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: Neodymium:Yttrium Aluminium Garnet
- Nd:YLF: Neodymium:Yttrium Lithium Fluoride
- Nd:Glass: Neodymium: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.

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

The main sample holder is the standard PPSD 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.

The simplest form of sub-fixture is a mounting pot, supplied as a standard accessory item with all PPSD 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 PPSD, 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 PPSD.
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.

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