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Astronaut Training, Accommodation, and Operations in Space (5)

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EUROPEAN MAINTENANCE AND REPAIR SKILLS COURSE FOR ASTRONAUTS

Abstract

Being permanently operated since 1998, the International Space Station requires regular inspection, maintenance and repair by the on-board crewmembers. Those tasks are usually foreseen in advance, trained on ground and performed on orbit following procedures with real time ground support. Crew must have experience in working with the variety of tools and spares components available on board. Furthermore, in comparison to LEO missions, future exploration scenarios beyond ISS, imply a delay in communication with Ground Control and even more limited re-supply capabilities, assuming a much higher level of crew autonomy and ability to assess and implement solutions independently from the ground. Recognizing this trend, the European Space Agency had identified the maintenance and repair skills training requirements, and commissioned the design and development of a Maintenance and Repair Skills Course to a consortium formed by Space Application Services, a Belgium independent company with 30 years' experience in space business the Dr. Reinold Hagen Stiftung, a German non-profit foundation with years of experience in vocational training for automotive and production industry. Under the coordination of the Astronaut Training Division at the European Astronaut Centre, a 7-days course was designed, developed and implemented covering mechanical, electrical electronics, hydraulic pneumatic and integrated skills, during which the astronauts could learn about all available tools and practical techniques that progressively help them build and troubleshoot the subsystems. The paper provides examples of on-orbit maintenance and repair tasks, explains the difficulties of developing the training course considering the level of uncertainty regarding the tools and the procedures available on board, and the vast number of electrical, electronic, pneumatic and hydraulic equipment, cables, connectors, pipes, compliant with different national standards of the ISS partners. The paper presents the structure of the course and the applied instructional design methodology. In February-March 2017 the course underwent the trial implementation with ESA astronaut Leopold Eyharts as the course evaluator, and after being certified by ESA, the course was given in December 2017 to the ESA astronauts Samantha Cristoforetti and Matthias Maurer. The feedback from the astronauts after the first implementation of the course is analysed followed by some lessons learned, that could be taken as a starting point for the development of Maintenance and Repair skill training for future exploration missions.