CASE STUDY: LUMENFLOW CORP.

Silicones create higher performance, lower costs and expanded opportunities for LumenFlow

The challenge

Based in Grand Rapids, Michigan, LumenFlow Corp. is a photonics engineering and manufacturing firm with customers in numerous industries, including automotive, manufacturing, agriculture and medical equipment.

LumenFlow was looking for a solution that would replace an existing polycarbonate 10° TIR (total internal reflection) lens in a customer's machine vision product. The old polycarbonate lens was a two-piece system (lens and carrier) that was having warranty issues with parts coming off of the LED printed circuit board assembly (PCBA).

The existing lens provided light in a narrow beam angle when matched with a specific LED. However, it created hot spots when used with alternative LEDs and was prone to yellowing after UV exposure, which limited the machine vision customer's applications.

The new lens needed to achieve similar photometric performance to the polycarbonate lens, over a wide range of correlated color temperatures, wavelengths and package sizes.

The replacement lens would also need to:

- Offer UV and thermal stability
- Have a footprint smaller than 11 mm square
- Provide both 10° and 25° beam angle optics
- Offer a robust mounting method to the LED PCBA
- Minimize prototype and tooling production costs
- Enable automated assembly

The solution

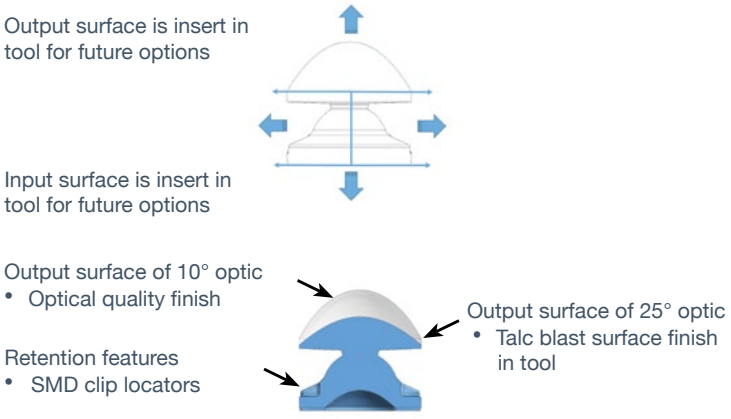
On the way to a solution, LumenFlow explored alternative designs. They considered a known design that had excellent performance — a system made from three separate lenses. While the design would meet the optical requirements, it would mean higher-than-targeted costs for tooling and assembly—and lower-than-desired efficiency from surface reflection loss.

That's when the LumenFlow design team talked with Dow to explore silicone materials, which would allow the optical system to be molded as a single, complex part.

The award-winning family of moldable optical silicones from Dow offers enhanced design freedom when compared to incumbent materials, including PC, PMMA and glass. These silicones can be easily demolded, even with complex and undercut profiles, and show little to no warping or shrinking, regardless of section thickness.

Working with Dow materials experts, LumenFlow selected SILASTIC™ MS-1002 Moldable Optical Silicone to mold its Compound Optic. A two-part, fast-curing optical resin, SILASTIC™ MS-1002 Silicone was chosen for its balance of optical and mechanical properties.

"We selected this silicone for molding the unique and complex geometries that make this part perform in a small footprint. The optical performance and exceptional moldability made our new optic a reality," said Brian Zatzke, president of LumenFlow Corp.



LumenFlow Corp.

The design of the new LumenFlow Compound Optic features:

- Two lenses that are joined along the center by a light pipe — all in one molded piece
- Narrow-angle output from the source along the center of the optic that is shaped by a single lens (two surfaces)
- Wide-angle output that is shaped by two lenses (four surfaces)

"Our designers carefully considered the optic's complex profiles, undercuts and surface finishes, as well as the unmolding and cure profiles of the material," said Zatzke. "We also designed this new optic while keeping in mind other future uses for it. We saw this as a foundational design that could also benefit other applications, such as automotive or image projection."

Both input and output optical surfaces are defined by tooling inserts, which allow for future options without major design modification.

The success

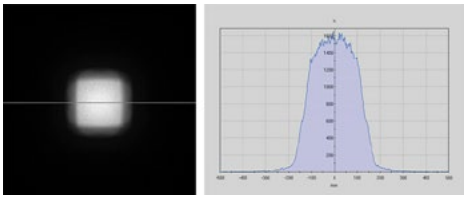
The new design has lowered the cost of ownership (TCO) for LumenFlow's client. As a single molded part, production was automated and assembly time was reduced. The silicone optic also solved the warranty issues and associated costs.

"Our Compound Optic is not only cost-effective, it also outperforms the previous off-the-shelf lens. The new optic provides a very high-intensity and uniformly illuminated spot with very little 'spilled' light," said Zatzke.

The Compound Optic provides nominal FWHM (full width at half-maximum) beam profiles of 10° and 25°. The design is also suitable for a wide range of LED footprints.

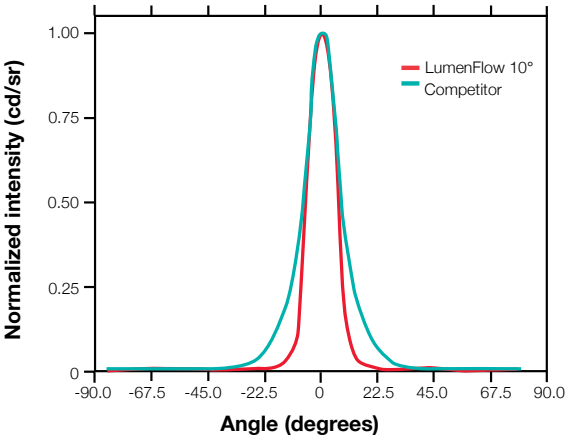
Photometric testing

10° Optic: Simulation profile



"When compared with other conventional thermoplastic TIR products, the lighting performance is enhanced because of the optical geometries that can only be achieved using the unique physical properties of moldable optical silicones from Dow," said Zatzke.

Intensity comparison between optics



LumenFlow has used the concept of this optic for applications in other industries. After the success of the 11 mm optic for the original machine vision illuminators, LumenFlow scaled up the diameters to 14 and 16 mm to address additional market needs, including those in automotive interior and exterior lighting applications.

Over time, new features, such as undercuts and locating features, can be added to the design to improve performance and reduce cost of assembly in certain applications. For example, a surface mount clip retention feature was added to allow the automated insertion of the optic over an LED package.

"We are excited about all of the possibilities available thanks to moldable optical silicone materials," he said. "The versatility of the silicones gives us the flexibility to offer innovative optical solutions for our clients."

About moldable silicones

SILASTIC™ moldable optical silicone elastomers are designed to meet the challenging needs of the optical market, including the need for good transmission, moisture resistance and photothermal stability. These two-part, heat-cure moldable silicones are especially suitable for precision molding applications.

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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