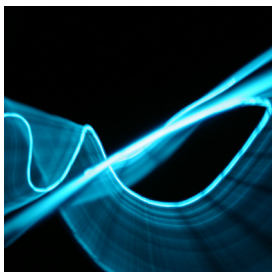
Application Note

Laser Rod Polishing



1. Introduction

Solid state laser rod polishing presents a difficult but highly appropriate application area for Logitech equipment and technology, due to the exacting needs in terms of geometric control and surface quality. The industry is used to “hand” preparation techniques and there is little real equipment on the market to cope with customer demands. The Logitech system offered is therefore a unique and highly capable package, designed to provide levels of performance which are consistent with industry requirements and bring high levels of capability to both the experienced and inexperienced operator alike.

2. Materials

Laser rod materials are fabricated such that the lasing material is housed in a stable host lattice - some commercially available materials used for laser rod preparation being:

Nd:YAG	Neodynium:Yttrium Aluminium Garnet
Nd:YLF	Neodynium:Yttrium Lithium Fluoride
Nd:Glass	Neodynium:Glass
Ruby	Chromium-doped Sapphire
Alexandrite	
GSGG	Gadolinium:Scandium Gallium Garnet

There is also development on alternative materials such as:

Co:MgF	Cobalt: Magnesium Fluoride
Ni:MgF	Nickel: Magnesium Fluoride
Ni:MgO	Nickel: Magnesium Oxide

3. Industry Requirements

Whilst end face parallelism specifications at the 2” arc level are common, a review of the requirements for polished laser rods reveals the following performance specifications to be more characteristic of the industry:

End face parallelism:	10” arc
End face/axis perpendicularity:	3” arc
End face flatness:	lambda/10
Surface finish:	0-0, 0-5 (scratch dig)

Note: 2” arc end face parallelism can be achieved if a single rod is processed; however, it should be noted that this is at the limit of system performance capability.

These very tight specifications are required to ensure that degradation of the emitted light beam is kept to a minimum, as laser beams are required to be highly uniform, parallel and directionally stable. Deviations from parallelism and perpendicularity would lead to problems with optical misalignment by deviating the beam through a prismatic effect. Surface irregularities and deviation from flatness adversely affect the directional uniformity of the beam through refraction, causing the light to spread out in directions away from the laser cavity axis.

4. System Specification

The system offered is generally based on a **PM5** auto machine and utilises the **PP5D Polishing Jig** for sample retention; a sub-fixture is generally used in conjunction with the PP5D, to exact type/design being dictated by the number and size of rods to be polished and the levels of specification required.

Logitech PM5 Lapping & Polishing System

The main sample holder is the standard **PP5D Precision Polishing Jig** and this is used in conjunction with a suitable sub-fixture, the choice of which depends upon the number and size of rods to be polished.

Logitech Precision Polishing Jig

The simplest form of sub-fixture is a mounting pot, supplied as a standard accessory item with all PP5 polishing jigs. Depending upon the rod length, the back of the mounting pot can be drilled out to allow the rod to be inserted into the bore of the PP5D, giving the capability to polish rods up to 6” long and 14mm diameter. The rod is wax mounted into the pot and can be orientated using the angular adjustment facility on the PP5.

Perpendicularity is achieved by aligning the rod such that its axis is perpendicular to a reference plane, e.g. the jig drive ring, which is in turn identical to the polishing plane.

Logitech LG2 Autocollimator

This is achieved by careful mounting of the sample into the mounting pot and the accuracy of the machining of the block during manufacture; current machining methods allow 3” arc perpendicularity. Parallelism of the end faces of the rod is achieved through the use of an LG2 Autocollimator. This allows accurate alignment of the polished first face of the rod parallel to the jig drive ring and on single rods can enable the production of 2” arc end face parallelism.

Multiple laser rod polishing is carried out in exactly the same manner as for single rods although the mounting pot sub-fixture is typically replaced by a more suitable fixture. An example of this is a V-block, allowing up to 16 rods (depending upon rod diameter) to be simultaneously prepared.

Perpendicularity is again achieved by the combination of careful sample mounting and the machining accuracy of the v-grooves/ holes in the sub-fixture (3” arc). End face parallelism of the rods is achieved by alignment of the rear face of the sub-fixtures with the plane of the PP5D drive ring.

It should be noted, however, that it is only possible to achieve end face parallelism around the 10” arc level when multiple rods are being processed, and usually by experienced operators - due to the difficulty of maintaining continuity of location of the individual rods. This is why the rear surface of the sub-fixture, rather than an individual sample, is used for alignment.

Another and more recently developed possibility, which again is more suited to experienced operators, is a v-block sub-fixture with a large v-groove capable of retaining multiple rods in this single groove. This type of sub-fixture requires the rods to have good external uniformity and has the advantage of allowing autocollimation from a single “reference rod” in the bundle.

5. Results

End face parallelism: 10” arc
End face/axis perpendicularity: 3” arc
End face flatness: lambda/10

Logitech Limited
Erskine Ferry Road, Old Kilpatrck, Glasgow G60 5EU, Scotland, U.K.

Tel: +44 (0) 1389 875444
Fax: +44 (0) 1389 890956

e-mail: info@logitech.uk.com
www.logitech.uk.com

LOGITECH
Materials Technologists & Engineers