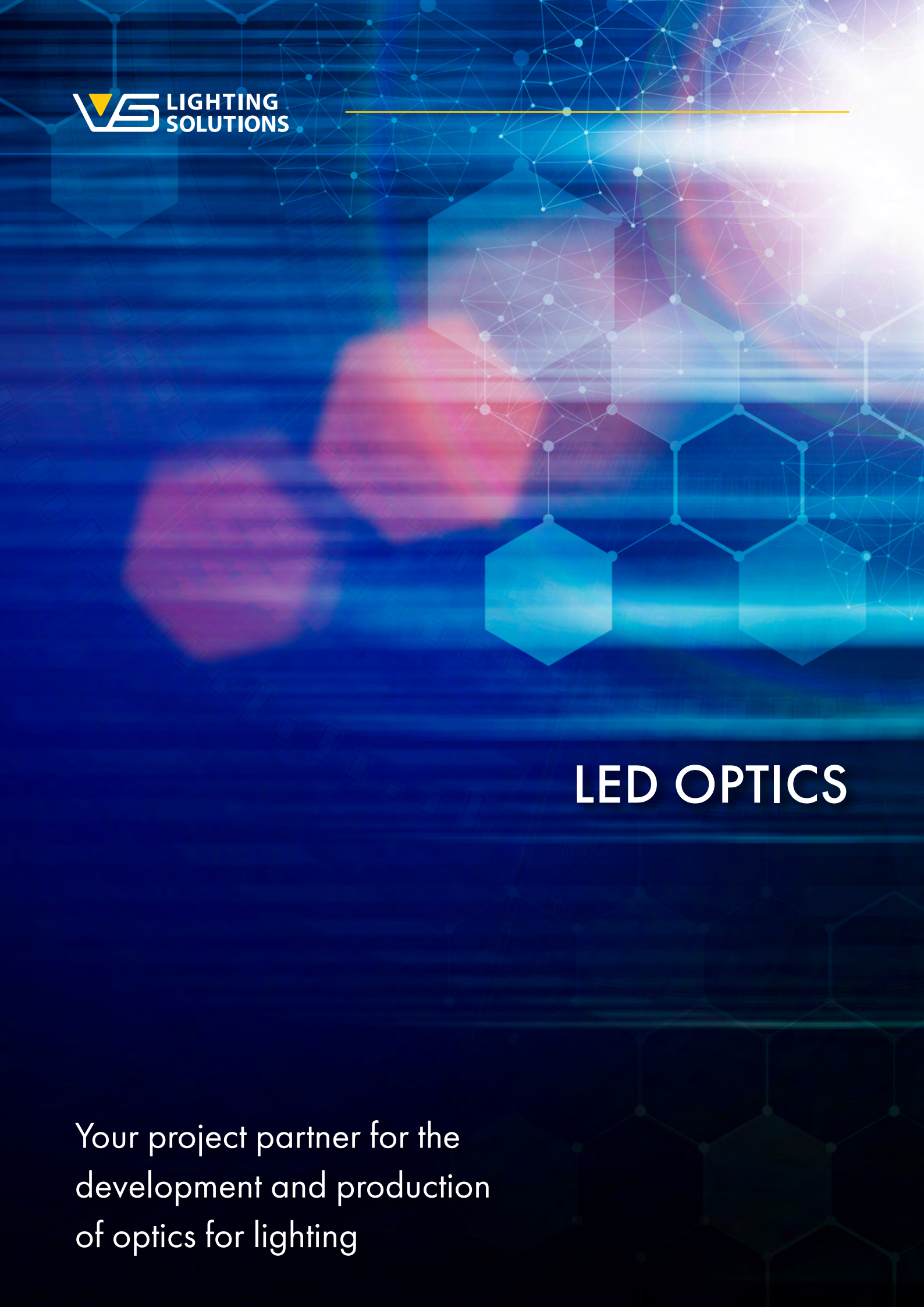

LIGHTING
SOLUTIONS
LED OPTICS
Your project partner for the
development and production
of optics for lighting

CUSTOMISED OPTICS FOR LIGHTING TECHNOLOGY

We have been developing and manufacturing plastic optics of the highest quality for a decade. With our development team specialising in optics, our in-house toolmaking in Germany and injection moulding in our production facilities in Europe, we are also experts in the field of customer-specific optics for lighting technology.

Because of the network within the VS Group and the close cooperation between the individual specialist teams, we have a wide range of expertise in the areas of optical development, material selection, tool technology and manufacturing processes for injection-moulded optics made from thermoplastic materials.

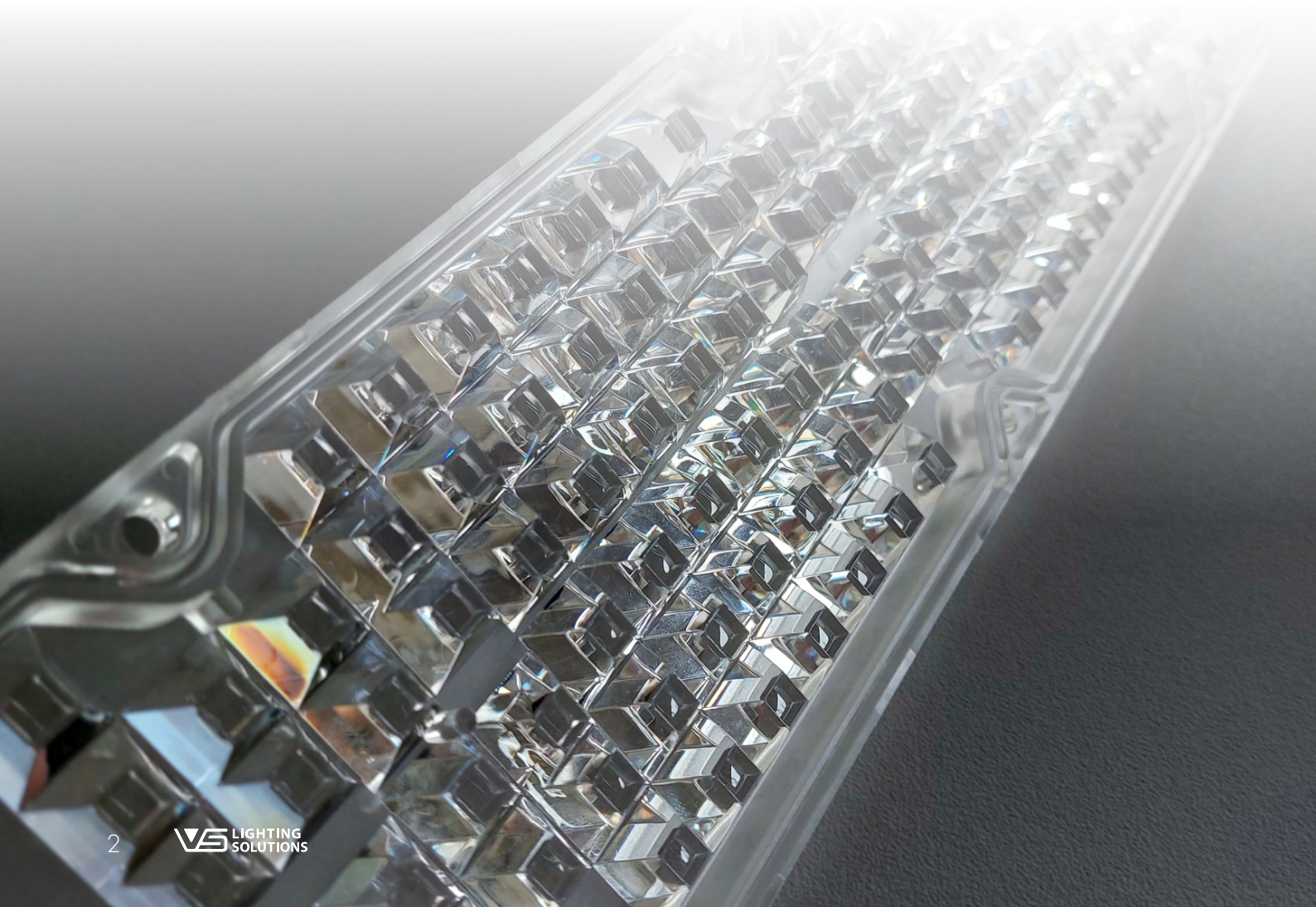
We actively accompany our customers at every stage of the project with our experienced project team. As a reliable development partner, we support our customers in the development, manufacturing, testing and verification processes.

Our product developments can be as varied and individual as the plastic material itself. Whether you have an idea or can already provide a detailed specification, we are happy to take on board your requirements and wishes and are fully committed to developing a solution.

We also offer the option of perfectly coordinating injection-moulded optics with LED modules and integrating them ideally into your luminaire.

VS Tool manufacture

With our in-house mould and tool construction, we guarantee highly flexible development and production for demanding projects - especially with regard to complex geometric shapes, surfaces and microprismatic structures for optics.



Over 10 years of experience in the design and manufacture of injection moulding tools for optics and a high-quality machine park with automated processing sequences are the basis for the quality, precision and durability of the tools and therefore also for your products.

VS injection moulding production for optics

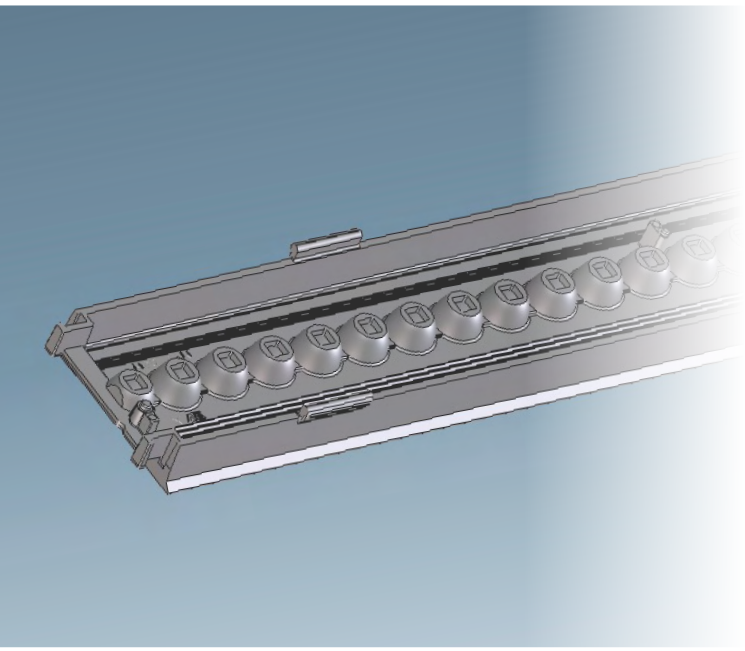
Our automated manufacturing processes in plastics processing with modern machines are the basis for the production of optical components. Most lighting optics are made from polymethyl methacrylate (PMMA) or polycarbonate (PC). The high demands placed on the material also include flawless workmanship. We place the highest demands on quality. Our quality measures during production, such as dimensional checks and visual inspections with documentation via our CAQ system, guarantee a consistently high standard.

DEVELOPMENT AND MANUFACTURING PROCESS

We offer you support from our experts at any time, no matter what phase of project development you are currently in. In lighting technology, optical components are often very complex and individually designed, which is why they require a high level of consulting expertise.

1. **Development** – Concept development, simulation and evaluation of the lighting technology and testing of the lighting technology in use
2. **Prototypes** – Production of prototypes from existing tool moulds
3. **Component design** – Plastic and production-oriented layout, interface consideration and material definition
4. **Simulation** – Assessment of filling, flow and warpage behaviour, strength analysis, derivation of design adjustments
5. **Tool construction** – Development of tool concepts, construction and complex injection moulding tools, integration of manufacturing processes and new technologies
6. **Toolmaking** – High flexibility with in-house toolmaking, modern technology and processing centers, precise and prompt implementation of tool projects, modifications and repairs
7. **Production of prototypes** – Series quality - realisation through the use of flexible master mould concepts
8. **Production concepts** – Suitable production solutions with modern injection moulding machines from 35 to 500 tons clamping force, production of optics up to a component size of one meter. Special peripherals for the production of optical components as well as automatic removal units and packaging of components.
9. **Validation** – Taking over article-related process validations, assessment of quality features during production, early detection of process deviations
10. **Measuring service** – Optical and mechanical component measurement, qualitative evaluation of the optics, measurement and verification of light distribution, CCT and UGR values and comparison against the project specifications

COLLABORATIVE DEVELOPMENT – IN ALL PHASES OF YOUR PROJECT



For our customers, we are more than "just" a supplier. We are a technology partner, solution finder and development partner. Based on your ideas and requirements, we develop a customised product that fits your application perfectly.

During project planning, our focus is on time and quality targets, cost-effectiveness and innovation. The know-how of our experts is incorporated into every development project in order to create innovative and technically outstanding products based on the requirements of your luminaire and application.

Thanks to our specialisation in optics for lighting technology, our team are familiar with the special requirements and have mastered the holistic range of services for successful product development. Coupled with the knowledge of your lighting technology specialists, the result is a product that is more perfect than can be achieved through separate development.

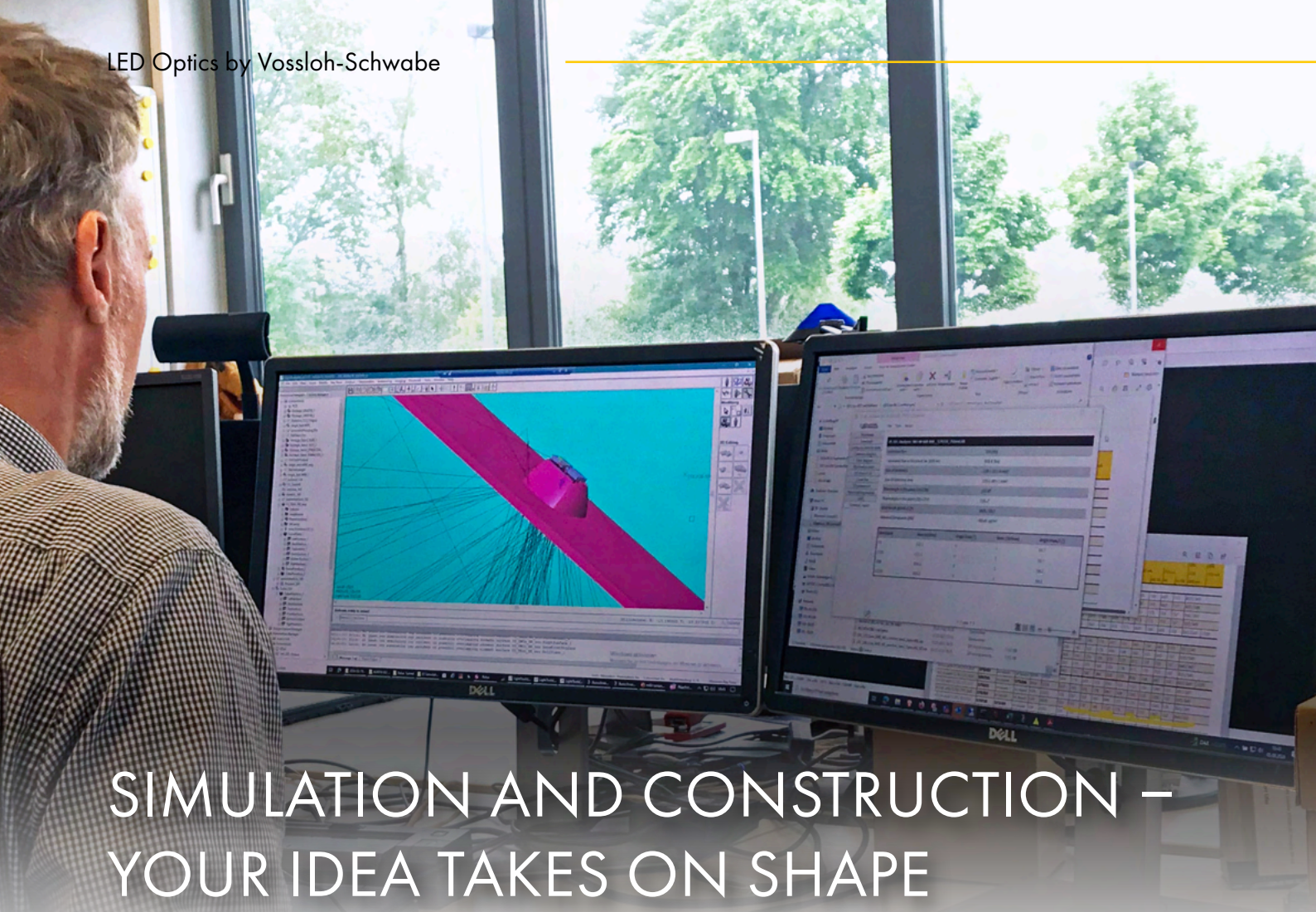
Together with you, we analyse the respective application and the framework conditions of the task. Taking existing technologies into account is just as important to us as offering alternative implementation options. Once the concept has been created and the light and colour distributions have been simulated, we assess the manufacturability and make recommendations for adjustments. Tolerance considerations as well as error and influence analyses are already integrated in this step.

Our services

- Influence analyses
- Simulation of light and colour distribution
- Calculation and optimisation of UGR values
- Mechanical product development
- Design suitable for plastics
- Risk and tolerance assessment
- Provision of simulation results and 3D data of the product

"In addition to the complex photometric requirements, optical systems for lighting technology also have design requirements, as they embody the "visible" range of light and represent a key design aspect of the luminaire. Our service goes beyond optical simulation. Rather, we see ourselves as a partner to our customers and also support them in downstream processes such as tool design, material selection, manufacturing processes and validation of the end product."

Christian Gerstberger, Head of optical systems development



SIMULATION AND CONSTRUCTION – YOUR IDEA TAKES ON SHAPE

Based on your requirements, the first step is to simulate the lens geometry on the basis of the photometric targets. The simulation takes into account the LED data as well as the lighting requirements of the application.

The optimisation of the light distribution curves, colour distributions across the beam angle and the optimisation of efficiency and glare values place high demands on the simulation tasks with the aim of generating the ideal lens geometry.

Design aspects such as microprismatic surfaces and surface luminance are also taken into account in this optimisation.

Verifying the simulation results with real measurements on prototypes is a very important step in the development of new lens systems.

For this purpose, VS has variable master moulds from which prototypes of the simulated lenses can be produced using new inserts. The prototypes are injection moulded under the same conditions as the later series product. They therefore provide validation of the simulations at an early stage of development and before the series tool is realised by means of metrologically determined light distributions, efficiencies and colour gradients.

Furthermore, these prototypes make it possible to visually assess the lighting quality using a prototype light thanks to the comparable light. This allows all those involved in the process to be convinced of the future end product before the start of series tooling.

The mechanical design of the optics is carried out in parallel, taking into account the interfaces and the attachment and alignment of the LED modules with or through the optics.

This also includes the evaluation of wall thicknesses and material selection as well as subsequent disassembly for recycling.

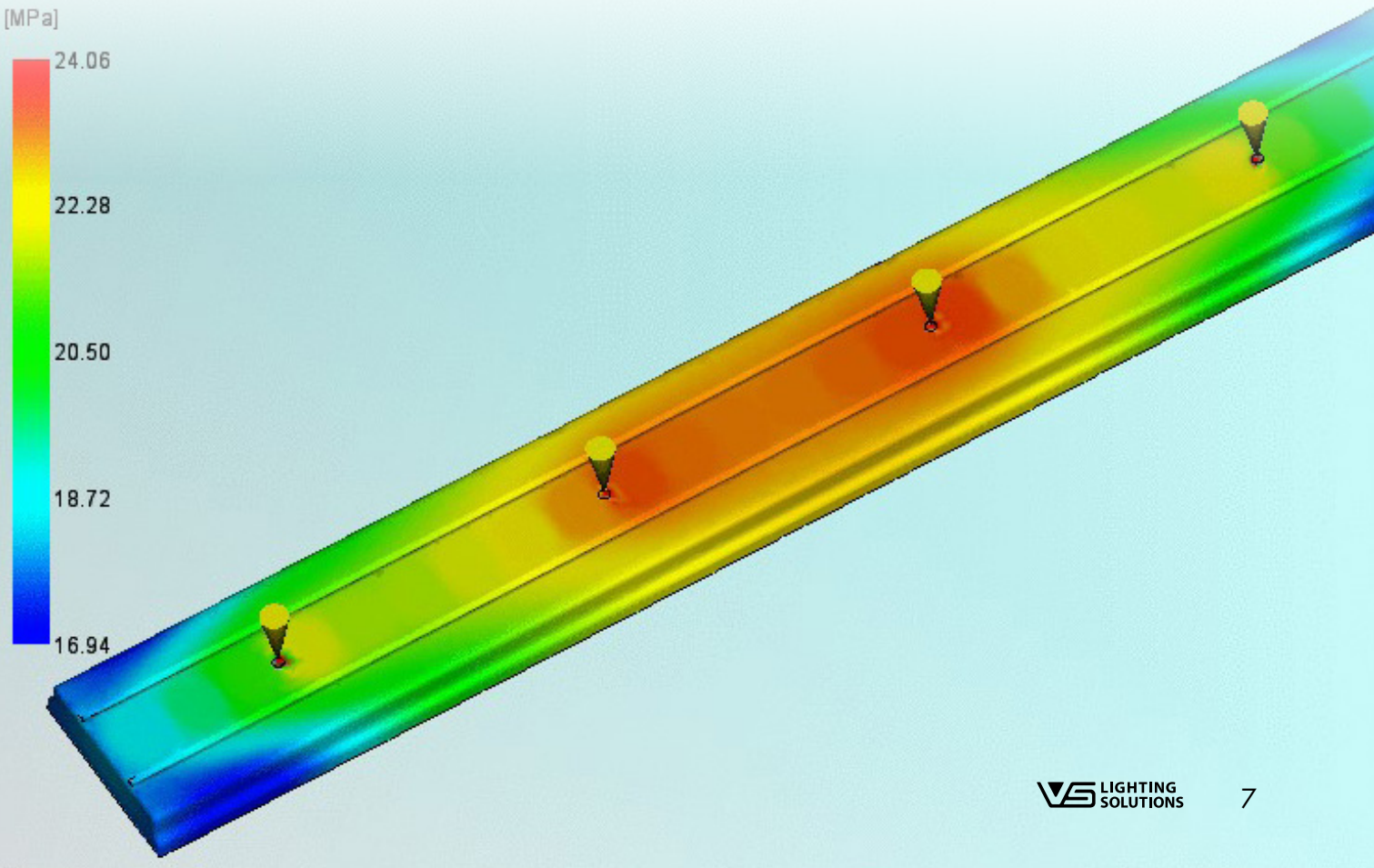
In this phase, simplifications can be introduced by adapting components and planning modern tool technologies, which can result in considerable savings potential.

Mouldflow analysis, the basis for optimal tool layout

Mouldflow analysis forms the basis for optimum production and quality of the optics. With the help of flow simulations, quick and precise statements about the filling behavior and the expected distortion of the component can already be obtained during the component and tool design phase. Statements can also be made about the temperature conditions in the mould as well as the ideal positioning and design of the gating depending on the geometry of the component and the planned plastic. This allows initial concepts to be verified and potential problems with filling and flow lines to be identified at an early stage. The findings are incorporated into the subsequent tool design. This speeds up the entire development process and avoids cost-intensive reworking of the tools.

Our services

- Simulation and optimisation of the lens design
- Mechanical and injection moulding-compatible layout of the components
- Validation of development results through prototypes
- Assessment of the filling/flow and warpage behavior through Mouldflow analyses
- Optimisation of the manufacturability and quality of the component

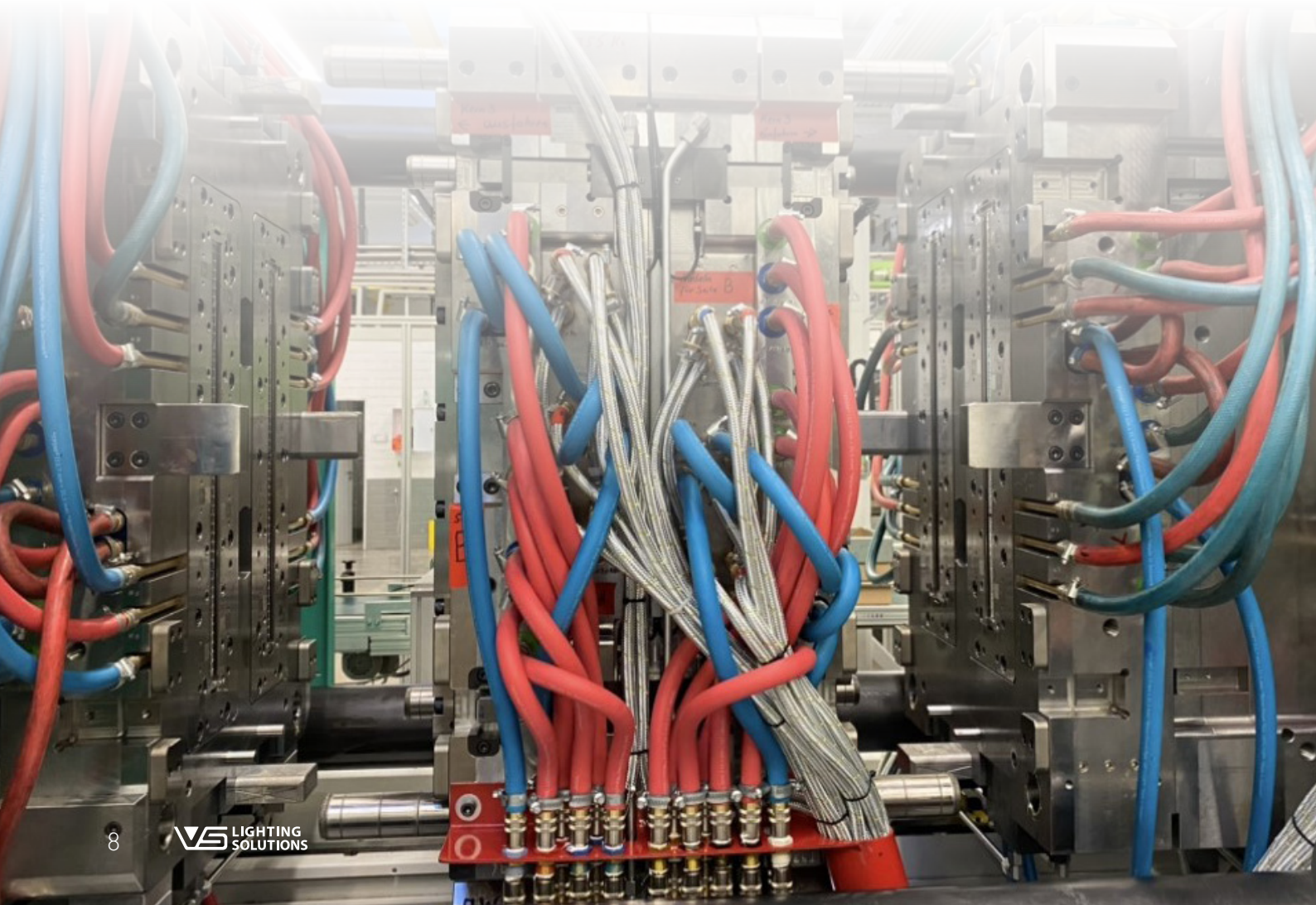


TOOL CONSTRUCTION – THE BASIS FOR TOOL QUALITY

Our specialised design engineers design the tools taking into account the economic framework conditions. Here, our experience from almost 50 years of injection mould construction and extensive technology-specific knowledge are incorporated.

Our services

- Development of tools for injection moulding processes
- Integration of ideal standard parts and sprue systems
- Component and process-optimised cooling
- Tool layout for very long tool life with the lowest possible maintenance requirements
- Modular concepts for different lens geometries from the same master tool



"The construction of the tool is the basis for the production of high-quality tools using state-of-the-art manufacturing processes. Our long-standing and successful collaborations are the result of intensive dialog between our tool constructors, our customers and our toolmaking department."

Thomas Wippermann, Development of injection moulding tools VS

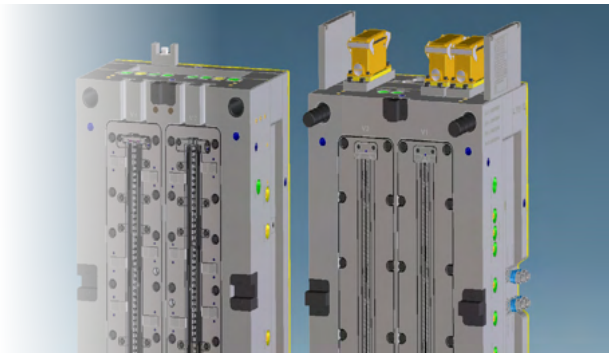
TOOLMAKING – PRECISION IS ACHIEVED RIGHT HERE!

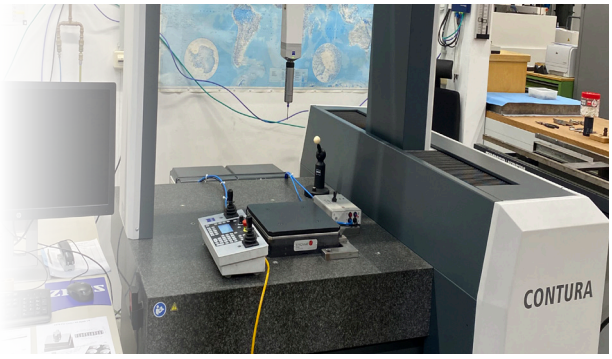
In our in-house mould and tool making department, the constructed tools can be created quickly and efficiently and the first injection moulded samples can be made available within a short time.

The required individual parts of the tool are manufactured using state-of-the-art production techniques. Our internal manufacturing guidelines guarantee a long service life and absolute precision of the tools, with all the necessary toolmaking steps being carried out in-house.

Our experienced specialists maintain their edge through on-going continuous improvement training programmes. We also offer all the services of modern toolmaking, such as tool repair and maintenance, spare parts production and the complete production of new tools with up to 32 cavities. We use die-sinking and wire erosion, the production of graphite electrodes, HSC milling, laser welding and the production of microprismatic surfaces using 5-axis high-speed milling.

Thanks to our in-house toolmaking department, we are flexible, which enables us to change products and create variants promptly, but also to transfer tools with some necessary adaptation work.





INJECTION MOULDING PRODUCTION CONCEPT – LONG OPTICS SPECIALISTS

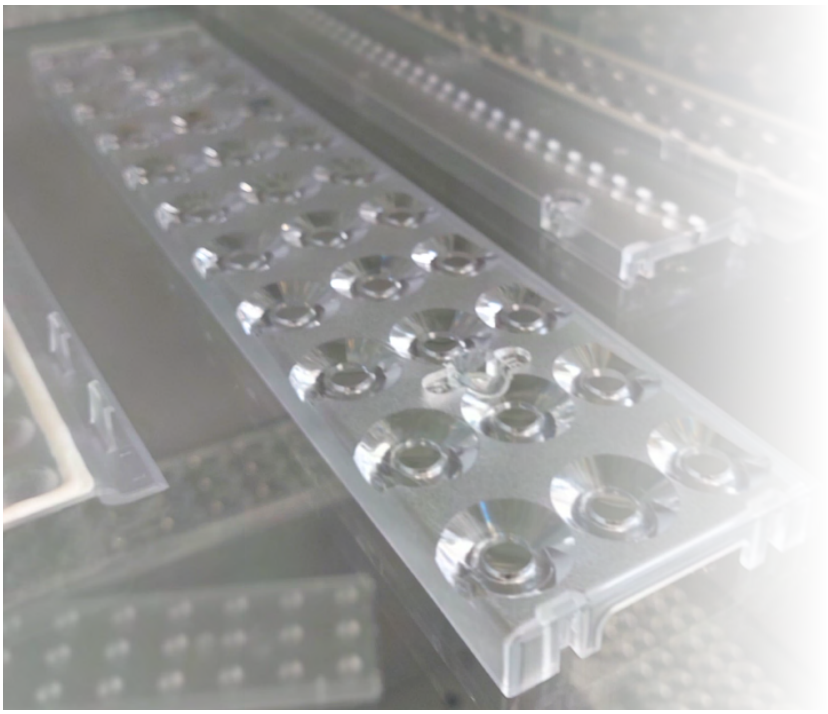
Experience with the behavior of very long components with different wall thicknesses and also made of clear material is something that only a few manufacturers have and have really mastered in production.

In order to achieve the high quality of the optics, special tooling techniques and tempering are required that have nothing to do with the plastic production of earlier "small parts".

The required quality and precision of optics are in the range of less than 0.1 mm tolerance and can only be realised with considerable tool and equipment expenditure in production.

VS offers you this experience through our specialists and our conviction that these requirements can only be met by manufacturing in Europe for Europe.

In addition, VS can also manufacture complete optics with seals that achieve up to protection class IP67. For this purpose, we have tested special sealing materials and assembly methods that guarantee reliable and durable sealing of the luminaire.



We offer:

- 24/7 production at our plant in Serbia
- 40 injection moulding machines with 35-500 tons clamping force
- Automatic removal and packaging
- Latest manufacturing and cooling processes for optical tools
- Changing variants by swapping inserts
- Single- and multi-component injection moulding
- Tool maintenance and toolmaking
- Assembly of several components or complete assemblies
- Quality control and batch tracking during production

"To produce optics, maximum precision is required. That is why our injection moulding production at VS takes place under controlled process conditions. We work with over 40 modern injection moulding machines in our production plant in Serbia, which specialises in optics. We also have a modern tool-making facility here, which supports injection moulding production and can make short-term adjustments and produce spare parts. This shortens the delivery time and guarantees the high quality of the optics."

Bernd Helleberg – Project manager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LIGHT
FOR YOU
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VALIDATION – GOAL ACHIEVED?

In addition to manufacturing and qualifying the tools, validation is also essential. It ensures that the optics can always be produced to a high quality, which in turn paves the way for a successful end product.

By integrating a risk management process into product development, critical product criteria can be identified at an early stage. These are then analysed and evaluated with the help of suitable product and process validations.

The aim here is to achieve the required lighting technology and the tolerance specifications for the optics, which are essential prerequisites for the product's photometric properties.

Measurement services - measurements show the result of the project

VS offers extensive measurement techniques for the assessment and measurement of lighting technology and mechanics. In addition to classic disciplines such as the measurement of light distributions, colour distributions and efficiencies of the optics and LED module system can also be measured. We also offer optical component measurements and their qualitative evaluation and classification.

For optical systems in particular, our equipment offers precise assessment and verification for reverse engineering. This involves reversing the development or production process, for example by recording the actual failed geometries during initial sampling.

These are transferred to the simulation models in order to simulate the influence of deviations and their effects on lighting technology in reverse. This allows product improvement measures to be defined before a product is transferred to series production.

We offer:

- Measurements of light distribution curves
- Colour deviations via beam angles
- Optical efficiency measurements
- Optical and dimensional component measurement
- Thermal measurements of assemblies

QUALITY MANAGEMENT – CERTIFIED SYSTEMS AND LOCATIONS FOR YOUR PRODUCT

Development and simulation

Products for lighting technology are subject to diverse and stringent requirements. The goal of producing only high-quality and safe products is in our DNA. We guarantee this quality promise through our certified quality management system (QMS) in accordance with DIN EN ISO 9001.

All production locations are certified to ISO 9001. Environmental management at all production locations has also been certified to ISO 14001 since 2005. All quality-relevant processes are subject to permanent monitoring and are managed using defined key figures.

During the entire production process, all products are checked for compliance with Vossloh-Schwabe's high quality standards. To maintain this standard, employees are constantly trained internally and externally.

Quality assurance agreement

The quality of the goods and processes supplied by a supplier to VS is assured by a quality assurance agreement (QAA). The framework conditions for achieving the desired quality targets are determined by agreements with each supplier, which means that deviations of the end product from the standards specified by VS are ruled out at an early stage.

We offer:

- Management according to ISO 9001, ISO 14001
- Digital solutions for quality management and quality assurance
- Qualification of production locations, tools, systems and suppliers
- Validation of manufacturing processes

CONSULTING AND REALISATION – WE OFFER SYSTEM SOLUTIONS

Technical consulting

VS has extensive experience when it comes to the technical requirements of lighting technology. Based on the requirements of your application, we can define a complete system comprising optics, module and driver for you and thus make an initial assessment of which technical solution will deliver the most efficient and best results. Once the system has been created, the next step is the detailed design and coordination of the individual components and the integration of the components into your product ideas. We see ourselves as a system supplier who shares the responsibility of development with you.

Feasibility studies

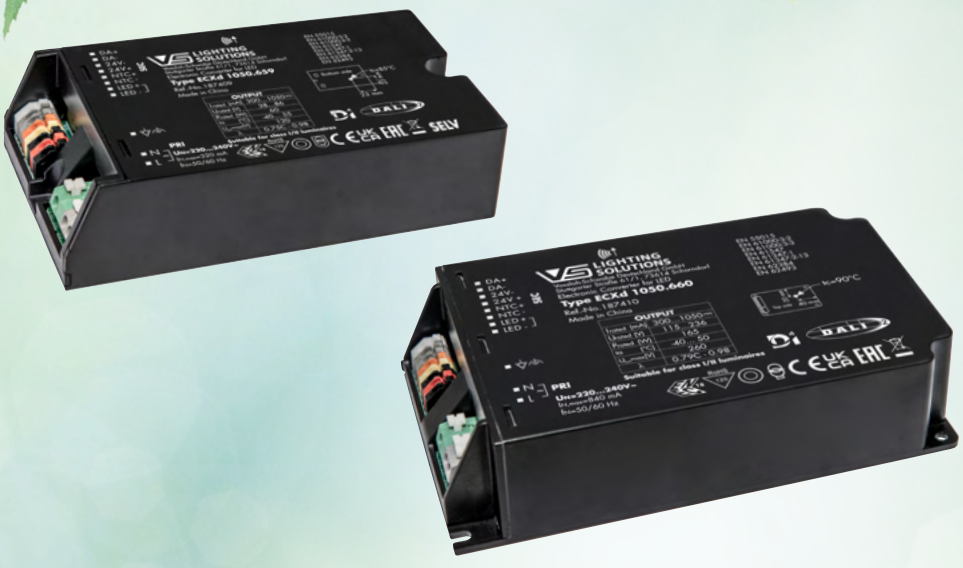
Realising complex assemblies requires detailed prior consideration of the technical lighting requirements and the interaction of the LED module and optics. The mechanical mounting and the precise alignment of the system with the interfaces to the luminaire are another point that needs to be considered. New screwless, quick-to-assemble joining techniques are increasingly being demanded as a challenge for the circular economy. The plastic-compatible design of the component and the economical manufacture in the production process are considered just as much as the selection of the right material. Not to be forgotten is the planning of the right tool concept during the feasibility analysis in order to achieve the best possible relationship between tool costs, manufacturing costs and also the quality of the end product.

Sustainability requirements

The requirement to produce the luminaire components sustainably in Europe and to dismantle them again at the end of their service life, separate them according to material and reuse or recycle them is an increasingly important requirement that can only be met by designing the luminaire accordingly and planning the recycling processes. In addition, the use of recycled materials or the use of plastic materials made from renewable raw materials is becoming increasingly important. VS has extensive experience in this area, which we would be happy to integrate into your project.

Regulatory Support - we know the regulations

When it comes to the certification processes for components or luminaires, we have many years of experience thanks to in-house testing in our VDE-certified laboratories for components. As the components must always be tested in conjunction with the relevant regulations, we can also advise you on this point and, if required, also offer individual tests of luminaires in our laboratories or support you in this regard.



System supplier

In addition to development, our production facilities also enable us to assemble VS components into prefabricated modules, test end products in accordance with regulations and finally package them. We offer you the opportunity to focus less on the procurement of components and production of assemblies and their logistics and instead concentrate entirely on your customers and markets. On request, we can offer you this service on a project-specific basis right from the planning stage of the luminaire, using our extensive capacities and cost-effective options in our production plants and logistics centers in Europe.

LIGHTING SOLUTIONS

WE THINK LIGHT FOR YOU

Vossloh-Schwabe Deutschland GmbH

Stuttgarter Straße 61/1 · 73614 Schorndorf
Telefon +49(0) 71 81/80 02-0

www.vossloh-schwabe.com

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