

A photograph of a space station in orbit above the Earth. The station's complex structure, including solar panels and various modules, is clearly visible against the bright blue and white clouds of the planet. The top of the image shows the station, while the bottom half is a dark gradient containing text and a logo.

Hellma[®]
Precision in Spectro-Optics. Worldwide.

Technology.
Expertise.
Innovation.



Hellma.
Hellma is the world's leading manufacturer
of cells and optical components for modern
analysis.



Welcome to the world of Hellma

Light is one of the most fascinating phenomena we can experience. Precise knowledge of its properties and the ability to use this together with unique optical components for analysis in industry and research have been a part of Hellma's history since 1922.

Now we are making an impact wherever high precision optics for analysis are needed and wherever we can fulfill a client's requests.

This brochure provides examples that give you an insight into what makes Hellma's solutions so special: unique technology, expertise and innovation that is reflected in every single Hellma product.



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Hellma. Time for the highest precision

Pioneering partnerships.

Manufacturing high-precision products demands in-depth understanding of our customers' requirements. For this reason, we work closely with research institutes, universities and scientific institutes at every stage of the product development process. The products and processes resulting from these partnerships often set new standards in the industry, many of which still apply today. Hellma not only produces standard cells and cells for specific analysis devices; it is also in demand for customised high end solutions in the field of fundamental research.

Hellma in space. And in Nobel Prize research.

A visible sign of this successful cooperation is the international success of Hellma products. Exceptional achievements for Hellma include cells taken on board the **International Space Station ISS** or the support of research for the Nobel Prize for Physics using Hellma cells in 1997 and 2001.

Hellma for the aerospace industry



Protein crystallisation reactor

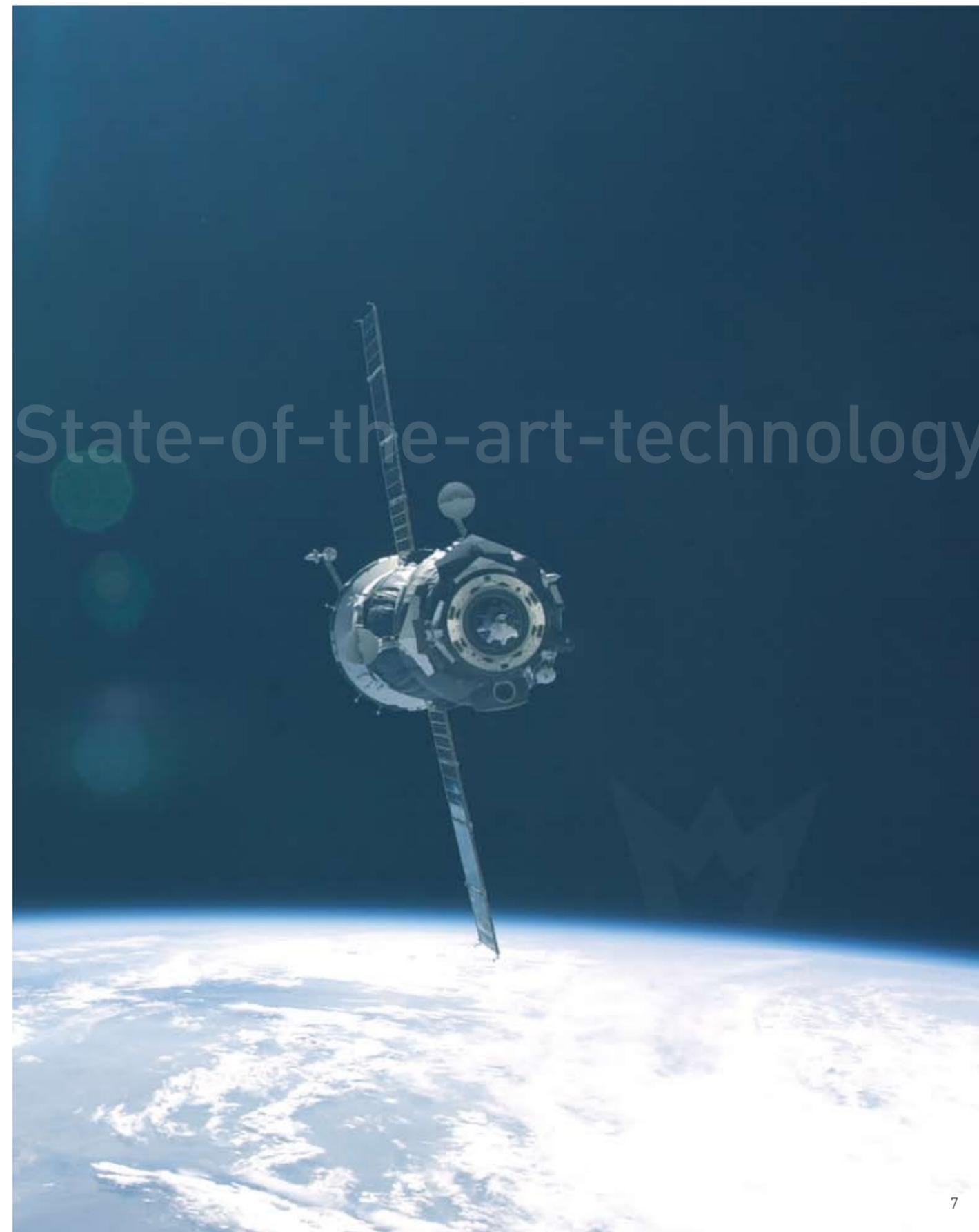
Application

Reaction vessel for measurements in space used in the European Columbus space laboratory, which was taken to the International Space Station in early 2008 on the 24th flight of the NASA Space Shuttle Atlantis.

Special characteristics

The reaction vessel is manufactured completely from Quartz glass and fused directly according to the Hellma process. The inner surfaces are polished with interferometric precision and have marker crosses for positioning. The outer surfaces feature an anti-reflection coating.

Material Quartz glass





Hellma. A leader in technology and quality

In Hellma's Technology department, Technology technicians and engineers are currently working on the optical glass components of tomorrow.

In close collaboration with universities and research institutes such as the **Fraunhofer Gesellschaft**, fabrication processes, new technologies and materials are analysed and continually refined. The results of this work lead to innovative concepts for optimised product quality and manufacturing efficiency. And from new ideas new products are born, which reaffirm Hellma's position as the number one.

In order to guarantee consistent high quality of production, Hellma follows by all official codes and standards.

The most important standards

- DIN 58963 Part 1**
Optical cells for photometric measurements
- DIN 58963 Part 2**
Optical cells for photometric measurements, precision rectangular cells, dimensions, requirements
- DIN ISO 10110**
Preparation of drawings for optical elements and systems, Part 1 to 11, part 14 and part 17
- DIN 58170 Part 54**
Dimensional and tolerance data for optical systems; blemishes
- DIN ISO 1101**
Tolerances of shape and position
- DIN EN ISO/IEC 17025**
Carrying out calibration operations
- DIN EN ISO 9001**
Quality management system
- DIN EN ISO 14001**
Environmental management system





Hellma. Expertise with that personal touch

People who not only understand their craft, but understand how to constantly develop it are the basis of Hellma's success.

With the special expertise of its highly-qualified employees, Hellma makes complex cells and fibre-optic systems using elaborate manufacturing processes tailored to suit the needs of clients. In demand worldwide: custom made products from Hellma.

The manufacturing of high-precision optical components demands up to 500 production steps. A fact that Hellma employees face with the highest concentration, wide-ranging skill and years of experience.

Hellma for chemical analysis and biotechnology



Flow-through cell with very short light path

Application

Measuring complex samples

Special characteristics

- Large measuring aperture with small measuring volume
- Individually measured and certified light path

Materials Quartz glass, stainless steel

This flow-through measuring cell is used to photometrically regulate the components of complex biological samples. It is distinguished by a large measuring aperture and individually measured and certified light path in the range of 0.1 mm. A bypass channel serves to optimise the flow. The sample supply is carried through passivated stainless steel tubes.



Technological know-how. Navigator

Forming
processes

UI Ultrasonic
lapping

Cn
CNC-machining

Ms
Micro sandblasting

La
Laser ablation

Tb
Thermal bonding

Hf
Heat forming

Ow
Orbital welding

Ot Other bonding
techniques

Surface processing

Sm Surface
modification

Fp
Fire polishing

Sc Special
cleaning process

Gd
Grinding

Lp
Lapping

Po
Polishing

Coating

Oc
Optical coatings AR/HR

Hc Hydrophobic/
hydrophilic coatings

Pc
Powder coating

Ec Electrically
conductive coatings

Micro and precision
technology

Fs
Fluidic structures

Mr
Microreactors

Ps
Precision structures

Materials

Tg
Technical glasses

Qg
Quartz glass

Cc Ceramics
and crystals

Sm Stainless steel,
metals and special alloys

Pl
Plastics

Measuring processes
for quality assurance

Sp Spectrophotometric
measurements

Pm Polarimetric
measurements

If Interferometric
flatness measurements

Ut Ultrasonic measure-
ments of thickness

Cm 3D coordinate
measurements

Pt Pressure
stability test

Lt
Leak testing



Technological know-how. For every requirement

Perhaps it is not immediately visible when looking at cells: every one is a highly-precise, optical component. Their manufacture requires a great amount of experience and skill. Below, several key technologies are described that are used in the manufacture of every single cell.



From a rough block of glass to high optical precision

The raw material is delivered mainly in the form of glass blocks or sheets. These are then cut to workable sizes using cutting processes. Then special cutting and lapping procedures bring the parts to the exact size.

Optical surfaces and surfaces that are to be joined are polished to a high finish. Joining of individual glass parts during cell assembly depends greatly on the quality of polishing.

Technological know-how.
For every requirement

Ultrasonic lapping

The most delicate glass structures can be created using techniques from the microchip and semiconductor industries – photolithography and etching. These etching processes are used for the most minute channels or volumes. This manufacturing expertise is supplemented by a further precision process: ultrasonic lapping. With this, it is possible to insert almost any shape or channel into a workpiece. A vibrating head passes the ultrasonic frequency on to a specially shaped tool. Very fine lapping abrasives then transmit the shape of this "vibrating tool" into the workpiece. This process is especially used in the manufacture of flow-through cells, where it is used to form borings and cavities with very complex forms.



Polishing process

A cell consists of high precision single parts. Each part has to have the very highest surface quality. Hellma achieves this by using the latest machinery and with the experience of highly qualified personnel. Especially for the surfaces of cell windows, two independent criteria must be considered above all others:

- The glass surfaces must be**
- > free from defects and
 - > have a high level of flatness (less than 1µm).



Technological know-how.
For every requirement

Wringing

At this stage the individual components of a cell (e.g. frame and window) are put together. This is not done with adhesive, but simply using the molecular attraction between the two assembled surfaces. This type of assembling is known as wringing. As a prerequisite, the surfaces must be free from dust, grease and other impurities.

This precision-cleaning is carried out on an ultra-modern, computer-controlled cleaning facility. Directly after the cleaning, the parts are wrung together under clean-room conditions.

Thermal bonding

The demands for extremely high temperatures and chemical resistance require highly-specialised techniques for the permanent bonding of components. Therefore the components, once assembled, are heated in an oven to a temperature far below the melting point of the glass used. This heating serves to strengthen the bond between the joined components.

After this thermal bonding, the product is almost like a one-piece component when it comes out of the oven. No changes are caused to the optical surfaces; the planeness of the polished surfaces remains intact. Complex products often undergo this cycle of surface treatment, wringing and heating many times. Even for the production of a standard cell comprising three parts, around 100 work steps are required from raw material to finished product.

The following requirements are extremely important:

- > The individual parts must be manufactured to ultra tight tolerances for dimensions and angles.
- > The polished surfaces must be very plano and may have no scratches or holes.
- > A bonding process must be used that on the one hand provides, a permanently stable bond between the components and on the other hand guarantees high chemical and temperature resistance.



Technological know-how.
For every requirement

Reducing reflection

If light passes through a cell then part of this is reflected by the exterior surface. Transmission is reduced due to these reflected light rays by a total of approx. 8 %. By vacuum depositing special thin layers onto the exterior surface, these unwanted rays of light are reduced, thereby improving the transmission of the cell. **Hellma** offers multi-layer reflection reduction as standard, which provides reduction in reflection over a wide spectral range. The remaining reflection is around 0.4 %, over the wavelength between 440 nm and 650 nm. The layer will not rub off and is not affected by climatic conditions. Other reflection reductions can be offered on demand. In order to do this, wavelength range and the value of remaining reflection per surface must be known beforehand.

Increasing reflection

For some applications (e.g. fluorescence measurements) cells with reflective windows are used. The right-hand window opposite the incoming light and the left window, at right angles to the right-hand window, are coated with a reflective surface on the outside.

The reflective layer delivered as standard is a vacuum deposited aluminium layer, that provides reflectivity of over 80 % over the wavelength range of 250 nm to over 2500 nm. It is covered with a protective layer and is very hard and wear-resistant. In addition, the reflective-coated exterior surfaces are protected from scratches with black enamel. Reflective coatings with other reflectivities and different reflective surface properties can be manufactured on request.

Quality testing and certification

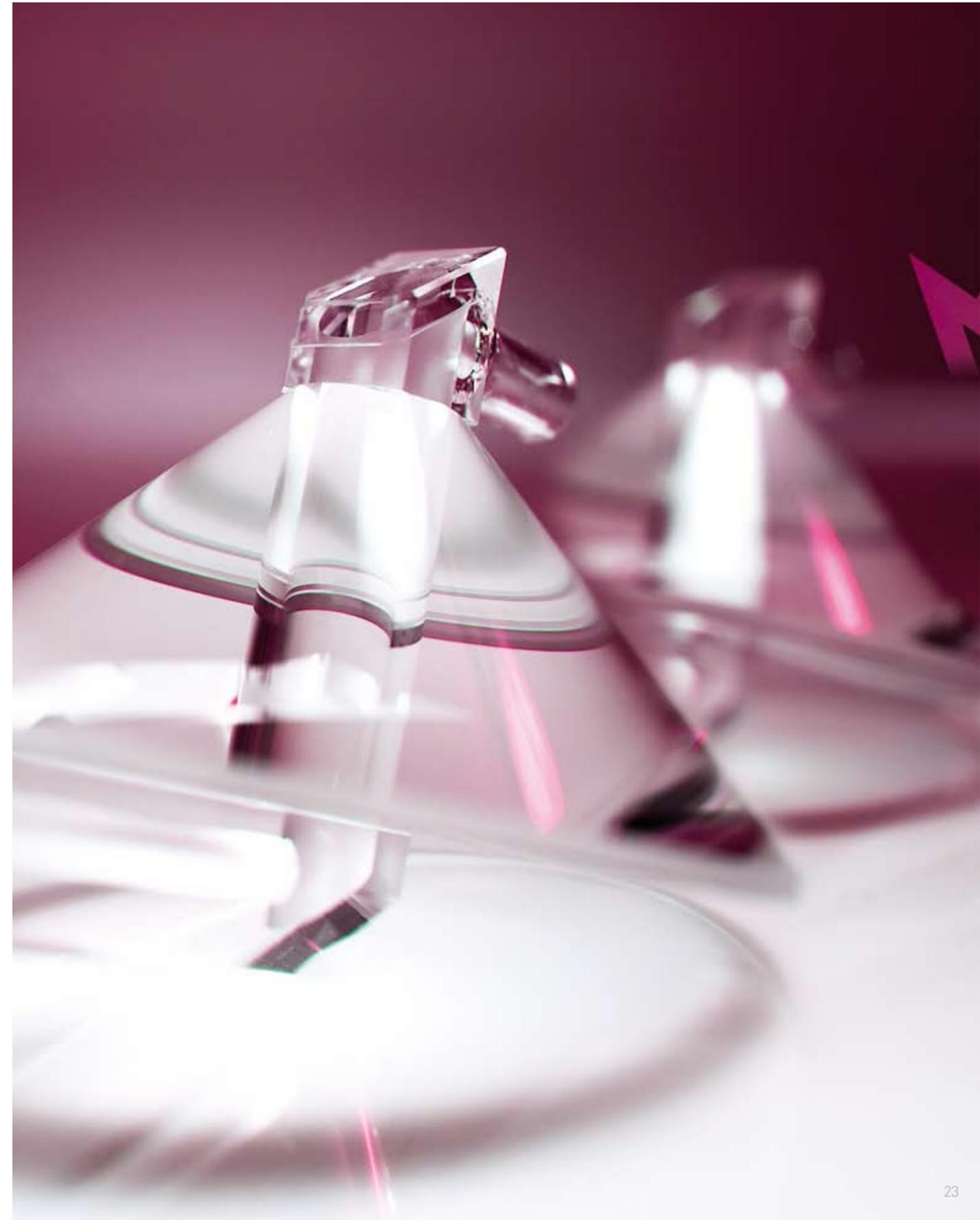
Before the high precision products are sent to the customer they have to pass through a comprehensive quality testing. During this assessment the products are checked interferometrically and surface quality is checked using a microscope. The cells are checked for their transmission performance with modern spectrophotometers and compliance with all the customer requirements is verified. Every product can be delivered with a certificate on request.



Technological know-how. Your idea. Our solution

Solutions from Hellma are used for all applications in the most diverse sectors. Maybe even for your individual needs? Come and discuss your requirements with us and benefit from our technological expertise in the manufacturing and development of high-precision optical components.

Know how



Cells. Trust in the original

After decades of experience in glass treatment Hellma produces cells of unrivalled quality. These are used in absorption measurements, fluorescence measurements, and even special uses such as cytometer, diffused light, and reflection measurements and measurements in ultra-high vacuums, guaranteeing precise and easily reproduceable results. With over 1,500 types there is one to suit almost every application. Furthermore, Hellma works in close partnership with its customers to produce customized solutions.

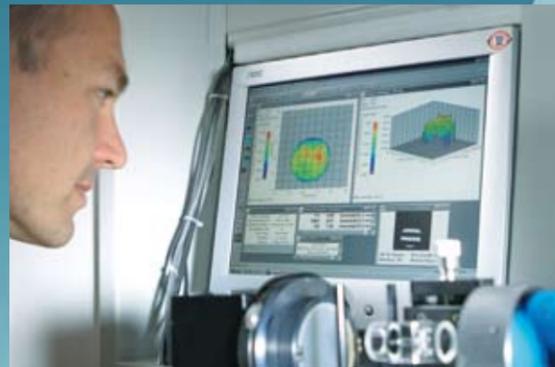




Where precision becomes an art. Explained with examples

At Hellma information is often asked for regarding sizes, flatness and parallelism or wedge errors.

To give a typical example: the 100-QS with 10 mm lightpath should demonstrate that it is not always easy to answer these questions.



Flatness

The question of flatness is easiest to answer for single windows. Their surfaces are plano to more than 0.001 mm (1 μ m). Just as important is the parallelism of the two surfaces relative to one another. On the other hand in the filled cell the effect of possible uneven interior surfaces is compensated for if the liquid inside has a similar refractive index to glass. The only remaining analysis now is how much an even wave is deformed as it passes through the cell.

Frontal deformation of the wave is under 4 Lambda in the example, which works out at 0.002 mm (2 μ m) if lambda is 546 nm.

Parallelism. Wedge errors.

The question of the parallelism of exterior surfaces with one another in this case only relates to the parallelism of the end surfaces of the U-shaped frame, as wedge errors of the window surfaces can be disregarded. From the lightpath tolerance a value of around three minutes is calculated in the least favourable case of a horizontal wedge error, otherwise expressed as 0.01 mm. As the relevant values depend on construction, shape and dimensions of the cell, individual figures must be calculated for each cell. For this reason Hellma can produce a technical drawing on demand for each cell, in which all technical data specific to the cells' use is specified.

Hellma for the pharmaceutical industry



Highly precise quartz glass microphotoreactors

Application

Microphotoreactor for obtaining an extremely pure material for combating colorectal cancers.

Special characteristics

- Lightpath of less than 1/10 mm
- Very high parallelism
- Very high pressure resistance

Material quartz glass

These extremely accurate photoreactors are very large flow-through cells with a dimension of 20 x 12 cm. Using the reactors and ultraviolet rays, it is possible to obtain through photolysis a highly pure material for combating colorectal cancers. The reactors represent a crucial element in this process, newly developed and patented by W.C. Heraeus GmbH, a division of the Heraeus precious metals and technology group. The requirements for production quality were correspondingly demanding. Especially given the fact that the lightpath is less than 0.1 mm – less than the width of a human hair. The parallelism of the exterior surfaces is less than 1 μ m over the entire surface. The sample supply is carried through passivated stainless steel tubes.

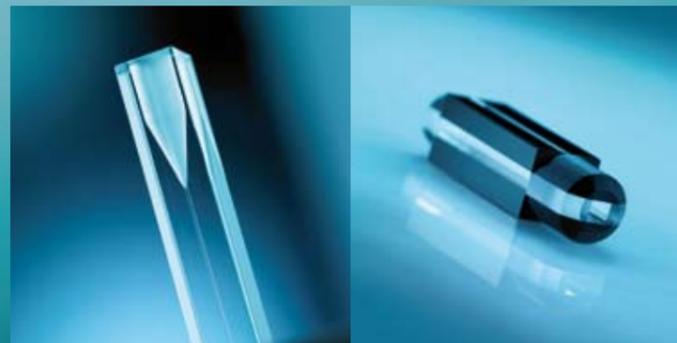


Micro flow channels. For modern cytometry and particle analysis

Flow cytometry is a technique of quantitative single cell analysis, that works by sensing optical properties of microscopic particles or components in a flow stream with light. Today the rapid and automated sorting and multiparameter analysis of cell preparations by measuring volume, light scattering and fluorescence of multiple dyes in a single instrument, makes flow cytometry one of the most powerful and important technologies for applied sciences in the 21st century.

Due to sophisticated technologies Hellma is capable of manufacturing customer specified channel dimensions down to 50 μm x 50 μm with any outside dimension and highly polished surfaces of fluorescence free material for interference free laser analysis.

Working with Hellma flow channels, you can rely on high reproducibility within tight tolerances. Hellma has ultrasonic and CNC drilling capabilities for all kinds of stream shaping cones as well as a direct lens mounting facility. A computer controlled inspection system guarantees the precise channel positioning.



Hellma is a member of the Mikrosystemtechnik Baden-Württemberg (MST BW), which represents nationally and internationally the interests of industry, research facilities, universities and institutions in Baden-Württemberg in the field of miniaturisation, microtechnology and in the area of the integration of nanotechnology as well as the synergies to mechatronics.



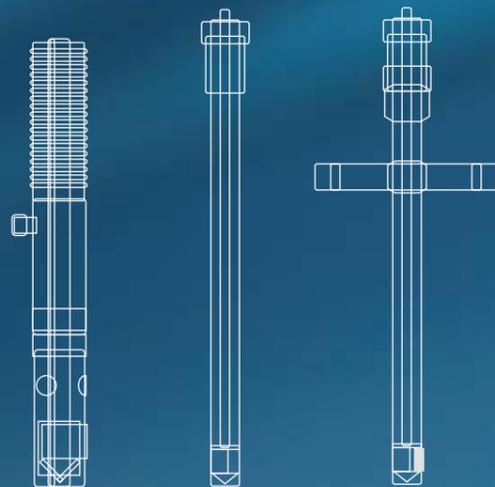
Quartz

Fibre-optic systems. The direct solution for immediate results

The use of fibre-optic cables allows chemical analysis to be carried out directly, instead of using cells in the laboratory. With the development of fibre-optic probes the analysis can be merged into the process.

This means that measurements can be taken whilst the process is ongoing. Time-consuming sample-taking and processing have become a thing of the past. Even toxic or radioactive substances can be safely measured with optical probes. Hellma has recognised the potential of these systems early and has built it into a

strategic business area with its own research, development and production. Hellma can meanwhile benefit from years of experience in the field of fibre-optic system manufacturing. In addition to its expertise in glass and cell production, Hellma now also has know-how from the fibre-optics, sealing technology and metal treatment sectors.



FOS

Sapphire



Nevermind if the end product has to undergo extreme temperatures, high pressure or aggressive chemicals. Using the testing rig developed by Hellma the company can test probes using high temperatures and pressures at the same time.

In the world of fibre-optic probes, knowledge of chemical resistance of the materials used plays a decisive role. By carefully selecting materials, Hellma can manufacture immersion probes for almost any measurement task.

The ability to find the right optics for the right job is also part of the fibre-optic probe expert's knowledge. Using special calculations and simulations, Hellma is able to achieve the optimum light efficiency for every application.



Hellma for the petrochemical industry



Under pressure: Flow-through cell

Application

Measurement applications in the petrochemistry

Special characteristics

- pressure resistant
- easily dismantles for cleaning

Materials

Sapphire, stainless steel, elastomer seals

For some measurements immersion probes cannot be used because of a prohibitively small tube section. For such online measurements a flow-through measurement cell has been specially developed. This comprises a stainless steel body. The optical windows into the sample space are made of sapphire. This means the cells can also be used under very high pressure. Fibre-optic cables connect the measuring cell to the spectrometer. As with cell measurements, the light beam passes through the sample compartment only once. This leads to very low diffused light levels and improves measurement quality. When using cold sample liquid, condensation can occur on the collimation optics and window interior. To avoid this, the cell is equipped with flush ports for dry and oil-free air.

Hellma for the paint and dye industry



When the solution is too viscous: Immersion probe with vertical measuring slit

Application

Measuring high-viscosity samples

Special characteristics

- high chemical resistance
- flow-optimised construction

Material

Quartz glass

The measuring slit in this immersion probe is aligned vertically in an all-quartz measuring head. The excellent optical properties of this measuring head are no different to those of a horizontal measuring head. Thanks to the flow-optimised geometry, the product can flow freely through the measuring slit when the probe is immersed. In this way, air bubbles that could alter the result are kept out of the slit. This design is particularly advantageous for measurements in highly viscous (thick) media.

This immersion probe is used for the measurement of emulsion paints. In this case the probe is fitted onto a robotic arm. The robot automatically immerses the probe within the paint. After measurement it holds the probe in a cleaning chamber where the measuring head is spray cleaned. Then the next measurement takes place.

TrayCell. Innovation in detail

The TrayCell is a fibre-optic ultra-micro measuring cell for carrying out quick and easy DNA/RNA or protein measurements (0,7 - 5 µl) with exceptionally high reproducibility.

It has the same dimensions as a standard cell and can be used in all current spectrophotometers.

In 2008 Hellma received a recognition at Germany's innovation award „Innovationspreis Baden Württemberg“. The jury evaluated the engineering progress, the power of innovation and the business success of a total of 69 innovations.



TrayCell: Awarded at
Innovationspreis
Baden Württemberg 2008

Optics in Premium Quality.

For laser technology and photonics



Cylinder Optics
Toric Optics
Flat Optics
Special Optics

Initially, a mere discipline of physics, optics has developed into a key 21st century technology: Photonics. Many diverse laser applications play a critical role within photonics.

Excimer lasers for instance are used for micro machining material, medical applications, and microlithography. Excimer lasers produce electromagnetic emission in the UV and far UV region.

To generate such emissions, cylindrical optics manufactured from special materials and with special coatings are required. In addition to special quartz glass material which we use for Excimer lasers (248 nm and 193 nm) we also work with Lithosil[®], Suprasil[®], CaF₂, MgF₂ and sapphire.

Hellma Optik Jena has many innovative technologies and years of experience producing such optics. Furthermore we have the capability to manufacture up to a length of 800 mm with the highest surface precision and exact centration.

Optics

Exclusively from Jena.

Success. At eye level

Long-term success is based on mutuality. Therefore relationships with customers are of primary importance to Hellma.

Hellma guarantees close partnerships with customers worldwide with 13 subsidiaries in Europe, Canada, the USA, South America and Asia as well as numerous exclusive representatives and laboratory dealers. Advice and customer service can be given on site – this is the best system for enabling customers to achieve their goals in the shortest time.





Hellma.
Leading in quality and
precision since 1922.

