CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39, ALTITUDE CHAMBERS
(John F. Kennedy Space Center, Operations and Checkout Building)
First Street, between Avenue D and Avenue E
Cape Canaveral
Brevard County
Florida

HAER No. FL-8-11-E

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Southeast Region
Department of the Interior
Atlanta, GA 30303

RELEASED - Printed documents may be obsolete; validate prior to use.

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
ALTITUDE CHAMBERS, (John F. Kennedy Space Center, Operation & Checkout Building)
HAER No. FL-8-11-E

Location:	Within the Operations and Checkout Building High Bay First Street, between Avenue D and Avenue E Cape Canaveral Brevard County Florida U.S.G.S. 7.5. minute Cape Canaveral, Florida, quadrangle, Universal Transverse Mercator coordinates: 17.534600.3155100
Date of Installation:	1965
Designer/ Manufacturer:	Stokes Equipment Division of the Pennsalt Chemical Corporation (now Pennwalt Corporation), Philadelphia, Pennsylvania
Installer:	Pittsburgh Des Moines Steel Corporation; Elsbery Corporation; Fischer Electric Corporation
Present Owner:	National Aeronautics and Space Administration (NASA) Kennedy Space Center, FL 32899-0001
Present Use:	Test facility (Chamber R); inactive (Chamber L)
Significance:	The two Altitude Chambers sit within the High Bay of the Operations and Checkout (O&C) Building. The O&C Building is located in the Industrial Area of the John F. Kennedy Space Center (KSC). The O&C Building was listed in the National Register of Historic Places (NRHP) in 2000 in recognition of its exceptional importance at the national level in the context of the Apollo program, for which it was used to assemble and test the Apollo spacecraft before launching. It is significant at the national level under NRHP Criterion A in the area of space exploration, and under Criterion C in the areas of engineering and architecture. Because the structure has achieved significance within the past 50 years and is of exceptional importance in the areas of space exploration, engineering, and architecture, Criteria Consideration G applies. The two Altitude Chambers were installed in 1965. Each chamber has an overall height of 58’, an outer diameter of 34’, and a 28’ clear working area inside the chamber. The chambers, capable of reaching a test altitude

RELEASED - Printed documents may be obsolete; validate prior to use.

of 250,000' within one hour, were used to test the environmental and life support systems on the Apollo Command/Service Module combination and the Lunar Module. The tests consisted of unmanned and manned runs made by the prime and backup astronaut crews, and were critical to the success of the lunar missions. Thus, they were considered contributing components to the NRHP-listed O&C Building.

Report Prepared by: Patricia Slovinac, Architectural Historian
Archaeological Consultants, Inc.
8110 Blaikie Court, Suite A
Sarasota, Florida 34240

Date: December 2009

RELEASED - Printed documents may be obsolete; validate prior to use.

HISTORICAL INFORMATION

Beginning of the U.S. Space Program

On October 4, 1957, the Union of Soviet Socialist Republics (USSR) launched the first man-made Earth satellite, Sputnik 1; on November 3, 1957, the USSR placed Sputnik II, carrying a dog named Laika, into orbit. This sparked a wave of interest in space exploration among the American public, and less than two weeks after the launch of Sputnik II, Senator Lyndon B. Johnson called for, and chaired, an examination of the American space effort.[1] Meanwhile, President Dwight D. Eisenhower assigned responsibility for a United States (U.S.) Space Program to the Department of Defense (DoD). As a result, the Development Operations Division (DOD) of the Army Ballistic Missile Agency (ABMA), led by Dr. Wernher von Braun, immediately shifted their focus to the use of missiles to propel payloads, or even a man, into space.[2] The U.S. successfully entered the space race with the launch of the Army's scientific satellite Explorer I on January 31, 1958, using a modified Jupiter missile named Juno I .[3]

With the realization that the military's involvement in the space program could jeopardize the use of space for peaceful purposes, the U.S. Congress formed the Committee on Space and Astronautics on February 6, 1958, to frame legislation for a national space program.[4] On July 29, 1958, President Eisenhower signed the National Aeronautics and Space Act into law. Subsequently, as per this Act, the National Aeronautics and Space Administration (NASA) was officially activated on October 1, 1958, as a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned.[5]

Soon after the creation of NASA, U.S. Navy personnel and facilities associated with Project Vanguard and over 400 scientists from the Naval Research Laboratory were reassigned to NASA, as was the Army-affiliated Jet Propulsion Laboratory of the California Institute of

---

[1] Roger D. Launius. *NASA: A History of the U.S. Civil Space Program.* (Malabar, Fla.: Krieger Publishing Company, 2001), 29.

[2] Dr. Wernher von Braun was one of 115 German rocket engineers and scientists who were brought to the U.S. after World War II as part of Project Paperclip. They were part of the group at Germany's Peenemünde site, who were responsible for developing the V-1 "buzz bomb" and the V-2 ballistic missile. They were originally stationed at Fort Bliss, Texas, and tested the rockets at the White Sands Proving Ground in New Mexico. In October 1949, the group was transferred to the Redstone Arsenal in Huntsville, Alabama, where they became the Army Ballistic Missile Agency (ABMA). Andrew J. Dunar and Stephen P. Waring. *Power to Explore: A History of Marshall Space Flight Center 1960-1990*. (Washington, D.C.: NASA History Office, 1999), 8-22.

[3] Charles D. Benson and William B. Faherty. *Gateway to the Moon. Building the Kennedy Space Center Launch Complex*. (Gainesville: University Press of Florida, 2001), 1-2.

[4] James M. Grimwood. *Project Mercury: A Chronology*. (Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963).

[5] As part of NASA's establishment, its predecessor, the National Advisory Committee for Aeronautics (NACA), was deactivated and all of its personnel and facilities were transferred to NASA. Grimwood; Launius.

RELEASED - Printed documents may be obsolete; validate prior to use.

Technology.[6] Additionally, in support of NASA's future space programs, several facilities at Cape Canaveral Air Force Station (CCAFS), including various offices and hangars, as well as Launch Complex (LC)-5, -6, -26, and -34, were assigned to the agency. T. Keith Glennan, then director of NASA, also attempted to acquire ABMA's DOD, but the U.S. Army resisted and offered the compromise that "ABMA would work on NASA programs as requested."[7] Glennan continued to pursue acquisition, and after extensive negotiations, President Eisenhower officially transferred a large portion of the division, including the team led by von Braun to NASA in March 1960. The group remained stationed within the Army's Redstone Arsenal in Huntsville, Alabama, but their facilities became known as NASA's George C. Marshall Space Flight Center (MSFC). Additionally, ABMA's Missile Firing Laboratory at Cape Canaveral was renamed the Launch Operations Directorate (LOD) and became a branch office of MSFC.[8] Eventually, as LOD's responsibilities grew, NASA separated the group from MSFC, and formed it into a field center called the Launch Operations Center (LOC).[9]

NASA's first space program, Project Mercury, was active from December 1958 through May 1963. Its goals were to "(1) Place a manned spacecraft in orbital flight around the earth. (2) Investigate man's performance capabilities and his ability to function in the environment of space. (3) Recover the man and the spacecraft safely."[10] Project Mercury flew a total of twenty-six missions, the vast majority of which were for research/development or vehicle qualification. Only six of the flights were manned, but with these missions, which included the first U.S. suborbital ballistic flight of Alan Shepard (May 5, 1961), and the first U.S. orbital flight of John Glenn (February 20, 1962), the program successfully met its goals. Despite the pace of Project Mercury, NASA was unable to beat the Russians, who had successfully launched cosmonaut Yuri Gagarin on April 12, 1961.

NASA's second program that put men in space, Project Gemini, was officially announced in December 1961, as an intermediate step between Project Mercury and the Apollo Program.[11] The primary objective of Project Gemini was to prepare for a lunar landing by (1) keeping a two-man

---

[6] Project Vanguard was the first official U.S. rocket program with the specific goal of launching a satellite. Cliff Lethbridge. "Vanguard Fact Sheet." *Spaceline.org*. 2001.

[7] Roger E. Bilstein. *Orders of Magnitude: A History of the NACA and NASA, 1915-1990*. (Washington, D.C.: NASA Office of Management, Scientific and Technical Information Division, 1989).

[8] The Missile Firing Laboratory was the launch team of the ABMA. It was led by Dr. Kurt Debus, another German rocket scientist brought to the U.S. through Project Paperclip, see footnote 14. Benson and Faherty, 15; Dunar and Waring, 70.

[9] In November 1963, the LOC and MILA were renamed John F. Kennedy Space Center to honor the late President. Harry Butowsky. *Reconnaissance Survey: Man in Space*. (Washington, D.C.: National Park Service, 1981), 5; Benson and Faherty, 146.

[10] Walter C. Williams, Kenneth S. Kleinknecht, William M. Bland, Jr., and James E. Bost. "Project Review." *Mercury Project Summary Including the Results of the Fourth Manned Orbital Flight, May 15 and 16, 1963 [SP-45]*. (Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963), 2.

[11] James M. Grimwood and Barton C. Hacker (with Peter J. Vorzimmer). *Project Gemini Technology and Operations, A Chronology*. (Washington, D.C.: NASA, Scientific and Technical Information Office, 1969).

RELEASED - Printed documents may be obsolete; validate prior to use.

crew in space for up to fourteen days; (2) rendezvousing and docking with orbiting vehicles, and maneuvering the combination; and (3) perfecting methods of re-entering the Earth's atmosphere and landing.[12] Project Gemini flew twelve missions between April 1964, and November 1966; all but the first two were manned. Like Project Mercury, Project Gemini met all of its goals, including the first successful extravehicular activity (EVA), the first vehicle rendezvous and docking sequence, and the longest flight duration, fourteen days, up to that point. Despite its successes, the program had its share of heartaches with the deaths of three astronauts during training exercises, Theodore Freeman on October 31, 1964, and Elliot See and Charles Bassett on February 28, 1966.

The Apollo Program

On May 25, 1961, twenty days following the successful suborbital flight of Alan Shepard, President Kennedy proposed the following historic goal before a joint session of Congress:

> *Now is the time to take longer strides -- time for this nation to take a clearly leading role in space achievement, which in many ways may hold the key to our future on Earth...I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish.*[13]

With widespread support, the public and Congress embraced the goal and the program proceeded rapidly to place a man on the Moon.

The Apollo Program had unofficially begun on February 5, 1959, when NASA established the Working Group on Lunar Exploration to formulate a lunar exploration program. Subsequently, a Research Steering Committee was created, which included personnel from the various NASA centers. At its first meeting in May 1959, the committee prioritized various aspects of a space program, which included a manned lunar landing and return to earth. The concept was further discussed at the committee's second meeting (June 1959) and at its third meeting (December 1959). By the following January (1960), enough progress had been made to bring about the suggestion of a formal name, "Apollo," for the new program, with the goal of landing astronauts on the moon and returning them safely to Earth. Glennan approved the name on July 25, 1960, and it was subsequently announced at the first NASA-Industry Program Plans Conference three

[12] NASA KSC. "Gemini Goals." *Gemini website*. 2000.
[13] Launius, 181-182.

RELEASED - Printed documents may be obsolete; validate prior to use.

days later. On September 1, 1960, the Space Task Group (STG) officially created the "Apollo Project Office."[14]

The Apollo Spacecraft

Fifteen months prior to the establishment of the Apollo Project Office, Dr. Robert Gilruth, director of the STG, met with his staff to discuss the possibilities of an advanced manned spacecraft to follow in the footsteps of Project Mercury. The topic continued to occasionally surface, and on November 2, 1959, the STG formally decided to develop plans for a lunar spacecraft. Preliminary guidelines were formulated by March 1960, which were then refined prior to being introduced to the other NASA centers. Following these presentations, the STG formed the Advanced Vehicle Team to incorporate suggestions received during the meetings and begin to define the requirements for a lunar spacecraft. In the meantime, NASA drafted a Request for Proposals for feasibility studies of Apollo spacecraft by private industry. The information was presented to interested parties on September 13, 1960, and three contracts were awarded approximately two months later to General Electric Company, The Martin Company, and the Convair/Astronautics Division of General Dynamics Corporation; their reports were submitted in May 1961. While the contractors conducted these feasibility studies, the STG's Flight Systems Division continued their in-house study of a lunar spacecraft design. NASA completed an initial set of draft specifications on May 5, 1961, ten days prior to the contractors' submittals of the feasibility studies. Five days later, a second draft of spacecraft specifications was issued. The Flight Systems Division then incorporated the information gleaned from the feasibility studies and completed the final specifications.[15]

The Apollo spacecraft was designed as three different modules: the Command Module, the Service Module, and the Lunar Module. The Command and Service Modules (CSM) would be integrated to fly as one until the Service Module was jettisoned prior to Earth re-entry. The Command Module contained all of the flight consoles and served as the living quarters for the astronauts while in space. It also provided the means of ingress and egress into the capsule both on-ground and in space. The Service Module supplemented the environmental control system of the Command Module, and held the propulsion system and engines, the reaction control system, and the fuel cells. The Lunar Module was the two-man vehicle that would carry astronauts to the lunar surface. It was comprised of two components, referred to as the descent stage and the ascent stage. The descent stage provided the velocity for lunar de-orbit and landing, held scientific equipment, and acted as the launch pad for the ascent stage of the module. The ascent

[14] Ivan D. Ertel and Mary Louise Morse. *The Apollo Spacecraft: A Chronology, Volume 1*. (Washington, D.C.: NASA, Scientific and Technical Information Office, 1969). The STG was the initial office created by NASA to operate its manned spaceflight program; it was stationed at the Langley Aeronautical Laboratory (now Langley Research Center) in Hampton, Virginia. As the space program grew, the STG became an autonomous NASA center, named the Manned Spacecraft Center, and was moved to Houston, Texas. Following the death of President Lyndon B. Johnson, it received its current name: the Lyndon B. Johnson Space Center (JSC).
[15] Ertel and Morse.

RELEASED - Printed documents may be obsolete; validate prior to use.

stage provided living quarters for the astronauts while on the Moon and returned them to the Command Module once their lunar work was complete.[16]

Construction of the Apollo spacecraft was divided into two contracts, one for the CSM and one for the Lunar Module. The invitation to bid for the CSM contract was issued on July 21, 1961. Five proposals were presented to NASA on October 11; the result of which was the selection of North American Aviation, Inc. (NAA) as the principal contractor for the CSM on November 28. The first flight-ready CSM was accepted by NASA on October 20, 1965. The invitation to bid for the Lunar Module was issued on July 25, 1962. Nine proposals were received by NASA on September 5, 1962 and the contract was awarded to Grumman Aircraft Engineering Corporation on November 7, 1962.[17]

The Launch Vehicle

On October 21, 1959, President Eisenhower made the decision to transfer ABMA's DOD, which had begun development of the Saturn family of rockets in 1957, to NASA.[18] While waiting for the transfer to be approved, the Saturn Vehicle Evaluation Committee, composed of representatives from the Air Force, NASA, the Advanced Research Projects Agency (ARPA), and ABMA, was formed on November 27, 1959, in order to determine the configuration and goals for NASA's future use of the Saturn missile. Commonly known as the Silverstein Committee, the group recommended that NASA consider three different Saturn configurations, all of which utilized the clustered first stage concept mated with several different upper stages.[19]

Of the three suggested configurations, known as Saturn A, Saturn B and Saturn C, the Saturn C was selected, which included five versions of the missile, Saturn C-1 through Saturn C-5, ranging from the least to the most powerful. The Saturn C-1 consisted of a two-stage vehicle that closely resembled the original Juno V, and was already under development. The Saturn C-2

[16] Richard W. Orloff. *Apollo by the Numbers: A Statistical Reference*. (Washington, D.C.: NASA History Division, Office of Policy and Procedures, 2000).

[17] Ertel and Morse; Courtney G. Brooks and Ivan D. Ertel. *The Apollo Spacecraft: A Chronology, Volume 3*. (Washington, D.C.: NASA, Scientific and Technical Information Office, 1973).

[18] Originally designated as Juno V, initial designs called for a rocket with a first stage composed of a cluster of eight Redstone missile stages surrounding one Jupiter missile stage. This pioneering design was the first to increase a rocket's payload capacity by clustering existing missiles. In August 1958, ARPA, a division of the DoD, officially authorized ABMA to proceed with the development of the Juno V, which was renamed two months later per von Braun's recommendation. Von Braun suggested the name of Saturn since the planet is the sixth from the sun following Jupiter, a name ARPA approved in February 1959. Clifford J. Lethbridge, "Saturn I Fact Sheet," *Spaceline.org*, 1998. President Eisenhower sent a formal proposal regarding the transfer to Congress on January 14, 1960, who never acted upon it within the 60-day limit for Congressional action. Therefore, by default, the transfer went through on March 15, 1960, although formal transfer would not occur until July 1. Ertel and Morse.

[19] Dr. Abe Silverstein, NASA's Director of Space Flight Development, led the committee. Ertel and Morse; John L. Sloop, *Liquid Hydrogen as a Propulsion Fuel, 1945-1959, The NASA History Series*. (Washington D.C.: National Aeronautics and Space Administration, 1978).

RELEASED - Printed documents may be obsolete; validate prior to use.

would utilize the same first stage with an improved second stage and an added third stage. The Saturn C-3, C-4, and C-5 would be based upon the C-2 configuration, but would employ varying numbers of more powerful Rocketdyne engines in the first stage. NASA selected the two-stage Saturn C-1 for Apollo research and development flights, which became known as the Saturn I. After initial testing and research was completed, two additional versions of the Saturn would be used for Apollo: the Saturn IB and the Saturn V.[20]

The Saturn I vehicle had two configurations, Block I and Block II. Block I had a live first stage and an inert second stage. The first stage was comprised of eight Redstone rockets surrounding one Juno rocket. The rockets, however, were used solely as fuel tanks, some containing liquid oxygen and the others RP-1 (kerosene) liquid fuel. At the base of the first stage were eight Rocketdyne H-1 engines, which produced a thrust of nearly 1,330,000 pounds at launch. The Block II configuration was essentially the same as the Block I configuration, except it had a live second stage that was powered by a single engine, which burned liquid oxygen and liquid hydrogen for a thrust of approximately 90,000 pounds. Additionally, the Block II configuration had longer fuel tanks and an improved H-1 engine design that increased the combined thrust at launch to roughly 1,520,000 pounds.[21]

Like the Saturn I Block II launch vehicle, the Saturn IB vehicle contained two live stages. The first stage mimicked that of the Saturn I vehicle, but used an advanced design for the H-1 engines, which made them lighter while increasing the combined thrust to nearly 1,640,000 pounds at lift-off; it continued to use the same fuel sources. The second stage of the Saturn IB burned a liquid oxygen/liquid hydrogen fuel combination that fed a Rocketdyne J-2 engine, which could produce a thrust of roughly 225,000 pounds. Also included in this stage were three solid-propellant ullage motors, a feature especially important for manned flights. During ascent, the ullage motors would provide positive acceleration for the spacecraft between the moment the first stage cutoff and separated and the second stage ignited.[22]

The Saturn V launch vehicle, designed specifically to send men to the moon, incorporated concepts and features from the Saturn I and Saturn IB, to become the largest and most powerful space launch vehicle in the world. Fundamentally, the Saturn V was a three-stage rocket that used forty-one different motors to carry the Apollo spacecraft into Earth orbit and lunar trajectory. The first stage of the vehicle used five Rocketdyne F-1 engines, which burned a liquid oxygen/RP-1 combination, for a combined thrust of 7,500,000 pounds at launch. The second stage employed five J-2 engines that produced a thrust of nearly 1,000,000 pounds. The third stage was essentially the second stage used for the Saturn IB vehicle, with a lessened thrust of 200,000 pounds. The forty-one motors were positioned on the different stages and were used to

[20] Benson and Faherty, 13-15; Lethbridge, "Saturn I Fact Sheet."
[21] Lethbridge, "Saturn I Fact Sheet."
[22] Clifford J. Lethbridge, "Saturn IB Fact Sheet," *Spaceline.org*. 1998.

RELEASED - Printed documents may be obsolete; validate prior to use.

aid in the separation of the stages (to prevent the jettisoned stage from hitting the active stage) and help maneuver the vehicle into the proper trajectory.[23]

The Apollo Missions

Altogether, the Apollo Program flew thirty-two missions, including the initial research/development, and qualification flights, the lunar flights, the Skylab application, and the Apollo-Soyuz Test Project. Three different launch complexes were used: LC-34 (seven launches) and LC-37 (eight launches) at CCAFS, and LC-39 (seventeen launches) at KSC. Of the total thirty-two flights, fifteen were manned, and of the seven attempted lunar landing missions, six were successful. No major launch vehicle failures of either the Saturn IB or Saturn V occurred; however, there were two major CSM failures, one on the ground (Apollo 1) and one on the way to the Moon (Apollo 13).[24]

The first four test flights of the Apollo program were launched from LC-34 and flew suborbital trajectories utilizing the Saturn I Block I vehicle. The first flight, Saturn/Apollo 1 [SA-1], launched on October 27, 1961 to verify the aerodynamics and structure of the launch vehicle and confirm NASA's decision to use the Saturn vehicles for the Apollo Program. SA-2 on April 26, 1962 and SA-3 on November 16, 1962, continued the vehicle verification tests, but also added scientific experiments known as Project High Water I and Project High Water II, respectively.[25] The launch of SA-4 on March 28, 1963, was the first time in the program that NASA tested an "engine-out" contingency, in which the fuel was rerouted to the seven remaining engines; it was a resounding success.[26]

The next phase of testing utilized the Block II configuration of the Saturn I vehicle. All six of these flights were launched from LC-37, since LC-34 was being modified for the assembly, checkout, and launch of the larger, more powerful Saturn IB vehicle. The first flight, SA-5, launched on January 24, 1964 and was the first orbital flight of the Apollo Program, as well as the first to test a fully-fueled second stage. The next flight, SA-6, launched on May 28, 1964, carrying the first boilerplate model (CSM only) of an Apollo spacecraft into space to test telemetry and various systems; this was followed by a similar test flight (SA-7) on September 18, 1964, which also tested the spacecraft's Launch Escape System. These two flights were so successful that NASA declared the Apollo-Saturn combination operational, and decided to use the next three flights for scientific missions. In addition to a boilerplate spacecraft, each of these launch vehicles carried a satellite. SA-9, carrying Pegasus 1, was launched on February 16, 1965;

[23] Clifford J. Lethbridge, "Saturn V (Apollo) Fact Sheet," *Spaceline.org*. 1998.
[24] NASA. *Facts: John F. Kennedy Space Center*. (1994), 82.
[25] These experiments created artificial clouds to provide data on atmospheric physics. Although the vehicle tests were successful, the experiments produced questionable results.
[26] Robert Godwin. *Project Apollo: The Test Program*. (Burlington, Ontario: Apogee Books, 2006), 4; Ertel and Morse; Mary Louise Morse and Jean Kernahan Bays. *The Apollo Spacecraft: A Chronology, Volume 2*. (Washington, D.C.: NASA, Scientific and Technical Information Office, 1973).

RELEASED - Printed documents may be obsolete; validate prior to use.

SA-8 launched on May 25, 1965, with Pegasus 2; and SA-10 launched on July 30, 1965, with Pegasus 3.[27]

The first test flight using the Saturn IB vehicle, designated Apollo/Saturn 201 (AS-201), launched from LC-34 on February 26, 1966, carrying the first true spacecraft on a suborbital flight to test its heat shield. Two more unmanned test flights followed, AS-202 from LC-34 and AS-203 from LC-37. AS-203 launched on July 5, 1966, for the first full orbital flight of the second stage in order to test its instrumentation unit and the behavior of the fuel. AS-202, which launched on August 25, 1966, subjected the Command Module to the full force of re-entry for the first time. The fourth scheduled flight, set to launch from LC-34 in February 1967, was to be the first manned mission of the Apollo Program. During a countdown simulation on January 27, 1967, the Command Module caught fire on the launch pad, killing its prime crew, Astronauts Virgil "Gus" Grissom, Edward White, and Roger Chaffee. The event was later commemorated as Apollo 1.[28]

Following the fire, and subsequent modifications to the spacecraft, NASA conducted three additional unmanned Earth orbital missions to continue verification testing of the Apollo-Saturn combination, and to begin testing of the Lunar Module. Apollo 4 was launched on November 9, 1967. This flight was the first to use the Saturn V vehicle, and thus, the first to launch from LC-39A at KSC. Apollo 5 launched on January 22, 1968, from LC-37 carrying the first Lunar Module into space for verification tests. Apollo 6 was the final unmanned mission of the Apollo Program; it launched on April 4, 1968, from LC-39A.[29]

Although still considered part of the Apollo Program's testing phase, the October 11, 1968, Apollo 7 launch from LC-34 was the first manned mission, which placed astronauts into an Earth orbit for ten days using a Saturn IB vehicle. The crew, Walter Schirra, Donn Eisele, and Walter Cunningham, tested the Command and Service Modules and their guidance and control systems, the Instrument Unit, the Spacecraft Lunar Adapter, the new spacesuit design, food supplies and work routines. During this flight, the astronauts separated the CSM from the second stage in order to practice rendezvous operations with the booster. The Command Module with the astronauts returned to Earth on October 22, after successfully completing all goals of the mission.[30]

The next mission, designated Apollo 8, launched on December 21, 1968, from LC-39A, and became the first manned flight to use the Saturn V vehicle. It was the first mission to reach the

[27] Godwin, *The Test Program*, 5-6, 16-24; Morse and Bays; Brooks and Ertel.
[28] Godwin, *The Test Program*, 7-8, 25-35; Ivan D. Ertel and Roland W. Newkirk (with Courtney G. Brooks). *The Apollo Spacecraft: A Chronology, Volume 4*. (Washington, D.C.: NASA, Scientific and Technical Information Office, 1978).
[29]Godwin, *The Test Program*, 9-10, 36-48; Ertel and Newkirk.
[30] Godwin, *The Test Program*, 52-55; Ertel and Newkirk.

RELEASED - Printed documents may be obsolete; validate prior to use.

moon, which it orbited ten times before returning to Earth. Apollo 9, which launched on March 3, 1969, from LC-39A, remained in a low-Earth orbit, where its crew, James McDivitt, Russell Schweickart, and David Scott, performed the first spacewalk of the Apollo Program and the first docking of the Lunar and Command Modules. Apollo 10 was the "final dress rehearsal" for landing on the moon. Launched on May 18, 1969, from LC-39B, it reached the Moon, which it orbited thirty-one times. While in orbit, the crew jettisoned the Lunar Module and allowed it to come within 50,000 feet of the Moon's surface, prior to initializing the ascent stage for its return to the Command Module (the descent stage was left to fall onto the moon; the ascent stage would be jettisoned into a solar orbit). All objectives were met, leading to the next phase of the Apollo Program, Lunar Exploration.[31]

On July 16, 1969, Apollo 11 launched from LC-39A, carrying its crew, Astronauts Neil Armstrong, Edwin "Buzz" Aldrin, and Michael Collins, into a lunar orbit just over three days later. On July 20, 1969, as Collins remained in the Command Module, Armstrong and Aldrin climbed into the Lunar Module and descended to the Moon's surface. Landing at 4:17 P.M., Eastern Standard Time (EST), Armstrong reported to Mission Control, "Houston, Tranquility Base here. The Eagle has landed."[32] Just under seven hours later, at approximately 10:56 P.M. EST, Armstrong became the first man to step foot on the moon, marking the event with his now famous phrase, "One small step for a man, one giant leap for mankind." Aldrin joined him twenty minutes later, and the pair completed one EVA to collect lunar surface material for scientific analysis. Just over twenty-one hours after landing, the Lunar Module ascent stage lifted-off to successfully dock with the CSM in lunar orbit, and the two astronauts rejoined their colleague in the Command Module, prior to jettisoning the ascent stage. The three astronauts landed in the Pacific Ocean on July 24, 1969, at roughly 12:50 P.M. EST, officially accomplishing the goal set by President Kennedy on May 25, 1961.[33]

Four months later, Apollo 12 launched from LC-39A for its rendezvous with the Moon. Essentially a repeat of Apollo 11, the crew remained in lunar orbit for one extra day to take photographs. On April 11, 1970, the ill-fated Apollo 13 lifted-off from LC-39A. Approximately fifty-six hours after launch, Oxygen Tank No. 2 ruptured, also causing a failure in Oxygen Tank No. 1. The three-man crew of James Lovell, Fred Haise, and John "Jack" Swigert, remained in limbo within the Lunar Module as the ground controllers at Mission Control in Houston frantically worked to bring them home safely. On April 17, they landed on Earth proving the ingenuity of the ground controllers. The event would have repercussions though, as two Apollo flights were removed from the program.[34]

---

[31] Godwin, *The Test Program*, 12-13, 56-69; Ertel and Newkirk.

[32] Tranquility Base refers to their designated landing site; Eagle was the name given to the Lunar Module. NASA MSC. *Apollo 11 Spacecraft Commentary*. July 16-24, 1969.

[33] NASA KSC. "Apollo 11." *Apollo website*. 2003; Robert Godwin. *Project Apollo: Exploring the Moon*. (Burlington, Ontario: Apogee Books, 2006), 3-5, 20-22; Ertel and Newkirk.

[34] Godwin, *Exploring the Moon*, 5-10, 23-30; Ertel and Newkirk. One flight had already been cancelled following the return of Apollo 12.

RELEASED - Printed documents may be obsolete; validate prior to use.

The next mission, Apollo 14, was launched on January 31, 1971. Astronauts Alan Shepard and Edgar Mitchell spent just over thirty-three hours on the Moon's surface and conducted two EVAs. Apollo 15, which launched on July 26, 1971, was the first mission to use the Lunar Rover, an electric-powered, four-wheel drive vehicle, to traverse around the lunar surface. The crew, David Scott and James Irwin (Alfred Worden remained in the Command Module), spent just under sixty-seven hours on the Moon collecting lunar samples, including one dubbed the "Genesis Rock." The next mission, Apollo 16, was essentially a repeat of Apollo 15, albeit with a different lunar landing site. Apollo 17, which launched on December 7, 1972, was the final lunar mission and the only one to carry a scientist-astronaut, Harrison "Jack" Schmitt, to the Moon.[35]

Skylab, an application of the Apollo Program, served as an early type of space station. With 12,700 cubic feet of work and living space, it was the largest habitable structure ever placed in orbit, at the time. The station achieved several objectives: scientific investigations in Earth orbit (astronomical, space physics, and biological experiments); applications in Earth orbit (Earth resources surveys); and long-duration spaceflight. Skylab 1 orbital workshop was inhabited in succession by three crews launched in modified Apollo CSMs (Skylab 2, 3 and 4). Actively used until February 1974, Skylab 1 remained in orbit until July 11, 1979, when it re-entered Earth's atmosphere over the Indian Ocean and Western Australia after completing 34,181 orbits.[36]

The Apollo-Soyuz Test Project (ASTP) of July 1975, the final application of the Apollo Program, marked the first international rendezvous and docking in space, and was the first major cooperation between the only two nations engaged in manned spaceflight. As the first meeting of two manned spacecraft of different nations in space, first docking, and first visits by astronauts and cosmonauts into the others' spacecraft, the ASTP was highly significant. The ASTP established workable joint docking mechanisms, taking the first steps toward mutual rescue capability of both Russian and American manned missions in space.[37]

NASA's John F. Kennedy Space Center

The John F. Kennedy Space Center (KSC) is NASA's primary Center for launch and landing operations, vehicle processing and assembly, and related programs in support of manned space missions. It is located on the east coast of Florida, about 150 miles south of Jacksonville, and to the north and west of Cape Canaveral, in Brevard and Volusia Counties, and encompasses approximately 140,000 acres. The Atlantic Ocean and CCAFS are located to the east, and the Indian River is to the west.

[35] Godwin, *Exploring the Moon*, 10-18, 31-49; Ertel and Newkirk.
[36] NASA, *Facts*, 91.
[37] NASA, *Facts*, 96.

RELEASED - Printed documents may be obsolete; validate prior to use.

With the goal set by President Kennedy to land a man on the moon by the end of the 1960s, and the decision to use the powerful Saturn V launch vehicle, it was apparent that a new launch complex was required, and CCAFS, already with twenty-two launch complexes, did not have the space for new rocket facilities. NASA solved the dilemma by acquiring land on Merritt Island, an undeveloped area west and north of the existing missile launching area. The U.S. Army Corps of Engineers (ACOE) acted as agent for purchasing land, and NASA began gaining title to the land in late 1962, taking over 83,903.9 acres by outright purchase, which included several small towns, such as Orsino, Wilson, Heath and Audubon, many farms, citrus groves, and several fish camps. Negotiations with the State of Florida provided submerged lands, resulting in the acquisition of property identified on the original Deed of Dedication. Much of the State-provided land was located south of the Old Haulover Canal and north of the Barge Canal.

With the newly purchased land and newly constructed facilities, NASA's offices at the Cape expanded and relocated to the new installation, initially known as the Merritt Island Launch Area (MILA). Eventually, MILA incorporated the LOC as part of its jurisdiction; the entirety was renamed the John F. Kennedy Space Center in November 1963 following the death of the president.[38]

Operations and Checkout Building

Originally referred to as the Manned Spacecraft Operations Building, preliminary groundwork for the Operations and Checkout (O&C) Building was completed by the Azzarelli Construction Company in November 1962. On January 16, 1963, the joint venture of Paul Hardeman and Morrison-Knudsen was awarded a $7.7 million contract to construct the building itself; the official groundbreaking occurred twelve days later. Although the original facility was completed in 1964, it underwent "continuous addition, modification, and alteration during the succeeding five years." This work fell under a separate contract awarded to Donovan Construction, Power Engineering, and Leslie Miller, Inc., and included additions to each end of the north and south wings.[39]

The O&C Building has historically contained instrumentation facilities for receiving, evaluating, and recording data from spacecraft during simulated and actual flight, as well as clean rooms, a malfunction laboratory, a calibration laboratory, bio-medical and bio-chemical laboratories, acceptance checkout equipment, a quick look data station, and living quarters for astronaut crews. Within the Low Bay of the facility, each module of the Apollo spacecraft (command module, service module, and lunar module) was received and inspected, and then moved into the High Bay area for integration and testing. Once this was completed, the spacecraft was taken to

[38] Benson and Faherty, 65-68, 96-98, 105, 133-137, 146-48.
[39] Benson and Faherty, 266; Anita Barrett. "Creating the Operations and Checkout Building." *Spaceport News* (45, 5) March 3, 2006, 7; NASA, *Facts*, 152-155.

RELEASED - Printed documents may be obsolete; validate prior to use.

the Vehicle Assembly Building for mating with the launch vehicle.[40] These same functions were performed in the 1970s in support of the Apollo-Soyuz Test Project and Skylab missions.

In the 1970s and 1980s, the O&C Building was reconfigured to accommodate the needs of the Space Shuttle program. Many of the original areas remained, including the astronaut quarters and suit room on the third floor. The Low and High Bay areas were remodeled to include a clean room, various pallet stands, and integration stands, all of which were removed prior to this documentation package in preparation for NASA's newest exploration program, Constellation. The only features remaining from the Apollo era are the two altitude chambers near the northeast corner of the High Bay.

The Altitude Chambers

The two altitude chambers within the High Bay of the O&C Building were designed and manufactured by the Stokes Equipment Division of the Pennsalt Chemical Corporation; installation was completed in 1965 by the Pittsburgh Des Moines Steel Corporation; the Elsbery Corporation; and the Fischer Electric Corporation. The two chambers were placed next to each other in the northeast corner of the High Bay (Figure No. A-13), directly west of the two integrated test stands (no longer extant). At the same time, a support area for the chambers was established among the second floor offices in the O&C Building's south wing, directly north of the chambers. This support area included the Altitude Chamber Control Room, which was positioned between the airlocks for the chambers (Figure No. A-14). The orientation of the Control Room to the two chambers led to the designations of "Chamber R" for the western chamber, which is positioned to the right of the Control Room when looking south towards the chambers, and "Chamber L" for the eastern chamber, which is located to the left of the Control Room. Although the chambers were used in late 1965 to test Apollo airframe 009 (a CSM) for the AS-201 test mission, they were not man-rated until the following year. The chambers would be re-man-rated in 1968 following minor modifications.[41]

The altitude chambers were used throughout the entire Apollo program, as well as the Skylab program and Apollo-Soyuz Test Project. Following the Apollo-Soyuz Test Project (1975), both of the chambers were deactivated.[42] In 1984, one of the chambers was used to allow KSC launch pad personnel to practice using the newly-developed Module Vertical Access Kit, designed to

[40] Butowsky, *Man in Space*, 51-52; Harry Butowsky. *Cape Canaveral Air Force Station National Historic Landmark Federal Agency Nomination*. (Washington, D.C.: U.S. Department of the Interior, National Park Service, January 24, 1983), 27-28.
[41] Bendix Launch Support Division. *Altitude Chambers "L and R" Manual, Volume 1*. August 1969. 1-1, On file, Kennedy Space Center; "Altitude Chamber Readied For Apollo Spacecraft." *Spaceport News* (4, 33), August 19, 1965, 4. Such modifications included new air conditioning units and lighting fixtures. Bendix Launch Support Division. *Altitude Chambers "L and R" Manual, Volume 2*. August 1969. 1-1, On file, Kennedy Space Center.
[42] "Apollo-era high altitude chamber reactivated." *Spaceport News* (38, 5), March 5, 1999: 1.

RELEASED - Printed documents may be obsolete; validate prior to use.

allow access to the Spacelab module while on the pad. For this, a mock-up of the orbiter middeck, the Spacelab module, and their connecting tunnel was constructed within the chamber; evacuation to a high altitude simulation was not required.[43] Following this training, all of the original pumping equipment and Control Room consoles were scrapped.[44]

In 1997, the decision was made to reactivate Chamber R in support of the International Space Station (ISS) program.[45] New vacuum pumping equipment was installed, and new consoles were placed in the Control Room. The Chamber was turned over to ISS payload operations on March 1, 1999, and since then has been used to perform leak tests on pressurized ISS modules.[46]

Chamber Operation

Throughout the Apollo Program, the altitude chambers were used to test the critical systems of the spacecraft, as well as to train astronauts, by simulating the environments experienced during a mission. Prior to these tests, the different modules were delivered to the Low Bay by special rubber-tired transporters, where they were given a thorough inspection. The integrated CSM was then inserted into Chamber L, arranged for testing the integrated CSM; and the Lunar Module was placed within Chamber R, to the east. This operation was conducted using the two bridge cranes within the Low and High Bay areas. The High Bay crane lifted the 27.5-ton lid of the appropriate chamber, while the other crane, which traversed both the Low and High Bays, lifted the spacecraft module and then lowered it into the chamber. Once the modules were in their respective chamber, the various access platforms were moved into place.

The process for testing each of the modules was essentially the same, except for a slight difference in the first step, and the addition of a fifth step for the Lunar Module. The first step for the CSM involved a thorough checkout of the spacecraft, integration tests, and connecting all of the necessary cabling once the module was within Chamber L. The procedure for the Lunar Module varied in that the integration tests were completed prior to it being positioned within Chamber R. Subsequently, following its insertion into the chamber, all necessary cabling was attached. The second step in the process was to conduct manned sea level tests of each module. Typically, this included two runs, one with the primary astronaut crew and one with the back-up crew. Following the successful completion of the sea level tests, an unmanned altitude test was conducted, after which came two manned altitude tests, one with the prime crew for a mission, the second with the backup crew. The testing process for the CSM ended with the successful

[43] "Altitude Chamber Used in SL-3 Drill." *Spaceport News* (24, 1), January 4, 1985: 4.
[44] "[C]hamber reactivated," 1.
[45] S. M. Francois. "Reactivate O&C Altitude Chamber, Contract NAS10-11400, International Space Station – Support Equipment Products and Services." Memo to OP-OSO-C/Contracting Officer, August 29, 1997. On file, Kennedy Space Center Archives.
[46] "[C]hamber reactivated," 1.

RELEASED - Printed documents may be obsolete; validate prior to use.

completion of the manned altitude tests; the LM underwent one additional unmanned altitude test following the two manned tests.[47]

During operational use, a NASA Test Controller was responsible for the test program and procedures; the Bendix Complex Operator was responsible for the activities of the Operational Staff.[48] The number of personnel required for testing operations differed between unmanned tests and manned tests. The former required eighteen controllers with two back-up personnel for each twelve hour shift; the latter required thirty-six controllers per shift, with a minimum back-up team of two operations and one rescue personnel. All of the operations were directed and controlled, automatically or manually, from the Control Room, which is located between the two chambers to the north.[49]

Although capable of simulating an altitude of 250,000' above sea level, the altitude tests on the Apollo spacecraft modules were conducted at a simulated altitude of 210,000'.[50] During tests, rescue teams manned both airlock compartments in case of an emergency within the chamber. The airlocks were held at a simulated altitude of 18,000' above sea level; rescue operations occurred at a simulated altitude of 25,000' above sea level.[51]

The chambers were equipped with a series of interrelated systems, which allowed the chamber to function as specified. These systems included: the Vacuum System; the Repressurization System; the Cryogenics System; the Oxygen System; the Chilled Water System; the Valve Air and Instrument Air System; the Gaseous Nitrogen (GN2) Purge System, the Water Deluge System; the Air Conditioning System; the Instrumentation System; the Fire Detection System; and the Electric Power Distribution System. The systems were arranged so that the same equipment was used for both chambers; however, in some cases, different equipment was used for the chambers and the airlocks (such as the vacuum pumps). All of the systems could be controlled and/or monitored from the Control Room.

The process of bringing a chamber to altitude began with initializing the Vacuum System's main vacuum pumping subsystem function, which pulled the air out of the chamber (only one could be evacuated at a time), thus creating a vacuum.[52] The corresponding Cryogenics System served to remove condensible vapors, which could harm the equipment, from the chambers with the aid of the Valve Air and Instrument Air System, which provided a continual supply of dry air to help dissipate moisture. While all of this was underway, the Chilled Water System activated "to remove the heat generated by the various units employed in the vacuum and repressurization

[47] "2 Altitude Chambers Readied To Simulate Space For Apollo." *Spaceport News,* (7, 11) May 23, 1968, 5.
[48] Bendix, *Volume 1*, 4-1.
[49] Bendix, *Volume 1,* 2-1, 2-2, 3-1, 5-1.
[50] Bendix, *Volume 1,* 3-1; "2 Altitude Chambers Readied."
[51] In such a case, the simulated altitude of the airlock was raised to this level; while that of the chamber was lowered to 25,000'. "2 Altitude Chambers Readied;" Bendix, *Volume 1*, 5-1.
[52] Bendix, *Volume 2,* 2-1; "2 Altitude Chambers Readied."

RELEASED - Printed documents may be obsolete; validate prior to use.

systems, enabling these units to operate within safe temperature limits."[53] Once the proper altitude was reached, the main vacuum pumping subsystem was shut off and the vacuum hold subsystem activated to keep the chamber at altitude. This subsystem also allowed the main vacuum pumping subsystem to be used to evacuate the other chamber. The chamber airlocks had their own separate vacuum pumping subsystem.[54]

Once the testing was completed, the Repressurization System was initialized to return the chambers and airlocks back to sea level by providing breathable air with a minimal amount of humidity. The system was equipped to run normally, i.e., to repressurize the chamber following the completion of a test, or in an emergency situation. During normal operations following a test, the chamber and airlock were equalized at a level 25,000' above sea level, where they were held for a short period and then lowered to sea level; there was no critical time factor.[55] Under emergency situations, the system had the capability of repressurizing the chamber to an altitude of 25,000' within thirty seconds, where rescue operations were conducted.[56]

The remainder of the chambers' systems provided support functions for routine use or emergency procedures. For example, the GN2 Purge System controlled the oxygen concentration within the chambers and airlocks during altitude simulations, and the Air Conditioning System kept their temperature at 70 degrees Fahrenheit when no testing was underway.[57] The Oxygen System provided backup breathing air for the rescue team if their main breathing supply failed, and the Water Deluge System provided protection for personnel in case of fire during egress operations.[58]

[53] Bendix, *Volume 2*, 4-1, 6-1, 7-1.
[54] Bendix, *Volume 2*, 2-21, 2-24, and 2-27
[55] Bendix, *Volume 1*, 5-1; Bendix, *Volume 2*, 3-1, 3-2.
[56] See page 16. Bendix, *Volume 2*, 3-3; "2 Altitude Chambers Readied."
[57] Bendix, *Volume 2*, 8-1, 9-1.
[58] Bendix, *Volume 2*, 5-1, 10-1, 10-3.

RELEASED - Printed documents may be obsolete; validate prior to use.

PHYSICAL DESCRIPTION

Operations and Checkout Building

The Operations and Checkout (O&C) Building was designed following the principles of the International Style, featuring a lack of ornament, flat roof, ribbon windows, and an emphasis on horizontality. It has overall dimensions of approximately 740' in length (east-west) and 420' in width (north-south) and stands five stories in height. It is comprised of two prominent, east-west oriented, rectilinear components on the north and south, linked by three narrow connectors. The O&C Building has a concrete foundation, walls composed of a concrete and steel skeletal frame with concrete wall panels, and a flat, built-up roof.

The building is divided into five functional areas: engineering and administration offices; an auditorium and cafeteria area; a laboratory and control room section; a High Bay and Low Bay assembly and test area; and a utility and service area.[59] Throughout these spaces are astronaut quarters and preparation areas, clean rooms, materials analysis laboratories, bio-medical and bio-chemical laboratories, guidance and navigation laboratories, acceptance checkout equipment systems, a quick look data station, medical facilities, and an assembly and test area.

The assembly and test area is comprised of the High and Low Bays within the south wing of the O&C Building. The Low Bay is approximately 475' in length, 85' in width, and 70' in height, with a bridge crane mounted 48' above the floor. At the time of documentation, the Low Bay consisted of one large, open space with no platforms, equipment, etc., other than a replacement bridge crane. The Low Bay opens into the High Bay, which sits directly to its east. The High Bay roughly measures 157' in length, 85' in width, and 104' in height. The original 27.5-ton bridge crane, which moves east-west, is mounted roughly 100' above the floor (Photo No. 43).

Altitude Chambers

Along the north wall of the High Bay are the two altitude chambers, Chamber R to the west and Chamber L to the east (Figure No. A-13). They are surrounded by a series of fixed, steel work platforms (Photo Nos. 2 and 5). These platforms have approximate overall dimensions of 95' in length (east-west) and 42' in width (north-south). There are four levels to these platforms: the 0'-0" Level, or ground floor level; the 15'-0" Level, or second level; the 30'-9" Level, or third level; and the 40'-2" Level, or fourth level; guardrails surround the perimeter of the upper floors. These platforms provide access to the outer surface of the chamber for visual observation and utility connections. Additionally, the ground floor level provides access to the lower access door, and the second level provides access to the Control Room, as well as the airlocks.[60]

---

[59] NASA. *Technical Facilities Catalog Volume II*. (October 1974), 9-3.
[60] Bendix, *Volume 2*, 1-3.

RELEASED - Printed documents may be obsolete; validate prior to use.

The two altitude chambers are exact mirror images of one another. Each altitude chamber is comprised of two principal components: a cylindrical main chamber (Photo Nos. 1-5, 47 and 48) and a rectangular airlock (Photo Nos. 40-42, 47 and 48). The main chamber dimensions are approximately 33'-6" in diameter and 59' in height, including the spherical top and bottom heads (Photo Nos. 13, 16-17), and is constructed of stainless steel. The walls are composed of ½"-thick shells reinforced with eighteen horizontal angle stiffeners that are spaced evenly over the height of the wall; the heads are 9/16" thick and reinforced with structural tees that extend in two directions. The top head is removable to allow spacecraft and other equipment to be placed within using the overhead bridge cranes. This upper dome is not fastened to the wall; rather, its weight presses down on a gasket, which forms the upper seal. This allows the top head to act as a pressure relief device in case of chamber over-pressurization. Matching grooves within the chamber's upper wall surface and the top head help tighten the seal and allow for correct alignment (Photo No. 15).[61]

Scattered around the cylindrical wall of each chamber are ten observation ports, twenty-five patchboards, and thirty-eight utility connections. The observation ports are positioned at heights accessible from the external platforms: two at the 0'-0" Level, four at the 15'-0" Level; and four at the 30'-9" Level. Each observation port has a 12" viewing diameter and is composed of two layers of ¾" Herculite tempered glass with a 1-3/32" vacuum space between the panes (Photo Nos. 8 and 9). The twenty-five patchboards (Photo Nos. 10 and 11) are of varying sizes, and are scattered across the chamber elevation, as are the thirty-eight utility connections. All of the patchboards and utility connections are leak proof and provide ports for electrical, communications and closed circuit TV cables; oxygen lines, water lines, cryogenic lines, and other necessary utilities.[62] Other penetrations around the main chamber include one observation port and two utility connections in the upper dome; four utility connections in the lower dome; and various spare patchboards and utility connections.

There are two personnel access points into each altitude chamber, one of which is the airlock to be discussed in more detail below. The other personnel opening is the access door at the 0'-0" Level of the chamber (Photo No. 7). Capable of carrying a full vacuum load, the door is approximately 6'-8" in height and 3'-0" in width. It is constructed of steel, fitted with a sealing gasket, and equipped with a 12"-diameter observation port. A special latching mechanism secures the door to the frame during chamber operation.[63]

The interior of each altitude chamber consists of one large open space, with nearly all of the permanent features mounted to the inner shell surface. One such feature is a set of 2'-0"-wide stainless steel stairs, which are welded to the wall (Photo Nos. 36 and 37). In Chamber L, the

[61] Bendix, *Volume 2*, 1-2; Eric Johnson. Personal communication with Patricia Slovinac, KSC, O&C Building, July 2, 2009.
[62] Bendix, *Volume 2*, 1-4.
[63] Bendix, *Volume 2*, 1-2; 2-3.

RELEASED - Printed documents may be obsolete; validate prior to use.

steps begin at the inner floor level, at due west, and ascend the wall in a counter-clockwise direction for one rotation, ending directly above the starting point. Chamber R is the opposite, beginning at due east at the inner floor level and ending at due east. Both sets of stairs have five fixed landings and are equipped with handrails.[64] In addition, the inner faces of the patchboards, some with metal safety strips, and viewing ports are scattered around the chamber wall (Photo Nos. 11, 51-54). Also attached to the internal wall surface are pipes for the various utilities, as well as 161 hazardous environment-rated fluorescent light fixtures in Chamber L; 173 in Chamber R (Photo Nos. 55 and 56).

Equally spaced around the inner perimeter of each chamber are twelve stainless steel columns that sit roughly 3'-9" from the interior wall surface, to which they are attached with six brackets, concentrated above the 15'-0" Level. The inner faces of these columns are fitted with pairs of holes, at 8" on center, along their entire height. This series of holes allowed removable access platforms to be placed wherever needed along the vertical axis (Photo Nos. 25 and 50).[65] At the time of documentation, Chamber L retained its Apollo-era configuration of platforms, located at the -2'-2" Level, the 6'-4" Level, and the 16'-8" Level; Chamber R contained only three wedges of platforms: one at the airlock, one directly below it at the 8'-4" Level, and one at the 8'-4" Level on the opposite side.[66] Additionally, Chamber L retained its series of cold panels at the -2'-2" Level, which were used to simulate temperatures in space (Photo No. 30), and the Apollo-era load banks on 6'-4" Level (Photo No. 33).

The internal "floor" of each chamber sits at 6'-3" below the 0' Level (Photo No. 27). It had the capability of rotating 360 degrees through the use of a ratchet and drive gears. The central portion of this plane contains removable stainless steel grating, supported by eight radial beams. The perimeter is composed of solid panels of stainless steel.[67]

Each altitude chamber has an airlock on its north side at the 15'-0 Level, which is the equivalent of the second floor of the O&C Building. The airlock (Photo Nos. 40-42) is roughly 14'-4" in length, 7'-6" in width, and 7'-6" in height, and is composed of stiffened carbon steel plate. Like the main chamber, the sides of the airlock are fitted with various penetrations, including two observation ports, one within the entry door and one on a side wall (east wall for Chamber L; west wall for Chamber R), and two patchboards, both on the "ceiling." Additionally, there are forty-six utility connections spaced across the east, north, and west walls and the ceiling. The entry door to the airlock, which is exactly like the door at the 0'-0" Level, is on the north side. In addition, there are two observation chairs on each airlock; one on the north wall (left of the door

[64] Bendix, *Volume 2,* 1-4.
[65] Bendix Launch Support Division. *Altitude Chambers "L and R" Manual, Volume 2*. August 1969. 1-2, On file, Kennedy Space Center;
[66] During the Apollo program, Chamber "R" had platforms at the 8'-4" Level, 16'-8" Level, and the 26'-8" Level; Bendix, *Volume 2,* 1-3
[67] Bendix, *Volume 2,* 1-3.

RELEASED - Printed documents may be obsolete; validate prior to use.

on Chamber L; right of the door on Chamber R), and one on the east wall (Chamber L) or the west wall (Chamber R).

Internally, the airlock is divided into two compartments: the Observation Airlock, which abuts the main chamber, and the Outer Airlock to its north. The Observation Airlock (Photo No. 42) has rough dimensions of 8'-7" in length and 7'-6" in width; the Outer Airlock (Photo No. 41) measures approximately 4'-5" x 7'-6". They are separated by an access door that matches the airlock entry; the same style door also provides access from the Observation Airlock into the main chamber. Within each of these sections, there are three seats for rescue personnel, and various panels for the crew to monitor the systems within the chamber during testing procedures.[68]

Support Areas

To the north of the Altitude Chambers, at the same level as the airlocks, is a 25' x 23' Control Room (Figures A-13 and A-14; Photo No. 44). The south wall of the Control Room is fitted with windows for visual access to the outer wall of the chambers. Additionally, the west end of the room opens directly into the airlock area for Chamber R; the east end has a wall separating the Control Room from Chamber L. All of the computer equipment within the Control Room dates to the reactivation of Chamber R (ca. 1997).

The Pump Room for the chambers (Figure A-13; Photo No. 45) is located across the High Bay to the south; a tunnel at the basement level of the O&C Building carries the equipments' pipes from the Pump Room to the chambers. Like the Control Room, all of the pumping equipment was replaced ca. 1997.

[68] Bendix, *Volume 2*, 1-2.

RELEASED - Printed documents may be obsolete; validate prior to use.

Bibliography

"2 Altitude Chambers Readied To Simulate Space For Apollo." *Spaceport News* (7, 11), May 23, 1968: 5

"Altitude Chamber Readied For Apollo Spacecraft." *Spaceport News* (4, 33), August 19, 1965: 4.

"Altitude Chamber Used in SL-3 Drill." *Spaceport News* (24, 1), January 4, 1985: 4.

"Apollo-era high altitude chamber reactivated." *Spaceport News* (38, 5), March 5, 1999: 1 and 2.

Barrett, Anita. "Creating the Operations and Checkout Building." *Spaceport News* (45, 5) March 3, 2006: 7.

Bendix Launch Support Division. *Altitude Chambers "L and R" Manual, Volume 1*. August 1969. On file, Kennedy Space Center.

_____. *Altitude Chambers "L and R" Manual, Volume 2*. August 1969. On file, Kennedy Space Center.

Benson, Charles D., and William B. Faherty. *Moonport: A History of Apollo Launch Facilities and Operations.* National Aeronautics and Space Administration, Scientific and Technical Information Office, 1978; reprint as *Gateway to the Moon: Building the Kennedy Space Center Launch Complex* and *Moon Launch! A History of the Saturn-Apollo Launch Operations*, Gainesville: University Press of Florida, 2001.

Bilstein, Roger E. *Orders of Magnitude: A History of the NACA and NASA, 1915-1990.* Washington, D.C.: NASA Office of Management, Scientific and Technical Information Division, 1989

Brooks, Courtney G., and Ivan D. Ertel. *The Apollo Spacecraft: A Chronology, Volume 3.* Washington, D.C.: NASA, Scientific and Technical Information Office, 1973.

Brooks, Courtney G., James M. Grimwood, and Lloyd S. Swenson. *Chariots for Apollo: A History of Manned Lunar Spacecraft.* Washington, D.C.: NASA, Scientific and Technical Information Office, 1979.

Butowsky, Harry. *Cape Canaveral Air Force Station National Historic Landmark Federal Agency Nomination.* Washington, D.C.: U.S. Department of the Interior, National Park Service, January 24, 1983.

RELEASED - Printed documents may be obsolete; validate prior to use.

Butowsky, Harry. *Reconnaissance Survey: Man in Space*. Washington, D.C.: National Park Service, 1981.

Compton, W. David, and Charles D. Benson. *Living and Working in Space: A History of Skylab*. Washington, D.C.: NASA, Scientific and Technical Information Office, 1983.

Dunar, Andrew J., and Stephen P. Waring. *Power to Explore: A History of Marshall Space Flight Center 1960-1990*. Washington, D.C.: NASA History Office, 1999.

Ertel, Ivan D., and Mary Louise Morse. *The Apollo Spacecraft: A Chronology, Volume 1*. Washington, D.C.: NASA, Scientific and Technical Information Office, 1969.

Ertel, Ivan D., and Roland W. Newkirk (with Courtney G. Brooks). *The Apollo Spacecraft: A Chronology, Volume 4*. Washington, D.C.: NASA, Scientific and Technical Information Office, 1978.

Ezell, Edward Clinton, and Linda Neuman Ezell. *The Partnership: A History of the Apollo-Soyuz Test Project*. Washington, D.C.: NASA, Scientific and Technical Information Office, 1978.

Francois, S. M. "Reactivate O&C Altitude Chamber, Contract NAS10-11400, International Space Station – Support Equipment Products and Services." Memo to OP-OSO-C/Contracting Officer, August 29, 1997. On file, Kennedy Space Center Archives.

Godwin, Robert. *Project Apollo: The Test Program*. Burlington, Ontario: Apogee Books, 2006.

_____. *Project Apollo: Exploring the Moon*. Burlington, Ontario: Apogee Books, 2006.

Grimwood, James M. *Project Mercury: A Chronology*. Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963.

Grimwood, James M., and Barton C. Hacker (with Peter J. Vorzimmer). *Project Gemini Technology and Operations, A Chronology*. Washington, D.C.: NASA, Scientific and Technical Information Office, 1969.

"Headquarters Approves New LOC Organization." Marshall Star (3, 31), May 1, 1963: 1 and 8.

Johnson, Eric. Personal communication with Patricia Slovinac, KSC, O&C Building, July 2, 2009.

RELEASED - Printed documents may be obsolete; validate prior to use.

Launius, Roger D. *NASA: A History of the U.S. Civil Space Program.* Malabar, Fla.: Krieger Publishing Company, 2001.

Lethbridge, Clifford J. "Saturn I Fact Sheet." *Spaceline.org*. 1998. Accessed via http://spaceline.org/rocketsum/saturn-I.html.

_____. "Saturn IB Fact Sheet." *Spaceline.org*. 1998. Accessed via http://spaceline.org/rocketsum/saturn-Ib.html.

_____. "Saturn V (Apollo) Fact Sheet." *Spaceline.org*. 1998. Accessed via http://spaceline.org/rocketsum/saturn-V-apollo.html.

_____. Vanguard Fact Sheet." *Spaceline.org*. 2001. Accessed via http://spaceline.org/rocketsum/vanguard.html.

Morse, Mary Louise, and Jean Kernahan Bays. *The Apollo Spacecraft: A Chronology, Volume 2*. Washington, D.C.: NASA, Scientific and Technical Information Office, 1973.

National Aeronautics and Space Administration. *Facts: John F. Kennedy Space Center*. 1994.

_____. *Technical Facilities Catalog Volume II*. October 1974.

National Aeronautics and Space Administration, Manned Spacecraft Center (MSC; now Johnson Space Center). *Apollo 11 Spacecraft Commentary*. July 16-24, 1969. Accessed via http://www.jsc.nasa.gov/history/mission_trans/AS11_PAO.PDF.

National Aeronautics and Space Administration, Kennedy Space Center. "Apollo 11." *Apollo website*. 2003. Accessed via http://www-pao.ksc.nasa.gov/kscpao/history/apollo/apollo-11/apollo-11.htm.

_____. *The Apollo Soyuz Test Project website*. 2003. Accessed via http://www-pao.ksc.nasa.gov/kscpao/history/astp/astp.html.

_____. "Gemini Goals." *Gemini website*. 2000. Accessed via http://www-pao.ksc.nasa.gov/kscpao/history/gemini/gemini-goals.htm.

_____. "Skylab Operations Summary." *Skylab website*. 2000. Accessed via http://www-pao.ksc.nasa.gov/kscpao/history/skylab/skylab-operations.htm.

Orloff, Richard W. *Apollo by the Numbers: A Statistical Reference*. Washington, D.C.: NASA History Division, Office of Policy and Procedures, 2000.

RELEASED - Printed documents may be obsolete; validate prior to use.

Sloop, John L. *Liquid Hydrogen as a Propulsion Fuel, 1945-1959, The NASA History Series*. Washington D.C.: NASA, 1978, http://history.nasa.gov/SP-4404/

Williams, Walter C., Kenneth S. Kleinknecht, William M. Bland, Jr., and James E. Bost. "Project Review." *Mercury Project Summary Including the Results of the Fourth Manned Orbital Flight, May 15 and 16, 1963 [SP-45]*. Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963.

RELEASED - Printed documents may be obsolete; validate prior to use.



Figure A-1. North and east elevations of the O&C Building, December, 1965.
Source: John F. Kennedy Space Center Archives, KSC-65C-3237.

RELEASED - Printed documents may be obsolete; validate prior to use.



Figure A-2. Construction of the Altitude Chambers within the O&C Building High Bay, 1965.
Source: John F. Kennedy Space Center Archives, KSC-65C-784.

RELEASED - Printed documents may be obsolete; validate prior to use.

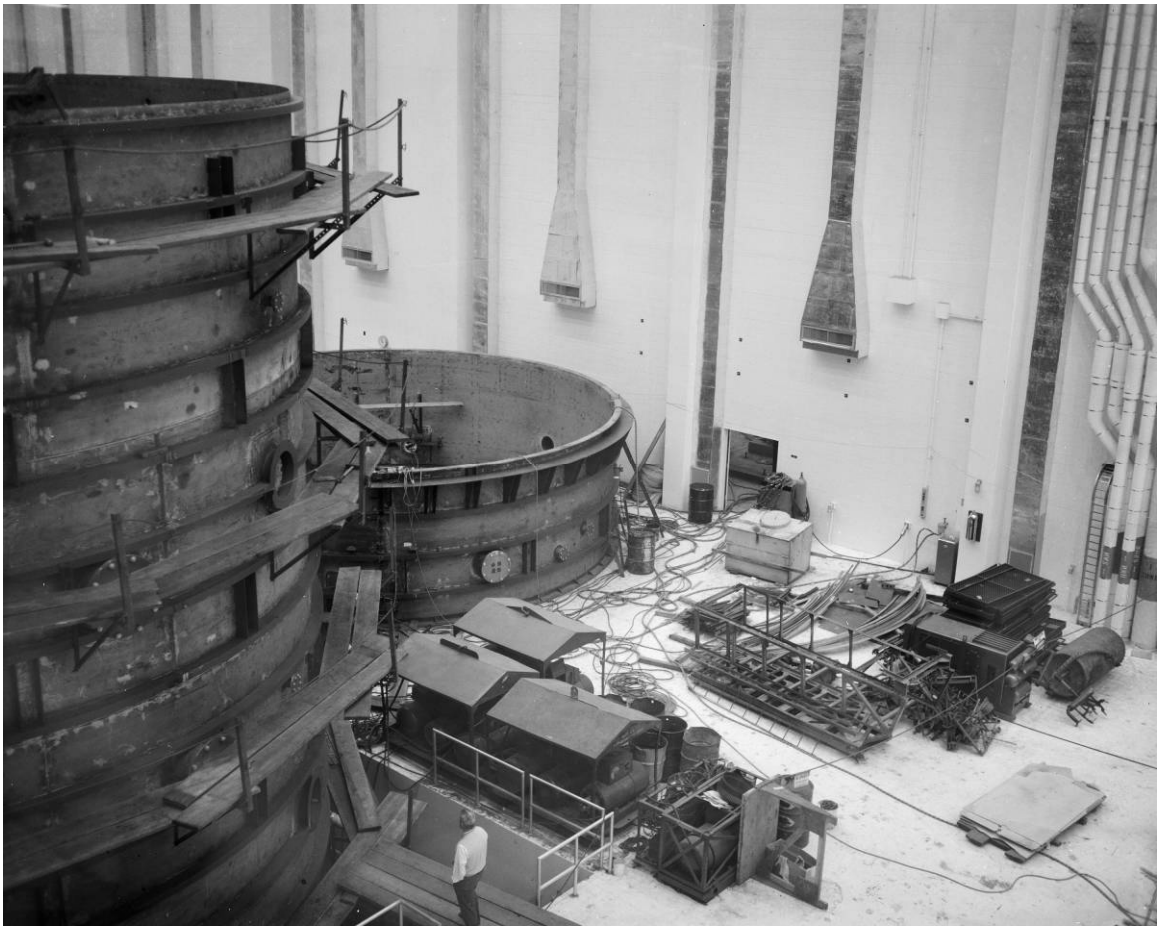


Figure A-3. Construction of the Altitude Chambers within the O&C Building High Bay, 1965. Source: John F. Kennedy Space Center Archives, KSC-65C-786.

RELEASED - Printed documents may be obsolete; validate prior to use.



Figure A-4. View of the Altitude Chambers within the O&C Building High Bay, 1966.
Source: John F. Kennedy Space Center Archives, KSC-66C-482.

RELEASED - Printed documents may be obsolete; validate prior to use.



Figure A-5. Apollo Service Module being lifted for placement in Altitude Chamber L, 1969.
Source: John F. Kennedy Space Center Archives, KSC-69P-933.

RELEASED - Printed documents may be obsolete; validate prior to use.

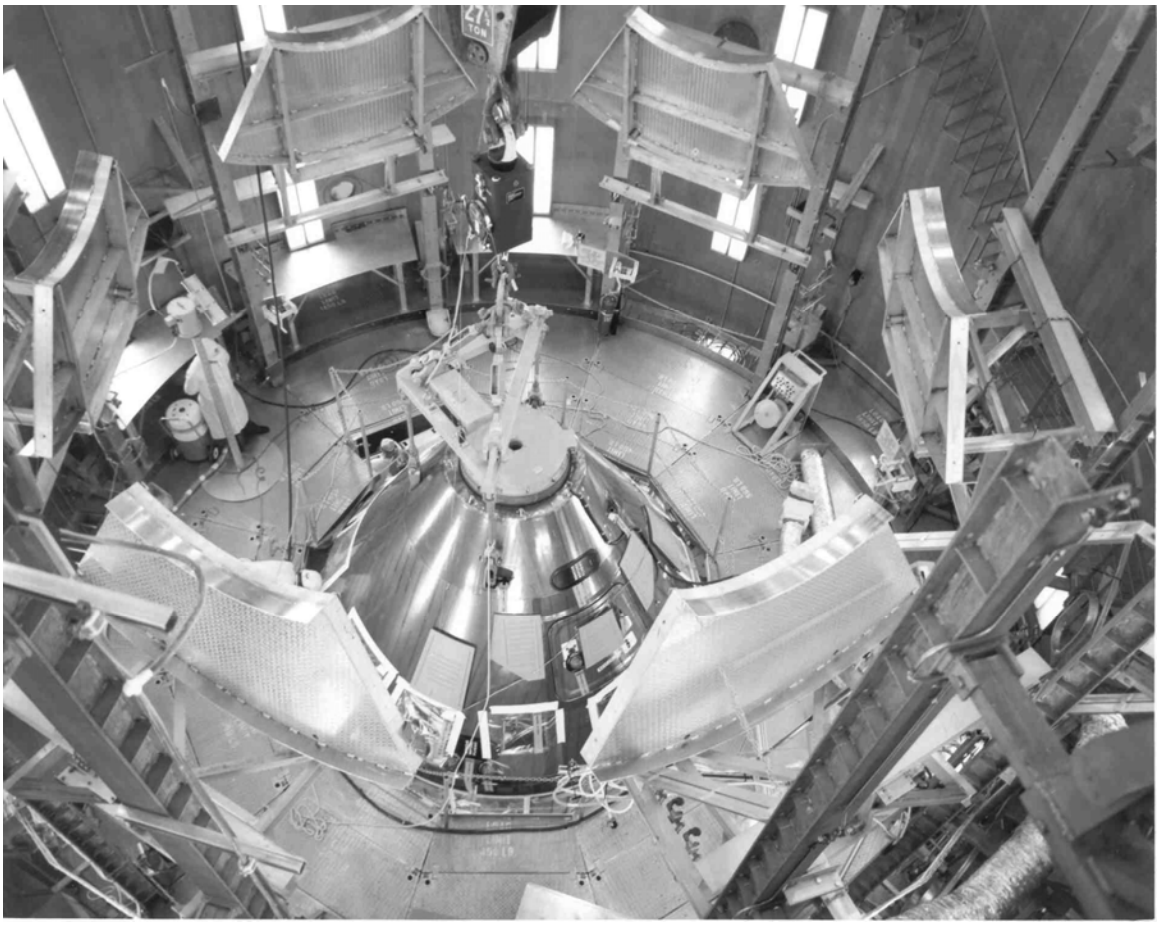


Figure A-6. Apollo Command Module being lowered in Altitude Chamber L, 1969.
Source: John F. Kennedy Space Center Archives, KSC-69P-44.

RELEASED - Printed documents may be obsolete; validate prior to use.



Figure A-7. Apollo Lunar Module descent stage being lifted for placement in Altitude Chamber R, 1968 (note the raised lid of the Altitude Chamber in background).
Source: John F. Kennedy Space Center Archives, KSC-68P-522.

RELEASED - Printed documents may be obsolete; validate prior to use.

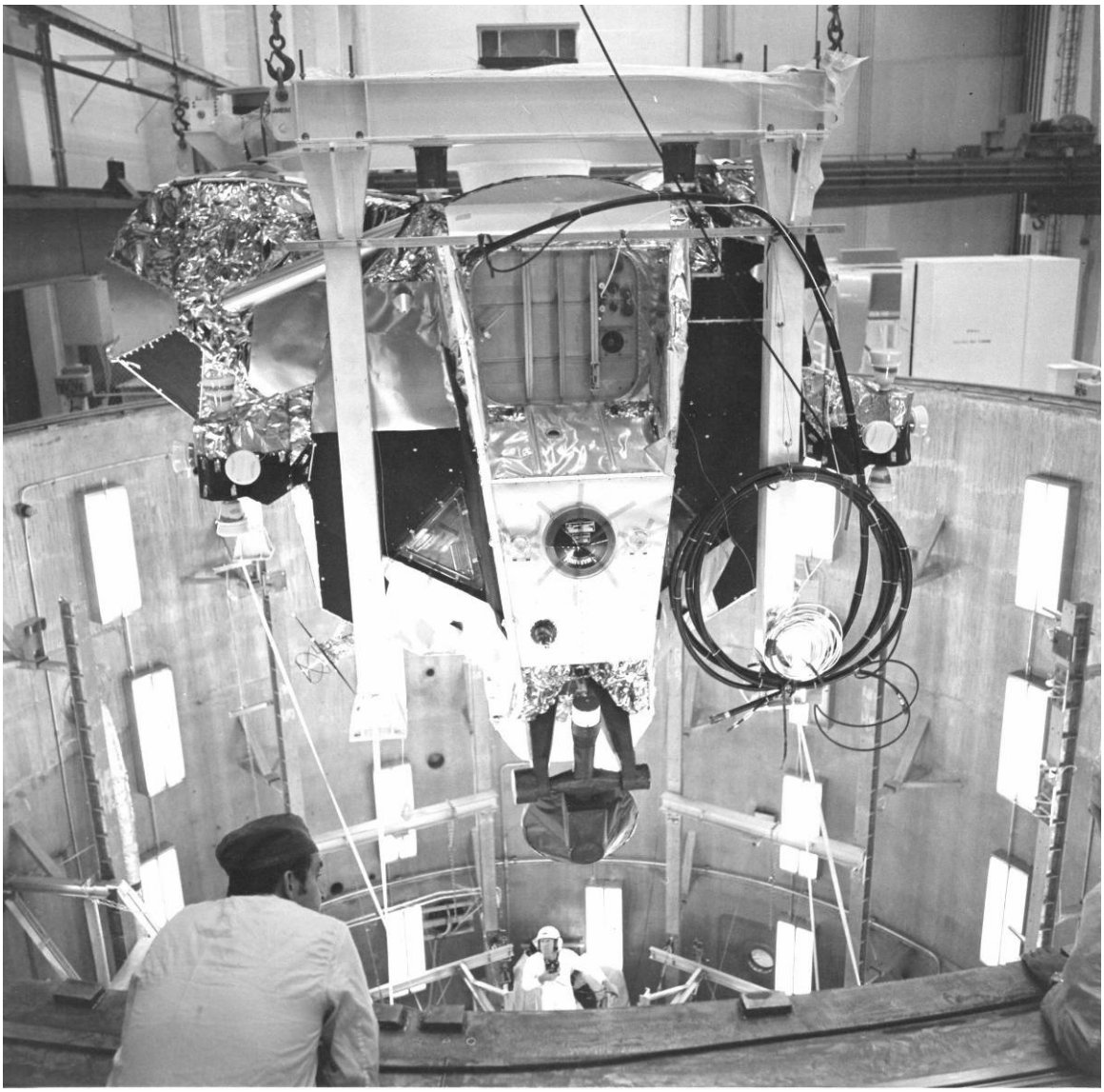


Figure A-8. Apollo Lunar Module ascent stage being placed in Altitude Chamber R, 1968. Source: John F. Kennedy Space Center Archives, KSC-68P-584.

RELEASED - Printed documents may be obsolete; validate prior to use.

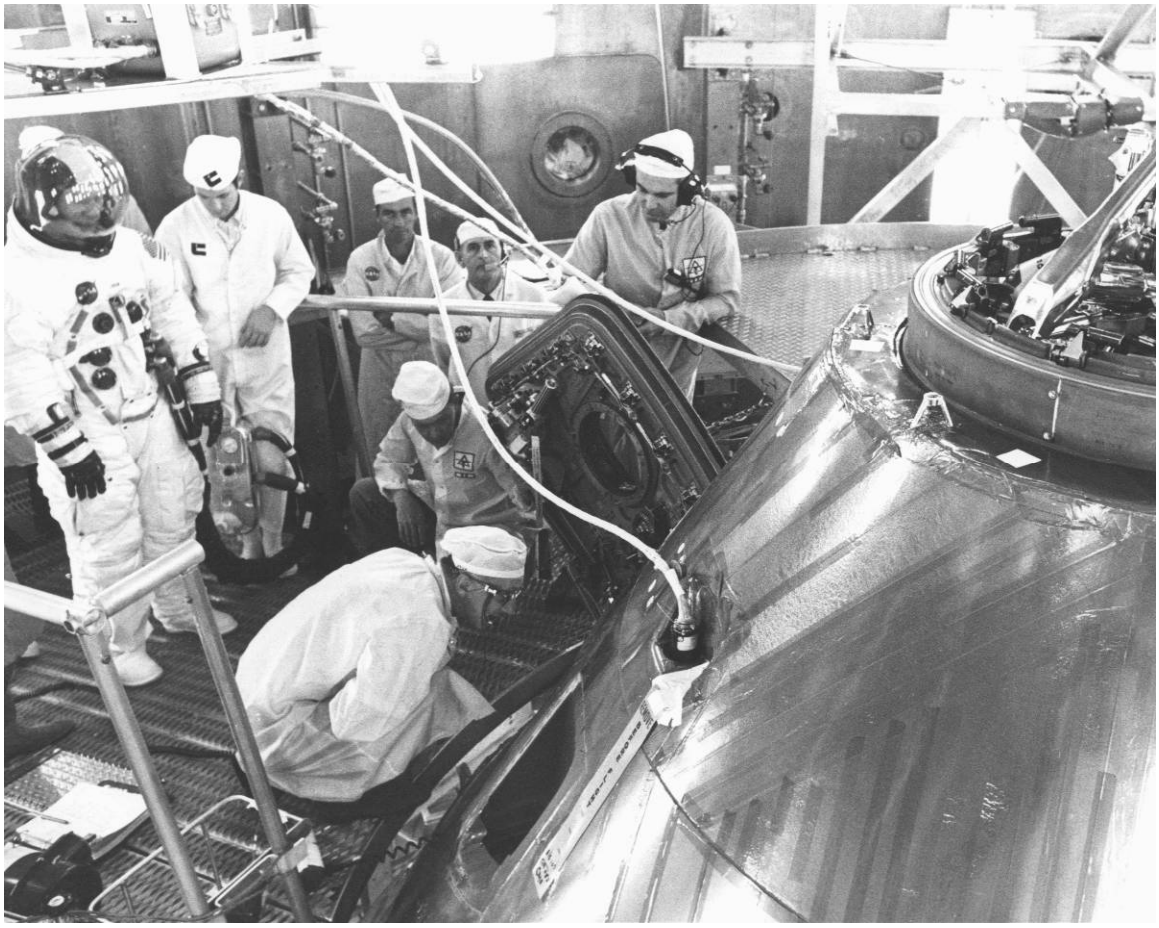


Figure A-9. Apollo 11 crew preparing to conduct tests in the Command Module, 1969.
Source: John F. Kennedy Space Center Archives, KSC-69P-216.

RELEASED - Printed documents may be obsolete; validate prior to use.

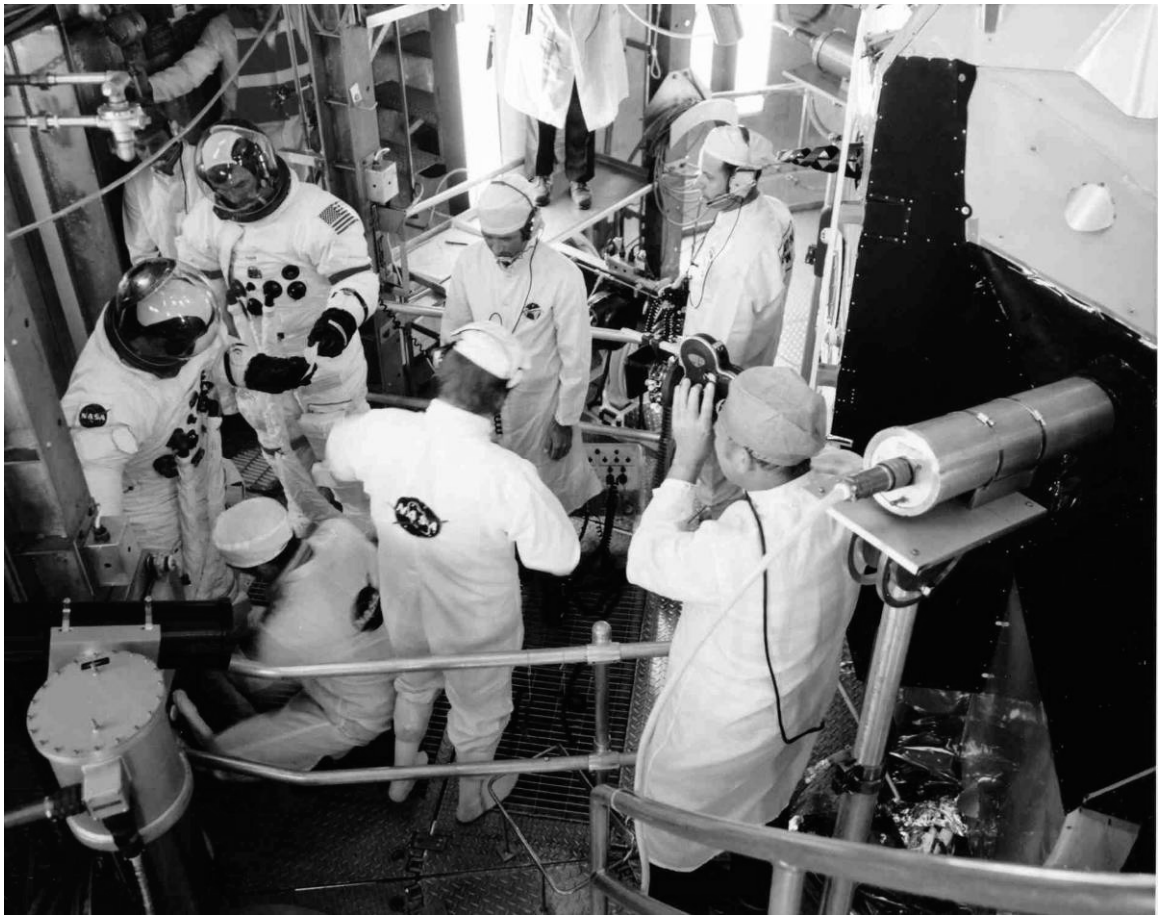


Figure A-10. Apollo 17 crew preparing to conduct tests in the Lunar Module, 1972.
Source: John F. Kennedy Space Center Archives, KSC-72P-384.

RELEASED - Printed documents may be obsolete; validate prior to use.

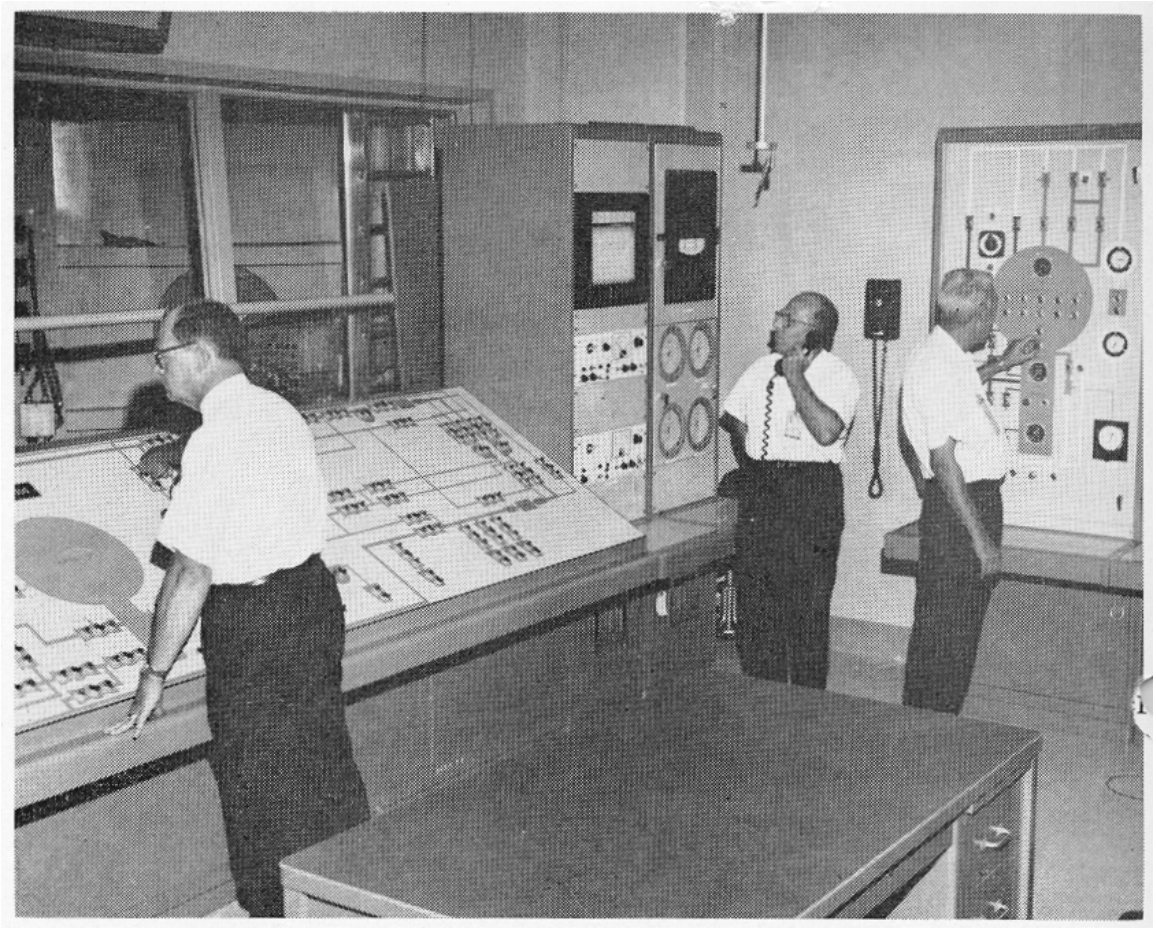


Figure A-11. View of the Control Room for the Altitude Chambers, 1965.
Source: John F. Kennedy Space Center, *Spaceport News*, August 19, 1965, page 4.

RELEASED - Printed documents may be obsolete; validate prior to use.



Figure A-12. Skylab 4 crew entering Altitude Chamber for test, 1973.
Source: Lyndon B. Johnson Space Center, S73-34095, accessed via NASA Image Exchange (NIX) at http://nix.nasa.gov/.

RELEASED - Printed documents may be obsolete; validate prior to use.

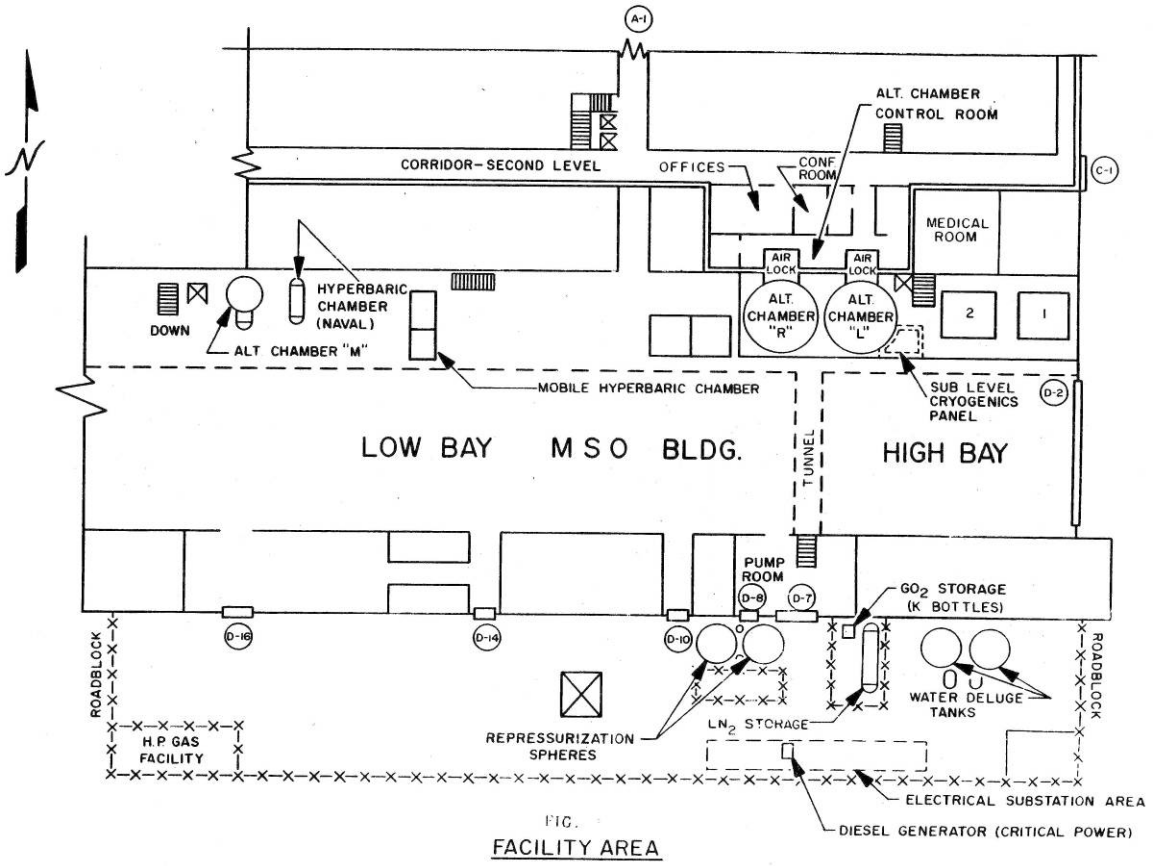


Figure A-13. Location of the Altitude Chambers within the O&C Building, 1969. Source: Bendix Launch Support Division, *Altitude Chambers "L and R" Manual, Volume 1*, page 3-3.

RELEASED - Printed documents may be obsolete; validate prior to use.

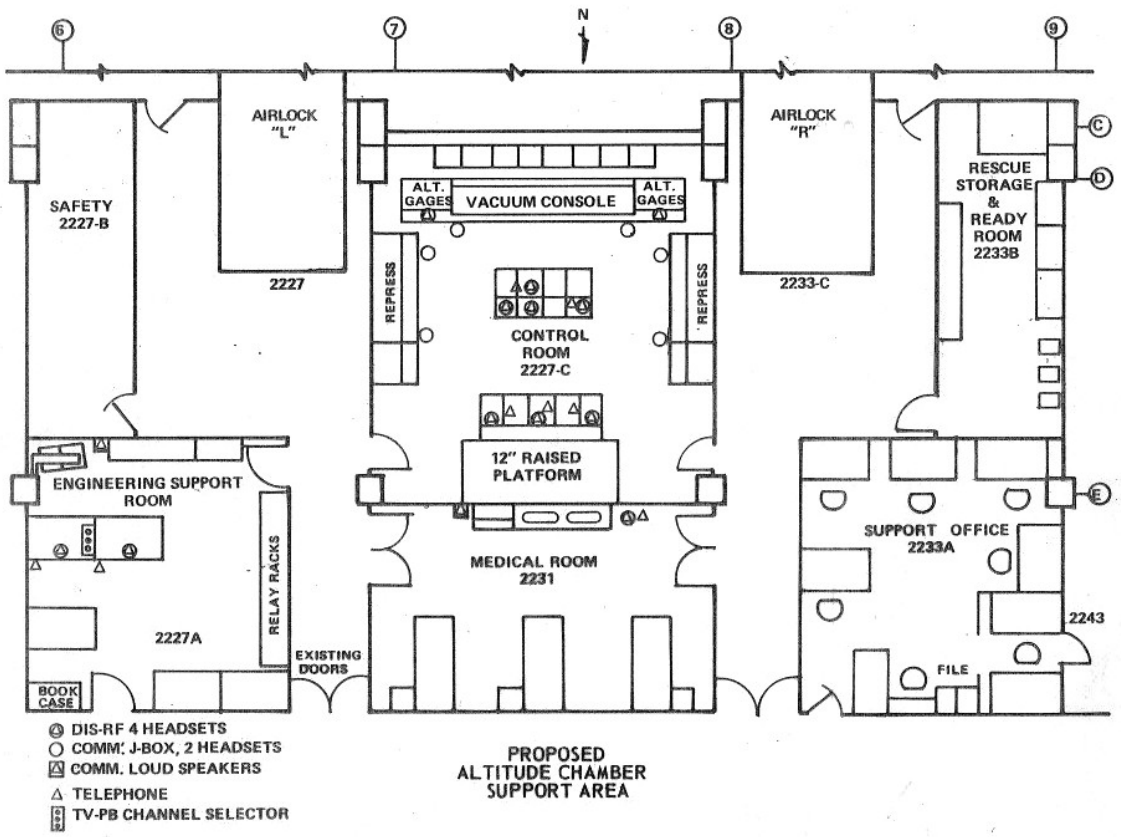


Figure A-14. Proposed support area for the Altitude Chambers, no date.
Source: John F. Kennedy Space Center Archives, File #ARCH00009762.

RELEASED - Printed documents may be obsolete; validate prior to use.

HISTORIC AMERICAN ENGINEERING RECORD

INDEX TO PHOTOGRAPHS

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39, ALTITUDE CHAMBERS, (John F. Kennedy Space Center, O&C Building) HAER No. FL-8-11-E
First Street, between Avenue D and Avenue E
Brevard County
Florida

Penny Rogo Bailes, Photographer; July 2009 (FL-8-11-E-1 through FL-8-11-E-45)

Penny Rogo Bailes, Photographer, September 2008 (FL-8-11-E-46 through FL-8-11-E-59)

FL-8-11-E-1 EXTERIOR OF ALTITUDE CHAMBER R, FACING EAST.

FL-8-11-E-2 EXTERIOR OF ALTITUDE CHAMBERS R (TO LEFT) AND L (TO RIGHT), FACING NORTHEAST.

FL-8-11-E-3 EXTERIOR OF ALTITUDE CHAMBER R, FACING NORTH.

FL-8-11-E-4 EXTERIOR OF ALTITUDE CHAMBER L, FACING NORTH.

FL-8-11-E-5 EXTERIOR OF ALTITUDE CHAMBERS R (TO LEFT) AND L (TO RIGHT), FACING NORTHWEST.

FL-8-11-E-6 DETAIL OF THE EXTERIOR OF ALTITUDE CHAMBER R FROM THE 15’-0” LEVEL OF ACCESS PLATFORMS, FACING NORTHWEST.

FL-8-11-E-7 DETAIL OF P133R (ACCESS DOOR) AT 0’-0” LEVEL, ALTITUDE CHAMBER R, FACING NORTHWEST.

FL-8-11-E-8 DETAIL OF THE EXTERIOR OF PP44L (VIEWING PORTAL), ALTITUDE CHAMBER L, FACING NORTHWEST.

FL-8-11-E-9 DETAIL OF THE INTERIOR OF PP37L (VIEWING PORTAL), AND A FLUORESCENT LIGHT, ALTITUDE CHAMBER L, FACING SOUTH.

FL-8-11-E-10 DETAIL OF THE EXTERIOR OF PP45L (PATCHBOARD), ALTITUDE CHAMBER L, FACING EAST.

FL-8-11-E-11 DETAIL OF THE INTERIOR OF PP45L (PATCHBOARD), ALTITUDE CHAMBER L, FACING WEST.

RELEASED - Printed documents may be obsolete; validate prior to use.

FL-8-11-E-12 VIEW OF THE TOPS OF ALTITUDE CHAMBER R (TO LEFT) AND ALTITUDE CHAMBER L (TO RIGHT) FROM THE 42’-0” LEVEL OF ACCESS PLATFORMS, FACING NORTHWEST.

FL-8-11-E-13 DETAIL OF THE EXTERIOR OF THE DOMED LID, ALTITUDE CHAMBER R, FACING NORTHWEST.

FL-8-11-E-14 DETAIL OF THE INTERIOR OF THE DOMED LID, ALTITUDE CHAMBER R, FACING NORTHWEST.

FL-8-11-E-15 DETAIL OF THE GROOVED RIM ON TOP FACE OF CHAMBER SHELL, ALTITUDE CHAMBER L, FACING SOUTHWEST.

FL-8-11-E-16 DETAIL OF DOMED BOTTOM, ALTITUDE CHAMBER R, FACING EAST.

FL-8-11-E-17 DETAIL OF DOMED BOTTOM, ALTITUDE CHAMBER L, FACING NORTHWEST.

FL-8-11-E-18 DETAIL OF VACUUM PIPE AT 0’-0” LEVEL, ALTITUDE CHAMBER R, FACING NORTHEAST.

FL-8-11-E-19 DETAIL OF VACUUM PIPE OPENING WITHIN ALTITUDE CHAMBER R, FACING SOUTHEAST.

FL-8-11-E-20 DETAIL OF VACUUM PIPE AT BASEMENT LEVEL OF O&C BUILDING, ALTITUDE CHAMBER R, FACING NORTHEAST.

FL-8-11-E-21 DETAIL OF RE-PRESSURIZATION AIR PIPE, ALTITUDE CHAMBER L, FACING SOUTHWEST.

FL-8-11-E-22 LOWER HALF OF THE INTERIOR OF ALTITUDE CHAMBER R, LOOKING UP FROM BOTTOM LEVEL, FACING NORTHEAST.

FL-8-11-E-23 UPPER HALF OF THE INTERIOR OF ALTITUDE CHAMBER R, LOOKING UP FROM BOTTOM LEVEL, FACING NORTHEAST.

FL-8-11-E-24 INTERIOR OF ALTITUDE CHAMBER R, LOOKING DOWN FROM AIRLOCK, FACING NORTHWEST.

FL-8-11-E-25 INTERIOR OF ALTITUDE CHAMBER L FROM TOP LEVEL OF ACCESS PLATFORMS, FACING WEST.

RELEASED - Printed documents may be obsolete; validate prior to use.

FL-8-11-E-26 INTERIOR OF ALTITUDE CHAMBER L, LOOKING UP FROM BOTTOM LEVEL OF INTERNAL PLATFORMS, FACING EAST.

FL-8-11-E-27 BOTTOM LEVEL OF ALTITUDE CHAMBER L, FACING SOUTHWEST.

FL-8-11-E-28 DETAIL OF UTILITY PIPES AT THE BOTTOM LEVEL OF INTERNAL PLATFORMS, ALTITUDE CHAMBER L, FACING WEST.

FL-8-11-E-29 DETAIL OF PLATFORM SUPPORT BRACKET, ALTITUDE CHAMBER L, FACING NORTHWEST.

FL-8-11-E-30 DETAIL OF HEATER PANEL, -2’-2” LEVEL OF INTERNAL PLATFORMS, ALTITUDE CHAMBER L, FACING NORTH.

FL-8-11-E-31 INTERIOR OF ALTITUDE CHAMBER L FROM 6’-4” LEVEL OF INTERNAL PLATFORMS, FACING EAST.

FL-8-11-E-32 INTERIOR OF ALTITUDE CHAMBER L FROM 6’-4” LEVEL OF INTERNAL PLATFORMS, FACING WEST.

FL-8-11-E-33 DETAIL OF LOAD BANK ON 6’-4” LEVEL OF INTERNAL PLATFORMS, ALTITUDE CHAMBER L, FACING NORTH.

FL-8-11-E-34 INTERIOR OF ALTITUDE CHAMBER L FROM 16’-8” LEVEL OF INTERNAL PLATFORMS, FACING NORTH.

FL-8-11-E-35 INTERIOR OF ALTITUDE CHAMBER L FROM 16’-8” LEVEL OF INTERNAL PLATFORMS, FACING SOUTH.

FL-8-11-E-36 INTERIOR OF ALTITUDE CHAMBER L FROM 16’-8” LEVEL OF INTERNAL PLATFORMS SHOWING WALL-MOUNTED STAIRS, FACING WEST.

FL-8-11-E-37 DETAIL OF WALL-MOUNTED STAIRS ON INTERIOR OF ALTITUDE CHAMBER L, FACING SOUTHWEST.

FL-8-11-E-38 DETAIL OF UTILITY PIPES AND PLATFORM SUPPORT COLUMN, INTERIOR OF ALTITUDE CHAMBER L, FACING EAST.

FL-8-11-E-39 DETAIL OF FIRE HOSE ON 16’-8” LEVEL OF INTERNAL PLATFORMS, ALTITUDE CHAMBER L, FACING NORTHWEST.

RELEASED - Printed documents may be obsolete; validate prior to use.

FL-8-11-E-40 EXTERIOR VIEW OF AIRLOCK FOR ALTITUDE CHAMBER R, FACING SOUTHEAST.

FL-8-11-E-41 EXTERIOR AND INTERIOR VIEW OF AIRLOCK FOR ALTITUDE CHAMBER R, FACING SOUTH.

FL-8-11-E-42 INTERIOR OF AIRLOCK FROM INTERIOR OF ALTITUDE CHAMBER R, FACING NORTHWEST.

FL-8-11-E-43 DETAIL VIEW OF BRIDGE CRANE USED TO LIFT DOMED LIDS OF THE ALTITUDE CHAMBERS, FACING SOUTHWEST.

FL-8-11-E-44 VIEW OF THE CONTROL ROOM FOR THE ALTITUDE CHAMBERS, FACING SOUTHWEST.

FL-8-11-E-45 VIEW OF PUMP ROOM FOR ALTITUDE CHAMBERS, FACING SOUTHWEST.

Photograph Nos. FL-8-11-E-46 through FL-8-11-E-59 are photocopies of engineering drawings, and are 8” x 10” enlargements from 4” x 5” negatives. Original drawings are located at the Engineering Documentation Center, KSC, Florida.

FL-8-11-E-46 Photocopy of drawing
SPACECRAFT INDUSTRIAL AREA, O&C BUILDING, A&T AREA, ALTITUDE CHAMBER “L”
NASA, John F. Kennedy Space Center, Florida
Drawing 79K00213, U.S. Army Corps of Engineers, no date
SYSTEM FUNCTIONAL DRAWING
Sheet 2

FL-8-11-E-47 Photocopy of drawing
ALTITUDE CHAMBERS “L” & “R” STRUCTURES
NASA, John F. Kennedy Space Center, Florida
Drawing 68-K-L-11213, NASA KSC, November, 1968
CHAMBER “L” ELEVATION
Sheet 3

RELEASED - Printed documents may be obsolete; validate prior to use.

FL-8-11-E-48 Photocopy of drawing
ALTITUDE CHAMBERS “L” & “R” STRUCTURES
NASA, John F. Kennedy Space Center, Florida
Drawing 68-K-L-11213, NASA KSC, November, 1968
CHAMBER “R” ELEVATION
Sheet 4

FL-8-11-E-49 Photocopy of drawing
ALTITUDE CHAMBERS “L” & “R” STRUCTURES
NASA, John F. Kennedy Space Center, Florida
Drawing 68-K-L-11213, NASA KSC, March, 1971
DOOR LATCH MECHANISM & DOOR LATCHING RATCHET
Sheet 14

FL-8-11-E-50 Photocopy of drawing
ALTITUDE CHAMBERS “L” & “R” STRUCTURES
NASA, John F. Kennedy Space Center, Florida
Drawing 68-K-L-11213, NASA KSC, November, 1968
WORK PLATFORM DETAIL
Sheet 6

FL-8-11-E-51 Photocopy of drawing
SPACECRAFT INDUSTRIAL AREA, O&C BUILDING, A&T AREA, ALTITUDE CHAMBER “L”
NASA, John F. Kennedy Space Center, Florida
Drawing 79K00213, U.S. Army Corps of Engineers, no date
SHELL PENETRATION LAYOUT
Sheet 3

FL-8-11-E-52 Photocopy of drawing
SPACECRAFT INDUSTRIAL AREA, O&C BUILDING, A&T AREA, ALTITUDE CHAMBER “L”
NASA, John F. Kennedy Space Center, Florida
Drawing 79K00213, U.S. Army Corps of Engineers, no date
SHELL PENETRATION SCHEDULE
Sheet 4

RELEASED - Printed documents may be obsolete; validate prior to use.

FL-8-11-E-53 Photocopy of drawing
SPACECRAFT INDUSTRIAL AREA, O&C BUILDING, A&T AREA, ALTITUDE CHAMBER "R"
NASA, John F. Kennedy Space Center, Florida
Drawing 79K00214, U.S. Army Corps of Engineers, no date
SHELL PENETRATION LAYOUT
Sheet 3

FL-8-11-E-54 Photocopy of drawing
SPACECRAFT INDUSTRIAL AREA, O&C BUILDING, A&T AREA, ALTITUDE CHAMBER "R"
NASA, John F. Kennedy Space Center, Florida
Drawing 79K00214, U.S. Army Corps of Engineers, no date
SHELL PENETRATION SCHEDULE
Sheet 4

FL-8-11-E-55 Photocopy of drawing
ALTITUDE CHAMBER LIGHTING MODS., O&C BUILDING
NASA, John F. Kennedy Space Center, Florida
Drawing 203-644, U.S. Army Corps of Engineers, May, 1967
LIGHTING LAYOUT, LEFT CHAMBER
Sheet 5

FL-8-11-E-56 Photocopy of drawing
ALTITUDE CHAMBER LIGHTING MODS., O&C BUILDING
NASA, John F. Kennedy Space Center, Florida
Drawing 203-644, U.S. Army Corps of Engineers, February, 1967
LIGHTING LAYOUT, RIGHT CHAMBER
Sheet 4

FL-8-11-E-57 Photocopy of drawing
RIGHT ALTITUDE CHAMBER REACTIVATION
NASA, John F. Kennedy Space Center, Florida
Drawing 82K06032, Boeing, December, 1997
15 FT LEVEL EQUIPMENT LAYOUT
Sheet E13

RELEASED - Printed documents may be obsolete; validate prior to use.

FL-8-11-E-58 Photocopy of drawing
RIGHT ALTITUDE CHAMBER REACTIVATION
NASA, John F. Kennedy Space Center, Florida
Drawing 82K06032, Boeing, December, 1997
ACCESS PLATFORM DEMOLITION
Sheet S1

FL-8-11-E-59 Photocopy of drawing
RIGHT ALTITUDE CHAMBER REACTIVATION
NASA, John F. Kennedy Space Center, Florida
Drawing 82K06032, Boeing, December, 1997
ACCESS PLATFORM INSTALLATION
Sheet S2

RELEASED - Printed documents may be obsolete; validate prior to use.