

Materials Science Research Rack Onboard the International Space Station. S.E. Reagan, J.R. Lehman, N.C. Frazier. NASA Marshall Space Flight Center; Teledyne Brown Engineering; Jacobs Engineering.

The Materials Science Research Rack (MSRR) is a research facility developed under a cooperative research agreement between NASA and ESA for materials science investigations on the International Space Station (ISS). MSRR was launched on STS-128 in August 2009 and currently resides in the U.S. Destiny Laboratory Module. Since that time, MSRR has logged more than 1400 hours of operating time.

The MSRR accommodates advanced investigations in the microgravity environment on the ISS for basic materials science research in areas such as solidification of metals and alloys. The purpose is to advance the scientific understanding of materials processing as affected by microgravity and to gain insight into the physical behavior of materials processing. MSRR allows for the study of a variety of materials, including metals, ceramics, semiconductor crystals, and glasses. Materials science research benefits from the microgravity environment of space, where the researcher can better isolate chemical and thermal properties of materials from the effects of gravity. With this knowledge, reliable predictions can be made about the conditions required on Earth to achieve improved materials.

MSRR is a highly automated facility with a modular design capable of supporting multiple types of investigations. The NASA-provided Rack Support Subsystem provides services (power, thermal control, vacuum access, and command and data handling) to the ESA-developed Materials Science Laboratory (MSL) that accommodates interchangeable Furnace Inserts (FI). Two ESA-developed FIs are presently available on the ISS: the Low Gradient Furnace (LGF) and the Solidification and Quenching Furnace (SQF). Sample Cartridge Assemblies (SCAs), each containing one or more material samples, are installed in the FI by the crew and can be processed at temperatures up to 1400°C.

ESA continues to develop samples with 14 planned for launch and processing in the near future. Additionally NASA has begun developing SCAs to support US PIs and their partners. The first of these Flight SCAs are being developed for investigations to support research in the areas of crystal growth and liquid phase sintering. Subsequent investigations are in various stages of development. US investigations will include a ground test program in order to distinguish the particular effects of the absence of gravity.