lbm)	---	---	38.80	49.16	76.94	63.93	75.18
Third Surface EVA	Duration	---	---	---	---	04:49:50	05:40:03	07:15:08
	Total Distance Traveled (n mi)	---	---	---	---	2.8	6.2	6.5
	LRV Ride Time,	---	---	---	---	00:35	01:12	01:31
	LRV Park Time	---	---	---	---	01:22	02:26	---
	Total LRV Time	---	---	---	---	01:57	03:38	---
	Samples Collected (lbm)	---	---	---	---	60.19	78.04	136.69
Total Lunar Surface EVA	Total Duration	---	02:31:40	07:45:18	09:22:31	18:34:46	20:14:14	22:03:57
	Total Distance Traveled (n mi)	---	0.5	1.2	2.2	15.1	14.5	19.3
	Total Samples Collected (lbm)	---	47.51	75.73	93.21	170.44	211.00	243.65
	Total LRV Ride Time	---	---	---	---	3:00	03:26	04:29
	Total LRV Park Time	---	---	---	---	05:10	10:01	---
	Total LRV Time	---	---	---	---	08:10	13:27	---
	Maximum Distance Traveled From LM (ft)	---	200[44]	1,350[45]	4,770[46]	16,470	15,092[47]	25,029
Transearth EVA	Participant	---	---	---	---	Worden	Mattingly	Evans
	Duration	---	---	---	---	00:39:07	01:23:42	01:05:44

[42]Compiled from mission reports. Durations represent time from cabin depressurization to cabin pressurization.

[43]Returned sample weights provided by Lunar Sample Curator, NASA Johnson Space Center.

[44]*Apollo 11 Preliminary Science Report* (SP-214), p. 44.

[45]*Apollo 12 Preliminary Science Report*, p. 26 (measured from map).

[46]*Skylab: A Chronology* (SP-4011), pps. 420-421 for Apollo 14, Apollo 15 and Apollo 17.

[47]Measured from map in *Apollo 16 Preliminary Science Report* (SP-315).

Lunar Surface Experiments Package Arrays and Status[48]

Experiment	Principal Investigator	Apollo 11	Apollo 12	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Array		EASEP	ALSEP A	ALSEP C	ALSEP A-2	ALSEP D	ALSEP E
Design Life (days)		14	365	365	365	365	730
Date Commanded Off			Sep. 30, 1977	Failed Jan. 1976	Sep. 30, 1977	Sep. 30, 1977	Sep. 30, 1977
Passive Seismic Experiment	Gary Latham, University of Texas	X	X	X	X	X	
Laser-Ranging Retroreflector	J. E. Faller, Wesleyan University	100 corner		100 corner	300 corner		
Lunar Surface Magnetometer	Palmer Dyal, Ames Research Center Charles Sonett, University of Arizona		X	X	X		
Solar Wind Spectrometer (Exposure)	Conway W. Snyder, Jet Propulsion Laboratory	1 hr 17 min[49]	18 hr 42 min	21 hr 0 min	41 hr 8 min	45 hr 5 min	---
Suprathermal Ion Detector Experiment	John Freeman, Rice University		X	X	X		
Heat Flow Experiment	Mark Langseth, Lamont-Doherty Geological Observatory, Columbia University				X	X	X
Charged-Particle Lunar Environment Experiment	D. Reasoner, Rice University			X			
Cold-Cathode Gage Experiment	Francis Johnson, University of Texas		X	X	X		
Active Seismic Experiment	Robert Kovach, Stanford University			X		X	
Lunar Seismic Profiling Experiment	Robert Kovach, Stanford University						X
Lunar Surface Gravimeter	Joseph Weber, University of Maryland						X
Lunar Mass Spectrometer	John H. Hoffman, University of Texas						X
Lunar Ejecta Meteoroid Experiment	Otto Berg, Goddard Space Flight Center						X
Dust Detector	James Bates, Manned Spacecraft Center	X	X	X	X		

[48] *Apollo Lunar Surface Experiments Package (ALSEP): Five Years of Lunar Science and Still Going Strong*, Bendix Aerospace.

[49] JSC-09423, p. 3-54.

Lunar Surface Experiments[50]

Designation	Experiment	Apollo 11	Apollo 12	Apollo 14	Apollo 15	Apollo 16	Apollo 17
M-515	Lunar Dust Detector		X	X	X		
S-031	Passive Seismic Experiment	X	X	X	X		
S-033	Active Seismic Experiment			X			
S-034	Lunar Surface Magnetometer		X		X		
S-035	Solar Wind Spectrometer		X		X		
S-036	Suprathermal Ion Detector		X	X	X		
S-037	Heat Flow Experiment				X	X	X
S-038	Charged Particle Lunar Environment			X			
S-058	Cold Cathode Ion Gauge		X	X	X		
S-059	Lunar Field Geology	X	X	X	X	X	X
S-078	Laser Ranging Retroreflector	X		X	X		
S-080	Solar Wind Composition	X	X	X	X	X	
S-151	Cosmic-Ray Detection (helmets)	X					
S-152	Cosmic-Ray Detector (sheets)						
S-184	Lunar Surface Close-up (photography)		X			X	
S-198	Portable Magnetometer			X		X	
S-199	Lunar Gravity Traverse			X	X		X
S-200	Soil Mechanics			X	X	X	X
S-201	Far-Ultraviolet Camera/Spectroscope					X	
S-202	Lunar Ejecta and Meteorites						X
S-203	Lunar Seismic Profiling						X
S-204	Surface Electrical Properties						X
S-205	Lunar Atmospheric Composition						X
S-207	Lunar Surface Gravimeter						X
S-229	Lunar Neutron Probe						X
---	Lunar sample Analysis	X	X	X	X	X	X
---	Surveyor III Analysis		X				
---	Long-term Lunar Surface Exposure						X

[50] *Project Apollo:* NASA Facts.

Lunar Surface Experiments[51]

Central Station

The heart of the experiment package, provided the radio frequency link to Earth for telemetering data, command/control, and power distribution to the experiments.

Early Apollo Scientific Experiment Package (EASEP)

Flown on Apollo 11 only, this experiment package was powered by solar energy and contained an abbreviated set of experiments. It continued to return data for 71 days.

Active Seismic Experiments

Used an astronaut-activated thumper device and mortar firing explosive charges to generate seismic signals. This experiment used geophone seismic listening devices to determine lunar structure to depths of about 1,000 feet.

Lunar Seismic Profiling Experiment

Flown on Apollo 17 only, this experiment was an advanced version of the Active Seismic Experiment. It used four geophones to detect seismic signals generated by eight explosive charges weighing from about 1/10 to 6.5 pounds. The charges were deployed at distances up to 2 nautical miles from the Lunar Module and were detonated by timers after the Lunar Module departed. Lunar structure to depths of 1.5 nautical miles was measured. Used in a listening mode, the experiment continued to provide data on moon/thermal quakes and meteoroid impacts beyond its planned lifetime

Lunar Mass Spectrometer

Used a magnetic deflection mass spectrometer to identify lunar atmospheric components and their relative abundance.

Heat Flow Experiment

Probes containing temperature sensors were implanted in holes to depths of 8 feet to measure the near-surface temperature gradient and thermal conductivity from which heat flow from the lunar interior could be determined.

Solar Wind Spectrometer

Measured interaction between the Moon and the solar wind by sensing flow-direction and energies of both electrons and positive ions. Results showed that solar wind plasma measurements on the lunar surface are indistinguishable from simultaneous plasma measurements made by nearby satellites

Suprathermal Ion Detector

Provided information on the energy and mass spectra of positive ions near the lunar surface. Evidence of prompt ionization and acceleration of gases generated on the Moon was found in the return data.

Charged Particle Lunar Environment

Measured the fluxes of charged particles, both electrons and ions, having energies from 50 to 50,000 electron volts. The instrument measured plasma particles originating in the Sun and low-energy particle flux in the magnetic tail of the Earth.

Laser Ranging Retroreflector

The retroreflector bounced laser pulses back to Earth ground stations to provide data for precise measurements of the Earth-Moon distance to determine Earth wobble about its axis, continental drift, lunar librations, etc. Arrays of 100 retroreflecting corners were flown on Apollos 11 and 14, and an array of 300 corners was flown on Apollo 15.

Lunar Surface Magnetometer

Measured the intrinsic remnant lunar magnetic field and the magnetic response of the Moon to large-scale solar and terrestrial magnetic fields. The electrical conductivity of the lunar interior was also determined from measurements of the Moon's response to magnetic field step-transients. Three boom-mounted sensors measured mutually-orthogonal components of the field

Lunar Ejecta and Meteorites Experiment

Three separate detectors which measured energy, speed, and direction of dust particles. Oriented east, west, and up. The dust particles measured were meteorites, secondary ejecta from meteorites, and, possibly, lunar surface particles levitated and accelerated by lunar surface phenomena.

Cold Cathode Ion Gauge

A separate experiment combined in an integrated package with the Suprathermal Ion Detector. It determined the density of neutral gas particles in the lunar atmosphere.

Passive Seismic Experiment

Detected moon-quakes and meteoroid impacts to enable scientists to determine the Moon's internal composition.

Radioisotope Thermoelectric Generator

Supplied about 70 watts of electrical power for continuous day-night operation.

Lunar Surface Gravimeter

Measured and sensed changes in the vertical component of lunar gravity, using a spring mass suspension. It also provided data on the lunar tides.

[51] *Apollo Lunar Surface Experiments Package (ALSEP): Five Years of Lunar Science and Still Going Strong*, Bendix Aerospace.

Lunar Orbit Experiments[52]

Designation	Experiment	Apollo 8	Apollo 11	Apollo 12	Apollo 14	Apollo 15	Apollo 16	Apollo 17
S-151	Cosmic Ray Detector (Helmets)	X						
S-158	Multispectral Photography			X			X	
S-160	Gamma-Ray Spectrometer					X	X	X
S-161	X-Ray Fluorescence					X	X	
S-162	Alpha-Particle Spectrometer					X	X	
S-164	S-Band Transponder (CSM/LM)				X	X	X	X
S-164	S-Band Transponder (Subsatellite)					X	X	
S-165	Mass Spectrometer					X	X	
S-169	Far-Ultraviolet Spectrometer							X
S-170	Bistatic Radar				X	X	X	
S-171	Infrared Scanning Radiometer							X
S-173[53]	Particle Shadows/boundary Layer					X	X	
S-174	Magnetometer					X	X	
S-176	Command Module Window Meteoroid				X	X	X	X
S-177	Ultraviolet Photography, Earth and Moon					X	X	
S-178	Gegenschein from Lunar Orbit				X	X		
S-209	Lunar Sounder							X
---	Candidate Exploration Sites							
---	CM Orbital Science Photography				X			
---	CM Photographic Tasks					X	X	X
---	Dim Light Photography				X			
---	Lunar Mission Photography From CM	X		X	X			
---	Selenodetic Reference Point Update			X	X			
---	SM Orbital Photographic Tasks[54]					X	X	X
---	Transearth Lunar Photography				X			
---	Visual Observations From Lunar Orbit					X	X	X

[52] *Project Apollo:* NASA Facts.

[53] Experiments S-173 and S-174 were Particles and Fields Subsatellite experiments.

[54] Included panoramic camera photography, mapping camera photography, and laser altimetry. Also supported geologic objectives.

Geology and Soil Mechanics Tools and Equipment[55]

Item	Apollo 11	Apollo 12	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Apollo Lunar Surface Hand Tools						
Hammer	1	1	1	1	1	1
Large Scoop	1	1	1	0	0	0
Adjustable Scoop	0	0	0	1	1	1
Extension Handle	1	1	1	1	2	2
Gnomon	1	1	1	1	1	1
Tongs	1	1	1	1	2	2
Adjustable Trenching Tool	0	0	1	0	0	0
Rake	0	0	0	1	1	1
Core Tubes	2	4	6	0	0	0
Core Tube Caps	2	1	0	0	0	0
Drive Tubes (Lower)	0	0	0	5	5	5
Drive Tubes (Upper)	0	0	0	4	4	4
Drive Tube Cape and Bracket Assembly	0	0	0	3	5	5
Drive Tube Tool Assembly	0	0	0	0	1	1
Spring Scale	1	1	0	0	0	0
Sample Scale	0	0	1	1	1	1
Tool Carrier	0	0	0	1	1	0
Sample Return Container	2	2	2	2	2	2
Bags and Special Containers						
Small Sample Bags	5	0	0	0	0	0
Documented Sample Bags (15-Bag Dispenser)	1	3	1	0	0	0
Documented Sample Bags (20-Bag Dispenser)	0	0	0	6	7	8
Documented Sample Bags (35-Bag Dispenser)	0	1	2	0	0	0
Round Documented Sample Bag	0	0	0	0	0	48
Protective Padded Sample Bag	0	0	0	0	2	0
Documented Sample Weigh Bag	2	4	4	0	0	0
Sample Collection Bag	0	0	0	2	2	2
Gas Analysis Sample Container	1	1	0	0	0	0
Core Sample Vacuum Container	0	1	3	3	1	1
Solar Wind Composition Bag	2	1	1	0	0	0
Magnetic Shield Sample Container	0	0	1	0	0	0
Extra Sample Collection Bags	0	0	0	4	6	6
Organic Control Sample	0	1	2	2	2	0
Lunar Surface Sampler (Beta Cloth)	0	0	0	0	1	0
Lunar Surface Sampler (Velvet)	0	0	0	0	1	0
Lunar Roving Vehicle Soil Sampler	0	0	0	0	0	1
Magnetic Sample Assembly	0	0	0	0	1	0
Tether Hook	1	1	1	0	0	0
Lunar Surface Drill	0	0	0	1	1	1
Core Stem With Bit	0	0	0	1	1	1
Core Stems Without Bit	0	0	0	5	5	5
Core Stem Cap and Retainer Assembly	0	0	0	2	2	2
Self-Recording Penetrometer	0	0	0	1	1	0

[55]JSC-09423, p. 3-27.

Lunar Subsatellites[56]

	Apollo 15	Apollo 16
Designations		
International	1971 063D	1972 031D
NORAD	05377	06009
Deploy Conditions		
GET	222:39:29.1	196:02:02
KSC Date	04-Aug-71	24-Apr-72
GMT Date	04-Aug-71	24-Apr-72
KSC Time	04:13:29 PM	04:56:09 PM
KSC Time Zone	EDT	EST
GMT Time	20:13:29	21:56:09
Weight (lbs)	78.5	90
Apogee (n mi)	76.3	66
Perigee (n mi)	55.1	52
Inclination (deg)	-28.7	-11
Period (min)	120	120
Flight Path Angle (deg)	-0.60	-0.41
Heading Angle (deg)	-41.78	-79.43
Weight (lbm)	79	93
Status	Selenocentric orbit, 1984	Impacted lunar surface
	Data for last telemetry	
GET (hh:mm)	[Unknown]	1,034:37
KSC Date	[Unknown]	29-May-72
GMT Date	July 30, 1971	29-May-72
KSC Time	[Unknown]	03:31 PM EDT
GMT Time	[Unknown]	20:31
Revolutions	[Unknown]	425
Lunar Impact Latitude (deg N)	[Unknown]	[Unknown]
Lunar Impact Longitude (deg E)	[Unknown]	110

[56]Compiled from *Apollo 15 Preliminary Science Report* (SP-289) and *Apollo 16 Preliminary Science Report* (SP-315) and mission reports.

Entry, Splashdown, and Recovery[57]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17[58]
Earth Entry											
Velocity (ft/sec)	25,846.4	36,221.1	25,894	36,314	36,194.4	36,116.618	36,210.6	36,170.2	36,096.4	36,196.1	36,090.3
Maximum Entry Velocity (ft/sec)	25,955	36,303	25,989	36,397	36,277						
Maximum g	3.33	6.84	3.35	6.78	6.56	6.57	5.56	6.76	6.23	7.19	6.49
Range (n mi)	1,594	1,292	1,835	1,295	1,497	1,250	1,250	1,234	1,184	1,190	1,190
Geodetic Latitude (deg N)	-29.92	20.83	33.52	-23.60	-3.19	-13.80	-28.23	-36.36	14.23	-19.87	0.71
Longitude (deg E)	92.62	-179.89	-99.05	174.39	171.96	173.52	173.44	165.80	-175.02	-162.13	-173.34
Flight Path Angle (deg E of N)	-2.0720	-6.50	-1.74	-6.54	-6.48	-6.48	-6.269	-6.370	-6.51	-6.55	-6.49
Heading Angle (deg)	87.47	121.57	99.26	71.89	50.18	98.16	77.21	70.84	52.06	21.08	156.53
Lift To Drag Ratio	---	0.300	---	0.305	0.300	0.309	0.291	0.280	0.290	0.286	0.290
Max. Heating Rate (BTU/ft^2/sec)	---	296	---	296	286	285	271	310	289	346	346
Total Heating Load (BTU/ft^2)	---	26,140	---	25,728	26,482	26,224	25,710	27,111	25,881	27,939	27,939
Duration (sec)	937.0	869.2	1,003.8	868.5	929.3	845.9	835.3	852.8	778.3	814.0	801.0
Avg. Radiation Skin Dose (Rads)[59]	0.16	0.16	0.20	0.48	0.18	0.58	0.24	1.14	0.30	0.51	0.55
Earth Splashdown											
GET	260:09:03	147:00:42.0	241:00:54	192:03:23	195:18:35	244:36:25	142:54:41	216:01:58.1	295:11:53.0	265:51:05	301:51:59
KSC Date	22-Oct-68	27-Dec-68	13-Mar-69	26-May-69	24-Jul-69	24-Nov-69	17-Apr-70	09-Feb-71	07-Aug-71	27-Apr-72	19-Dec-72
GMT Date	22-Oct-68	27-Dec-68	13-Mar-69	26-May-69	24-Jul-69	24-Nov-69	17-Apr-70	09-Feb-71	07-Aug-71	27-Apr-72	19-Dec-72
KSC Time	07:11:48 AM	10:51:42 AM	12:00:54 PM	12:52:23 AM	12:50:35 PM	03:58:25 PM	01:07:41 PM	04:05:00 PM	04:45:53 PM	02:45:05 PM	02:24:59 PM
Time Zone	EDT	EST	EST	EDT	EDT	EST	EST	EST	EDT	EST	EST
GMT Time	11:11:48	15:51:42	17:00:54	16:52:23	16:50:35	20:58:25	18:07:41	21:05:00	20:45:53	19:45:05	19:24:59
Splashdown Site	Atlantic Ocean	Pacific Ocean	Atlantic Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean
Latitude (deg N)	27.63	8.10	23.22	-15.07	13.30	-15.78	-21.63	-27.02	26.13	-0.70	-17.88
Longitude (deg E)	-64.15	-165.00	-67.98	-164.65	-169.15	-165.15	-165.37	-172.67	-158.13	-156.22	-166.11
CM Weight (lbm)	11,409	10,977	11,094	10,901	10,873	11,050	11,133	11,481.2	11,731	11,995	12,120
Distance To Target (n mi)	1.9	1.4	2.7	1.3	1.7	2.0	1.0	0.6	1.0	3.0	1.0
Distance To Recovery Ship (n mi)	7	2.6	3	2.9	13	3.91	3.5	3.8	5	2.7	3.5
Distance Traveled (n mi)	3,953,842	504,006	3,664,820	721,250	828,743	828,134	541,103	1,000,279	1,107,945	1,208,746	1,291,299
Maximum Distance Traveled From Earth (n mi)	244.2	203,752.37	275.0	215,548	210,391						

[57] Compiled from mission reports, USN Historical Office data, *Apollo Program Summary Report* (JSC-09423) and other sources.

[58] Some Apollo 17 entry phase data are preflight predictions because actual data were not obtained.

[59] *Space Physiology & Medicine*, SP-447.

Entry, Splashdown, and Recovery

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Splashdown Weather											
1st Level Cloud Type	Light rain showers	Scattered clouds	30%	10%			Broken	High Scattered	Scattered	Scattered	Scattered
1st Level Cloud Cover (ft)	600 (overcast)	2,000	2,000	2,000			2,000	2,000	2,000	2,000	3,000
2nd Level Cloud Type	---	Overcast	Broken	20%							
2nd Level Cloud Cover (ft)	---	9,000	9,000	7,000							
Visibility (n mi)	2	10	10	10		10	10	10	10	10	10
Wind Speed (ft/sec)	27	32	15	8	27						
Wind Speed (knots)	16	19	9	5	16	15	10	15	10	10	10
Wind Direction (deg from True N)	260	70	200	100		68				110	130
Air Temperature (F)	74		79								
Water Temperature (F)	81	82	76	85							
Wave Height (ft)	3	6	7	3	3	3, with 15 ft swells	4	4	3	4	2 to 3
Wave Direction (deg from True N)	260	110	340								
Spacecraft Recovery											
Flotation Attitude	Inverted	Inverted	Upright	Upright	Inverted	Inverted	Upright	Upright	Upright	Inverted	Upright
Minutes To Upright	12.0	6.0	0.0	0.0	7.6	4.5	0.0	0.0	0.0	4.5	0.0
Minutes To CM Pickup	111	148	132	96	188	108	88	124	94	99	123
Launch Site Pickup Time	09:03 AM	01:20 PM	02:13 PM	02:28 PM	03:58 PM	05:45 PM	02:36 PM	06:09 PM	06:20 PM	04:24 PM	04:28 PM
Time Zone	EST	EST	EST	EDT	EDT	EST	EST	EST	EDT	EST	EST
GMT Pickup Time	13:03	18:20	19:13	18:28	19:58	22:45	19:36	23:09	22:20	21:24	21:28
Crew Recovery											
Minutes To Crew Pickup	56	88	49	39	63	60	45	48	39	37	52
Launch Site Pickup Time	08:08 AM	12:20 PM	12:50 PM	01:31 PM	01:53 PM	04:57 PM	01:53 PM	04:53 PM	05:25 PM	03:33 PM	03:17 PM
Time Zone	EST	EST	EST	EDT	EDT	EST	EST	EST	EDT	EST	EST
GMT Pickup Time	12:08	17:20	17:50	17:31	17:53	21:57	18:53	21:53	21:25	20:22	20:17
Recovery Ship	Essex (CVS-9)	Yorktown (CVS-10)	Guadalcanal (LPH-7)	Princeton (LPH-5)	Hornet (CVS-12)	Hornet (CVS-12)	Iwo Jima (LPH-2)	New Orleans (LPH-11)	Okinawa (LPH-3)	Ticonderoga (CVS-14)	Ticonderoga (CVS-14)
Commanding Officer (Captain)	John A. Harkins	John G. Fifield	Roy M. Sudduth	Carl M. Cruise	Carl J. Seiberlich	Carl J. Seiberlich	Leland E. Kirkemo	Robert W. Carius	Andrew F. Huff	Frank T. Hamler	Frank T. Hamler
Recovery Forces[60]											
Navy Ships Deployed	9	12	6	8	5	5	4	5	4	4	3
Atlantic Ocean	4	6	3	4	3	3	2	3	2	1	1
Pacific Ocean	5	6	3	4	2	2	2	2	2	3	2
Aircraft Deployed	31	43	29	30	31	26	22	19	17	17	15
Navy	8	21	7	10	13	9	8	5	5	6	5
Air Force	23	22	22	20	18	17	14	14	12	11	10

[60] JSC-09423, p. 7-18.

Selected Mission Weights[61]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
CSM/LM at EOI	36,419	87,382	95,231	98,273	100,756.4	101,126.9	101,261.2	102,083.6	107,142	107,226	107,161
CSM/LM at Separation	---	---	---	94,063	96,566.6	---	---	---	---	---	---
CSM/LM at Transposition & Docking	---	---	91,055	94,243	96,767.5	97,119.8	97,219.4	98,037.2	103,105	103,175	103,167
CSM at Transposition & Docking	---	---	58,925	63,560	63,473.0	63,535.6	63,720.3	64,388.0	66,885	66,923	66,893
LM at Transposition & Docking	---	---	32,130	30,683	33,294.5	33,584.2	33,499.1	33,649.2	36,220	36,252	36,274
CSM/LM at 1st MCC Ignition	---	63,307	---	93,889	96,418.2	96,870.6	97,081.5	97,901.5	---	---	---
CSM/LM at 1st MCC Cutoff	---	---	---	93,413	96,204.2	96,401.2	96,851.1	---	---	---	---
CSM/LM Before Cryogenic Tank Anomaly	---	---	---	---	---	---	96,646.9	---	---	---	---
CSM/LM After Cryogenic Tank Anomaly	---	---	---	---	---	---	96,038.7	---	---	---	---
CSM/LM at 2nd MCC Ignition	---	62,845	---	---	---	---	95,959.9	97,104.1	---	---	---
CSM/LM at 2nd MCC Cutoff	---	---	---	---	---	---	95,647.1	---	---	---	---
CSM at TEI Ignition	---	45,931	---	37,254	36,965.7	34,130.6	95,424.0	34,554.4	35,899	38,697	36,394
CSM at TEI Cutoff	---	---	---	26,172	26,792.7	25,724.5	87,456.0	---	---	---	---
CSM at 3rd MCC Ignition	---	32,008	---	---	---	---	87,325.3	24,631.9	---	---	---
CSM at 3rd MCC Cutoff	---	---	---	---	---	---	87,263.3	---	---	---	---
CSM/LM at LOI Ignition	---	62,827	---	93,319	96,061.6	96,261.1	---	97,033.1	102,589	102,642	102,639
CSM/LM at LOI Cutoff	---	46,743	---	69,429	72,037.6	72,335.6	---	71,823.0	76,329	77,647	76,540
CSM/LM at Circularization Ignition	---	46,716	---	69,385	72,019.9	72,243.7	---	---	---	---	---
CSM/LM at Circularization Cutoff	---	---	---	68,455	70,905.9	71,028.4	---	---	---	---	---
CSM/LM at Descent Orbit Insertion	---	---	---	---	---	---	---	71,768.8	76,278	77,595	76,354
CSM/LM at Separation for Lunar Landing	---	---	---	68,238	70,760.3	70,897.3	---	70,162.3	74,460	76,590	74,762
CSM at Separation for Lunar Landing	---	---	---	37,072	37,076.8	36,911.8	---	36,036.4	37,742	39,847	37,991
LM at Separation for Lunar Landing	---	---	---	31,166	33,683.5	33,985.5	---	34,125.9	36,718	36,743	36,771
LM at Powered Descent Initiation	---	---	---	---	---	---	---	34,067.8	36,634	36,617	36,686
LM at Descent Orbit Insertion Ignition	---	---	---	31,137	33,669.6	33,971.8	---	---	---	---	---
LM at Descent Orbit Insertion Cutoff	---	---	---	30,903	33,401.6	33,719.3	---	---	---	---	---
LM at Lunar Landing	---	---	---	---	16,153.2	16,564.2	---	16,371.7	18,175	18,208	18,305
CSM at Plane Change	---	---	---	---	---	---	---	35,610.4	37,219	38,994	37,464
CSM at Circularization Ignition	---	---	---	---	---	---	---	35,996.3	37,716	39,595	37,960
LM at Phasing Ignition	---	---	---	30,824	---	---	---	---	---	---	---
LM at Phasing Cutoff	---	---	---	30,283	---	---	---	---	---	---	---
LM at Fuel Depletion	---	---	5,616	5,243	---	---	---	---	---	---	---
CSM/LM Ascent Stage at Docking	---	---	36,828	44,930	42,585.4	41,071.8	---	39,906.8	41,754	44,318	41,914
CSM at Docking	---	---	26,895	36,995	36,847.4	35,306.2	---	34,125.5	35,928	38,452	36,036
LM Ascent Stage at Lunar Liftoff	---	---	---	---	10,776.6	10,749.6	---	10,779.8	10,915	10,949	10,997
LM Ascent Stage at Orbit Insertion for Docking	---	---	---	8,077	5,928.6	5,965.6	---	5,917.8	5,985	6,001	6,042
LM Ascent Stage at Terminal Phase Initiation	---	---	---	---	---	---	---	5,880.1	5,965	5,972	5,970
LM Ascent Stage After Staging	---	---	---	8,273	---	---	---	---	---	---	---
LM Ascent Stage at Coelliptic Sequence Initiation	---	---	---	8,052	5,881.5	5,885.9	---	---	---	---	---
LM Ascent Stage at Docking	---	---	9,933	7,935	5,738.0	5,765.6	---	5,781.3	5,826	5,866	5,878
CSM at After Post-Docking Jettison	---	---	27,139	---	37,100.5	35,622.9	---	34,596.3	36,407	38,992	36,619
LM Ascent Stage After Post-Docking Jettison	---	---	---	7,663	5,462.5	5,436.5	---	5,307.6	5,325	5,306	5,277
CSM (CSM/LM) at Subsatellite Jettison	---	---	---	---	---	---	---	---	36,019	38,830	---
CSM at 4th MCC Ignition	---	---	---	---	---	---	87,132.1	---	---	---	---
CSM at 4th MCC Cutoff	---	---	---	---	---	---	87,101.5	---	---	---	---
CSM at Pre-Entry Separation	23,435	31,768	24,183	25,095	26,656.5	25,444.2	---	24,375.0	26,323	27,225	26,659
CSM/LM Before CSM/LM Separation	---	---	---	---	---	---	87,057.3	---	---	---	---
CM/LM After CSM/LM Separation	---	---	---	---	---	---	37,109.7	---	---	---	---
SM After Pre-Entry Separation	11,071	19,589	11,924	12,957	14,549.1	13,160.7	---	11,659.9	13,358	14,199	13,507
CM After Pre-Entry Separation	12,364	12,179	12,259	12,138	12,107.4	12,283.5	12,367.6	12,715.1	12,965	13,026	13,152
CM at Entry	12,356	12,171	12,257	12,137	12,095.5	12,275.5	12,361.4	12,703.5	12,953	13,015	13,140
CM at Drogue Deployment	11,936	11,712	11,839	11,639	11,603.7	11,785.7	11,869.4	---	---	---	---
CM at Main Parachute Deployment	11,855	11,631	11,758	11,558	11,318.9	11,496.1	11,579.8	12,130.8	12,381	12,442	12,567
CM at Landing	11,409	10,977	11,094	10,901	10,873.0	11,050.2	11,132.9	11,481.2	11,731	11,995	12,120

[61]Compiled from mission reports. Apollo 7 did not have a LM. Apollo 13 includes CSM and LM until separation before Earth entry.

Command Module Cabin Temperature History (°F)[62]

Mission	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Launch	70	65	65	75	70	70	70	70	70	70	70
Average	70	72	70	73	63	67	64	74	69	70	69
High	79	81	72	80	73	80	71	77	81	80	81
Low	64	61	65	64	55	58	58	60	59	57	61
Reentry	65	61	67	58	55	60	75	59	59	57	62

[62] *Biomedical Results of Apollo*, SP-368, p. 133. All temperatures are in Fahrenheit, measured at the inlet to the heat exchanger.

Accumulated Time in Space During Apollo Missions[63]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17	Flight Time (sec)	Flight Time (hh:mm:ss)
Mission Duration (hh:mm:ss)	260:09:03	147:00:42	241:00:54	192:03:23	195:18:35	244:36:25	142:54:41	216:01:58	295:11:53	265:51:05	301:51:59		
Mission Duration (sec)	936,543	529,242	867,654	691,403	703,115	880,585	514,481	777,718	1,062,713	957,065	1,086,719		
David Randolph Scott			867,654						1,062,713			1,930,367	536:12:47
Eugene Andrew Cernan				691,403							1,086,719	1,778,122	493:55:22
John Watts Young				691,403						957,065		1,648,468	457:54:28
Ronald Ellwin Evans											1,086,719	1,086,719	301:51:59
Harrison Hagan Schmitt											1,086,719	1,086,719	301:51:59
James Benson Irwin									1,062,713			1,062,713	295:11:53
Alfred Merrill Worden									1,062,713			1,062,713	295:11:53
James Arthur Lovell, Jr.		529,242					514,481					1,043,723	289:55:23
Charles Moss Duke, Jr.										957,065		957,065	265:51:05
Thomas Kenneth Mattingly, II										957,065		957,065	265:51:05
Ronnie Walter Cunningham	936,543											936,543	260:09:03
Donn Fulton Eisele	936,543											936,543	260:09:03
Walter Marty Schirra, Jr.	936,543											936,543	260:09:03
Alan LaVern Bean						880,585						880,585	244:36:25
Charles Conrad, Jr.						880,585						880,585	244:36:25
Richard Francis Gordon, Jr.						880,585						880,585	244:36:25
James Alton McDivitt			867,654									867,654	241:00:54
Russell Louis Schweickart			867,654									867,654	241:00:54
Edgar Dean Mitchell								777,718				777,718	216:01:58
Stuart Allen Roosa								777,718				777,718	216:01:58
Alan Bartlett Shepard, Jr.								777,718				777,718	216:01:58
Edwin Eugene Aldrin, Jr.					703,115							703,115	195:18:35
Neil Alden Armstrong					703,115							703,115	195:18:35
Michael Collins					703,115							703,115	195:18:35
Thomas Patten Stafford				691,403								691,403	192:03:23
William Alison Anders		529,242										529,242	147:00:42
Frank Frederick Borman, II		529,242										529,242	147:00:42
Fred Wallace Haise, Jr.							514,481					514,481	142:54:41
John Leonard Swigert, Jr.							514,481					514,481	142:54:41
Total Man-Seconds From Liftoff	**2,809,629**	**1,587,726**	**2,602,962**	**2,074,209**	**2,109,345**	**2,641,755**	**1,543,443**	**2,333,154**	**3,188,139**	**2,871,195**	**3,260,157**	**27,021,714**	
Total Time In Space (hh:mm:ss)	**780:27:09**	**441:02:06**	**723:02:42**	**576:10:09**	**585:55:45**	**733:49:15**	**428:44:03**	**648:05:54**	**885:35:39**	**797:33:15**	**905:35:57**	**7,506:01:54**	**7,506:01:54**

[63]Calculated.

Apollo Medical Kits[64]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Command Module Medical Kit											
Methylcellulose eye drops (0.25%)	2/1	2/2	2/0	2/0	2/0	2/0	2/0	2/0	1/0	2/0	1/0
Tetrahydrozoline HCl (Visine)	---	---	---	---	---	---	---	---	---	---	1/1
Compress - bandage	2/0	2/0	2/0	2/0	2/0	2/0	2/0	2/0	2/0	2/0	2/0
Band-Aids	12/2	12/0	12/0	12/0	12/0	12/0	12/0	12/0	12/0	12/0	12/0
Antibiotic ointment	1/1	1/0	1/0	1/0	1/0	2/0	2/0	2/0	2/0	2/1	2/1
Skin cream	1/0	1/1	1/1	1/0	1/0	1/0	1/0	1/0	1/0	1/1	1/0
Demerol injectors (90 mg)	3/0	3/0	3/0	3/0	3/0	3/0	3/0	3/0	3/0	---	---
Marezine injectors	3/0	3/0	3/0	3/0	3/0	3/0	3/0	3/0	3/0	---	---
Marezine tablets (50 mg)	24/3	24/1	24/4	12/0	---	---	---	---	---	---	---
Dexedrine tablets (5 mg)	12/1	12/0	12/0	12/0	12/0	12/0	12/1	12/0	12/0	12/0	12/0
Darvon compound capsules (60 mg)	12/2	18/0	18/0	18/0	18/0	18/0	12/1	18/0	18/0	18/0	18/0
Actifed tablets (60 mg)	24/24	60/0	60/12	60/2	60/0	60/18	60/0	60/0	60/0	60/0	60/1
Lomotil tablets	24/8	24/3	24/1	24/13	24/2	24/0	24/1	24/0	24/0	24/0	48/5
Nasal emollient	1/0	2/1	2/1	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0
Aspirin tablets (5 gr)	72/48	72/8	72/2	72/16	72/Unk	72/6	72/30	72/0	72/0	72/0	72/0
Tetracycline (250 mg)	24/02	24/0	24/0	15/0	---	---	---	---	60/0	60/0	60/0
Ampicillin	---	60/0	60/0	45/0	60/0	60/0	60/0	60/0	60/0	60/0	60/0
Seconal capsules (100 mg)	---	21/1	21/10	21/0	21/0	21/6	21/0	---	21/0	21/3	21/16
Seconal capsules (50 mg)	---	12/7	---	---	---	---	---	---	---	---	---
Nose drops (Afrin)	---	3/0	3/1	3/0	3/0	3/1	3/0	3/1	3/0	3/0	3/3
Benadryl (50 mg)	---	8/0	---	---	---	---	---	---	---	---	---
Tylenol (325 mg)	---	14/7	---	---	---	---	---	---	---	---	---
Bacitracin eye ointment	---	---	1/0	---	---	---	---	---	---	---	---
Scopolamine (0.3 mg) - Dexedrine (5 mg capsules)	---	---	---	---	12/6	12/0	12/2	12/0	12/0	12/0	12/1
Mylicon tablets	---	---	---	---	40/0	40/0	40/0	40/0	40/0	40/0	40/0
Opthaine	---	---	---	---	---	---	1/0	1/0	1/0	1/0	1/0
Multi-Vitamins	---	---	---	---	---	---	---	20/0	---	---	---
Auxiliary Medications											
Pronestyl	---	---	---	---	---	---	---	---	---	80/0	80/0
Lidocaine	---	---	---	---	---	---	---	---	---	12/0	12/0
Atropine	---	---	---	---	---	---	---	---	---	12/0	12/0
Demerol	---	---	---	---	---	---	---	---	---	6/0	6/0

[64] SP-368, P. 33.

Apollo Medical Kits[65]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Apollo Medical Accessories Kit											
Constant Wear Garment Harness Plug	---	---	---	---	----	---	---	---	3	3	3
ECG Sponge Packages	---	---	---	---	---	---	---	---	14	14	14
Electrode Bag	1	1	1	1	1	1	1	1	1	1	1
Electrode Attachment Assembly	12	12	12	12	20	20	20	20	100	100	100
Micropore Disc	12	12	12	12	20	20	20	20	50	50	50
Sternal Harness	1	1	1	1	3	3	3	3	3	3	3
Axillary Harness	1	1	1	1	1	1	1	1	1	1	1
Electrode Paste	1	1	1	1	1	1	1	1	1	1	1
Oral Thermometer	1	1	1	1	1	1	1	1	1	1	1
pH Paper	1	1	1	1	1	1	1	1	1	None	None
Urine Collection and Transfer Assembly Roll-On Cuffs	3	3	6	6	6	6	6	6	6	6	6
Lunar Module Medical Kit[66]											
Rucksack	---	---	---	---	---	1					
Stimulant Pill s (Dexedrine)	---	---	---	---	---	4					
Pain Pills (Darvon)	---	---	---	---	---	4					
Decongestant Pills (Actifed)	---	---	---	---	---	8					
Diarrhea Pills (Lomotil)	---	---	---	---	---	12					
Aspirin	---	---	---	---	---	12					
Band-Aids	---	---	---	---	---	6					
Compress Bandages	---	---	---	---	---	2					
Eye Drops (Methylcellulose)	---	---	---	---	---	1					
Antibiotic Ointment (Neosporin)	---	---	---	---	---	1					
Sleeping Pills (Seconal)	---	---	---	---	---	6					
Anesthetic Eye Drops	---	---	---	---	---	1					
Nose Drops (Afrin)	---	---	---	---	---	1					
Urine Collection and Transfer Assembly Roll-On Cuffs	---	---	---	---	---	6					
Pronestyl	---	---	---	---	---	12					
Injectable Drug Kit											
Injectable Drug Kit Rucksack	---	---	---	---	---	1					
Lidocaine (cardiac)	---	---	---	---	---	8					
Atropine (cardiac)	---	---	---	---	---	4					
Demerol (pain)	---	---	---	---	---	2					

[65]SP-368, P. 33.

[66]Typical quantities and items; there was no “standard” lunar module medical kit. The adequacy of the kits was reviewed after each mission and appropriate modifications were made for the next mission.

Crew Weight History (kg)[67]

Mission	Crewman	30 Days Before Launch	30-Day Average	Launch	Recovery
Apollo 7	Schirra	87.1	87.8	88.0	86.1
	Eisele	69.4	69.5	71.2	66.7
	Cunningham	69.4	70.7	70.8	67.8
Apollo 8	Borman	76.2	76.6	76.6	72.8
	Lovell	76.4	76.8	78.0	74.4
	Anders	66.0	66.4	64.4	62.6
Apollo 9	McDivitt	73.5	73.0	72.1	69.6
	Scott	82.8	82.0	80.7	78.2
	Schweickart	74.7	74.3	71.2	69.4
Apollo 10	Stafford	80.1	79.6	77.6	76.4
	Young	76.6	76.8	74.8	72.3
	Cernan	79.4	79.4	78.5	73.9
Apollo 11	Armstrong	78.0	78.4	78.0	74.4
	Collins	74.4	75.6	75.3	72.1
	Aldrin	77.6	78.1	75.7	75.3
Apollo 12	Conrad	66.2	66.6	67.7	65.8
	Gordon	71.0	70.7	70.4	67.1
	Bean	69.4	69.9	69.1	63.5
Apollo 13	Lovell	79.8	78.7	80.5	74.2
	Swigert	89.1	89.4	89.3	84.4
	Haise	71.0	70.8	70.8	67.8
Apollo 14	Shepard	78.0	78.4	76.2	76.6
	Roosa	74.2	75.3	74.8	69.4
	Mitchell	83.5	83.2	79.8	80.3
Apollo 15	Scott	80.5	81.1	80.2	78.9
	Worden	73.7	73.6	73.5	72.1
	Irwin	74.3	74.3	73.2	70.8
Apollo 16	Young	80.8	80.1	78.9	75.5
	Mattingly	63.2	62.6	61.5	58.5
	Duke	73.1	73.2	73.0	70.5
Apollo 17	Cernan	81.0	80.7	80.3	76.1
	Evans	78.2	77.3	75.7	74.6
	Schmitt	76.0	76.0	74.8	72.9

[67] *Biomedical Results of Apollo*, SP-368, pps. 76-77.

Inflight Medical Problems in Apollo Crews[68]

Symptom/Finding	Etiology	Cases
Barotitis	Barotrauma	1
Cardiac arrhythmia	Undetermined, possibly linked with potassium deficit	2
Dehydration	Reduced water intake during emergency	2
Dysbarism (bends) [69]	Undetermined	1
Excoriation, urethral meatus	Prolonged wearing of urine collection device	2
Eye irritation	Spacecraft atmosphere	4
	Fiberglass	1
Flatulence	Undetermined	3
Genitourinary infection with prostatic congestion	Pseudomonas aeruginosa	1
Head cold	Undetermined	3
Headache	Spacecraft environment	1
Nasal stuffiness	Zero gravity	2
Nausea, vomiting	Labyrinthine	1
	Undetermined (possibly virus-related)	1
Pharyngitis	Undetermined	1
Rash, facial, recurrent inguinal	Contact dermatitis	1
	Prolonged wearing of urine collection device	1
Respiratory irrigation	Fiberglass	1
Rhinitis	Oxygen, low relative humidity	2
Seborrhea	Activated by spacecraft environment	2
Shoulder strain	Lunar core drilling	1
Skin irrigation	Biosensor sites	11
	Fiberglass	2
	Undetermined	1
Stomach awareness	Labyrinthine	6
Stomatitis	Aphthous ulcers	1
Subungual hemorrhages	Glove fit	5
Urinary tract infection	Undetermined	1

[68] *Biomedical Results of Apollo*, SP-368.

[69] Also occurred during Gemini 10; later incidences were reported by the same crewman five years after his Apollo mission.

Postflight Medical Problems in Apollo Crews[70]

Diagnosis	Etiology	Cases
Barotitis media	Eustachian tube blockage	7
Folliculitis, right anterior chest	Bacterial	1
Gastroenteritis	Bacterial	1
Herpetic lesion, lip	Herpes virus	1
Influenza syndrome	Influenza B virus	1
	Undetermined	1
	Influenza A virus	1
Laceration of the forehead	Trauma	1
Rhinorrhea, mild	Fiberglass particle	1
Papular lesions, parasacral	Bacteria	1
Prostatitis	Undetermined	2
Pulpitis, tooth No. 7		1
Pustules, eyelids		1
Rhinitis	Viral	3
Acute maxillary sinusitis	Bacterial	1
Ligamentous strain, right shoulder		1
Urinary tract infection	Pseudomonas	1
Vestibular dysfunction, mild		1
Rhinitis and pharyngitis	Influenza B virus	1
Rhinitis and secondary bronchitis	Beta-streptococcus (not group A)	1
Contact dermatitis	Fiberglass	1
	Beta cloth	1
	Micropore tape	6
Subungual hemorrhages, finger nails	Trauma	3

[70] *Biomedical Results of Apollo*, SP-368.

NASA Photo #s For Crew Portraits and Mission Emblems

Event	NASA Photo #
Apollo 1 Mission Emblem	S66-36742
Portrait of Apollo 1 Prime Crew	S66-30236
Apollo 7 Mission Emblem	S68-26668
Portrait of Apollo 7 Prime Crew	S68-33744
Apollo 8 Mission Emblem	S68-51093
Portrait of Apollo 8 Prime Crew	S68-50265
Apollo 9 Mission Emblem	S69-19974
Portrait of Apollo 9 Prime Crew	S69-17590
Apollo 10 Mission Emblem	S69-31959
Portrait of Apollo 10 Prime Crew	S69-32616
Apollo 11 Mission Emblem	S69-34875
Portrait of Apollo 11 Prime Crew	S69-31739
Apollo 12 Mission Emblem	S69-52336
Portrait of Apollo 12 Prime Crew	S69-38852
Apollo 13 Mission Emblem	S69-60662
Portrait of Apollo 13 Original Prime Crew	S69-62224
Portrait of Apollo 13 Flight Crew	S70-36485
Apollo 14 Mission Emblem	S70-17851
Portrait of Apollo 14 Prime Crew	S70-55635
Apollo 15 Mission Emblem	S71-30463
Portrait of Apollo 15 Prime Crew	S71-37963
Apollo 16 Mission Emblem	S71-56246
Portrait of Apollo 16 Prime Crew	S72-16660
Apollo 17 Mission Emblem	S72-49079
Portrait of Apollo 17 Prime Crew	S72-50438

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