

Automotive

Backlighting diffuser



The challenge

When a tier-one automotive supplier was designing the backlighting module for a new gear shift indicator (otherwise known as a PRNDL), they came to GMN to develop a custom light diffuser. The light diffuser would be a die-cut polycarbonate that is screen printed with inks of varying opacity and density levels. This variance allows different amounts of light to come through the PRNDL.

The PRNDL was set to be featured in a new line of premium vehicles, so the lighting had to meet strict visual standards for color, brightness, and opacity. Upon looking further into the backlighting diffusion requirements, GMN realized that there would be a few challenges to perfecting the look.

Project goals

- Create a custom light diffuser that achieves uniform backlighting through the PRNDL
- Ensure the backlighting met the visual specifications in all lighting conditions
- Eliminate any hot spots or light leaks from the PRNDL

The solution

GMN was supplied with the PRNDL and an LED light fixture that was identical to the actual model used in the vehicle. The customer also provided target values for brightness and color for each printed character on the gear shift indicator.

Work began in GMN's state-of-the-art light lab. First, GMN's engineers used a spectroradiometer to get a reading on all five individual LEDs in the light fixture. This provided a luminance value

CASE STUDY

in footlamberts, which became a reference point while creating the diffuser. To ensure uniformity across all of the iconography on the PRNDL, multiple spectroradiometer readings were taken across each character and subsequently averaged together. Various lighting scenarios were then tested in the lab to ensure the diffused backlighting accurately matched the desired look, regardless of external lighting conditions.

**MULTIPLE READINGS FROM:
SPECTRORADIOMETER
DENSITOMETER**

With these reference luminance values, it was possible to begin mixing colors for screen-printing the inks on the diffuser. The colors were mixed based on the spectroradiometer readings and the X/Y stimulus values provided by the customer. Each ink had to closely match the specified reference color, so several inks were created for different areas of the diffuser. The inks were screen printed on the polycarbonate sheet in three separate passes. On the fourth pass, an adhesive was printed onto the back of the diffuser for easy adhesion to the PRNDL.

**FOUR SCREEN PROCESS:
GREY INK
BLUE INK
PURPLE INK
ADHESIVE**

It was also crucial to reconcile the specified values with the actual look of the part. Based on several variables such as external lighting and different spectroradiometer readings, colors can match specifications but still look off on the PRNDL itself. To prevent this, densitometers and spectroradiometers were used to frequently spot-check different parts throughout production runs to ensure they met the correct values.

With five bright LEDs installed within the compact lighting fixture, it was also crucial that the PRNDL didn't have hot spots or emanate light from undesired areas. The ink densities were monitored and adjusted throughout production to prevent bright spots and excessive light from escaping through the edges of the PRNDL.

Ultimately, the light diffuser made its way to two separate car models. GMN was able to leverage its automotive experience, backlighting expertise, and printing capabilities to create a custom solution that met all of the project requirements.

