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# High Precision Optical Components and Electro-Optic Solutions

## From concept, to volume production

ZYGO Optical Systems Division specializes in producing complex electro-optical systems and high-precision optical components for the Life Sciences, Defense & Aerospace, Semiconductor, and Industrial OEM markets. From concept, design and prototype to volume production, ZYGO will work with you to optimize your design for performance, cost and delivery. ZYGO engineers and technicians can engage your project at any point in the process, with the thoroughness and know-how expected from an industry leader.

## World-class optical know-how and innovation

ZYGO's experience and history of innovation makes it one of the most respected optical companies in the world. From developing the industry's first precision asphere grinder for production, to becoming the world's sole volume supplier of laser fusion amplifier slabs, to developing cutting edge medical laser delivery systems and helmet mounted displays – ZYGO is more than a collection of people and machines; it embodies a culture of industry-changing innovation.

## Industry leading metrology team

ZYGO benefits not only from world leading optical metrology but, more critically, benefits from the people who create it. A synergistic relationship with our Metrology Solutions Division integrates our scientists, engineers, and production technicians into a resource of extensive knowledge and experience found only in tier-one optical companies. The application of this knowledge ranges from proprietary metrology for real-time process control, to ISO standardized quality assurance procedures, yielding cost effective systems, and components manufactured to your exacting specifications.

## Multiple capabilities, one mission

ZYGO Optical Systems Division has the breadth of expertise to join high precision optical design with high quality volume manufacture. One mission – bringing high precision, quality, and volume production together.



Life Sciences



Defense & Aerospace



Semiconductor

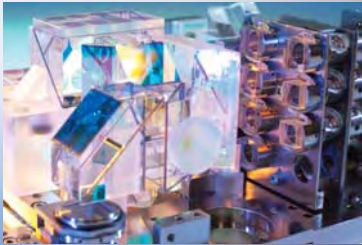


Industrial/OEM

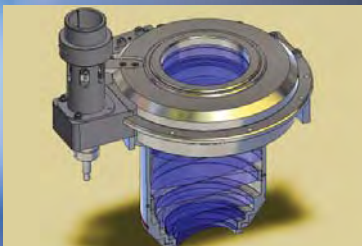


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# Electro-Optic Design and Assembly



Complex Optical Bonding



Custom Design



Space Sensor



FDA Registered Contract Manufacturer

## Integrated System Design and Prototyping

ZYGO offers a wide range of engineering services designed to take on the industry's most demanding product development challenges. These projects range from Advanced Helmet Mount Display systems to high precision UV objectives, to integrated sensor packages and interferometric alignment systems for semiconductor applications. Core to ZYGO's strengths is an industry leading prototype manufacturing facility featuring multi-axis alignment, optical contact assembly, custom tooling, Single Point Diamond Turning, and proprietary metrology.

## Integrated System Assembly

ZYGO is a tier-one optical system assembly facility for high precision, volume production bringing together world class configurable manufacturing and Design for Manufacture and Assembly. ZYGO assembles and integrates devices ranging from medical laser delivery systems to vacuum relay telescopes to opto-electronic surveillance devices. Located in the Tucson Optics Valley, the facility boasts some of the region's most advanced clean room, metrology, and process control capabilities all backed by highly skilled engineers and assembly technician staff.

## Products:

### Customized Objectives

- Refractive and reflective
- Low distortion
- High NA
- Wide FOV
- Focus mechanisms

### Contract Manufacturing (CM)

- Turn key "Build-to-Print" (BTP) services
- FDA registered CM
- ISO 9001 and ISO13485 registered
- Tier 1 proprietary metrology enabled manufacturing technologies

### Telescopes

- Cassegrain
- Three mirror anastigmats
- Wide field refractive systems
- Catadioptric systems

### Other Complex Optical Assemblies

- Illumination
- Beam expanders
- Full beam path design and integration
- Image relays
- Zoom lenses
- IR system

Ask about our industry-leading objective design and manufacturing services!



EUV Schwarzschild



Semiconductor Fluoride



Medical Laser Scanning





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# High Precision Optical Components

## Extreme Precision Optics

ZYGO's Extreme Precision Optics Group in Richmond, California, fabricates world-class aspheric and spherical surfaces, precision machined structures, and ultra-high precision optical assemblies, serving the Defense & Aerospace, Life Sciences, and Semiconductor markets.

The EPO group has a distinguished heritage that has ranged from the repair of the Hubble Space Telescope to the development of sub 0.1 nm RMS precision EUV optics used in today's most demanding lithographic systems. Whether it is development of a Statement of Work, building a prototype system, or redesigning for improved performance, ZYGO is ready to take on your most demanding optical challenges.

## Products:

### Intelligence, Surveillance & Reconnaissance

- Reflective and transmissive
- AR, HR coating, EMI grids, conductive films
- Sapphire, Cleartran™, Silicon, BK-7

### Machined Optical Structures

- Lightweighted components
- Monolithic structures
- Ring laser gyros
- Vacuum chucks
- Zerodur® and Clearceram® stages

## Large Format Optical Fabrication and Coating

ZYGO is a world leading manufacturer of high precision optics, featuring innovative and proprietary manufacturing technologies. Our vertically-integrated approach encompasses CNC glass machining and lightweighting, rotational, double-sided and MRF polishing, and thin-film coating, with ZYGO proprietary metrology. These highly-refined capabilities give ZYGO the distinction of being the world's only production manufacturer of laser fusion amplifiers and a world recognized producer of meter-class plano optics, including low aspect ratio and advanced materials such as sapphire. From laser fusion optics, to aircraft windows, to high precision prisms and wedges, ZYGO is leading the way in high precision optics.

### High Energy Optics

- Laser amplifiers
- Reflective and transmissive
- Polarizers
- UV optics
- Windows and mirrors
- Prisms
- Phase plates

### Other High Precision Components

- Reference surfaces and mirrors
- Retroreflectors
- Prisms, wedges, and flats
- Spherical optics



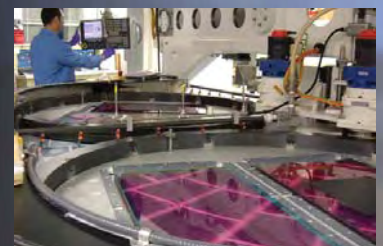
Aspheres and freeform



Sapphire and other exotic materials



Flats, Wedges, Prisms, Stages, & Mirrors



Laser Amplifier



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## Capabilities

### Optical Components

#### Quality Certification

- ISO 9001:2000

#### CNC Glass Machining

- Glass machining to >1 meter size
- Lightweighting

#### Aspheric Surface Fabrication

- Sizes to 500mm
- Accuracy to  $\lambda/5000$  RMS @ 633nm
- Wide range of materials and geometries

#### Rotary Polishing (up to 1.2m diameter)

- Flats to 12nm ( $\lambda/50$ ) PV
- Low Power Spectral Density signatures
- Surface roughness to <0.2 nm RMS
- Angular tolerances to 0.1 arc second
- Wedge tolerances to 2 arc second
- 20/10 at meter class optics

#### Sub-Aperture Finishing

- Computer Controlled Optical Surfacing (CCOS)
- Ion Beam Figuring (IBF)
- MRF polishing

#### Cleaning

- Class 10,000 and 100,000 cleanrooms

#### Materials

- Precision optical glass, fused silica, Zerodur<sup>®</sup>, sapphire, Cleartran<sup>™</sup>, ceramics, silicon, silicon carbide (SiC), ALON<sup>™</sup>, phosphate

#### Coating

- Sizes from 1mm to 760mm
- Wavelengths from 200nm to 2000nm
- Spectra V<sup>™</sup> high-efficiency anti-reflective coatings at 633, 1053, and 1550nm
- Polarizing and non-polarizing beamsplitters and prisms
- Custom coating design and manufacturing
- Low-stress metal and dielectric coatings
- Aluminum, silver, and enhanced reflectors
- High laser damage threshold coatings
- Polarization Beam Combiners

#### Metrology

- Interferometers up to 32", and stitching capabilities for larger sizes
- Transmission Spheres up to 12"
- Roughness measurement (WLI & AFM)
- Mid-spatial frequency measurements
- Null lenses (CGH, etc.)

### Electro-Optics

#### Quality Certification and Process Control

- ISO 9001:2000 (Tucson)
- ISO 13485:2003 (Medical devices– Quality Management Systems) (Tucson)
- FDA registered contract manufacturer
- Demand Flow Technology system
- MIL-STD-1246 cleaning standard (NIF Certified)

#### Services

- Concept design and prototyping
- Pre-production manufacturing
- Design for Manufacture and Assembly
- Custom tooling design
- Prototype manufacturing facilities

#### Facility

- Class 10 clean room
- Configurable manufacturing
- Laminar flow work stations
- ESD production stations
- Precision cleaning

#### Production Equipment and Processes

- Single point diamond turning
- Multi-axis active alignment stations
- Reticle projection systems
- Fully integrated metrology

#### Metrology

- ZYGO advance metrology systems
- ZYGO 532nm, 633nm, 1054nm and 1550nm GPI<sup>™</sup>, NewView<sup>™</sup>, and ZMI<sup>™</sup> systems
- Aspheric null and metering mirror systems
- Vertical tower system test benches
- Multi-axis MTF, large aperture, and multi-spectral
- Starrett<sup>®</sup> CMM
- Distortion Testers



5-Axis Glass & Ceramic Machining



Thin Film coating



MRF



Ion Beam Figuring



Fused silica



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