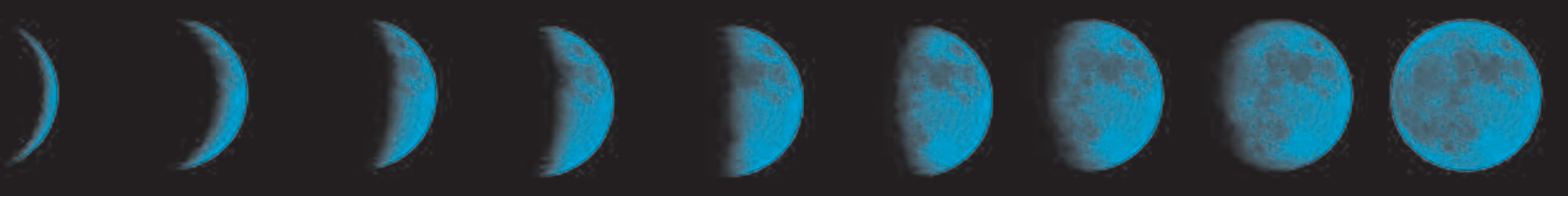


APOLLO SPACE SUIT

1962–1974

Frederica, Delaware

A HISTORIC MECHANICAL ENGINEERING LANDMARK

SEPTEMBER 20, 2013

ILC DOVER
creating what's next

ASME
SETTING THE STANDARD

History of the Apollo Space Suit

International Latex Corporation (ILC) was founded in Dover, Delaware in 1937 by Abram Nathanial Spanel. Mr. Spanel was an inventor who became proficient at dipping latex material to form bathing caps and other commercial products. He became famous for ladies apparel made under the brand name of Playtex that today is known worldwide. Throughout WWII, Spanel drove the development and manufacture of military rubberized products to help our troops. In 1947, Spanel used the small group known as the Metals Division to develop military products including several popular pressure helmets for the U.S. Air Force.

Based upon the success of the pressure helmets, the Metals Division, which became known as the Specialty Products Division in 1955, began designing and manufacturing pressure suits when they were awarded a contract to supply a prototype suit for the X-15 program. This suit was identified as the model XMC-2-ILC suit. That suit was not selected to support the X-15 program but it did possess excellent mobility when pressurized. This mobility was possible because of the advanced latex-dipped joints. Seeing how good the mobility was, the Air Force continued to award small development contracts to ILC to further evolve this suit for other possible uses. At the same time, there was a general agreement within ILC that a manned space program was on the horizon and that the ILC suit stood a good chance of beating any competition. As fortune would have it, NASA requested that bids for the Apollo Lunar suits be submitted by December 1, 1961. This was for the engineering design, development and construction of the pressure suits to support the lunar missions. These would be the first autonomous extra-vehicular activity (or EVA) space suits used on an extra-terrestrial surface. Eight companies including ILC submitted proposals. In March, 1962, ILC was selected as the winner of the competition with the model AX1L suit that was a direct outgrowth of the XMC-2-ILC suit.

Since NASA was developing all of the Apollo systems including the capsule and the Lunar Module at the same time that the ILC Apollo suits were being developed, the suit design and performance requirements became a moving target. Following several variations of suit designs between 1962 and 1965, the nearly final version began to appear in the model A5L suit. By 1968, ILC produced the final lunar version, the model A7L suit. This model would be used on Apollo 7 through Apollo 14 including the first lunar mission of Neil Armstrong and Buzz Aldrin on Apollo 11. Further design improvements were made to improve mobility for astronauts on Apollo 15 through 17 who needed to sit in the lunar rovers and perform more advanced mobility exercises on the lunar surface. This suit was known as the model A7LB. A slightly modified ILC Apollo suit would also go on to support the Skylab program and finally the American-Soyuz Test Program (ASTP) which concluded in 1975. During the entire time the Apollo suit was produced, manufacturing was performed at both the ILC plant on Pear Street in Dover, Delaware, as well as the ILC facility in Frederica, Delaware. In 1975, the Dover facility was closed and all operations were moved to the Frederica plant.

The Apollo suits were used on eleven missions from 1968 until 1972 (see History Log) resulting in 158 combined hours on the lunar surface. There was never a mission that had to be cut short or cancelled due to a problem with the Apollo space suits. They would go on to be the basis of iconic image of man on the moon in photos of Buzz Aldrin and the eleven others who traversed the lunar surface.

The displayed landmark Apollo suit at the ILC Dover company museum is the Model A7L, serial number 036, delivered to NASA in September, 1968. It was manufactured as a primary flight suit for Astronaut Edwin (Buzz) Aldrin as a member of the Apollo 8 backup crew. Aldrin then used it as his primary training suit for the Apollo 11 mission where it played a critical role in helping him develop skills for lunar exploration. The same model suit was used on Apollo 11, the first successful lunar mission, during which both Aldrin and Neil Armstrong were the first humans to set foot on the moon. This suit was later returned to ILC Dover by NASA so that it could be modified as a training suit to support Astronaut William Pogue for the Skylab Mission he flew in November 1973.

Engineering
Significance

For the Apollo astronauts who ventured into space outside of their pressurized capsules and Lunar Modules, the hazards were severe. They included a hard vacuum, exposure to cosmic and solar radiation, possible impacts by micrometeoroid particles traveling at high velocities and a range of surface temperatures between +/- 300 °F (+/-150 °C). At the same time, these protective systems had to provide an excellent fit while permitting as much freedom of mobility as possible so all mission plans could be carried out safely and successfully. One of the more significant challenges was to keep the profile of the pressurized suit as compact as possible so that the three astronauts could comfortably operate side-by-side in the tight Command Module. That meant that the suits served a dual-purpose: both as an intravehicular activity (IVA) suit as well as an extravehicular activity (EVA) suit. Although the Command and Lunar Modules were pressurized during all phases of flight, if a problem occurred during critical stages and pressure was lost, the suits would keep the astronauts alive and possibly allow a safe landing on Earth. They were designed to be used as a constant-wear pressure garment for up to 120 hours should all pressure be lost onboard the Command Module on its trip to the moon and back. This required feed ports in the helmet and a pass-through fitting for urine management. Other mission requirements included interfacing the suit systems with the space vehicles.

The Apollo space suit consisted of three major components as outlined in the Apollo Space Suit U.S. patent number 3,751,727, filed in August 1968. They include:

1. *The inner comfort liner*
2. *An intermediate pressure garment assembly providing a controlled atmosphere within the garment without excessively inhibiting astronaut mobility*
3. *The outer insulating and protective layer referred to as the thermal micrometeoroid garment (TMG) that contained several layers of aluminized Mylar® and spacer fabrics to reflect radiation as well as reduce thermal conductivity. This was encapsulated by the outer-most Beta Cloth cover-layer that provided fire protection*

Arguably, one of the most important challenges was to provide an encapsulating, pressurizable garment that permitted as close to a full range of body-joint motion as in the nude condition. When an elbow or knee bends, the fabric cylinder containing the pressurized gas surrounding the joint has to allow that gas some place to go so that the wearer is not compressing the air and as a result, unnecessarily expending muscle energy. The solution came with the convoluted, latex-dipped joints that maintained a near constant-volume enclosure around all of the flexible body joints. Thus, when the suit was pressurized at 3.8 lb/in^2 (26 kPa) the suit provided excellent mobility. Steel cables along both sides of the convolutes as well as other key locations about the suit restrained the growth when under pressure and provided added security when astronauts were adding mechanical loads such as pulling and pushing on tools or bounding about on the lunar surface.

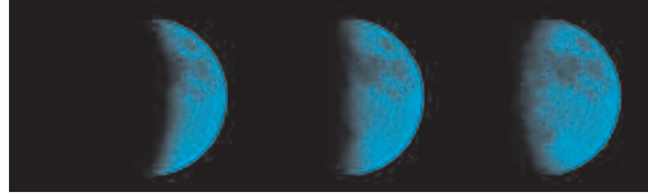
Suit Operation

The Apollo space suits provided all of the necessities and life support required for autonomous operations on the lunar surface. Some of the main features included:

- Pure oxygen airflow at the continuous rate of 6 ft^3/min (170 LPM)
- Suit pressurization at 3.8 lb/in^2 (26 kPa) (absolute pressure)
- A continuous flow of cooling water provided to the liquid cooling garment
- Radio communications back to Earth as well as signal telemetry containing heart rates and suit conditions

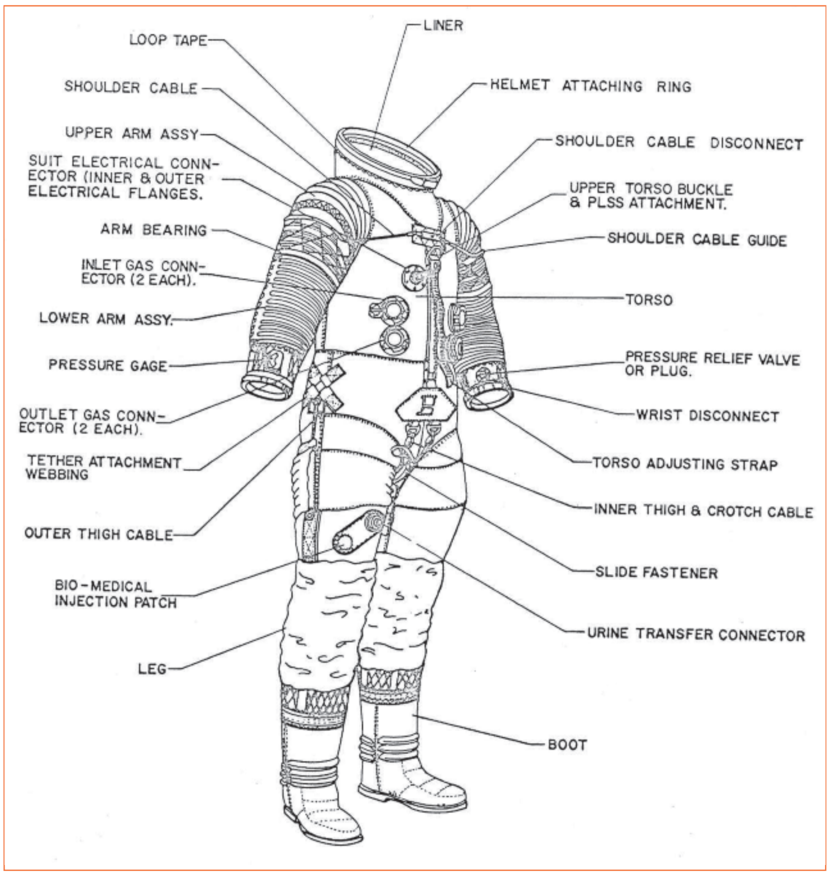
In addition to the time these suits spent on the lunar surface, they were also used by several astronauts who stepped outside of the Command Module into deep space as they ventured between the earth and the moon so that they could retrieve science packages and film cartridges that were placed outside the vehicle.

Every part of the Apollo space suits served an important purpose. The following sections highlight the most significant components.



Torso-limb Suit Assembly

The overall sketch of the pressure restraint garment with the outer cover-layers removed for clarity of the details is shown below. This was also referred to as the Torso-Limb Suit Assembly or TLSA. It is a one-piece garment with all components integrated. The gloves and helmet were removable. The externally worn lunar boots and the primary life support system (or backpack) were also separate components assembled onto the suit when leaving the Lunar Module to walk on the moon.



The suit consisted of a torso assembly onto which the arms, legs and boots were permanently integrated. These components were custom-tailored for each astronaut based on hundreds of individual body dimensions. Additionally, lacing cords were provided on the arms and legs that allowed engineers to make minor sizing adjustments based on input from the crewmember during the final fit check that took place just months or weeks prior to the launch.

Upper-arm bearings permanently integrated onto the assembly were provided for both the Lunar Module pilot and the commander who would need all of the mobility possible when on the moon. The Command Module pilot did not have arm bearings since they took up precious width onboard the Command Module and were not needed for his activities.

Two separate zipper closures were installed in the torso to allow donning and doffing of the suit. The internal zipper was the pressure closure that maintained oxygen pressure within the suit during operations. The outer zipper, or "slide fastener," overlaid the pressure closure and maintained structural integrity and assured that the pressure closure was never structurally loaded.

A tether attachment bracket was provided on each side of the waist where tethers from the floor of the Lunar Module would be attached to secure the astronauts when standing inside the Lunar Module during the decent and assent. No seats were provided in order to keep weight to a minimum. During the periods of zero-gravity on descent and ascent and because of the possibility of a rough landing, the tether would secure them in place at all times.

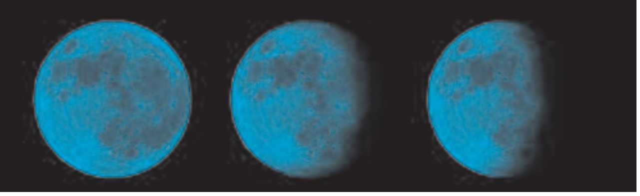
An electrical connector was provided on the torso for the pass-through of the communications system as well as biomedical signals that would be broadcast back to NASA doctors who would monitor astronauts' conditions.

Various steel cables were integrated into the suit in areas such as the outer and inner thigh and shoulders so that the shape of the suit would be maintained at all times while maintaining the structural loading necessary to assure that the suit would provide complete integrity when stressed under pressure and mechanical loads. The shoulder cable was routed through a steel tube formed to take the shape of the outer shoulder. This permitted the full range of shoulder motion.

A bio-medical injection patch was provided in the event that the astronauts had to give themselves a shot as directed by NASA flight doctors. The chances of doing so were remote and it was never used, but testing showed that the self-sealing soft durometer rubber would seal the hole when the needle was removed.

Hardware attachment rings were provided for the helmet and gloves. The suited astronaut could easily attach or remove the helmet or gloves via the simple yet secure attachment system.

A urine collection and transfer connector was in place in the event of an extended period of depressurization in either module.

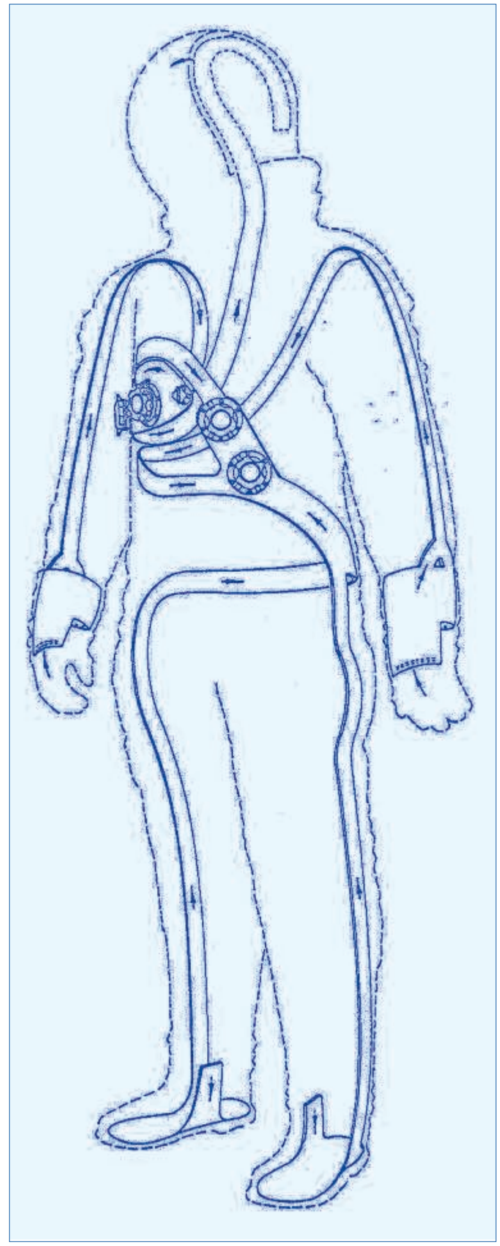


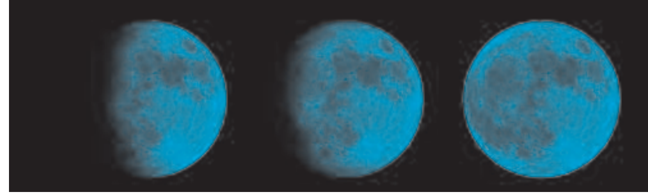
Ventilation
System

The suit provided oxygen via one of two inlet gas connectors on the chest. Oxygen would flow directly to the helmet through an internal vent duct thus providing clean, pure oxygen at either 6 ft^3/min (170 LPM) or 12 ft^3/min (340 LPM) based on the setting of a diverter valve also located on the chest. When connected to the oxygen supply on board the Command or Lunar Module, the flow rate was 12 ft^3/min (340 LPM) and the crewmember could divert 50% of the flow to the hands and legs by rotating the diverter valve, with the other 50% directed to the helmet. The air vent system integrated into the suit restraint provided the path for the oxygen flow both in and out. When connected to the backpack on the lunar surface, the flow was limited to 6 ft^3/min (170 LPM) so that 100% of the oxygen was directed to the helmet. Two outlet connectors on the chest removed the spent oxygen that was now mixed with the exhaled carbon dioxide and added humidity. This spent gas was recirculated either through the spacecraft or the backpack where the carbon dioxide and the humidity were scrubbed out for recirculation.

When setting up the suits in preparation for the extravehicular walk on the lunar surface, the astronauts attached oxygen hoses from the Lunar Module (both inlet and outlet) while at the same time attaching to the inlet and outlet hoses of the portable backpack. Once the pressure in the Lunar Module was reduced to the hard vacuum of the moon and the suits were pressurized at 3.8 lb/in^2 (26 kPa), the backpack would become the sole source for the suit pressure and the astronauts would disconnect from the Lunar Module and descend the ladder to the surface. The suit inlet and outlet fitting for the Lunar Module interface both sealed closed once the hoses were removed. They would reverse the process upon reentry to the Lunar Module.

A pressure relief valve ensured protection in the event that the internal pressure exceeded approximately 4.2 lb/in^2 (29 kPa), at which point the extra pressure would be harmlessly vented.



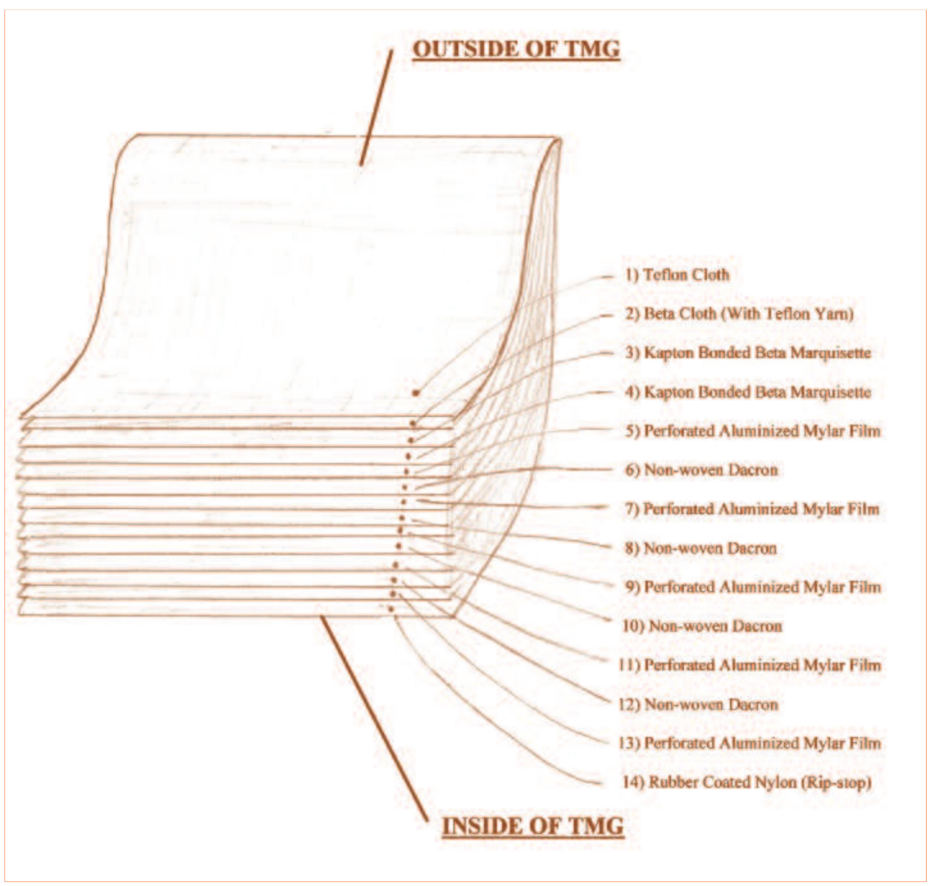


Thermal Micrometeoroid

Garment

The outer cover assembly of the Apollo suit consisted of many plied-up layers of materials that protected against micrometeoroid impacts, solar and galactic radiation, thermal conduction and abrasion. The outer cover also provided fire protection. This cover layer was securely attached to the pressure garment during the production process and was not removable by the crew. Because of that, it was also referred to as the "Integrated" Thermal Micrometeoroid Garment or ITMG.

The outermost layer of the TMG consisted of a TeFlou® fabric that provided good thermal radiation control and was slippery to minimize dust accumulation. The second layer was known as Super Beta Cloth. Following the Apollo 1 fire that took the lives of three astronauts, ILC worked with NASA and Owens Corning to develop this woven fiberglass fabric. This new material protected against temperatures up to 1,200 °F (649 °C) that could occur during launch pad fires, thus giving the astronauts a better chance to escape the capsule. The Super Beta Cloth yarns were coated with a Teflon® extrusion prohibiting self-abrasion during strenuous activity. The next eleven layers consisted of alternating plies of Mylar® film, Dacron® and Beta Marquisette that worked together to shield the astronaut against the solar and galactic radiation on the lunar surface. This combination of layers also served as a barrier against possible micrometeoroid impacts that could strike the suit at a speed of 44,000 ft/sec (13.4 km/sec). If this were to have occurred, these microscopic particles would explode on the suit's surface, decelerate as the finer particles moved through the multi-layers and be absorbed by the inner liner of the neoprene-coated nylon fabric.



DuPont, another Delaware-based company, led the development of many materials originally intended for use on Earth. However, with their superior properties, many advanced synthetic materials were selected by ILC for the moon suits.

Lunar Boots

The boot sole consisted of a molded silicone rubber with the upper portion consisting of Beta Cloth and layers of aluminized Mylar® and Dacron® spacer fabric as in the torso cover layer. In addition, the boots were wrapped in a woven chromium steel fabric called Chromel-R. This provided a cut-resistant protective barrier between the astronaut's pressurized boot and potentially sharp rocks that they might come into contact with. A strap-and-snap assembly was used to secure the lunar boots over the pressure garment boots.

Gloves

Each Apollo crewmember had one pair of neoprene natural rubber dipped gloves that were structurally supported by layers of Dacron® tricot cloth between dipping cycles.

The gloves also had wire cables integrated into them that would maintain structural support while affording good flexibility in all directions. The two crewmembers who performed the extra-vehicular activities also had another similar pair of gloves that had a protective cover of a multi-layer thermal barrier and an outer layer of the Chromel-R chromium steel fiber cloth across the palm area and in the fingers to prevent cutting should they come into contact with sharp rocks, tools, etc. They also included silicone finger-tips tips to aid in picking up objects.

Helmets

The polycarbonate pressure helmet was worn at all times when the suit was in use.

The helmet provided a feed port in the event of an emergency requiring long-term suit pressurization. A tube containing a paste-like food nutrient could be inserted through the port where the astronaut could access it by mouth.

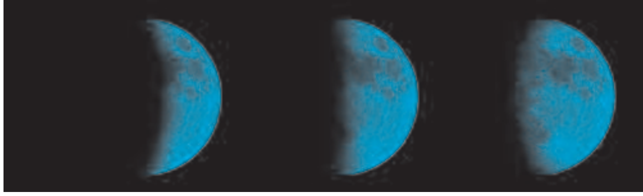
Worn over the pressure helmet was the extravehicular visor assembly or EVVA.

The EVVA had a latch device that would open around the lower front section and allow it to pass over the pressure helmet and attach in place for activities on the lunar surface. This unit had a protective visor made of polycarbonate and another gold-coated polysulfone visor that could be pulled down to shade the eyes from intense solar energy. It also included a center eye shade that could be pulled down halfway as well as two full-retracting side shades, all of which were opaque and could shield the sun completely.

The backpack, the lunar boots, lunar gloves and the EVVA were all thrown out on the lunar surface just prior to liftoff to offset the weight of the rocks collected for return to Earth.

Developmental Personnel

The credit for the development of this suit goes to those engineers who had a vision of how to make pressurized suits fit humans throughout their full range of motion while providing protection under extreme conditions. Further credit goes to the seamstresses who would take the engineering ideas and sew the pieces of fabric together to function properly while providing high reliability. In some instances, the tolerance on a sewn seam was +/- 1/32 in. (0.79 mm). These seamstresses knew that the suit they were assembling would be the barrier between life and certain death if a failure occurred. As one Apollo astronaut would write on a note to the ILC seamstresses, "I would hate to have a tear in my pants while on the moon."



The U.S. patent for the Apollo space suit recognized eight ILC Inventors who were responsible for the early development of that suit:

Leonard F. Shepard, Program Manager, Apollo space suit 1965–1968

George P. Durney, Senior Development Engineer, Apollo space suit

Melvin C. Case, Design Engineer

A. J. Kenneway III, Design Engineer

Robert C. Wise, Design Engineer

Dixie Rinehart, Design Engineer

Ronald J. Bassette, Design Engineer

Richard C. Pulling, Design Engineer

Other engineers not listed as inventors but just as significant to the suit development throughout the program include:

Homer Reihm, Program Manager, 1968–1975

John Scheible, Design Engineer

John McMullen, Systems Engineer

Bob Wood, Design Engineer

Aside from the significant contributions from the talented engineering staff, others played a major role. These include:

Eleanor Foraker, Seamstress and Group Leader

Ceil Webb, Seamstress and Group Leader

Roberta Pilkington, Seamstress

Iona Allen, Seamstress

Clyde Wasylkowski, Quality Lead Inspector

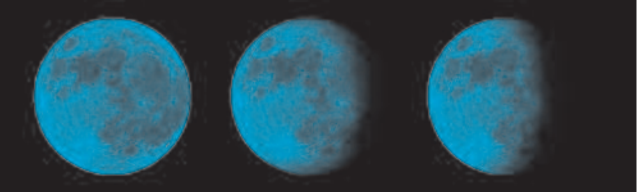
Madeline Ivory, Quality Inspector

Tom Townsend, Model Maker

Kenny Dennis, Model Maker

Sid Williams, Draftsman

At its peak in 1969, ILC employed almost 900 individuals, many of whom worked on the Apollo program. It is impossible to list everyone here who played a significant role in the success of the suits' performance over the years. Those who did recalled years later how magnificent it felt watching Neil Armstrong and the others step onto the lunar surface wearing a garment they had a direct part in making.



History Log

The following is an outline of all Apollo missions that utilized the ILC A7L and A7LB model space suits.

APOLLO 7 | **OCT. 11–22, 1968** | **MODEL A7L SUIT**

Wally Schirra
Walt Cunningham
Don Eisele

PURPOSE: To test the Apollo Command and Service Module as well as the control and guidance systems while in Earth's orbit. There were no extravehicular activities (EVAs) on this mission. The suits were used for launch and reentry. Disregarding strict procedures, however, Cunningham decided against putting the helmet on during reentry due to a cold he was suffering from. This decision, in part, cost him the chance for any future Apollo missions.

APOLLO 8 | **Dec. 21–27, 1968** | **MODEL A7L SUIT**

Frank Borman
James Lovell
William Anders

PURPOSE: This was the first time humans traveled beyond the gravity of Earth and ventured to the moon. This mission was a test of all systems required to get us to the moon, orbit it and then return successfully to Earth. The space suits were used for launch and reentry only.

APOLLO 9 | **MARCH 3–13, 1969** | **MODEL A7L SUIT**

James McDivitt
Dave Scott
Russell Schweickart

PURPOSE: The Apollo 9 mission was the first test of the Apollo space suits as well as the first to fly the Lunar Module (LM) in outer space. This mission remained in low Earth orbit as astronauts extracted the LM and docked/undocked with the Command Module (CM) for the first time. Schweickart performed a spacewalk between the CM and the LM while using the primary life support system (or backpack) and thus was not dependent on any internal spacecraft systems – also a first. The total EVA time in space was 37 minutes.

APOLLO 10 | **MAY 18–26, 1969** | **MODEL A7L SUIT**

Thomas Stafford
John Young
Eugene Cernan

PURPOSE: The Apollo 10 mission was intended to be a full-up lunar landing mission with the exception of touching down on the surface of the moon. Both Cernan and Stafford flew the lander to within 8 miles (13 km) of the lunar surface in order to check out all systems. It was a success and paved the way for the Apollo 11 mission to follow. No EVAs were performed on this mission.

APOLLO 11 | **JULY 16–24, 1969** | **MODEL A7L SUIT**

Michael Collins
Buzz Aldrin
Neil Armstrong

PURPOSE: The Apollo 11 mission was the first manned landing and EVA using the Apollo suits. Both Armstrong and Aldrin spent a total of 2 hours and 32 minutes walking on the lunar surface as they tried out the suits and other equipment while gathering rock samples to bring back to geologists. Armstrong reported that moving around on the moon's surface was perhaps easier than the simulations on Earth. As with the missions to follow, the lunar boots, lunar visor assemblies and the back packs were thrown out on the surface prior to liftoff from the moon to offset the weight of lunar rock cargo.

APOLLO 12 | **NOV. 14–24, 1969** | **MODEL A7L SUIT**

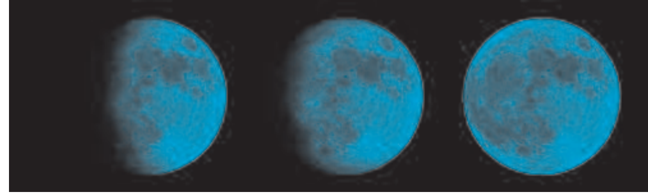
C. Peter Conrad
Richard Gordon
Alan Bean

PURPOSE: The Apollo 12 mission landed within 600 feet (183 m) of the Surveyor 3 spacecraft that was sent there in 1967. Both Conrad and Bean spent a total of 7 hours and 27 minutes on the lunar surface gathering rock samples as well as parts from the Surveyor for study back on Earth. Conrad lost his footing at one point and actually fell but there were no problems with the suit, thus helping to validate its design and fabrication.

APOLLO 13 | **APRIL 11–17, 1970** | **MODEL A7L SUIT**

James Lovell
Jack Swigert
Fred Haise

PURPOSE: While approximately 200,000 miles from Earth and on the way towards the moon, an oxygen tank ruptured onboard the service module, putting an end to the lunar mission. The crew did survive but other than launch and re-entry, the suits were not used for any EVA activity.



APOLLO 14 **JULY 26–AUG. 7, 1971** **MODEL A7L SUIT**

Alan Shepard
Stuart Roosa
Edgar Mitchell

PURPOSE: The Apollo 14 crew consisting of Mitchell and Shepard touched down at Fra Mauro, which was the intended landing area for the Apollo 13 crew. The total EVA time was 9 hours, 35 minutes, split between two separate lunar walks. This crew used orange stripes on the legs and helmets of the mission commander since otherwise the two suits looked alike on camera. On their second excursion, the plan was for both crew members to venture a total distance of 1.8 miles (2.9 km) from the LM which was determined to be as far as safely possible. Both astronauts took turns pulling a small rickshaw designed to carry cameras and tools necessary to study the lunar surface along the way. Also packed on this rickshaw was a special 8-foot (2.4 m) long umbilical called the Buddy Secondary Life Support System, or BSLSS, that could connect both suits in the event that one of the suits' cooling systems failed. This umbilical would then connect between the suits and share cooling water. Fortunately this was never an issue and the mission was a success.

APOLLO 15 **JULY 26–AUG. 7, 1971** **MODEL A7LB SUIT**

Dave Scott
Alfred Worden
James Irwin

PURPOSE: Apollo 15 was the first crew to use the new A7LB version suit that provided improved mobility and permitted the crew to sit comfortably in the lunar rover that was used to expand the travel distance from the LM. A total of three EVAs were performed on the lunar surface for a total of 18 hours and 7 minutes. The rover allowed the astronauts to travel a total of about 28 miles (45 km) on the moon's surface in order to collect some of the best rock samples including the Genesis Rock, believed to be from the original lunar crust and more than four billion years old.

APOLLO 16 **APRIL 16–27, 1972** **MODEL A7LB SUIT**

John Young
Thomas "Ken" Mattingly
Charles Duke

PURPOSE: Young and Duke spent a total of 19 hours and 14 minutes exploring the lunar surface during three separate EVAs. This mission explored some of the most rugged terrain and the suits performed flawlessly. Duke admitted after the mission that he had trouble donning his suit for the EVAs because he did not take into account during his suit fittings here on Earth the fact that his total body length would grow about 1.5 inches (38.1 mm) due to the lack of gravity. As a result, he had to squeeze himself into the suit more than expected.

APOLLO 17 **DEC. 7–17, 1972** **MODEL A7LB SUIT**

Eugene Cernan
Ronald Evans
Harrison Schmitt

PURPOSE: Apollo 17 was the last mission to the lunar surface. Schmitt was the only geologist to travel to the moon and as a result he worked the suit very hard as he gathered samples from the surface and used tools that required a lot of energy and mobility. Both Cernan and Schmitt spent a total of 22 hours and 5 minutes in three separate EVAs. They both treated their suits roughly on this mission since previous experiences on prior missions led them to feel very secure. Out of all of the Apollo suits in the collection at the Smithsonian Air & Space Museum, Schmitt's is considered the dirtiest – still covered in lunar dirt – thus providing evidence that he did not pamper his suit. This was the only mission where the astronauts brought back their lunar boots and did not leave them on the moon. They now reside in the Smithsonian Air and Space Museum in Washington, DC.

BEYOND APOLLO 17

NASA had originally intended to have an additional nine Saturn rockets and lunar landers beyond the first manned landing (Apollo 11) mission (up to Apollo 20). However, due to budget concerns and a lack of interest on the part of the Nixon administration, those final missions were cancelled. The Apollo hardware that remained was used to support the Skylab and Apollo-Soyuz Test Program (ASTP). Both of these missions utilized a modified ILC manufactured Apollo model suit.

Only two years after the last ASTP mission that utilized the Apollo-style suits, ILC secured the contract for the Space Shuttle EVA space suits. These suits went on to provide 248 EVAs totaling 1002 hours of safe operation. Routine Shuttle activities included numerous satellite missions as well as four visits to the Hubble Space Telescope and the interaction with a countless number of external science experiments. Another notable accomplishment was the record setting accumulation of EVA time spent on building the International Space Station, where ILC suits are still in use today.

While building on the knowledge gained from Apollo and the Space Shuttle EVA suits, ILC continues to develop new space suits perhaps to be used some day on the surface of Mars.

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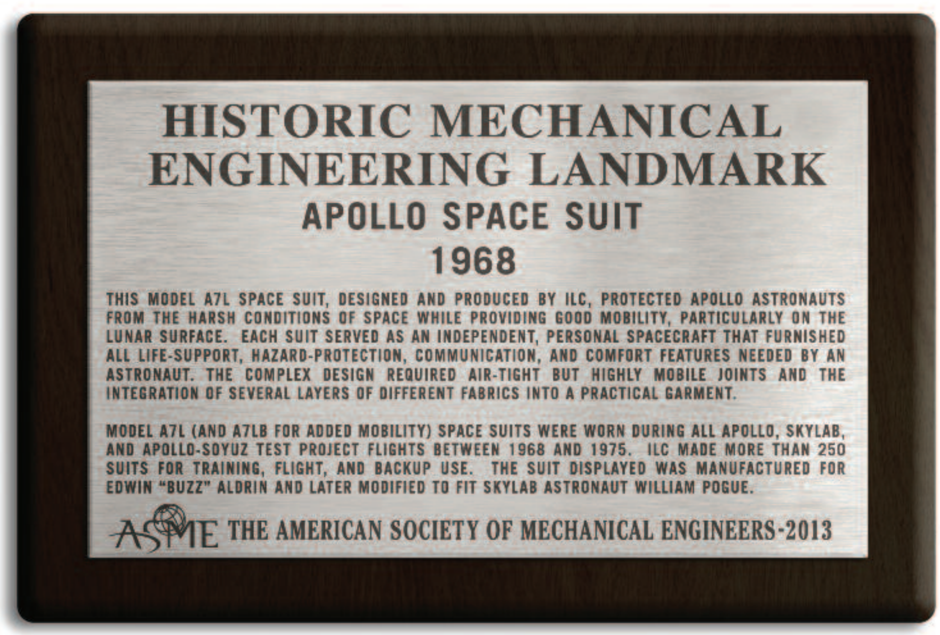
ACKNOWLEDGMENTS

The nomination of the Apollo Space Suit as a mechanical engineering landmark was suggested by Raymond L. Jackson, then chair of the DelMarVa ASME Subsection and was submitted by ASME member Scott L. Davidson, P.E. Special thanks to William K. Ayrey, Quality Manager and Company Historian of ILC Dover for his dedicated efforts in providing and organizing the historical information for the nomination and this brochure. Also thanks to ILC Dover for the financial support to make this designation possible. The DelMarVa Subsection also thanks Wil Haywood of ASME Public Information and ASME History & Heritage Committee members Richard Pawliger, chair, and Robert Woods for their encouragement and support.



THE HISTORY AND HERITAGE PROGRAM OF ASME

Since the invention of the wheel, mechanical innovation has critically influenced the development of civilization and industry as well as public welfare, safety and comfort. Through its History and Heritage program, the American Society of Mechanical Engineers (ASME) encourages public understanding of mechanical engineering, fosters the preservation of this heritage and helps engineers become more involved in all aspects of history.

In 1971 ASME formed a History and Heritage Committee composed of mechanical engineers and historians of technology. This Committee is charged with examining, recording and acknowledging mechanical engineering achievements of particular significance. For further information, please visit http://www.asme.org.

LANDMARK DESIGNATIONS

There are many aspects of ASME's History and Heritage activities, one of which is the landmarks program. Since the History and Heritage Program began, 254 artifacts have been designated throughout the world as historic mechanical engineering landmarks, heritage collections or heritage sites. Each represents a progressive step in the evolution of mechanical engineering and its significance to society in general.

The Landmarks Program illuminates our technological heritage and encourages the preservation of historically important works. It provides an annotated roster for engineers, students, educators, historians and travelers. It also provides reminders of where we have been and where we are going along the divergent paths of discovery.

ASME helps the global engineering community develop solutions to real world challenges. ASME, founded in 1880, is a not-for-profit professional organization that enables collaboration, knowledge sharing and skill development across all engineering disciplines, while promoting the vital role of the engineer in society. ASME codes and standards, publications, conferences, continuing education and professional development programs provide a foundation for advancing technical knowledge and a safer world.

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A HISTORIC MECHANICAL ENGINEERING LANDMARK

SEPTEMBER 20, 2013

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