

**White Paper on Reflective Signs**  
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**Introduction**

. According to the Research and Innovation Technology Administration (RITA), United States Bureau of Transportation Statistics, the number of registered motor vehicles in 2010 was over 250 million, up from 226 million just ten years earlier. This steady increase of vehicle ownership, coupled with complex highway systems, multi-lane freeways, and competing roadside advertising cause navigation nightmares for drivers. Easy to read road signs play a critical role on today's chaotic roadways. However, in many states, road signs often do not meet their intended purpose by utilizing what AASHTO (American Association of State Highway and Transportation Officials) defines as "rotationally sensitive" reflective sheeting. Manufactured from prismatic materials and designed to provide optimal reflective performance at 0 degrees orientation, these materials, often used incorrectly, produce signs with inconsistent and contrasting legend and background brightness. Thus, signs prove difficult to read from different angles and approach heights (i.e. by cars, trucks and motorcycles) and potentially reduce driver response time, putting everyone on the road at risk.

The current Manual on Uniform Traffic Control Devices (MUTCD), which dictates the national guidelines for appearance, placement and maintenance of road signs, specifies standard minimum levels of reflectivity which all states must meet. In response, some states are adopting new road sign standards. **However, adhering to minimum levels of reflectivity alone does not address sign consistency and performance issues.** For instance, signs with

varying levels of reflectivity are noticeably less clear to drivers, especially at night and in bad weather conditions, potentially reducing reaction time. In addition, inconsistent reflectivity impacts driver perception of the roadways in general, since drivers equate quality signs to quality roads, and ultimately, increased personal safety. According to the Texas Transportation Institute (TTI), an organization highly regarded in retroreflectivity research, “Surveys from several states have found that the visibility of signs and markings is valued highly by the users of their roadways.”

Increasing numbers of local, county and state traffic engineers and officials now recognize the role quality signs play in addressing the distracted driver problem. However, many jurisdictions are unaware they can easily achieve improved road sign performance by incorporating rotationally insensitive materials. Materials, which can ultimately save Agencies (end-users) time, money and frustration, provide less risk, and make the roadways safer for all.

### **From Glass Beads to Prismatic Materials**

Sign sheeting orientation is a relatively new concern. In the early years of road sign production, glass beading provided consistent reflectivity when viewed from all angles and directions. As a result, sheeting specifications and road sign specifications went hand-in-hand, regardless of how the sign was manufactured or installed. In the 1990’s however, prismatic sheeting was introduced as a brighter option to glass beads and quickly adopted by sign fabricators. Over time, commercialization of prismatic sheeting triggered a rush for a brighter product. Yet, increasing brightness could not remedy that prisms are fundamentally asymmetrical. When manufactured in identical rows, prisms provide optimal reflectivity only in one direction. As a result, sheeting material suppliers began recommending optimal usage

specifications to clients along with instructions for cutting the material in one direction. Some of these recommendations, however, proved costly for sign fabricators. Previous cost-efficient practices, such as cutting different-shaped signs simultaneously to save time (i.e. triangular yield signs and pentagonal school zone signs), turning material to fit odd-shaped signs, and nesting letters to avoid waste, didn't flow with these recommendations. Overall, fabricators will use the fastest, cheapest option unless they think an end-user will not accept the sign.

As a result, some fabricators used rotationally sensitive products incorrectly.

Agencies rely on the sign-maker's integrity and their treatment of rotationally sensitive materials. So when fabricators use rotationally sensitive products incorrectly, end-users don't get what they pay for. They expect to purchase and receive visually consistent, clear, easy-to-read signs. In addition, the end-user expects to install the signs and use them for typically 10-15 years. Installing signs requires roadway closures and creates dangerous situations for road crews and drivers. Installers work quickly so sign deficiencies are not observed during installation. As a result, problems with fabrication, such as the use of nesting legends, which appear as a mixture of bright and dark letters, are not noticed until later. The same goes for distracting lines on large road signs where bolted panels cut from different orientation materials meet, and white sign borders with tops and bottoms appearing darker or lighter than the two sides. Time and weather conditions can increase this contrast, making darker areas appear to lose luminance faster, which can further compromise the sign's effectiveness.

For the end-user, an unsatisfactory sign is a time-consuming, costly nuisance requiring them to repeat the whole process: resubmit the order, reclose the road and take down the

signs; ultimately, placing crews and drivers in harm's way for a second time. The alternative would be to leave up a sign that does not meet its intended purpose and is unsafe to the driver.

Fabricators' improper use of rotationally sensitive sign materials also impact drivers. Human beings see contrast. Improperly oriented sign materials appear like puzzles of dark and light images, making signs difficult to read and potentially slowing driver reaction times. Along with numerous distractions, such as cell phone calls and texting, drinking, eating, applying makeup, and roadside billboards, distracting signs take the driver's eyes off the road. More distractions increase accident probability and risk. These risks are compounded for older drivers who have more difficulty distinguishing road signs in general.

### **Agency Responses to Prismatic Concerns**

When AASHTO published M268-10 in 2011 it officially recognized prismatic sheeting specifications, presenting the problem of "rotational sensitivity". The Federal Highway Administration (FHWA) which collaborated with TTI produced the second edition of the 2003 MUTCD. This manual, listed minimum standards for retroreflectivity, which in turn initiated dialogue on rotational sensitivity.

In the intervening years, various state agencies have taken up the rotational sensitivity issue, eliciting coast to coast concern.

- Texas Department of Transportation (TxDOT) innovates and leads the way in road sign standards and rotational sensitivity. After researching and observing inconsistencies in road signs manufactured using rotationally sensitive products, TxDOT developed a way to identify rotational sensitivity and introduced a specification category of acceptable sign making materials for specific types of

signs. In addition, TxDOT inspectors visit fabricators' businesses with whom they contract to inspect materials and processes to make sure signs meet TxDOT standards.

- The Illinois Department of Transportation, (IDOT) revised its road sign specifications to ensure rotationally sensitive materials were well-marked: "If material orientation is required for optimum retroreflectivity, permanent orientation marks shall be incorporated into the face of the sheeting. Neither the overall pattern nor the orientation marks shall interfere with the retroreflectivity of the sheeting." Not long ago, IDOT replaced several new signs on the Dan-Ryan expressway (Interstate 94) due to retroreflectivity problems caused by legend nesting of rotationally sensitive sheeting materials.
- The Missouri Department of Transportation (MODOT) outsourced sign-making in 2010. To ensure their signs conform to national standards, MODOT updated their road sign requirements: "Retroreflective sheeting applied as legend and border for specific signing applications, without a datum mark on the surface of the sheeting, shall be evaluated for rotational sensitivity per AASHTO M 268." MODOT stipulates precise procedures for traffic engineers if products do not meet the rotational sensitivity requirements.
- Utah (UDOT) recently updated specifications for road sign manufacturing to "establish proper orientation of the sheeting for all traffic signs and traffic control devices. Verify cutout legends, symbols, and borders have the same sheeting orientation as background sheeting."

## **Resistance to Change**

Though more agencies recognize problems with rotationally sensitive sign materials, many have long-standing relationships with familiar sign material manufacturers and are reluctant to alter the status quo. For others, the demands of shrinking budgets and overburdened personnel mean little time for research and education to investigate optional products. Others may be confused about how rotationally insensitive products work and how they are utilized. Those who see time on their side with road signs typically lasting 10-15 years, decide to postpone focus on the issue.

## **Thinking Outside the Rotational Sensitivity Box**

Regardless of the reasons, end users hesitate to order and install rotationally insensitive sign materials, even though switching carries great benefit. Orientation no longer raises complications. Regardless of how the material arrives at the fabricators or comes off the roll, how it's turned to fit a particularly odd-shaped sign, or even if it is pieced together from scraps, the reflective performance will remain robust and consistent. For fabricators, this means time-saving and waste-reducing best practices. Fabricators can nest letters for optimal material usage, cut different shaped signs simultaneously, and even bolt panels without worrying about orientation.

Choosing rotationally insensitive products also benefits end-users. It increases confidence in the fabricators, and ensures the resulting signs will have optimal reflective performance from any angle and in any location. Choosing rotationally insensitive products means one less audit check. In addition, with less fabricator waste, savings may be passed to end users, making rotationally insensitive material more cost-effective. Most importantly,

optimal visibility due to consistent retroreflectivity on all signs, on all roads, means fewer opportunities for driver error, ultimately increasing traffic safety.

### **Solution: Avery Dennison's Omni-Directional Prismatic Retroreflective Films**

Avery Dennison, an innovator in the creation and application of prismatic materials, has a long, successful history with this product. Avery Dennison's Omni-Directional films stand alone as the only truly rotationally insensitive prismatic sheeting on the market today. Durable and robust at any angle, omni-directional sheeting is the fabricator's foolproof solution, perfect for any sign of any size or any shape. Compliant with all federal and state specifications, omni-directional sheeting materials take the guesswork out of sign-making. Virtually every piece of sheeting is usable, eliminating most waste. Avery Dennison Omni-directional films are cost efficient for fabricators and end users alike. Road signs manufactured from omni-directional materials provide consistent retroreflectivity, whether on dark rural roads or in bright urban areas, and regardless of installation. The driver's angle or height of car approaching the sign becomes completely irrelevant. Avery Dennison's products are not just easier to use, but can also be used in conjunction with, or in place of, any competitor's products. This allows fabricators and end-users to utilize the most efficient products for every job.

### **Summary and Conclusion**

Dangerous driving conditions are here to stay. An ever-increasing population means ever-growing roadway congestion. Transportation planning struggles to keep pace, with sometimes confusing, complex roadway systems that feature multi-lanes and frequent exits. Add to this the many contemporary driver distractions and it can be a recipe for traffic

problems and accidents. In addition, an increasing aging population, with reduced response times, further dictates the importance road sign consistency.

Variations in sign reflectivity needn't add to challenges on today's roads. MUTCD and other updated specifications, such as AASHTO M 268 provide a solid foundation for more uniformity in nationwide road signs. These specifications, however, don't address all reflectivity and performance issues. Sign fabricators, end users and installers should utilize sign production and installation materials which provide the best overall sign performance. Only when we consider all sign specifications, material specifications, sign-making specifications, and usage specifications will optimal retroreflectivity, and thus optimal road safety be achieved in the United States.

### **Avery Dennison Credentials**

Avery Dennison, a recognized industry leader in developing innovative identification and decorative solutions for businesses and consumers worldwide, has been manufacturing components for prismatic signs since 1924. Globally recognized as a supplier to preferred sign shops, Avery Dennison offers the most comprehensive range of reflective sheeting in the industry, providing a full spectrum of products to meet or exceed local specifications.