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# CRYOGENIC TECHNICS IN RUSSIAN SCIENTIFIC SPACE MISSIONS

**Abstract**

The use of refrigeration and cryogenic systems in space has always been a challenge. In Russia, such problems are solved by specialists in thermal control system, but it requires more deep knowledge in a field of cold. Currently, Russia are working on a range of scientific space missions, where the success or failure of the project as a whole will depend on the work of active cryogenic systems. Cooling in space below the ambient temperature need to improve characteristics of unique scientific equipment installed on telescopes, operating in various ranges of the electromagnetic radiation, for example. Thermostating of gas, dust, soil in extreme space conditions need to save them for later studies of their properties. Cooling machines can be used in thermal control systems of spacecrafts (orbiters, landers, rovers) in order to maintain the operating temperature of service systems and scientific instruments. Also cryogenic systems needed for ground testing of space vehicles elements. One of the most challenging and ambitious Russian scientific projects is the promising astrophysical mission "Spektr-M" (Millimetron), which can be launched in mid-2020. Main telescope reflector, working in submm- range of electromagnetic radiation, is subject to cryostatting of 4 K. Receivers of telescope must be cooled to a temperature of 0.1-0.3 K. No less difficult is the task of preserving the lunar soil in the promising Russian project "Luna-Grunt" ("Luna-Soil"). It is necessary to carry out drilling with minimal changes in soil temperature in order to preserve the volatile components that have accumulated in it for millions of years. Thereafter, it is necessary to encapsulate and deliver soil to Earth, also in thermostatic state, what is an extremely difficult task. The temperature in the always shaded craters on the Moon is estimated at between -150C to -240C. Another example. The use of refrigerating machine as a part of Venusian lander can significantly increase the active lifetime of lander on the planet's surface at ambient temperature of about 480C. The report will focus on the use of refrigeration and cryogenic machines in Russian projects study of the Moon, Venus, and as part of the astrophysical space complex "Spektr-M".