



## CONSTRUCTION TECHNOLOGY FOR LASER-OPTICAL COMPONENTS

### Task

Optical components in satellite-based LIDAR laser systems are exposed to extreme environmental conditions such as mechanical shocks, vibrations and temperature changes between  $-30\text{ °C}$  to  $+50\text{ °C}$ . In addition, they have to exhibit a permanent tilt stability of  $< 10\text{ }\mu\text{rad}$  in most cases. These components also have to be adjustable, small, light and free of organic substances such as adhesives. Furthermore, the soldered components have to be screwed onto an aluminum base with high positional accuracy, which allows them to be exchanged in case of failure.

### Method

To meet these requirements, various construction technologies have been developed and combined. The soldering techniques already established at the Fraunhofer ILT, such as »Heavy-Duty Reflow Soldering for Compact Optic Modules«, on the one hand, and »Pick & Align - Joining of Optical Components with Active Alignment«, on the other, form the foundation for a non-adhesive construction technology. In addition, a sub-mount structure that compensates for thermal expansion was used. On this basis, opto-mechanical holders have been developed and their stability and reproducibility in climatic cycle and vibration testing demonstrated many times.

### Result

Using the example of the optical parametric oscillator (OPO) developed for the German-French Climate Mission MERLIN, the Fraunhofer ILT could examine the process on a representative laser assembly. Here, the institute was able to demonstrate aspects such as a sufficient number of melting cycles as well as sufficient holding time above the melting temperature of the solder in order to optimize the OPO parameters. Two identical OPO modules have been constructed. With the same conversion efficiency, the good adjustability and high positional accuracy could be shown as compared to arrangements with conventional holder systems. The temperature stability of the arrangement was proven in the climate test.

### Applications

In addition to applications in the field of aerospace industry, this construction technology is also particularly suitable for building robust laser sources for industrial use. The holder designs tested here can be expanded to new geometries as well as new materials.

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2 *Laser optical components in the optical parametric oscillator.*

3 *Pick & Align: Post adjustment with assembly plant.*