

Lunar Module

Dennis Brindell Fradin

Moon Lander Thomas J. Kelly, 2012-01-11 Chief engineer Thomas J. Kelly gives a firsthand account of designing, building, testing, and flying the Apollo lunar module. It was, he writes, “an aerospace engineer’s dream job of the century.” Kelly’s account begins with the imaginative process of sketching solutions to a host of technical challenges with an emphasis on safety, reliability, and maintainability. He catalogs numerous test failures, including propulsion-system leaks, ascent-engine instability, stress corrosion of the aluminum alloy parts, and battery problems, as well as their fixes under the ever-present constraints of budget and schedule. He also recaptures the exhilaration of hearing Apollo 11’s Neil Armstrong report that “The Eagle has landed,” and the pride of having inadvertently provided a vital “lifeboat” for the crew of the disabled Apollo 13.

Building Moonships Joshua Stoff, 2004 In 1961, after the United States had acquired a total of fifteen minutes of spaceflight experience, President John F. Kennedy announced his plans for landing a man on the moon by 1970. The space race had begun. In 1962, after a strenuous competition, the National Aeronautics and Space Administration (NASA) announced that the Grumman Aircraft Engineering Corporation of Bethpage, Long Island, had won the contract to build the lunar module—the spacecraft that would take Americans to the moon. This was the first, and the only, vehicle designed to take humans from one world to another. Although much has been written about the first men to set foot on the moon, those first hesitant steps would not have been possible without the efforts of the designers and technicians assigned to Project Apollo. *Building Moonships: The Grumman Lunar Module* tells the story of the people who built and tested the lunar modules that were deployed on missions as well as the modules that never saw the light of day. This is the first publication to chronicle the visual history of the design, construction, and launch of the lunar

module-one of the most historic machines in all of human history.

Chariots for Apollo Charles R. Pellegrino, Joshua Stoff, 1999 The fascinating and true story of one of America's greatest scientific achievements: the race to put a man on the Moon and bring him home safely.

Apollo Experience Report Richard J. Gillen, 1972 A functional description of the environmental control subsystem is presented. Development, tests, checkout, and flight experiences of the subsystem are discussed; and the design fabrication, and operational difficulties associated with the various components and subassemblies are recorded. Detailed information is related concerning design changes made to, and problems encountered with, the various elements of the subsystem, such as the thermal control water sublimator, the carbon dioxide sensing and control units, and the water section. The problems associated with water sterilization, water/glycol formulation, and materials compatibility are discussed. The corrective actions taken are described with the expectation that this information may be of value for future subsystems. Although the main experiences described are problem oriented, the subsystem has generally performed satisfactorily in flight.

The Grumman Lunar Module Rita Muriel, 2021-05-19 The Apollo Lunar Module, or simply Lunar Module, originally designated the Lunar Excursion Module, was the lander spacecraft that was flown between lunar orbit and the Moon's surface during the U.S. Apollo program. Although much has been written about the first men to set foot on the moon, those first hesitant steps would not have been possible without the efforts of the designers and technicians assigned to Project Apollo. This book the story of the people who built and tested the lunar modules that were deployed on missions as well as the modules that never saw the light of day.

Apollo Experience Report Jesse A. Vernon, 1975 A review of the concept, operational

requirements, design, and development of the lunar module mission program is presented, followed by a review of component and subsystem performance during design-feasibility, design-verification, and qualification tests performed in the laboratory. The system was further proved on the unmanned Apollo 5 mission. Several anomalies were detected, and satisfactory solutions were found. These problems are defined and examined, and the corrective action taken is discussed. Suggestions are given for procedural changes to be used if future guidance and control systems of this type are to be developed.

To The Moon Jasmin Defalco, 2021-05-19 The Apollo Lunar Module, or simply Lunar Module, originally designated the Lunar Excursion Module, was the lander spacecraft that was flown between lunar orbit and the Moon's surface during the U.S. Apollo program. Although much has been written about the first men to set foot on the moon, those first hesitant steps would not have been possible without the efforts of the designers and technicians assigned to Project Apollo. This book the story of the people who built and tested the lunar modules that were deployed on missions as well as the modules that never saw the light of day.

Mission Report, Apollo 10 United States. National Aeronautics and Space Administration, 1969
Apollo and America's Moon Landing Program - Lunar Module Reference World
Spaceflight News Staff, 2000-05

Lem Lunar Excursion Module Familiarization Manual Grumman Aircraft Engineering Co., 2011-05 Designed by Grumman's brilliant Tom Kelly, the Apollo Lunar Excursion Module (or LEM for short) was a triumph of purpose-built engineering. In the six years 1962-1968 between drawing board and first flight, a myriad of challenges were overcome related to weight, reliability and safety. The final design, designated the Lunar Module or LM, boasted tiny windows instead of

large portholes, four legs instead of five and most famously had no seats instead relying on the astronauts' legs to cushion a lunar landing. Ten LMs made it into space including three flown in development and test missions, and six which landed on the Moon. A seventh famously saved the crew of Apollo 13 when that mission's Command Module suffered a catastrophic malfunction. Originally created for NASA by Grumman in 1964, this LEM Familiarization Manual provides an operational description of all subsystems and major components of the lunar lander. It includes sections about the LEM mission, spacecraft structure, operational subsystems, prelaunch operations, and ground support equipment.

Dynamic Simulation of Lunar Module Docking with Apollo Command Module in Lunar Orbit Howard G. Hatch, 1967

Apollo Spacecraft News Reference Robert Goodwin, 2011-06-15 Book & DVD. The Ultra Rare and Coveted Apollo News Reference Manuals. These books have become legendary amongst the space collecting fraternity and have been known to sell at auction for as much as \$6,000 for the pair. Each book comes with an accurate replica of the original 1960's cover and the pages are set out in the same sequence as the original. Hundreds of pages of in depth detail about the Apollo spacecraft in the exact words of the contractors who built them. Along with the companion Command Module book the chapters include: Crew Systems, Displays and Controls, Docking, Earth Landing, Electrical Power, Environmental Control, Launch Escape, Reaction Control, Service Propulsion, Stabilization & Control, Telecommunications, Guidance & Navigation, Space Suit, Automatic Checkout Equipment, Kennedy Space Center Operations, Training Equipment, Test & Reliability, Manufacturing, Launch Vehicles, Mission Description, Crew Personal Equipment, Propulsion, Electrical Power, Lighting, PLSS, LM Anatomy, Biographies and not least the exciting chapter on LM Derivatives. The what-ifs

of the Apollo program.

Chariots for Apollo Courtney G. Brooks, James M. Grimwood, Loyd S. Swenson, 2012-05-14 This illustrated history by a trio of experts is the definitive reference on the Apollo spacecraft and lunar modules. It traces the vehicles' design, development, and operation in space. More than 100 photographs and illustrations.

Lunar Module Lm 10 Thru Lm 14 Vehicle Familiarization Manual Grumman, NASA, 2013-01-01 Originally created for NASA in 1969 by prime contractor Grumman, this Lunar Module Vehicle Familiarization Manual was mandatory reading for Apollo astronauts, contractors and NASA support staff. This version of the manual describes the so-called ELM, or Extended Lunar Modules designed for the Jclass missions Apollo 15-17 and the never-flown Apollo 18 and 19. The ELM came about as part of NASA's efforts to enhance the scientific study of the Moon and its geology. To do that, longer surface stays would be needed. To make it possible, LM 10 to LM 14 received various modifications intended to increase their payloads, and allow them to return larger samples to Earth. Over forty major changes were planned, including enlarging the fuel and oxidizer tanks on both the ascent and descent stages, extension of the descent engine nozzle to improve its efficiency and allow it to deliver more power, and added capacity of oxygen and water. Some changes, such as adding solar cells and affiliated batteries to allow surface stays of up to 72 hours, proved too difficult given the program's schedule. In the end, the maximum duration of stays on the Moon would be limited to 54 hours. The extended LM weighed up to 36,500 pounds compared to 32,000 for earlier versions. The ELM's larger payload capacity enabled it to carry the 463 pound (mass) Lunar Roving Vehicle and other scientific equipment. The LRV greatly enhanced the astronauts' range and ability to retrieve samples. It's never been easy to find a copy of this text because copies were never made available to

the general public -- until now. This reprint features all the original text and diagrams. It's a wonderful reference for the space flight fan, docent or engineering buff or for anyone else who ever wondered, How'd they do that!

The Apollo Lunar Samples Anthony Young, 2017-03-22 This book focuses on the specific mission planning for lunar sample collection, the equipment used, and the analysis and findings concerning the samples at the Lunar Receiving Laboratory in Texas. Anthony Young documents the collection of Apollo samples for the first time for readers of all backgrounds, and includes interviews with many of those involved in planning and analyzing the samples. NASA contracted with the U.S. Geologic Survey to perform classroom and field training of the Apollo astronauts. NASA's Geology Group within the Manned Spacecraft Center in Houston, Texas, helped to establish the goals of sample collection, as well as the design of sample collection tools, bags, and storage containers. In this book, detailed descriptions are given on the design of the lunar sampling tools, the Modular Experiment Transporter used on Apollo 14, and the specific areas of the Lunar Rover vehicle used for the Apollo 15, 16, and 17 missions, which carried the sampling tools, bags, and other related equipment used in sample collection. The Lunar Receiving Laboratory, which was designed and built at the Manned Spacecraft Center in Texas for analysis and storage of the lunar samples returned from the Apollo lunar landing missions is also described in detail. There are also descriptions of astronaut mission training for sample collecting, with the focus on the specific portions of the mission EVAs devoted to this activity.

The First Lunar Landing Dennis Brindell Fradin, 2010 Students visit some of the most critical moments of United States history in this exciting new series. Each title brings the reader back in time to those defining moments and events, and provides a clear and concise description of what

happened, the historical background of the situation, and why America changed because of that event. Full-color photographs and illustrations enhance the text, along with relevant sidebars that highlight and expand the topics and ideas in the text. a timeline at the end of each title places the turning point in context for the reader and provides a quick review of the important events that helped to shape the America we know today.

Full-scale Dynamic Landing-impact Investigation of a Prototype Lunar Module Landing Gear
Ulysse J. Blanchard,1969

Lunar Landing and Site Selection Study James L. Lewis,Charles D. Wheelwright,1965

After LM John F. Connolly,2020

Apollo - America's Moon Landing Program National Aeronautics and Space Administration (NASA),World Spaceflight News (WSN),U. S. Government,2017-05-04 The primary objective of this paper is to present an analysis and a historical review of the Apollo Lunar Module landing dynamics from the standpoint of touchdown dynamic stability, landing system energy absorption performance, and evaluation of the first-order terms of lunar soil mechanical properties at the Apollo 11 landing site. The first-order terms of lunar surface mechanical properties consisted primarily of the surface bearing strength and sliding friction coefficient. The landing dynamic sequence started at first footpad contact. The flight dynamics data used to assess the Apollo 11 landing system performance and the lunar soil mechanical properties included the body axis pitch, roll, and yaw rate time histories as measured by the on-board guidance computer during the Apollo 11 Lunar Module touchdown maneuver, and the landing gear stroke data derived from post-landing photographs. The conclusions drawn from these studies were that the landing gear system performance was more than adequate from a stability and energy absorption standpoint for all Apollo lunar landings, and

the lunar soil parameters were well within the limits of the design assumptions for all Apollo landing sites. Chapter 1.0 - Introduction * Chapter 2.0 - Landing Dynamic Analysis * Chapter 3.0 - Drop Testing of Subscale and Full-scale Lunar Module Models * Chapter 4.0 - The Lunar Module * Chapter 5.0 - Critical Design Cases * Chapter 6.0 - Analysis of the Apollo 11 Lunar Module Landing Dynamics and Lunar Surface Mechanical Properties * Chapter 7.0 - The Apollo Lunar Module Landings * 7.1 Apollo 11 Lunar Landing * 7.1.1 Summary: Apollo 11 Lunar Module Landing * 7.2 Apollo 12 Lunar Landing * 7.2.1 Summary: Apollo 12 Lunar Module Landing * 7.3 Apollo 13 Lunar Landing (Aborted) * 7.4 Apollo 14 Lunar Landing * 7.4.1 Summary: Apollo 14 Lunar Module Landing * 7.5 Apollo 15 Lunar Landing * 7.5.1 Summary: Apollo 15 Lunar Module Landing * 7.6 Apollo 16 Lunar Landing * 7.6.1 Summary: Apollo 16 Lunar Module Landing * 7.7 Apollo 17 Lunar Landing * 7.7.1 Summary: Apollo 17 Lunar Module Landing * Chapter 8.0 - Author's Annotation - Apollo 16 and 17 Landings * Chapter 9.0 - Conclusions * Chapter 10.0 - References * Appendix A: Apollo 11 Lunar Module Touchdown Dynamics * Appendix B: Lunar Soil Mechanical Properties Model * Appendix C: Apollo 11 Lunar Module Mass Properties at Touchdown * Appendix D: Apollo 11 Lunar Module Landing Gear Load Stroke Characteristics * Appendix E: Apollo 11 Lunar Module Descent Engine Thrust Tail-off Characteristics

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