Assembly and Testing of the unit as a module

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The optical system has now entered a critical phase of integration and testing. At its core are three lasers, combined and routed via a fibre switch to three independent beam delivery heads. This setup is further enhanced with integrated acoustic and optical sensors, enabling real-time monitoring of the laser process. Each of these technologies presents challenges individually, but this ambitious project brings them together in a single machine.

A key component is the fibre switch developed by Cailabs, which uses a mechanical stage to reposition mirrors and direct laser delivery between different optical fibres. This switch requires high mechanical precision to ensure consistent coupling efficiency. Safety features have also been implemented to guarantee that each laser is correctly routed to its corresponding optical head, preventing damage to optical components.

Process monitoring is enabled by a custom sensor developed by AIMEN, which combines optical and acoustic inputs to provide a comprehensive view of system performance and process conditions. The optical sensors detect light signals emitted by the plasma generated during laser processing, while the acoustic sensors capture sound waves produced during cutting. This monitoring sensor will be further characterised in a later work package to support process control in applications such as welding, drilling, cutting, and surface texturing.

Initial validation of the module will be conducted using a low-power laser. These early tests will focus on verifying beam quality and measuring power losses along the optical path. The system is designed to keep power losses below 5% from the laser source to the process fibre output, while maintaining beam quality in line with operational specifications.

This stage of integration marks a significant milestone toward demonstrating the full capability of the optical system and its embedded sensing features.