CASE STUDY: HELLA KGAA HUECK & CO.

SILASTIC™ moldable optical silicones help pave the way to a groundbreaking LED headlamp design from Hella KGaA Hueck & Co.

The challenge

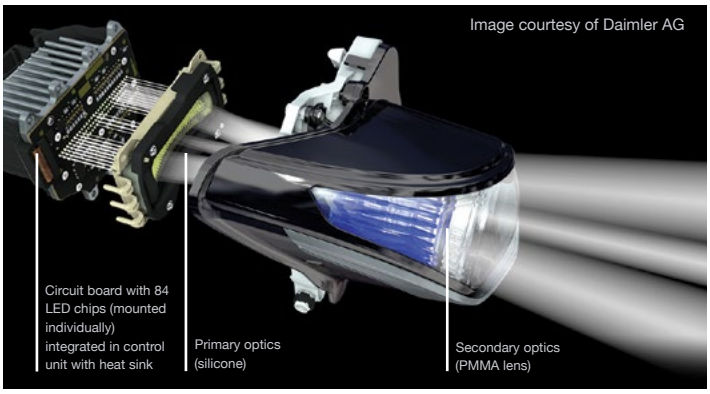
For years, the conventional approach to automotive LED headlamp design relied on mechanical actuators to position the beams of a single, controllable LED row. Hella KGaA Hueck & Co., a leading manufacturer of innovative automotive lighting components, envisioned a more dynamically adaptive solution that needn't rely on mechatronic components.

Image courtesy of HELLA

That vision became the award-winning MULTIBEAM LED headlamp. Developed in partnership with Daimler AG, the MULTIBEAM module incorporates 84 individually controllable LED pixels arrayed in three rows, enabling the headlamp to dynamically distribute light in real time based on changing traffic, weather and road conditions. Hella's groundbreaking headlamp module further ensures that the high beam function can be used more frequently, therefore offering greater safety and comfort.

Such innovation did not come without challenges, however. Distributing light evenly from the MULTIBEAM module's 84 LEDs required design of a complicated primary lens structure that incorporated 84 light guides. Most of these optics needed to be placed at an angle that, in turn, required them to incorporate a strong undercut that would have been impractical to impossible to achieve with glass or transparent plastics, as demolding the proposed lens design would require a highly flexible material.

Lastly, in order to optimize optical efficiency, the MULTIBEAM's light guides are positioned in close proximity to its high-power LED dies. Consequently, the primary lens material would need to perform reliably despite long exposure to high temperature and photodensity — organic plastics such as PMMA and PC would darken and turn brown within a relatively short time.

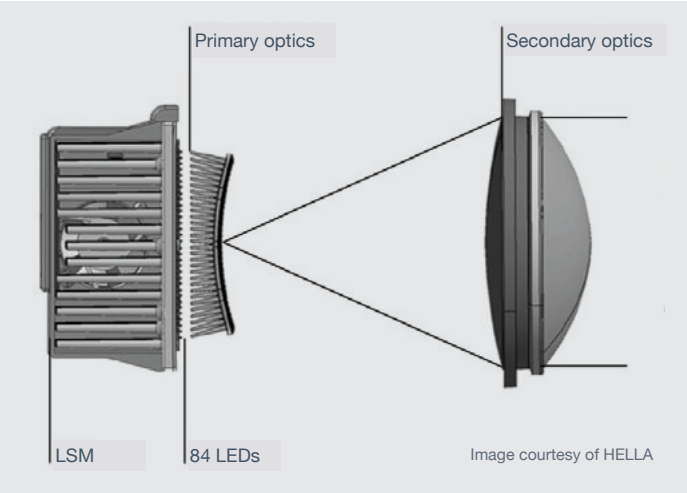


Design implementation of the precision LED grid module — all components have clear interfaces defined with very small tolerances.

The solution

Hella's search for a solution led it to Dow, a global leader in silicones, silicon-based technology and innovation, where it explored several grades from the award-winning moldable optical silicones product family. This sophisticated product portfolio offers optical grade silicones in a broad range of durometers, ranging from 52 to 85 Shore A. Hella eventually specified SILASTIC™ MS-1002 Moldable Silicone which, exhibiting 72 Shore A, delivered the most suitable combination of hardness and elongation to produce complex lenses for Hella's headlamp application.

SILASTIC™ MS-1002 Moldable Silicone is a highly transparent material that processes easily at room temperature and exhibits very low viscosity before cure. Combined with its high elongation and tear strength and easy demolding performance, these qualities significantly expand design possibilities for fabrication of complex shapes, micro-scale optical structures, multifunctional parts, and undercuts that are difficult to achieve with organic polymers.



Optical design of the precision LED grid module with Light Source Module (LSM) as well as primary and secondary optics.

The success

SILASTIC MS-1002 Moldable Silicone's superior processability vs. glass and greater reliability vs. organic plastics were both key to Hella's successful development of its state-of-the-art headlamp module.

The material's viscosity, easy demolding and controlled shrinkage enabled Hella to fabricate its light guide with a high degree of accuracy. The excellent consistency of SILASTIC™ MS-1002 Moldable Silicone ensured a stable and reliable injection molding production process.

The outstanding thermal stability of SILASTIC™ MS-1002 Moldable Silicone was, however, the most important criteria to Hella's success.

"All moldable optical silicones from Dow have undergone a considerable number of automotive qualification tests," said Tilman Maucher, project manager for lighting development at Hella KGaA Hueck & Co. "So, we were not surprised when the SILASTIC™ MS-1002 Silicone grade maintained excellent optical transparency at temperatures up to 150°C for more than 6,000 hours. Excellent photothermal stability was one of our most critical criteria when selecting a material for the MULTIBEAM module's primary optics, as we knew it would need to withstand long exposure to very high temperatures and lumen densities in this application.

"Dow's close collaboration with us throughout our product development process helped to ensure we achieved the optimal performance of SILASTIC™ MS-1002 Moldable Silicone in our application," said Maucher. "As an innovation partner, Dow is highly responsive and even proactive with regard to our design challenges, and they took ownership of our success at every step, from design through the molding process. Their leadership in silicone science offered important support to Hella's leadership in automotive lighting design."

Learn more

We bring more than just an industry-leading portfolio of optics materials. As your dedicated innovation leader, we bring proven process and application expertise, a network of molding and optical experts, a reliable global supply base and world-class customer service.

To find out how Dow can support your lighting applications, visit **consumer.dow.com/lighting.**

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S91376/E2658

Form No. 11-3675-01 C