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DEVELOPMENT OF THE NASA/GRUMMAN LUNAR MODULE

Grumman Aircraft Engineering Corporation, Bethpage, New York, primarily known as a maker of fighter planes for the Navy, began research back in 1960 with a LM team which now comprises approximately 6000 scientists, engineers and technicians.

Two years of pioneer work on Apollo paid off in 1962 when the National Aeronautics and Space Administration (NASA) called for bids on developing a LM. A major criterion, NASA said, would be knowledge the companies had already acquired in the field. Grumman was able to present NASA with a mountain of data, evidence that it understood the two paramount problems -- weight and dependability.

In late 1962, Grumman won the contract that plunged it deep into the Apollo Moon-Landing Program -- the NASA/Grumman Lunar Module. The cost-incentive contract totals approximately $1.61 billion for development, manufacture, test and delivery of two mission simulators, 10 ground test articles (LTA's) and 15 flight articles (LM's).

M-1, an engineering mockup, was first displayed in Spring 1964. LTA-1 is being used at Grumman for testing LM electrical and electronics systems.

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The thermal-vacuum test article, LTA-8, was delivered to the NASA Manned Spacecraft Center September 17, 1967. It has completed a series of tests in the Space Simulation Laboratory under temperature and vacuum extremes simulating a typical moon mission.

Before the LM was committed to the lunar mission, its ability to meet the operational requirements of the mission was demonstrated to assure astronaut safety and mission success. The Flight Development Test Program (FDTP) provided this assurance by a series of developmental missions.

LTA-10R was aboard the November 9, 1967 flight of Apollo 4. It was instrumented to measure vibration, acoustics and structural integrity during launch. Data was telemetered to ground stations during the first 12 minutes of flight of the first Saturn V.

The first flight vehicle, LM-1, was shipped from Grumman's Bethpage facility to NASA Kennedy Space Center June 23, 1967. LM-1 was launched January 22, 1968 on Apollo 5 for its first unmanned test flight. During this mission the Lunar Module's ascent and descent propulsion systems, along with the reaction control system, were successfully test fired for the first time in space. As a result of the LM-1 flight, the second scheduled unmanned flight, LM-2, was deleted from the NASA flight program. LM-2 is undergoing ground tests at MSC.

Another LM Test Article, LTA-2R aboard Apollo 6, provided flight test data on the Saturn V launch load and environment criteria.

LTA-B, designed to simulate the weight and mass of a Lunar Module was launched aboard Apollo 8. LTA-B consisted of two concentric rings arranged to form a cylinder with four internal water ballast tanks.

LM-3, the first manned LM, was launched on Apollo 9 for an earth orbital flight on March 3, 1969. USAF Col. James McDivitt was Commander; USAF Col. David Scott, Command Module Pilot; Civilian Russell Schweickart, LM Pilot.

LM-4, the second manned flight of the spacecraft, was launched aboard Apollo 10 on May 18, 1969 for a flight to within 10 miles of the moon's surface. Its' crew, commanded by USAF Col. Thomas Stafford, included USN Cdr. John Young, Command Module Pilot; and USN Cdr. Eugene Cernan, LM Pilot.

LM-5 (Apollo 11) will make the first lunar landing. Mission plans include the deployment of scientific instruments, photography, and the retrieval of lunar surface materials for return to Earth. The descent stage of LM-5 was shipped to Kennedy Space Center on January 12, 1968 and the ascent stage on January 8, 1969. The crew of Apollo 11 is Civilian Neil Armstrong, Commander; USAF Lt. Col. Michael Collins, Command Module Pilot; and USAF Col. Edwin Aldrin, Jr., LM Pilot.

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