

Micro-Optics

Competence, Capabilities
and Products



Qioptiq, an Excelitas Technologies Company, designs and manufactures photonic products and solutions that serve a wide range of applications across the medical, life sciences, industrial manufacturing, defense, semiconductor, aerospace, and scientific sectors.

Qioptiq customers benefit from the integrated knowledge and expertise of Avimo, Gsänger, LINOS, Optem, Point Source, Rodenstock, Spindler & Hoyer and others.

In October 2013, Qioptiq was acquired by Excelitas Technologies Corp., a global photonic technology leader focused on delivering innovative, customized solutions to meet the high-performance illumination, optical and, detection technology demands of OEM customers worldwide. Today, the Excelitas team proudly includes more than 7,000 employees across North America, Europe and Asia.

Visit www.excelitas.com for more information.

1877



Rodenstock
founded

1898



Spindler & Hoyer
founded

1969

Gsänger

Gsänger
Optoelektronik
founded

1991



Point Source
founded

1996

LINOS

Linus is founded merging
together Spindler & Hoyer, Steeg
& Reuter, Franke Optik and
Gsänger Optoelektronik.
LINOS acquires Rodenstock
Präzisionsoptik in 2000

2005



Qioptiq founded
as a spin off from
Thales High Tech Optics
Group

2009



Qioptiq acquires
Linus and Point Source
establishing a new and
consolidated brand

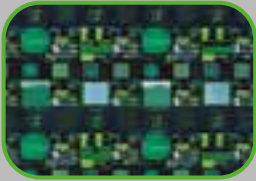
BIOMEDICAL



CONSUMER PRODUCTS



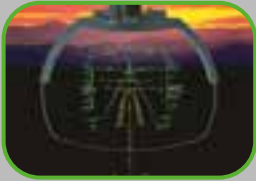
SEMICONDUCTOR



INDUSTRIAL



DEFENSE & AEROSPACE



SCIENTIFIC & ANALYTICAL



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2010

2013

2018

2019

2020

EXCELITAS
TECHNOLOGIES®

Excelitas Technologies Corp. is founded, spinning-off of PerkinElmer Analytical Instrumentation Division which sprung from EG&G founded in 1947

QIOPTIQ
Photonics for Innovation

LUMEN DYNAMICS
PUTTING YOU IN CONTROL

Excelitas acquires Qioptiq and Lumen Dynamics

REO
precision optical solutions

Excelitas acquires Research Electro Optics (REO)

AXSUN
TECHNOLOGIES

Excelitas acquires Axsun Technologies

Solidtron

Excelitas acquires Solidtron from Silicon Power Corp.

Precision Micro-Optics

With more than 80 skilled optics professionals, Qioptiq in Asslar, Germany specializes in the development and manufacture of micro-optic components, assemblies and solutions.

Micro-Optics

Qioptiq utilizes a good eye, steady hand and ultra-precise tools to manufacture miniature lenses, some measuring less than 1 millimeter in diameter. As one might imagine, the daily production output for our micro-optics operation fits in the space equivalent to a shoebox. Upon production, we ship these precision lenses all over the world to meet the micro-optic needs of our customers in the medical, analytical instrumentation, automated optical inspection and scientific research sectors.



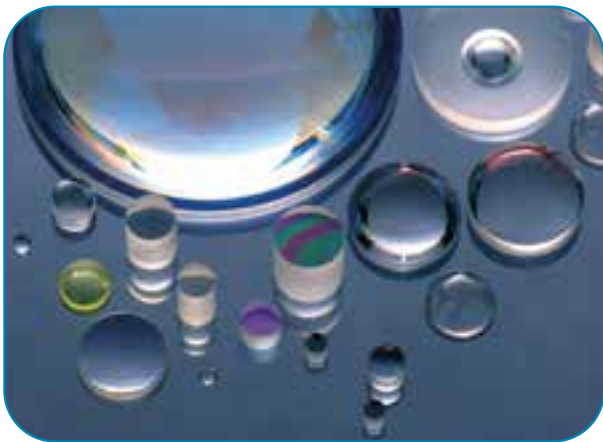
Our Micro-Optic Capabilities

- Grinding and polishing of spherical and plano optical components $\geq 0.3\text{mm}$ from all established glasses
- CNC and traditional production technologies
- Thin film coating of precision optics
- Optical fine cementing and alignment
- Assembling, testing and documentation
- Narrow tolerances for high-end applications
- Special test equipment

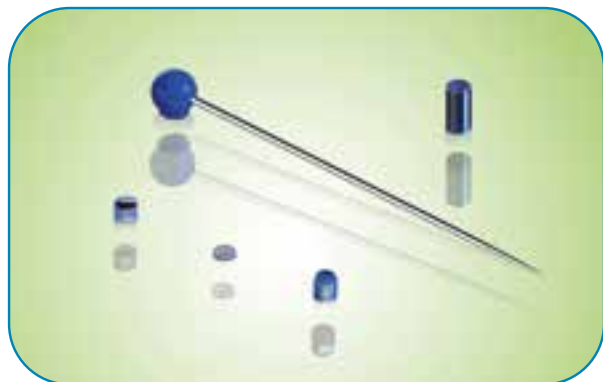


Expertise in Micro Since 1952

Our team in Asslar has been part of the Qioptiq Group since 2005, but our "Optical competence" reaches back to 1952, when Neeb-Optik GmbH was founded in Wetzlar, one of Germany's top centers of the optical excellence.



The production flow covers all work steps of lens production, from grinding and polishing, to coatings up through complex micro-assemblies. The components produced are used not only in medical applications such as endoscopy, but also in many industrial fields including metrology and automation technology. The Asslar production site supplies OEMs and business units within the Qioptiq Group, both of which further integrate the products supplied into complex optical products and systems.



Optical Expertise in Asslar

Over the last few years, we have experienced an emergence of increasingly innovative and efficient technologies for examining the smallest of spaces, driving medical diagnostics to advance into incredibly small dimensions. In addition to the substantial contribution of chip technology, developments in optics have also played a significant role in the growth of this field, which is where Qioptiq's Micro-Optics center of excellence has specialized.

Leading Manufacturer of High-Quality Micro-Optics

As a successful manufacturer of micro-optics for over 65 years, Qioptiq has continually strived to advance its special competencies as a precision lens developer. Today, as part of Excelitas Technologies, our Micro-Optics experts maintain and build upon our position as a highly specialized precision lens solutions provider.

Applications & Markets:

- Endoscopy
- Surgical robotics
- Clinical diagnostics
- Dental imaging
- Ophthalmology
- Machine vision
- Metrology
- Automation

OEM Expertise

The motto “faster, higher, stronger” drives Olympic competitors. However, at Qioptiq, our motto “smaller, more complex, more powerful” guides us to deliver the utmost in performance and innovation to the field of micro-optic manufacturing.

While this trend toward miniaturization of optics and mechanics offers tremendous new possibilities to our photonics customers, it also poses new challenges for manufacturers of optoelectronic devices and assemblies.

Today’s optical sensors are so small that they can be easily guided through blood vessels and organs – giving users deep insight into the human body. These innovative technologies allow medical physicians to experience the human organism in its immediate



function, recognize causes of diseases at the source and evaluate therapeutic effects. As a result, complex and sometimes even risky surgical interventions can be avoided and replaced by minimally invasive procedures with faster recovery times.



Unbeatably small and efficient: our customized video camera

As a highly trusted brand, Qioptiq enables manufacturers of endoscopes, dental cameras and surgical robotics systems to utilize our latest optical and mechanical technologies in leading-edge medical devices and applications. We provide leading medical systems manufacturers with broad expertise across all disciplines of photonic technology. Our components and assemblies enable OEMs to develop and manufacture everything from prototypes to series production, resulting in the delivery of complex medical products.

Applications:

- Rigid and flexible medical endoscopes
- CCD cameras
- Surgical robotics
- Image processing
- Technical endoscopes

In one specific case requiring direct imaging into the human heart, our specialists were tasked with developing and producing a lens consisting of five high-precision, mounted micro-lenses with an outer diameter of less than one millimeter. We offer micro-optic sample, pre-serial and serial production according to customer design and drawing (build-



Our Services:

- Build-to-print
- Mechanical and coating design
- Prototyping and pre-serial and serial production
- Testing and documentation

to-print), or can partner with our OEM customers to jointly develop products from concept through completion. Regardless of the engagement for development, we listen attentively to our customer to fully understand every requirement, whilst sharing our constantly expanding knowledge of economic and technical feasibility of micro-optical components and assemblies.

A mutual project often begins with a customer utilizing one of our standard HD lenses, which provide superior image quality and performance. Once the customer builds the first functional pattern, we then adapt the standard lens to meet his unique requirements for optical performance, size and/or mechanical interfaces.

For more than 65 years, Qioptiq has been developing and manufacturing micro-optical components and assemblies with and for our customers, ensuring that their specifications and intellectual property is our highest priority.

From simple rigid endoscopes to complex systems consisting of microelectronic sensors, multi-element microlens assemblies integrating a multitude of optical glasses, and assembled in filigree metal or plastic housings, Qioptiq solutions allow 4k resolution and fantastic images in 3D for a variety of applications in the medical field and beyond. Technical endoscopy, machine vision, aerospace, safety and security are just a few examples of the areas in which our products fulfill a critical role.

Offering optics manufacturing and testing within a micrometer band, product inspection exclusively under a microscope, use of the latest gluing and mounting methods with comprehensive documentation of the results for complete traceability and verification of specified and guaranteed performance data - are each examples of our on-going commitment to achieving highest standards for our OEM partners.

Our motto may differ slightly from that of top Olympic athletes but not the passion to constantly evolve and push the limits of the achievable. We stand firmly committed to achieving excellence in all aspects of micro-optic product performance, quality, reliability, delivery and service to deliver customized, market-driven solutions which enable our customers to advance their innovation and excel in their end-markets and applications.

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Fisheye objectives



LED collimator

Micro-Optics Components:

- Spherical lenses, doublets, triplets
- Plano optics
- Rod lenses
- Opto-mechanical assemblies

Our Capabilities ...

Design & Development

Customized spherical optics:	
• Assistance in defining specifications with narrow tolerances for high-end applications, e.g. 3D	
• Development of optical systems according customer requirements	
• Mechanical design	
• Coating design	
• Use of Zemax OpticStudio [®] , Code V, SolidWorks, AutoCAD [®]	
• Wide range of Qioptiq test plates available in Zemax OpticStudio [®] TPL	
... or simple build to print	



Design & development

Lens Grinding and Polishing

Customized spherical optics:	
• Lens diameter	0.3-20 mm
• Possible surface quality	≥ 0.5 fringes
• Possible irregularity	≥ 0.2 fringes
• Center thickness tolerance	up to ±0.01 mm
• Surface quality	5/1x0.01



CNC-Polishing

Centering

Specifications	
• Centering error	≥ 1'
• Diameter tolerance	≥ 0.002mm
• Various edge geometries	



Centering

Lens Coating

Specifications	
• Single layer for all wavelengths, e.g. MgF2	
• Double layer (V-coating)	
• Multilayer for UV to NIR	
• Anti-reflective coating	
• Beamsplitter for specific wavelengths	
• Back and front mirrors with Al and Ag	
• Filters (e.g. IR-cut)	
• Index match	



Optics placed in substrate holder

... for the Success of your Projects.

Lens Cementing

Cementing capabilities

- Diameter ≥ 0.5 mm (smaller diameters on request)
- Doublets / triplets / compact objectives / rod lens systems
- All typical UV glues
- Alignment $\geq 0.5'$
- High precision field stop with chromium layer within the glued surface, decentering ± 0.01 mm

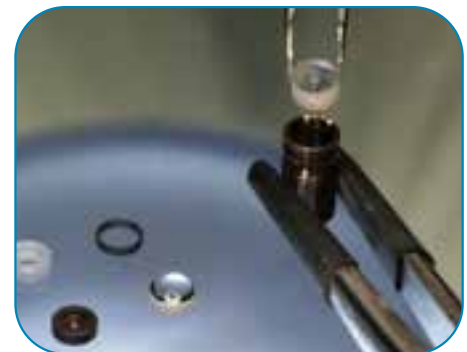


Lens cementing

Opto-Mechanical Assembling

Specifications

- | | |
|--------------------|------------------------------|
| • Field of view | up to 190° |
| • Diameter | ≥ 0.8 mm |
| • Pinhole diameter | ≥ 0.1 mm ± 0.005 mm |
| • Waterproof | |
| • Biocompatible | |
| • Explosion proof | |
| • Autoclavable | |

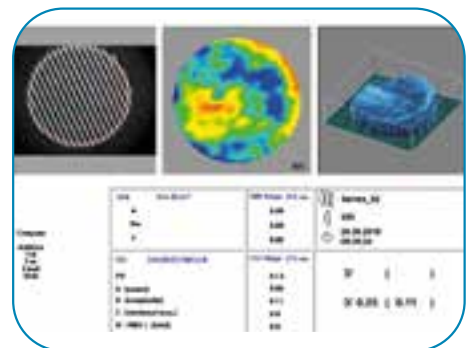


Lens assembling

Comprehensive Inspection & Documentation

Range of services

- Surface quality inspection with microscopes
- Tactile or non-contact measurement
- Interferometric inspection
- Centering error control
- Focal length measurement
- Customer specific test equipment
- Environmental testing
- Durability testing
- Spectrometric measurements
- FAT protocol, COC, melt data and many more upon customer request



Interferometric inspection

**Additional specifications upon request.
Please ask our specialists!**



HD Micro-Objectives

FALCON Series for 1/10" Sensors

The FALCON objectives for 1/10" image sensors are available in fields-of-view of 90°, 110° and 140°. With a total length of only 5 mm (including back focal distance), the FALCON micro-objectives contain a five-part lens system with an integrated infrared-absorbing filter and a lithographically generated aperture.

Another specific feature is the unvignetted image of these objectives, which guarantees an optimal homogeneity of the illumination intensity (means a minimum middle-edge fall-off in brightness), only limited by physical rules.

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A significant feature of the FALCON micro-objectives is the high MTF, making them ideal for small detector dimensions. These objectives are designed for the nominal object distance of $s_0 = 6$ mm. Each of the objectives can be focused at a respective working distance of 3–50 mm. Within this working distance and at a spatial frequency of 100 lp/mm, the MTF is >30%. Within the nominal object distance, the guaranteed MTF of 135 lp/mm for the near-axis rays is above average.

Features:

- Exceptional high MTF
- Low vignetting
- Infrared-absorbing filter
- Lithographically generated aperture
- Excellent homogeneity of the illumination

Applications:

- Video endoscopes for medical or technical applications
- Cameras for the industrial sector
- Image processing systems

HD Falcon Objectives for 1/10" Sensors	Part- No.:	201 090 900	201 110 900	201 140 900
Sensor size		1/10"	1/10"	1/10"
Focal length		1.17 mm	0.99 mm	0.86 mm
Diagonal FOV (incl. distortion)		90°	110°	140°
Image circle		1.84 mm		
F-number		f/6		
Spectral range		450-650 nm		
Nominal object distance		6.0 mm		
Object distance range through focusing		3-50 mm		
MTF _{Fave} @ 135 lp/mm @ s ₀ = 6 mm		≥ 32% on axis ≥ 14% at the edge	≥ 34% on axis ≥ 22% at the edge	≥ 37% on axis ≥ 16% at the edge
Vignetting		≤ 1%		
Average transmission		≥ 92%		
Max. chief ray angle in image plane		12.5°	12.6°	12.6°
Distortion (acc. to tangent rules)		26%	39%	66%
IR-rejection filter		λ cut off = 650 nm (T = 50%)		
Overall length (entrance surface to detector)		5.0 mm	5.2 mm	5.1 mm
Distance exit surface to detector (BFL)		1.70 mm	1.90 mm	1.80 mm
O.D. of housing		1.70 mm		

HD Micro-Objectives

EAGLE Series for 1/6" and 1/10" Sensors

The EAGLE Series objectives, providing pin-sharp image, have originally been developed for endoscopes. Due to the compact size of the CMOS image sensors which produce the HD resolution (1920 x 1080 pixels), each pixel is only 1 – 2 μm (0.001 – 0.002 mm) small. Needless to say, the objective was developed to also work with CCD sensors.



HD Micro-Objectives
FALCON Series for 1/10" Sensors

Features:

- Biocompatible material of entrance lens
- High resolution
- Infrared-absorbing filter

Applications:

- Video endoscopes for medical or technical applications
- Cameras for the industrial sector
- Image processing systems

HD Eagle Objectives for 1/6" and 1/10" Sensors, Part-No.	105 006 900	105 014 900
Sensor size	1/6"	1/10"
Focal length	1.4 mm	1.4 mm
Diagonal FOV (incl. distortion)	140°	80°
Image circle	2.70 mm	1.84 mm
F-number	f/6 optional f/10	f/6
Spectral range	450-650 nm	
Nominal object distance	12.0 mm	
Object distance range through focusing	2-100 mm	
MTF _{ave} @ 80 lp/mm @ s0 = 12 mm	≥ 40% on axis ≥ 28% at the edge	≥ 45% on axis ≥ 39% at the edge
Vignetting	≤ 3.5%	≤ 2.0%
Average transmission	≥ 92%	
Max. chief ray angle in image plane	18°	12.6°
Distortion (acc. to tangent rules)	66%	23%
IR-rejection filter	λ cut off = 650 nm (T = 50%)	
Overall length (entrance surface to detector)	≤ 8.0 mm	
Distance exit surface to detector (BFL)	1.0 mm	1.0 mm
O.D. of housing (changing upon request)	3.2 mm	2.4 mm



As an Excelitas Technologies company, Qioptiq delivers cutting-edge technology for all photonic and optical requirements of OEM system development and scientific research alike. Global production capabilities and state-of-the-art manufacturing guarantee an impressive portfolio of products and solutions. Discover our high-performance micro-optics.

Enabling the future through light.



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