

3M Science.
Applied to Life.™

3M™ Pavement Marking Solutions.





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Pavement markings by day, lifelines by night.

The visibility of road markings is critical day or night, rain or shine.

All road authorities and agencies in Australia, New Zealand and the world over are working the 'Towards Zero' (fatalities) target, it is of the utmost importance to understand the root cause of the problem to be able to address it in the most efficient manner. And by efficient we mean the right product for the right conditions that will bring tangible results (reduced crashes and deaths), with minimum disruption to the road network and be cost effective.

It's easy to see pavement markings on a bright, sunny day. But what about at night? During a rainstorm when water covers the roads? In these types of conditions, non-wet retroreflective pavement markings disappear, leading to reduced driver visibility and a higher risk of crashes. This is why the type of markings you choose is critical to helping keep drivers safe on sunny days and during wet weather conditions at night —especially when you factor in changing driver demographics like increased numbers of older drivers with vision limitations.

What drivers see:

As demonstrated below, parts of the non-wet retroreflective road markings virtually disappear in the dark when they become covered in water, making the driver unaware the upcoming lane is a left turn lane. With diverse and aging populations, driver-assisted and automated vehicles and new inexperienced drivers converging on the roads, having pavement markings that are visible to both humans and automotive cameras in a wide range of conditions is more important than ever.



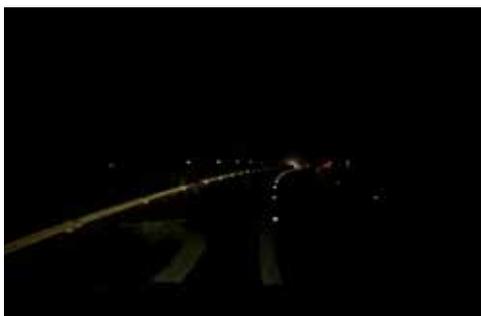
Day time dry

Both the non-wet retroreflective white symbol and centre line and the wet retroreflective yellow edge line are visible.



Night time dry

Both types of markings are visible in dry night conditions.



Night time rain

While the non-wet reflective symbol and centre line seem to disappear, the wet retroreflective marking remains visible.

1. Road trauma Australia 2018 statistical summary, Department of Infrastructure, Transport, Cities and Regional Development, Bitre Safety.

3M Stamark™ Removable Line Marking Tape

Best Applications

1. Highlight temporary lanes to help drivers navigate safely through work zones and protect road workers from collisions.
2. Black tape - ideal for masking lane and edge lines, skip lines, gore lines and symbols & legends.

Creating a path of safety in work zones.

3M Stamark™ Removable Line Marking Tape Series 710

3M Stamark™ makes traffic lane adjustment fast and simple. It is engineered for easy application and removal to reduce the amount of time drivers and workers are exposed to road works hazards. Newly marked roads can be opened to traffic immediately following application. To make removal simple, Stamark is structured with a reinforcing net. It can be removed from asphalt and concrete surfaces intact or in large pieces at temperatures above freezing without leaving scarring or 'ghost' markings, which can dangerously mislead motorists.

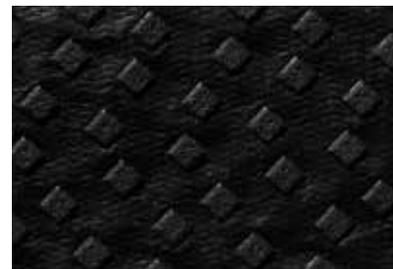
- ▶ Quick and easy to apply for temporary applications.
- ▶ Highly reflective and skid resistant in wet and dry conditions.
- ▶ Will not damage or scar road surface when removed.
- ▶ All-weather performance, providing highly visible lane delineation even in the wet.
- ▶ Roadway may be opened to traffic immediately after application.
- ▶ Suggested by RMS as the preferred method of temporary road marking for arterial roads, work zones and construction.



710 White



711 Yellow



715 Black

Want Diamond Grade safety and visibility to save lives in your work zones?

Positive guidance is enhanced when these 3M™ high performing reflective materials are used:

✓ **1. Full-Cube Technology**

Early-recognition brightness.

At nearly twice the brightness of conventional prismatic sheeting, the full-cube technology in 3M™ Diamond Grade™ DG³ Reflective Sheeting attracts drivers' attention sooner to improve comprehension and response times.

✓ **2. Colour Fluorescence**

Around-the-clock visibility.

Regardless of available light, highly-conspicuous fluorescent material(s) are recognised at greater distances with more accurate colour perception than nonfluorescent coloured products.²

✓ **3. Wet Reflectivity**

All-weather performance.

Wet reflective pavement markings provide highly visible lane delineation even in poor weather. Simple to apply and remove, these durable solutions last through a normal construction season.

3M Solutions to improve Safety and Mobility in work zones:



Bright rigid signs:

- > **Maximum reflected light:** 3M Diamond Grade™ DG³ Fluorescent Reflective Sheeting Series 4080 (Best).
- > **Intermediate to high reflectivity:** 3M High Intensity Prismatic Series 3800 (Better).



High visibility vehicle markings:

- > 3M Diamond Grade™ Series 983.



High visibility and durable cones, bollards and barriers:

- > 3M Flexible Prismatic Sheeting Series 3300.



Reflective Pavement Markings:

- > 3M Stamark™ Wet Reflective Removable Pavement Marking Tapes Series 710.

2. Evaluation of Fluorescent Orange Signs, Texas Transportation Institute, TDOT, TX-00/2962-S, 2000.

3M Stamark™ Permanent Line Marking Tape

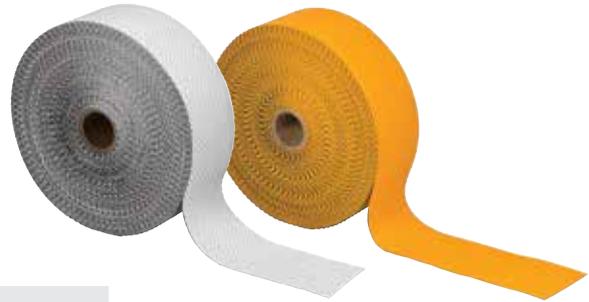
Best Applications

- ▶ Black Spot Zones.
- ▶ Intersections.
- ▶ Zebra crossings.
- ▶ Main Roads, Freeways and Motorways.

Not all lines are created equal.

3M Stamark™ Permanent Line Marking Tape series 380IES

Whether you need to mark a few road lines or delineate a stretch of motorway, 3M has permanent line marking tapes that will stay the course and remain bright and clear. Our tapes have been proven internationally as a bright, long-lasting alternative to thermoplastic or traditional painted line markings.



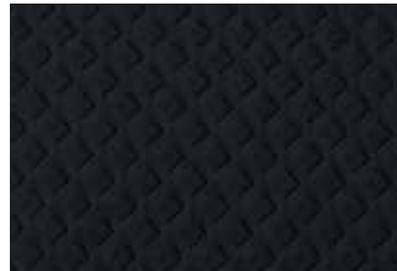
- ▶ Highly reflective in wet and dry conditions.
- ▶ Quick and easy to apply.
- ▶ Roadway may be opened to traffic immediately.



White – 380IES



Yellow – 381IES



Black – 385IES



Advancing pedestrian crossing & intersection safety.

Pedestrians are a vulnerable road user group and are increasing susceptible to road traffic injury. Did you know that in Australia pedestrians make up approximately 14% of the annual Australian road toll¹. Increasing intersection and pedestrian crossing safety are a key focus for many road agencies. 3M Stamark™ Tape Series 380IES provides maximum visibility for motorists compared to traditional zebra crossings made of paint or thermo.

Specially designed microcrystalline beads embedded in the tape, give it its unique retroreflective properties that make it light up in the dark when illuminated.

3M Stamark™ 380IES also comes in pre-cut bars and piano keys to make installation quick, then the road can be opened immediately post application.

- ▶ Highly reflective and skid resistant in wet and dry conditions.
- ▶ Designed to stay white for longer, eliminating discolouration issues.
- ▶ Long replacement cycles, maximises life and return on your investment.
- ▶ Very high adhesion and durability on common road surfaces.

1. Bureau of Infrastructure, Transport and Regional Economics. (2013). Road safety statistics.

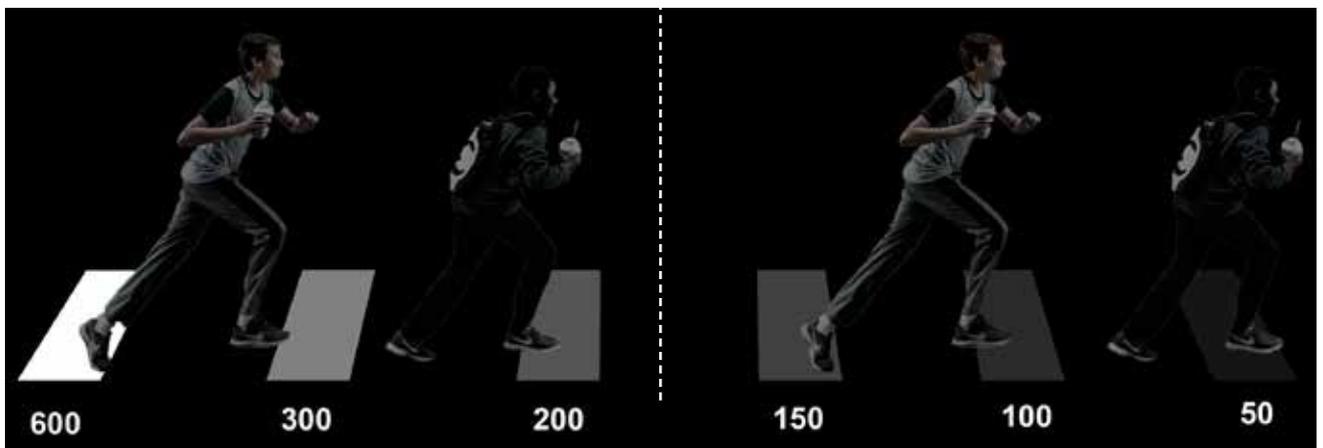


Which crossing would you let your kids cross?

A higher contrast ratio helps make Pedestrians more visible at night. 3M Stamark™ 380IES has an initial minimum retro reflectance: 500+ mcd/sqm²/lx. This is typically more than double the performance of a paint application.

Stamark Tape

Typical Paint



Coefficient of Retroreflective Luminance: R_L in (mcd/m²lx)

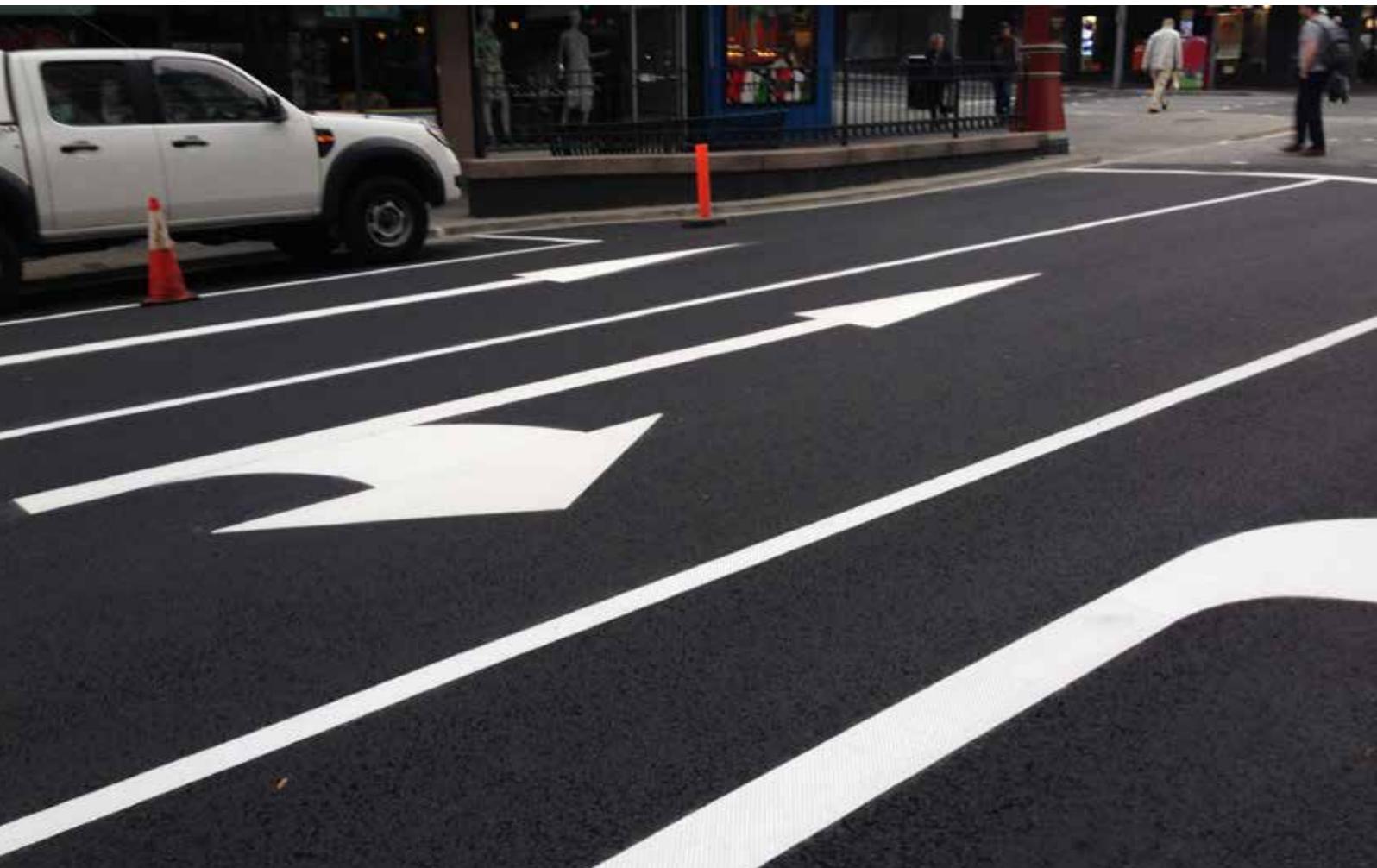
Symbols of safety.

3M Stamark™ pre-cut Symbols and legends series in permanent 380IES series and removable 710 series.

3M Stamark™ pre-cut symbols and legends are available in both permanent and removable tape. From motorways to road work zones 3M Stamark™ symbols and legends are ideal for creating a path of safety.

3M Stamark™ Symbols & Legends adhere to properly prepared pavement surfaces and is as easy as peel, apply and tamp. Stamark™ Symbols & Legends can also be inlaid into hot asphalt for an optimum life cycle.

Due to the ease of application and no drying time required, allow the road to be immediately opened after application.



Advancing cycleway and pedestrian safety.

As our cyclist population continues to grow, there is an increasing need to better control traffic operating on dedicated cycleways, pedestrian and shared pathways.

Cycleway and pedestrian symbols made from 3M Stamark™ Tape Series 380IES are an ideal solution to deliver very long durability and outstanding day and night visibility.

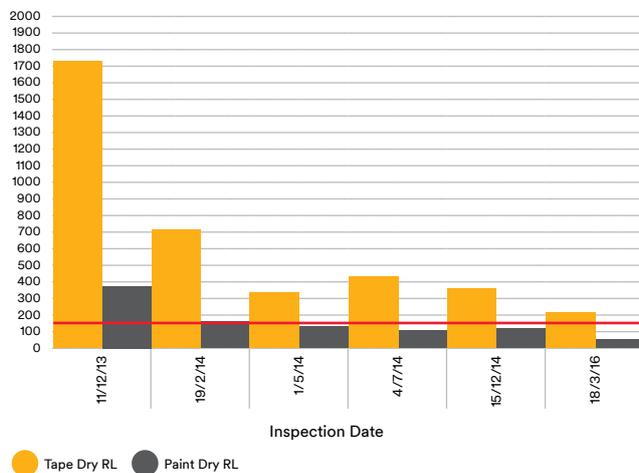
3M Stamark™ Tape delivers better visibility in wet and dry conditions.

3M Stamark™ is a bright long-lasting alternative to thermoplastic or traditional painted line markings. Looking at data from the TeHoroproject in New Zealand the advantages of the Tape Markings over standard line marking delineation can be clearly seen. The red line, shows the typical intervention levels/points marked on the graph at (150mcd/lx/m2).

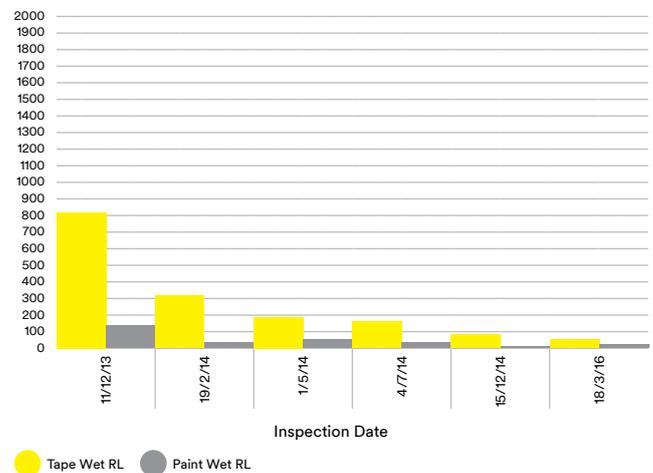
As shown in the below graph, tape has superior performance over the life of the product. The paint shows that only after a few months of application it drops below the intervention level, while tape markings will perform above intervention levels for at least 3 years.



Tape vs Paint - Dry reflective performance



Tape vs Paint - Wet reflective performance



3M All Weather Elements Series 90

Best Applications

- ▶ Black spot zones
- ▶ Main roads, freeways and motorways
- ▶ Residential roads
- ▶ Intersections
- ▶ Zebra crossings

3M™ Connected Roads All Weather Elements Series 90.

There's a lot riding on the line: According to the USDOT, 70% of adverse weather-related crashes happen on wet pavement. 3M™ Connected Roads All Weather Elements can help you efficiently build roads that support human vehicles with machine vision systems even in rain or other low-visibility conditions.

- ▶ Ultra high 2.4 refractive index beads results in high reflectivity performance in the wet.
- ▶ Factory-optimised bonded core elements—microcrystalline ceramic beads embedded on a center core.
- ▶ Installs with double-drop systems.



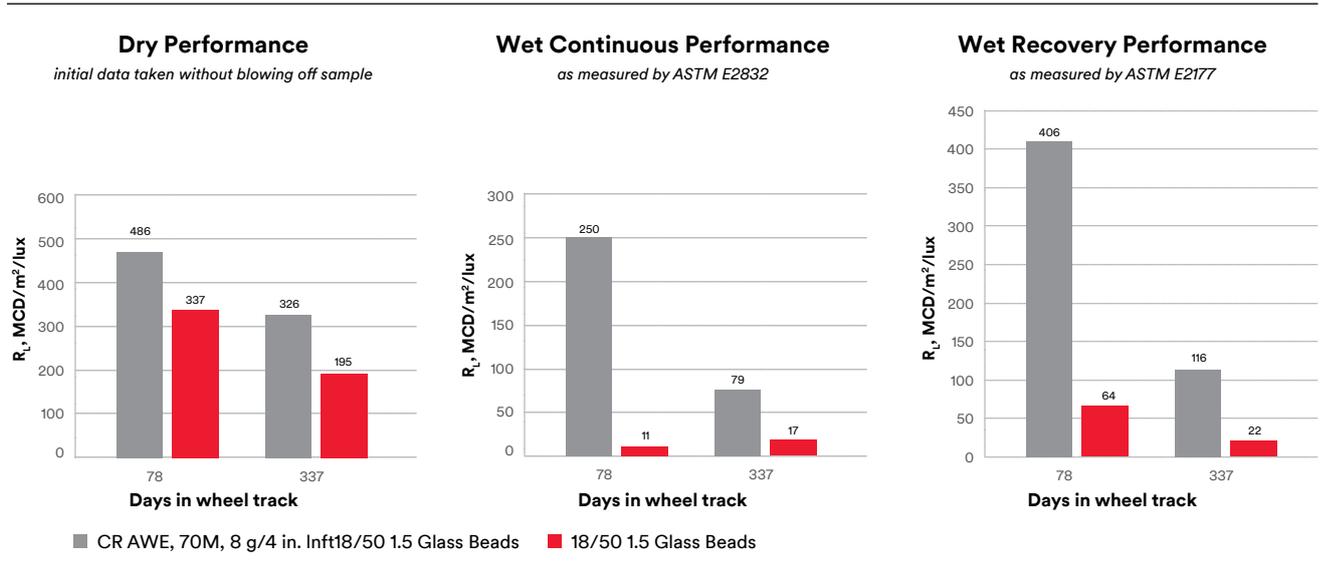
Compatible with most liquid pavement marking binders



Designed for detection.

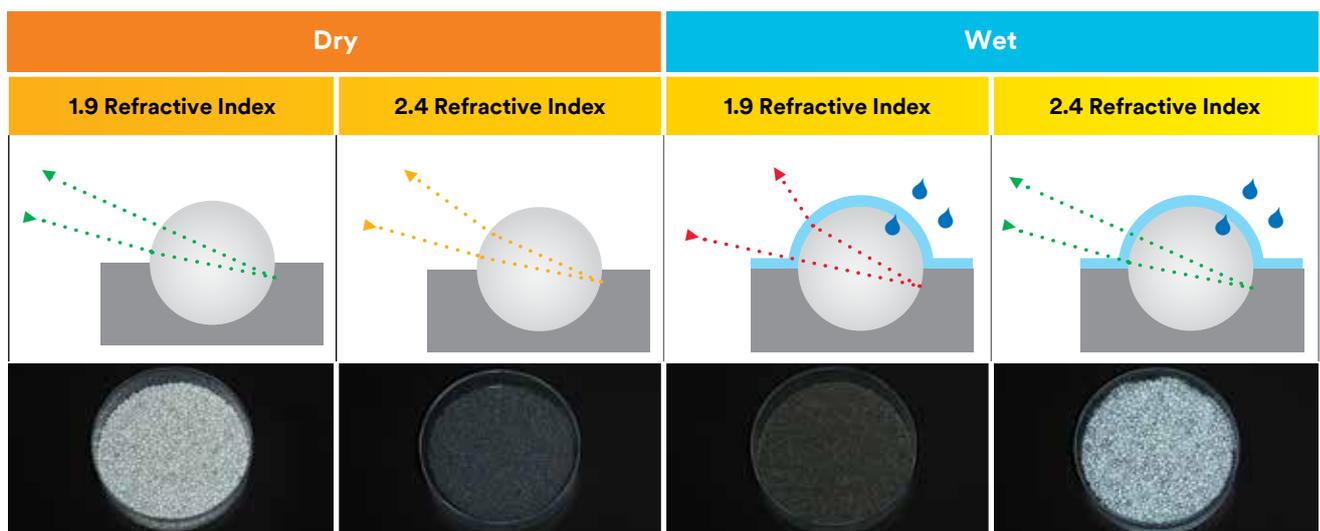
3M Connected Roads All Weather Elements

It's impossible to prepare for every scenario—but that doesn't mean we won't try. At 3M, we test our pavement markings using wet-continuous methods, measuring brightness levels in a way that simulates actual weather situations. The result is pavement markings optimized to perform when it matters most: all the time.



Not all optics are created equal.

The science beneath the surface of different types of wet-continuous retroreflective markings.



Refractive Index Key:

■ Least optimal light return
 ■ Sub optimal light return
 ■ Green – optimal light return

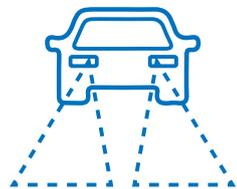
Why wet retroreflective pavement markings matter.

It's easy to see pavement markings on a clear, sunny day. Even older, more worn markings can provide drivers enough guidance under ideal circumstances. But what about at night? During a rainstorm when water covers the roads? In these types of conditions, non-wet retroreflective pavement markings disappear, leading to reduced driver visibility, increased driver discomfort, less effective CAV lane guidance systems and a higher risk of crashes.

This is why the type of markings you choose is critical to helping keep drivers safe on sunny days and dark, stormy nights—especially when you factor in changing driver demographics like increased numbers of older drivers with vision limitations.

With many road authorities today adopting a Toward Zero Deaths approach to road safety, understanding the correlation between dark, wet conditions and crashes is of the utmost importance.

At night, during rainy conditions, non-wet retroreflective pavement markings disappear, which leads to:



Reduced driver visibility



Increased driver discomfort



Less effective CAV lane guidance systems



Crash risk increases



Third-party research suggests that wet retroreflective markings will reduce crashes.

Study Summary

It's well known that pavement markings with standard 1.5 or 1.9 refractive index optics lose most of their visibility in wet nighttime conditions. To counteract the effects of rain and water on pavement marking visibility, wet-weather pavement markings with specialized 2.4 refractive index optics were developed. As interest in wet-weather pavement markings grew, the Texas A&M Transportation Institute (TTI) discovered that there was a lack of research evaluating the safety effectiveness of these pavement markings in actual rainy, nighttime conditions.

To start developing this body of research, TTI studied crash counts in 131 segments (1,174 Kms) of roads in the Atlanta District of the Texas Department of Transportation (TxDOT) where wet weather pavement markings were installed between 2011 and 2017. The researchers employed both an Empirical Bayes (EB) before-after analysis and the more powerful Full Bayes (FB) method before-after analysis with comparison groups to ensure robust, statistically valid results.

Key Findings

- ▶ The results from both evaluation methods suggest that wet-weather pavement markings have positive safety benefits in all conditions — wet, dry, day and night.
- ▶ The crash reduction data for wet-weather pavement markings is statistically significant for wet-night crashes, wet-night fatal injury crashes, and wet-night run off road crashes.
- ▶ The study shows that wet weather pavement markings reduce wet-night crashes by 32% and wet-night fatal injury crashes by approximately 49% (Full Bayes Methodology).

Reduction
of wet-night
crashes



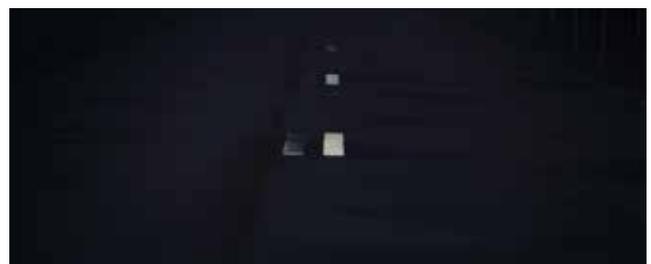
Reduction
of wet-night
fatal injury
crashes



Wet Recovery vs. Continuous Markings
under Dry Conditions



Wet Recovery vs. Continuous Markings
under Rainy Conditions



3M™ Connected Roads technologies are CAV-ready.

Signs

Recommended technology:

3M™ Diamond Grade™ DG³ Reflective Sheeting

The brightness and long-term durability of this sheeting material results in signs that are highly visible at a distance, enabling automated vehicles to capture, process and react to information in real time. This may help enable CAV functions like:

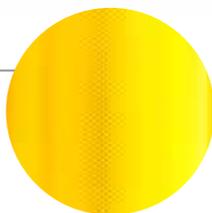
- ▶ Traffic sign recognition
- ▶ High speed automation
- ▶ On-highway platooning
- ▶ Autopilot



Returns up to
58%
of light to driver



**ROADWORK
AHEAD**



Temporary Traffic Control

Recommended technology:

3M™ Diamond Grade™ Fluorescent

Fluorescent reflective materials are highly visible around the clock including day, night, dawn, dusk and inclement weather conditions. The result is greater readability and quicker sign identification, providing automated vehicle assistance in critical areas like roadwork. Providing additional safety to workers on site.



○ 3M All Weather Elements.

- ▶ Ultra high 2.4 refractive index beads results in high reflectivity performance in the wet.
- ▶ Compatible as an additive to traditional line marking techniques such as waterborne paint and thermoplastic.

○ 3M Stamark™ Removable Tapes.

- ▶ Highlight temporary lanes to help drivers navigate safely through work zones and protect road workers from collisions.
- ▶ Provide all-weather performance, providing highly visible lane delineation even in the wet.



○ 3M Stamark™ Permanent Pavement Marking Tape.

Excellent performance in both wet and dry conditions provides superior performance 24/7. These preformed reflective tapes are for permanent type applications such as lane and center lines, intersections, edge lines, zebra crossings, stop bars, symbols and legends.



For more information please contact your 3M Traffic Safety expert today or visit our website.

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