The Signs of Safety.

3M

How 3M Full Cube Technology is making roadways safer.

Featuring 100% efficient, "Full Cube" optical elements, 3M™ Diamond Grade™ DG³ Reflective Sheeting is, on average, nearly twice as bright as other prismatic sign sheeting.

Brighter signs mean safer roads.

According to the Federal Highway Administration (FHWA), fully **half of all traffic fatalities occur at night,** even though the nighttime hours account for only a quarter of total vehicle miles driven. In fact, "the rate of night fatalities is … three times higher than that for daytime."[1] Closing this gap has been a major priority for many years, and the FHWA recommends that making traffic control devices more visible to drivers at night is one of the most cost-effective solutions to the problem.[1]

3M has invested ten years and tens of millions of dollars looking for ways to help make nighttime driving safer. The result is 3M Full Cube Technology—the first material with true, 100% efficient optical elements. Incorporated into 3M™ Diamond Grade™ DG^3 Reflective Sheeting, 3M Full Cube Technology nearly **doubles the effective brightness of roadway signs.** Studies have found that where more-visible signs are installed, crash numbers have fallen 25 to 46% in three to six years.[2]

1 http://safety.fhwa.dot.gov/roadway_dept/retro/gen/back_needs.htm

2 Ripley, D. A., Howard R. Green Company, ITE AB04H313, *Quantifying the Safety Benefits of Traffic Control Devices—Benefit-Cost Analysis of Traffic Sign Upgrades,* 2005 Mid-Continent Transportation Research Symposium Proceedings

Drivers comprehend brighter signs faster.

Less time reading, more time driving.

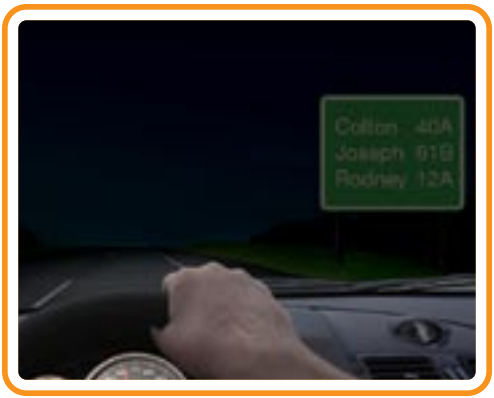
The purpose of a traffic sign is to communicate important information to drivers. And in real situations—driving fast, traveling at night—drivers simply have a limited time to read and understand signs.

At night, highly retroreflective sheeting helps make traffic signs not only more conspicuous, but also quicker to understand. In fact, a recent study at the University of Iowa found a direct correlation between a sign's brightness and a driver's ability to comprehend the sign's message.[3] Study participants were able to read and understand brighter signs substantially faster. This study suggests that brighter signs require less eyes-off-the-road time and more time to attend to the driving task, which is directly related to safety.[4]

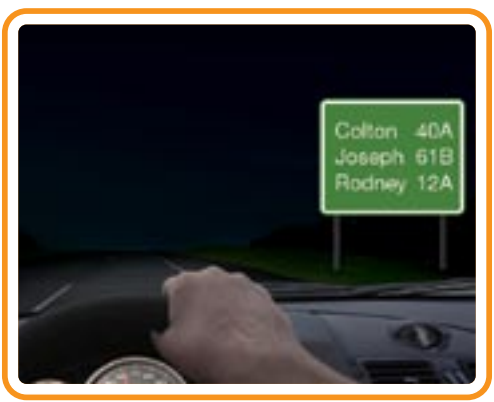
> *"Implementation of highly reflective signs and pavement markings has the potential to reduce night-time collisions by increasing sign conspicuity, sign legibility and consequently driver perception time."*
>
> *Hamilton Associates Report for the Insurance Corporation of British Columbia (ICBC) study.[2]*

3 Schnell, T., Yekhshatyan, L., Daiker, R., Konz, J., *Effect of Luminance on Information Acquisition Time and Accuracy from Traffic Signs.* Paper accepted for presentation and publication, Transportation Research Record, Journal of the Transportation Research Board, 2008. Full report available at http://www.ccad.uiowa.edu/opl/projects/luminance

4 Dewar, R. and Olson, P., *Human Factors in Traffic Safety,* Second Edition, 2007: Lawyers & Judges Publishing Company, Incorporated. 549p



Simulation of traffic sign with conventional microprismatic sheeting at night.



Simulation of traffic sign with 3M Full Cube Technology sheeting at night.

Why we need brighter road signs now.

It's a different driving environment.

Over the last ten to 15 years, significant changes have been taking place in both the driving population and the vehicles on our roads:

More older drivers.

According to the U.S. Census, more than 50 million people aged 65 or older will be driving by 2020—about one in every five. And nearly half of those drivers will be 75 years plus. It has been well documented that older drivers have slower response times and decreased visual acuity at night.[5] In fact, the eyes of a typical 70-year-old detect about 1/8th as much light as a 20-year-old's eyes.

1992 Ford Taurus at 60 feet—traditional headlights.

1999 Ford Mustang at 60 feet—modern cut-off headlights.

Low cut-off headlights.
Since the late 1990s, vehicle manufacturers have been installing more and more VOA or low cut-off headlights. As shown in the photos above, these headlights emit little light above the headlight level. This can have a profound effect on a vehicle's ability to illuminate road signs. In fact, one study found that these headlights reduced the illumination of signs by as much as 53% in common sign configurations.[6]

Larger vehicles, different sight lines.
The number of trucks on U.S. highways has increased by 60% in the last ten years, while the number of passenger cars has remained about the same.[5] Trucks feature significantly greater angles between the driver and the headlights. This means that very little retroreflected light from road signs reaches these drivers, so signs appear dimmer, if visible at all.

5 http://www.minimumreflectivity.org/safetyconcerns.asp?pg=1
6 Sivak, M., University of Michigan Transportation Research Institute, 2000-2001

3M Full Cube Technology:

State-of-the-science in retroreflection.

Today, there are three main technologies available for retroreflective signs for roadways: beads, truncated microprismatic cube-corner optics and fully-reflective microprismatic cube-corners, namely 3M's Full Cube Technology. Among the three technologies, only 3M Full Cube Technology features 100% efficient optical elements. When incorporated into 3M™ Diamond Grade™ DG^3 Reflective Sheeting, it nearly doubles the average brightness of road signs.

One of the original retroreflective technologies, encapsulated glass bead sheeting reflects only 14% of light back toward its source.

Truncated cube corner sheeting—the most common sign sheeting in use today—reflects about 32% of light back toward its source.

3M™ Diamond Grade™ DG³ Reflective Sheeting, made with 3M Full Cube Technology, reflects 58% of light back toward its source—almost doubling the overall brightness of road signs.

Brighter signs are also a cost-effective safety investment.

Traffic professionals are trusted to be good stewards of public funds. So a new product must do more than improve public safety; it must also prove its cost effectiveness. 3M™ Diamond Grade™ DG³ Reflective Sheeting has proven its value here, as well.

- A three-year program of upgrading sign sheeting in Sioux City, Iowa resulted in a 34:1 benefit-to-cost ratio, and a six-year program in Mendocino County in California resulted in "savings of 159:1 to 299:1."[2]
- Over the life of a sign, use of higher performance reflective sheeting may actually cost less. "Agencies may experience a reduction in service life costs because of the longer service life of the improved sign face materials."[8]

8 Turner-Fairbank Highway Research Center Technical Report No. FHWA-HRT-07-042

Take the 3M Full Cube Challenge.

See for yourself how brighter signs are easier to read and understand while driving. Take the 3M Full Cube Challenge at **www.3M.com/TSS/FullCubeChallenge**. You'll be taking a test drive down a dark road at night. And like drivers around the world are finding out every day, we think you'll see how brighter signs work to help make our roadways safer.

For more information about improving safety with 3M Full Cube Technology, go to **www.3M.com/TSS**. To schedule a demonstration with your 3M representative, call **1-800-447-5392**.

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