

54th IAA HISTORY OF ASTRONAUTICS SYMPOSIUM (E4)
Scientific and Technical Histories (2)

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THE TECHNICAL EVOLUTION OF SPACESUITS

Abstract

The human exploration of the Solar System, particularly of the Moon and of Mars, is the pioneering goal of the 21st century space race of all space agencies and of private stakeholders worldwide. Since the dawn of crewed space exploration following the Second World War, providing an adequate protection to the astronauts from the hostile space environment has been an imperative requirement. Spacesuits cannot be considered only garments, but vital tools essential for the success of any exploring mission. If in the past the spacesuits were considered only for the protection of the crew, considering also that missions were extremely short; nowadays, planning long-term missions that could last even years, the suit is no longer just for survival, but also for living and working in space. The new generation of spacesuits must therefore not only be very efficient against all environmental hazards, but also be comfortable, in order to allow mobility as similar as possible to the one on Earth. The aim of this paper is to provide an overview on the chronological evolution of the spacesuits, comparing the design of those of cosmonauts and of astronauts from the 1960s. For the Mercury program, NASA decided to only modify the high-altitude jet-aircraft pressure suits already in use at the US Navy, just in case of an accidental decompression of the cabin. For the Gemini missions, more flexible and comfortable suits were designed, in particular the G4C suit was developed for extra-vehicular activities (EVA). Similarly, also Russians decided to adapt the suits already in use by the military pilots for the stratospheric flights to create the SK-1 suit, used by Gagarin and for all the following Vostok missions. A female version of this suit, named SK-2, was produced for Valentina Tereshkova. In view of the first spacewalk of Sergey Korolev, Russians developed the Berkut full pressure suit, suitable for both intra-vehicular activity (IVA) and EVA periods. The Moon race boosted the development of more and more protective, but still flexible, suits in both countries. Since the 1980s, astronauts of the Space Shuttle era, and now of the International Space Station (ISS), have performed several extra vehicular activities, using the Extravehicular Mobility Unity (EMU). Astronauts currently flying to the ISS with the Soyuz wear the Russian Sokol or Falcon suit. The need for increasingly performing spacesuits has led to great technological progress in the material science. For this reason, new materials and architectures currently under research and futures trends are analysed in this review.