

Manx Precision Optics

# Company Profile.

2020

Manx Precision Optics

# Contents.

## Company Overview

- 4 About us
- 5 Our Technical Team
- 6 Our Experience
- 7 Our History
- 8 Our Offering

## Capabilities

- 9 Overview
- 10 -11 Coatings
- 12-13 Polishing

## Specialisms

- 14 Our Expertise
- 15 Full in house manufacturing
- 16 Metrology
- 17 High LIDT optics

# Our Mission.

"Supporting our customers with fast and flexible quotes, designs, manufacture & delivery of fully custom and catalogue high energy laser optics. Coupled with excellent customer service, value and performance"



# About Us.

Established in 2013, Manx Precision Optics Ltd. (MPO) is a family-owned company manufacturing a wide range of precision optics. Our optical components for Ultra-fast and high power lasers are used by many leading companies and research facilities throughout the world.

4

Manx Precision Optics employs an experienced workforce with all senior employees having over 20 years experience in precision optics manufacture.

Since 2013 we have grown significantly and expanded our workforce and workspace year on year. Furthermore our commitment to long-term sustainable growth has seen us invest significantly in equipment, including our brand new 72" Lapmaster pitch polishing machine delivered in November 2019 and a 1.35m IAD-coating chamber in 2018.

Craftsmanship, Quality , Service

Our state of the art production facility is based in an Isle of Man Government owned high-tech industrial park and comprises over 7000ft² in manufacturing space in close proximity to the Isle of Man Airport.

To ensure full traceability and the highest quality standards Manx Precision Optics' manufacturing processes are all ISO 9001:2015 certified.

Within our facility we control all aspects of the manufacturing process from shaping, grinding and polishing to optical coating (e-beam, IAD

and sputter) and assembly. This means we can guarantee the quality of the materials craftsmanship throughout the manufacturing process allowing us full traceability of every optic we make.

We work with our customers to identify cost drivers at the very early stages of development and find the best, tailor-made solution for their applications. Our large stock enables us to manufacture prototypes within a short time-frame.

As a leading manufacturer of optical components for high laser-induced damage threshold and ultra-short pulse laser applications we constantly expand our product range to offer our customers the latest, state-of-the-art components.

# Our Technical Team.

Dr. Helmut  
Kessler

Co-Founder/Managing Director

Dr of Physics and specialised in Optical Coatings his whole career. Has been working on the Isle of Man since 1995 at Technical Optics and then founded MPO. Known for his knowledge of coating and specialisation in high laser damage and Ultra-fast design.

Richard  
Batey

Operations Manager

Rich has worked in optics since he left school. A real Engineer, very practical and highly skilled, he has been with Manx Precision Optics almost since the beginning, joining the company a few months after its incorporation.

Chris  
Bridle

Sales Manager

Chris has over 32 years experience in optics and has a wealth of experience in both the manufacturing and sales side of optical components. Chris is a specialist in coating, design, technology and manufacturing.

Andy  
Collister

Polishing Manager

Andy has specialised in Optical polishing since 1984. A key member of our team, Andy is an expert in large optics and achieving flatness after coating.

5



# Our Experience.

Our team are all highly trained and experienced when it comes to working with optics. We take pride in our work and set ourselves the highest standards.

# Our History.

Helmut and Jeanette Kessler found Manx Precision Optics on February 11th with production starting in October 2013.

2014

Acquisition of third coating chamber to increase capacity.

2015

Acquisition of fourth coating chamber - a 1.35m chamber with E-beam and IAD capability.

2017

Installation of new metrology to enable manufacture of spherical optics up to 205mm diameter.

Expansion of range to include large spherical optics. An additional mezzanine floor is installed in unit 12a

2018

Delivery of new 72" Lapmaster pitch polishing machine to allow full manufacture (polishing and coating) of optical components up to 500mm diameter and a further expansion of the workforce.

2019

Launch of new, extended range of optical components for ultra-short laser applications.

First major expansion of the workforce in February with MPO's second coating chamber arriving in April.

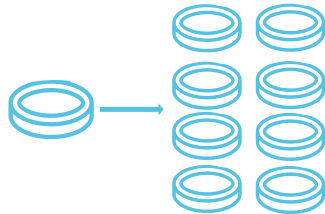
Floorspace expanded to include additional unit to accommodate increased production levels.

# Our offering.



## Partnership with our customers

We work with customers to find solutions to their optical applications. Through partnership with our customers we help address challenges through research and development, finding solutions through our knowledge and experience.



## Small batches through to large volume OEM

We are capable of providing both small and large volume orders. Our range of equipment and materials, as well as the experience of our team means we are able to deal with orders for small and large quantities without having to apply minimum order quantities.



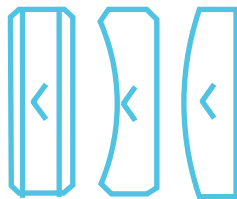
## Competitive and fair pricing

Our prices reflect the work we do and aim to be as competitive as possible. We work with customers to find efficient solutions for their budget and we never oversell an optic when a cheaper option provides the same solution.



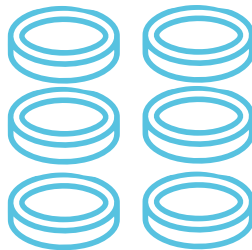
## High Damage Threshold (LDT) coatings

One of our specialist areas is in high laser-induced damage threshold optics. We are experts in creating optics that can withstand the highest laser power applications in the world. We work with a range of partners to meticulously test our high LIDT capabilities.



## Constantly expanding range

Our range of optics is constantly growing as we expand our workforce and equipment. The most recent expansion of our product range was our optics for ultra-short pulse applications, offering purely dielectric and metal-hybrid coatings on substrates up to 500mm diameter.



## Repeatable Products

Having customers consistently return to MPO due to our quality, reliability and service means we often manufacture repeat orders. Customers can be assured that the quality of their repeated products will be consistent time and time again.

# Overview.

We have a range of capabilities owing to the fact that our manufacturing facility can manufacture optics from raw material through to substrate and final coated optic. This huge manufacturing depth allows us to rapidly respond and adapt to changing customer demand.

## We make 99% of what we sell

Our facility has a range of equipment suitable for the manufacture of a range of different optics. This equipment, combined with the experience of our team allows us to manufacture 99% of what we sell. This means we can guarantee the quality and should any issues arise with a customer order, we can responded quickly to find an effective solution.

## Pitch Polishing laps, Double Sided Polishers

We have a significant number of polishing laps allowing us to offer pitch polishing with tight tolerances. Most recently, we took delivery of a 72" pitch polisher. A high end machine , this purchase has allowed us to significantly expand our polishing capacity.

## Lens Generating

At Manx Precision Optics we have the ability to generate lenses up to 205mm diameter, we can also manufacture lenses up to Lambda/10 surface figure with 10-5 Scratch-Dig (or corresponding ISO 10110 specifications).

## Optical Contacting

We offer optically contacted optics both coated and uncoated in a range of varying sizes. This allows us to manufacture prism assemblies for high laser power applications.

## Extensive polishing and Coating capabilities

Our equipment gives us extensive polishing and coating capabilities. In regards to size we have the ability to polish and coat optics from a few microns up to 500mm diameter. We offer three types of coating, E-beam , ion-assisted deposition (IAD) and magnetron-sputtered coatings. We offer these in a range of wavelengths, anywhere from 193nm up to 3 microns.

## Research and Development with/for our customers

We work with our customers to develop solutions for their optical applications. Whilst this can often be a solution based on our extensive range of catalogue optics, sometimes it requires a solution that needs to be developed.

## Capabilities

# Coatings.

**Manx Precision Optics specialises in all manner of bespoke optical coatings across an wide spectrum of wavelengths. We are always pushing the boundaries of what is possible, striving to produce extremely high performance, high LIDT, multi purpose coatings. Our coatings serve a wide range of applications and customers from medical to military to high-power laser labs.**

10

## Our Coatings

At MPO we work with our customers to determine the most suitable optical coatings for their specific applications. With years of experience and an intimate knowledge of thin film design we produce bespoke, high quality coatings according to the specifications you require.

To achieve this, we utilise numerous materials in our optical coatings covering a large range of refractive indices. These materials are well suited for the UV, visible and near-infrared bandwidths with low dispersion and negligible absorption. Thanks to the hardness and high adhesion of these materials our coatings are very resilient and failures extremely rare.

MPO also specialises in low Group Delay Dispersion (GDD <50 fs<sup>2</sup> and less) thin film dielectric, metal and metal-hybrid mirrors. The metal and metal-hybrid mirrors are coated from a range of materials from gold (Au) to silver (Ag) to aluminium (Al) and are ideal as highly reflecting mirrors for ultra-short pulse infrared lasers. We also take care in giving our metal and metal hybrid mirrors robust oxide-based overcoats to prevent tarnishing or damage to the soft metals underneath. Our metal-hybrid mirrors are

designed with a high LIDT in mind while offering a very broad reflectivity bandwidth with a low GDD.

As coating performance and LIDT can be significantly reduced by even the smallest impurities we source our materials from reliable and well-established suppliers.

## Coating Process

Our coating chambers utilise Electron Beam Evaporation (EB), Ion Assisted Deposition (IAD) and Magnetron Sputtering (MS) to deposit optical coatings.

All of these are robust, energetic and industry standard methods for thin film production. In EB, a powerful electron beam is directed towards the coating material, heating it and causing it to evaporate or sublime. The resultant vapour settles onto the substrate and forms a thin film. Compared to other Physical Vapour Deposition (PVD) methods where the material is simply heated EB is a much cleaner and reproducible process avoiding unwanted contamination.

MS is a fast and powerful vacuum coating technique for depositing coatings, it entails the bombardment of a target with high energy ions via



electric and magnetic fields. Unlike in EB, instead of heating the target the ions cause material to be directly ejected from the target from where it settles onto the substrate. As a result, MS is highly suitable for coating materials with very high melting points and can achieve very high film uniformity and adhesion whilst maintaining a high deposition rate.

We are well equipped for Ion Assisted Deposition (IAD) where the substrate is bombarded with highly energetic ions. The extra energy transferred to the coating material particles increases their mobility, improving our MS and EB methods processes even further with higher adhesion, lower stress and reduced film moisture content.

## LIDT

Another of MPO's specialities are our high Laser Induced Damage Threshold (LIDT) coatings. LIDT is an extremely important property for any high-power laser system as it determines the laser fluency at which point a failure of the component is likely. MPO's optical coatings are designed with LIDT in mind. We are constantly developing our designs and coating processes further to ensure as high an LIDT as possible.

Failures are often due to either defects within a coating that scattered or absorb the laser light causing it to heat and de-laminate. Maintaining a clean coating environment and a smooth substrate surface is therefore of paramount importance to us.

As laser technology advances and extreme high power/ultra-short pulses are required to probe nature's mysteries the need for high LIDT optics with long lifetimes becomes increasingly apparent. MPO are proud to say that we are a leader in the field of high LIDT optics, our products seeing regular and constant use in some of the most powerful laser systems in the world.

11



# Polishing.

**Manx Precision Optics is equipped with state-of-the-art facilities for the shaping, grinding and polishing of glass. The MPO glass fabrication department is comprised of industry veterans with the capabilities to achieve the highest standards.**

## Our Glass

Raw optical glass components are produced by manufacturers such as Schott, Corning, Heraeus, Nikon or others. These roughly shaped pieces come in a variety of shapes, dimensions and compositions, with properties such as refractive index, Abbe number (dispersion) and quality grades specified by the manufacturer.

Among the most well-established materials in the industry are Fused Silica and N-BK7. A very predominant glass type for our products is Corning 7980 Fused Silica and equivalent materials from other manufacturers. This type of Fused Silica has over the years proved itself as a staple of the precision optics industry due to its low refractive index ( $n_d = 1.46$ ), low dispersion ( $v_d = 67.8$ ), low coefficient of thermal expansion and exceptionally high transmittance from the deep UV through the visible and infrared. Additionally, Fused Silica substrates are non-crystalline, exhibit extraordinarily low refractive index variations, low birefringence and are highly laser resistant. As a result, Fused Silica is a staple for precision optic purposes, finding use in systems requiring extremely high LIDT and performance.

Corning Fused Silica is also notable in that

all types (aside from industrial grade FS) are classified as grade 5 i.e. free of striae under ISO 10110 Part 4, striae being strands with a differing refractive index to the rest of the material. This means that a customer needn't worry about striae introducing additional unwanted aberrations when purchasing an optical component made of Fused Silica from us.

Another material we have a great amount of experience fabricating with is the Borosilicate glass N-BK7. Like its cousin Fused Silica, N-BK7 Has a low index ( $n_d = 1.52$ ), low dispersion ( $v_d = 64.2$ ) and high transmittance throughout the visible and infrared (380-2100nm). It is hard, scratch resistant and shows high homogeneity with low bubble and inclusion content.

Though we primarily deal with Fused Silica and N-BK7 components we regularly fabricate many other glass types.

## Our Process

Optical fabrication is an involved and complex process. Raw glass must be put through multiple distinct phases of production before they satisfy the extremely high standards required for precision optics. At MPO we are equipped to carry out all steps of the glass fabrication process from



small sample to OEM quantities.

## Shaping and milling

Our products begin life as glass blanks supplied by an optical glass manufacturer. Being no more than a piece of material fresh from a factory, a blank is understandably very rough and will not be in the desired shape of the final optic. The blank needs to be milled to bring its dimensions closer to that of the final piece. If the final piece is a lens of some kind then the radius of curvature is ground into the optic during this step. Plano-surfaces are machined using a surface grinder where either a single part or a large number of small parts are fixed to a rotating table and ground against a diamond face mill. Curved surfaces undergo generating where diamond-cup wheels grind the blank at an angle. By adjusting this angle, the blank can be tailored to any desired focal length! Prism milling requires diamond tools mounted on machines with adjustable spindle angle and height due to the specific angles involved in the design of a prism.

## Grinding, Polishing and edging

With the glass now in roughly the right shape it undergoes Loose Abrasive Lapping or Grinding to remove fractures caused by milling and improve the overall sphericity, though not before the edges of the optic are bevelled to avoid small pieces of material chipping off and scratching the surface. The lapping process removes glass via the friction between the glass and the lapping plate in conjunction with a combination of water and grit. The resultant slurry introduces tiny, local fractures into the surface of the glass, leading to splintering and the removal of material. The size of the individual grains in the slurry can vary from around  $3\mu\text{m}$  up to around  $300\mu\text{m}$ , with a

larger grit size leading to a faster removal rate at the cost of a rougher finish. As a result, grinding begins with an aptly named process known as "roughing", and progresses through stages with finer and finer grit. As small grains produce pits that are about  $\frac{1}{2}$  their diameter the surface is refined to a micrometre scale surface roughness by the end of the process.

Next the glass is finely polished to the point at which the optics reach their final shape and acquire a transparent and reflective finish. The best possible surfaces finishes are possible through a polishing method known as "Pitch Polishing". In pitch polishing the glass is finely polished in a process similar to lapping only with a lap composed of pitch and a watery slurry generally containing oxide-based materials, pitch being a unique visco-elastic compound. The slurry chemically and mechanically removes material very finely, improving the surface roughness from micrometre scale to  $1\text{nm rms}$  or even to  $2\text{Angstroms}$  ( $\pm 0.2\text{nm}$ ).

Towards the end of the polishing process, we make frequent interferometric measurements to determine the topology and surface roughness. With this knowledge our experienced polishing staff can remove aberrations and tailor a part to the desired shape and flatness.

The last step in the fabrication of precision optics is edging and centering. The previous steps will introduce a slight wedge that offsets the optical and mechanical axes. Centering is an additional grinding process whereby these axes are aligned. It can be carried out via precise mechanical or optical methods. This is a vital step as if the axes are not aligned well then coma and astigmatism aberrations are introduced.



## Specialisms

# Our Expertise.

We offer an extensive range of catalogue and custom optics. Our stock management system allows us to check item availability with regards to a wide range of parameter, allowing us to very quickly find a suitable stock component wherever possible.

## Specialisms

# Full in house Manufacture.

**At Manx Precision Optics we have the ability to manufacture optics from scratch, from initial substrate through to final coated optic, making us your perfect one stop shop.**

## Process

Once an order is placed for either one of our catalogue or custom made optics we can manufacture it from scratch.

From initial substrate shaping and grinding, through to polishing and coating our state of the art facility based on the Isle of Man is capable of manufacturing a significant number of optics.

## Why is this important?

Having the ability to manufacture optics from scratch allows us to better control the quality of our products. By having the full, ISO9001:2015 certified manufacturing process in house, we can be certain that no unwanted variations to our processes affect the quality of our optics.

As well as this, our full manufacturing capabilities mean that we act as a one stop shop so our customers can order a fully specified and warranted product from a single source.

Furthermore, our manufacturing capabilities allows us greater understanding of the optics we produce. We can see first hand how different raw materials work with different coatings and polishing processes, allowing us to make better recommendations and give more comprehensive advice to our customers. Combine this with our

competitive pricing and world leading quality, Manx Precision Optics makes an ideal partner for any optical requirements.





# Metrology.

We are equipped with some of the latest metrology equipment to allow accurate measurements of all our optical specifications.

We have invested significantly in Metrology complementing our polishing experience and technology with the capability to accurately measure our work.

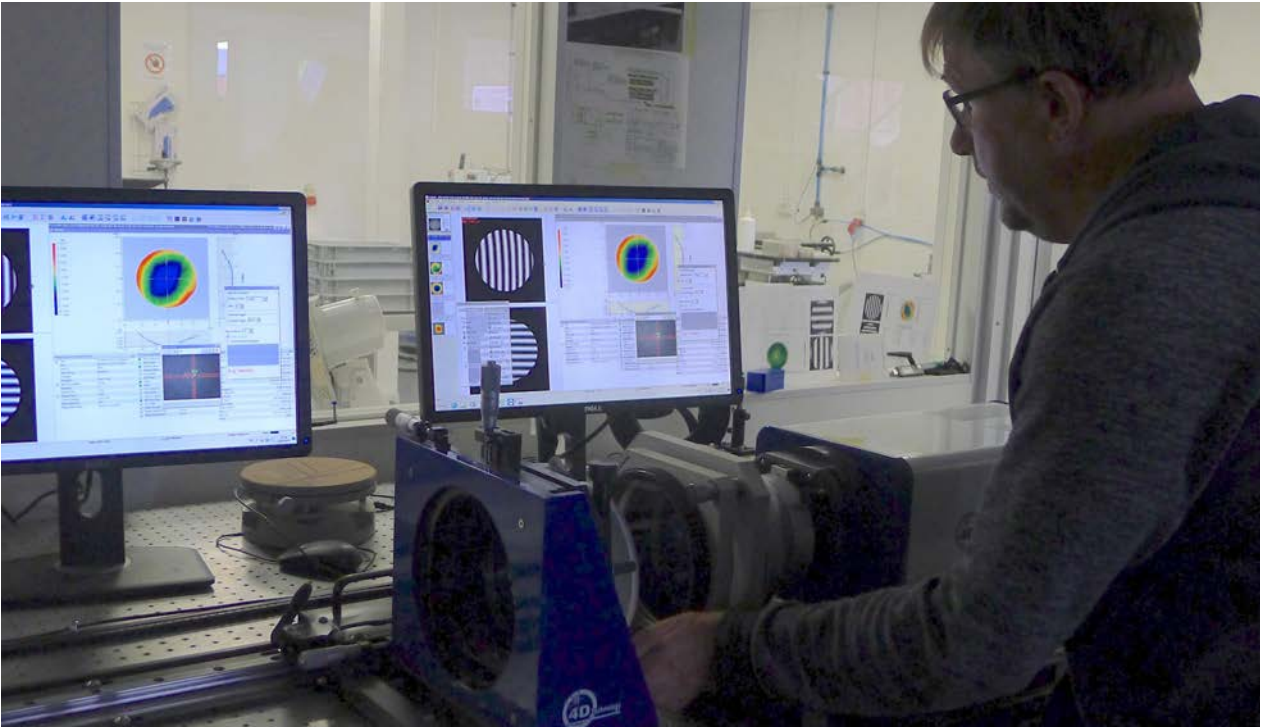
16

Our equipment includes 6" 4D Interferometer, Chromatis White light interferometer (for measuring GDD of Ultrafast Optics) and 2 spectrometers for spectral measurement. This equipment alongside the accompanying staff training represents a significant investment by Manx Precision Optics and serves to guarantee the quality of the optics we produce.

## LIDT Metrology

We work with partners across the world to test our optics for LIDT. As our optics are used in some of the worlds most powerful lasers, we believe it's important to test them on similar equipment in order to accurately and rigorously verify their quality.

We've worked with our partners over a number of years and have built up a level of trust allowing us to guarantee the quality of optics we send out to our customers.



# High LIDT Optics.

Our optics for Ultra-fast applications include our TT range of optics. The TT range is a collection of optics suitable for a range of applications involving high power lenses.

**TTS** - Single stack optic for the highest LDT offering. The TTS has the fewest layers of the TT range meaning the least stress on the optic. The TTS offers the simplest design.

**TTB** - Broadband optic designed with High power materials, the TTB offers a custom "geometric" design. The TTB has more layers than a single stack as well as slightly lower LDT due to E-field.

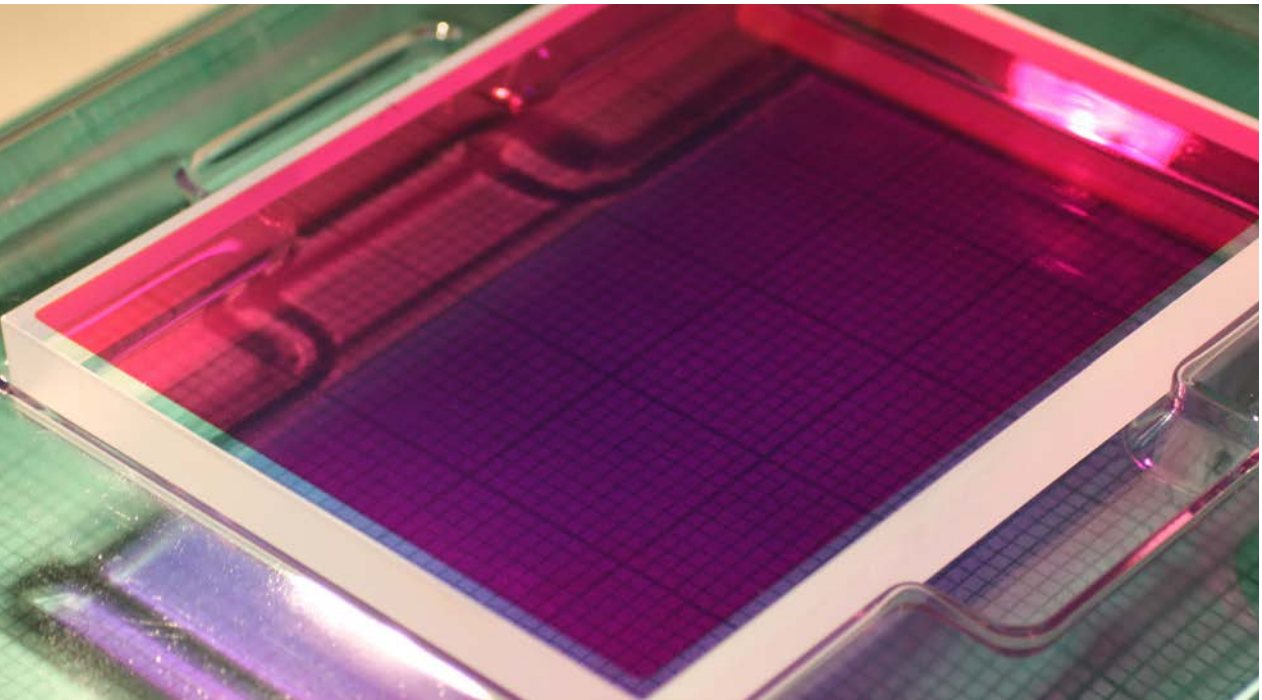
**TTW** - Similar to the TTB the TTW offers a wider spectral range than the TTB to allow for alignment and tolerance. The TTW contains more layers, thicker coating and is therefore more complex and expensive to make.

**TTMP** - A range of mirrors with protected metal coatings with optimised protective overcoat to ensure the highest performance at the required wavelength range.

**TT-MH** - Manx Precision Optics newest offering in the TT range. The TT-MH combines the high reflectance of conventional metal coatings, combined with the High LDT of dielectric coatings.

We also offer bespoke high LDT custom optics. Designed with the end user in mind our custom optics are widely regarded for their craftsmanship and quality.

17





# Company Profile.

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