



ENVIRONMENTAL TESTS ON LASER COMPONENTS

Task

Laser systems that are operated or transported under extreme environmental conditions must be qualified beforehand – a requirement that applies particularly to the satellite-based use of these laser systems. Environmental tests are conducted on the individual laser components to provide overall qualification of the laser systems.

Method

The environmental tests include temperature change and vibration tests. In the course of the temperature change tests e.g. from -30 °C to +50 °C, the laser components are subjected to a fixed number of temperature cycles using a controlled-environment chamber. As materials with different coefficients of thermal expansion often have to be joined, the stresses and deformations induced by the temperature changes attract particular interest. Many of the modules assembled in the laser system (e.g. mirrors) rely on very precise angular positioning. Fraunhofer ILT therefore used an autocollimator to take angular measurements on components with plane mirrors during the temperature change tests. These measurements record the change in the plane mirror's angular position over the duration of the climate test. In the course of the vibration tests, a shaker is used to test components mechanically by applying shock and vibration loads at room temperature. Following the environmental tests, the components can undergo optical measurements or mechanically destructive tests where necessary.

Result

The environmental tests allow for determining the extent to which components are thermomechanically stable against temperature changes and/or mechanically stable against shock and vibration loads. The findings from subsequent optical measurements or mechanical destruction tests provide further insights into the thermal or mechanical behavior of components and modules.

Applications

The climate tests conducted at Fraunhofer ILT are a core component of qualifying laser components for LIDAR systems for aerospace applications. They can also be used as qualification methods for any components that are exposed to harsh environmental conditions.

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Contacts

Dipl.-Ing. Erik Liermann
Phone +49 241 8906-394
erik.liermann@ilt.fraunhofer.de

Dipl.-Ing. Michael Leers
Phone +49 241 8906-343
michael.leers@ilt.fraunhofer.de

*3 Laser components during
the temperature change test.*