

3M Science.
Applied to Life.™

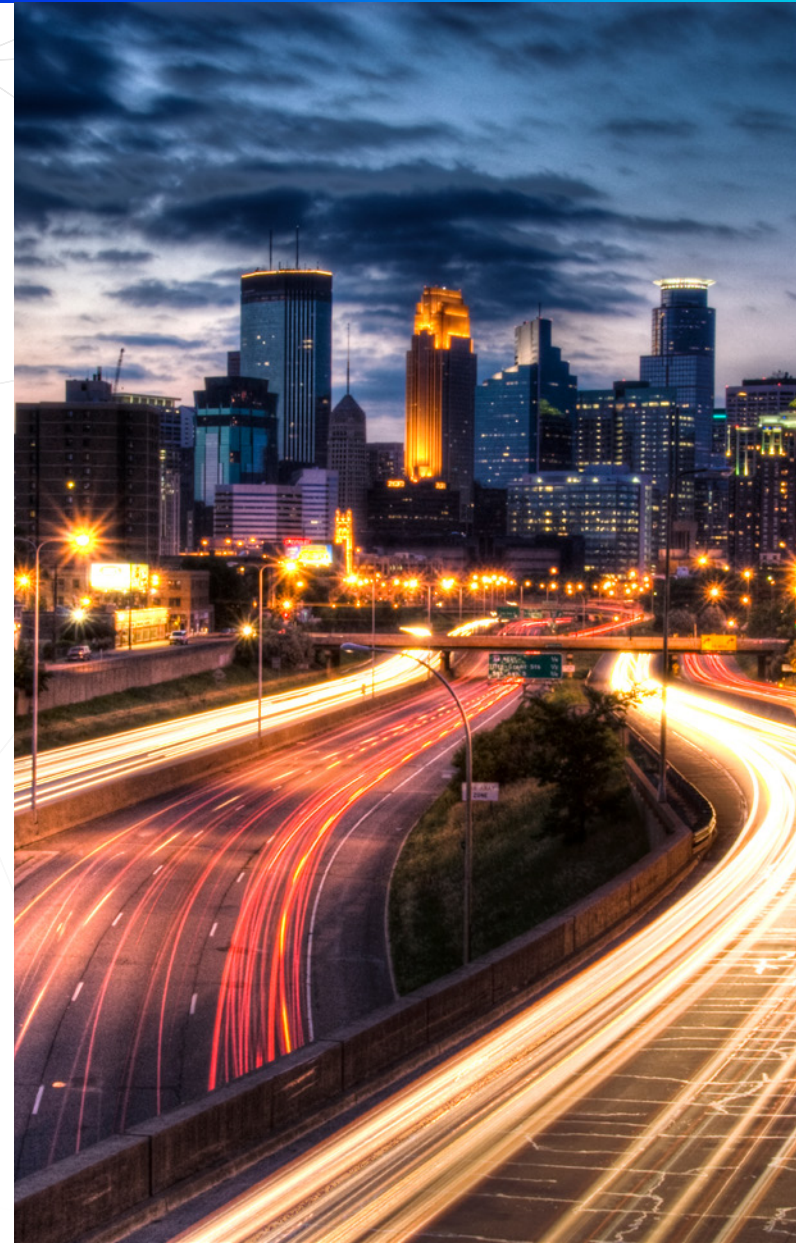
Safer roads for a safer future

3M™ Stamark™ Pavement Markings



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How markings affect road safety

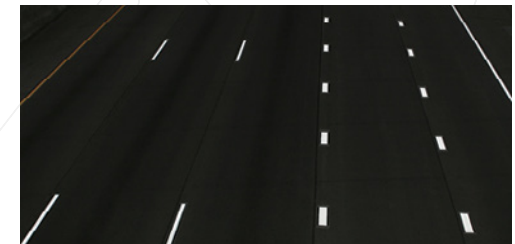
How markings affect road safety

Visibility in all weather conditions.

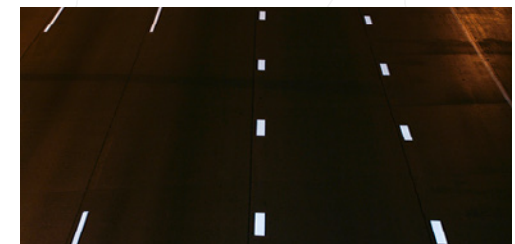
- ▶ Pavement markings are considered traffic signs under most countries' road regulations.
- ▶ They must be clearly and unambiguously recognisable to every road user **at all times of day and in all weather conditions.**
- ▶ Effective road markings provide drivers with **clear guidance and an understandable layout of the road to ensure good visibility** of each lane, helping increase traffic safety.



Day-time dry



Night-time dry



Night-time wet

At night and in the rain, the risk of fatal accidents increases significantly.

The 3M™ Stamark™ Road Marking Tape is a high-quality solution with excellent wet reflective properties – for enhanced safety day and night.

How markings affect road safety

Statistics on human brightness perception.



of traffic engineering information are perceived by the eye



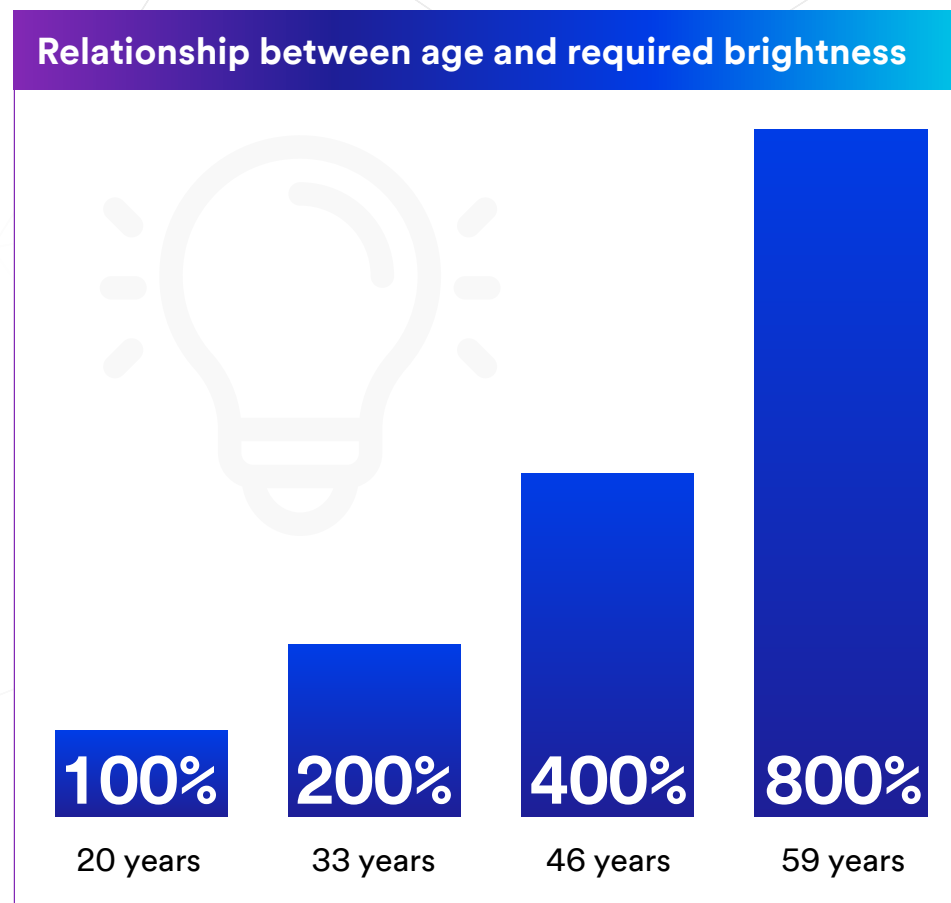
visual performance of the human eye at night compared to the level during the day



of the population will be over 60 years old by 2050.* A motorist in the 60-plus generation needs 8x more brightness than a 20 year old

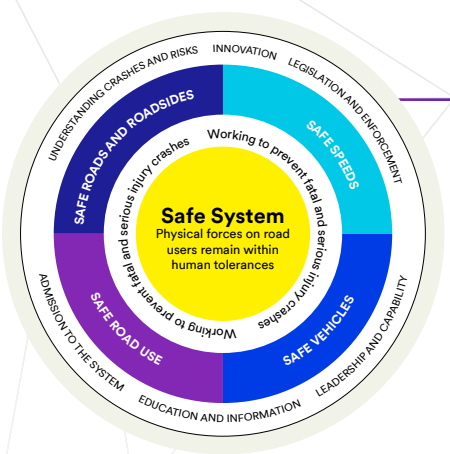
*Source: UN report World Population Ageing, 2017

Relationship between age and required brightness



Customer needs and global trends

Customer needs and pain points



Improving road safety

- ▶ 1.35M people die every year¹
- ▶ Eliminating black spots
- ▶ Working towards zero deaths
- ▶ Actively looking for solutions to reduce the risk of crashes

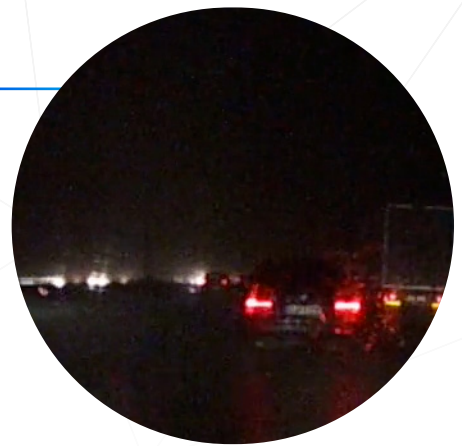


Adhesion to concrete

- ▶ Thermoplastic can prematurely de-bond from concrete²
- ▶ Less durable markings must be re-stripped frequently

Night-time visibility

- ▶ Standard glass beads can lose their dry reflectivity quickly
- ▶ Standard glass beads fail to return useful light back to driver in wet/rainy conditions



Low inspection capability

- ▶ Liquid markings install quality is dependent on skill set of applicator
- ▶ Road authorities may not have robust means to ensure pavement markings are meeting specs



Global market trends

Good road markings are becoming increasingly relevant to customers today.



Aging drivers

- ▶ Globally, the population aged 65 and over is growing faster than all other age groups³
- ▶ Older drivers require greater reflectivity than younger drivers⁴



Increased congestion

- ▶ 239 cities globally reported YOY increases in congestion⁵
- ▶ MOTs moving to more durable markings to avoid frequent restriping



Sustainability awareness

- ▶ Directives to lower environmental impact from central government
- ▶ Reconsidering use of solvent based materials⁶

Sustainability

The sustainable solution – at all times.

3M road markings offer increased sustainability through:

- ▶ Longer durability
- ▶ Less congestion due to quick application and long service life
- ▶ No need to interfere with the traffic flow for remarking work
- ▶ Can be applied during asphalt surfacing, minimising interruption and increasing safety for installation crews
- ▶ Immediate rollover / no drying times
- ▶ High visibility in all weather conditions helps reduce accidents
- ▶ Low noise emissions

3M markings always meet and exceed all statutory and regulatory requirements (EN 1436). They're optimised for use on all common road surfaces. Even under high traffic loads, 3M road markings need to be replaced much less frequently than standard liquid markings.



3M™ Stamark™ Permanent marking tapes A380

3M™ Stamark™ Permanent marking tape A380

- ▶ **Wet reflective pavement markings**

- ▶ **Pre-manufactured self-adhesive permanent marking tape**

Consistent, high quality marking tape

- ▶ **Ceramic reflective beads**

Provides particularly high reflection values

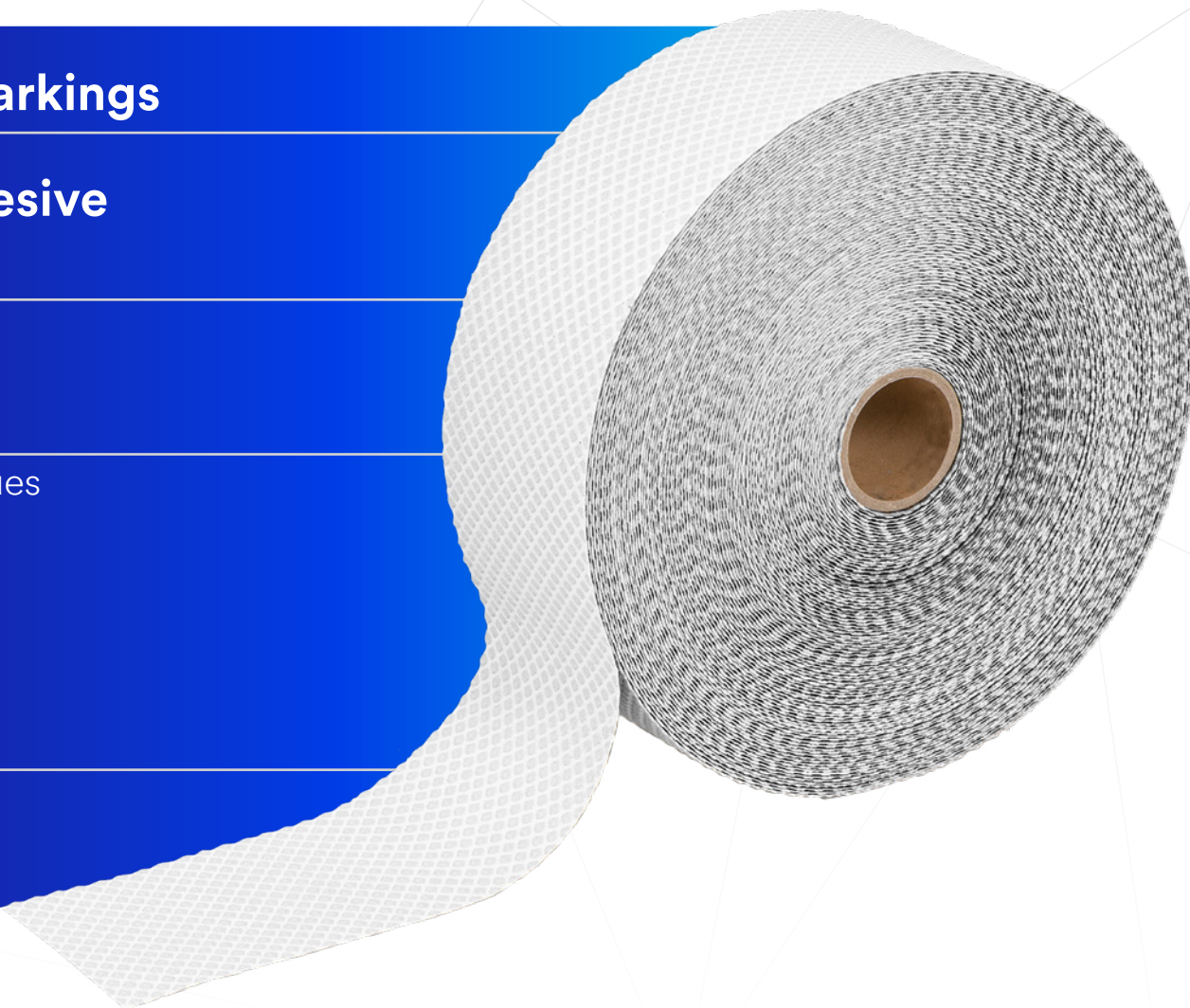
Significantly extends useful life

Stamark A380ESD tape features skid particles for increased skid resistance

- ▶ **3M typical pattern profile**

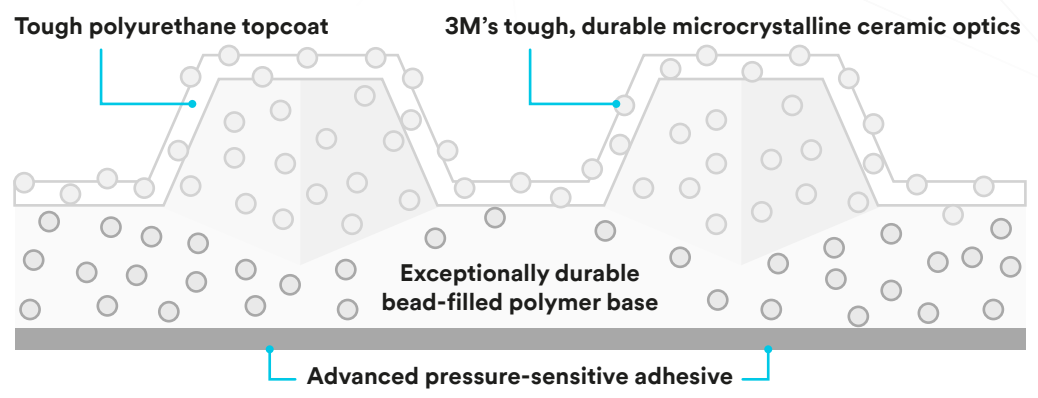
High visibility at night and on wet roads

Increased durability



3M™ Stamark™ technical features and benefits

Advanced technologies in every aspect of 3M™ Stamark™ construction, inside and out.



Technical benefits of 3M™ Stamark™ construction vs. traditional liquid markings

- ▶ **Polyurethane topcoat**
Better durability on the wearing surface and greater bead adhesion
- ▶ **Profiled pattern**
Higher initial and retained dry and wet retroreflectivity
- ▶ **Advanced pressure sensitive adhesive**
Reliable adhesion to asphalt and concrete surfaces, colder weather applications
- ▶ **Ceramic high-index optics**
High and durable reflectivity
- ▶ **Reinforced netting in 380IES and 380AW**
Durability
- ▶ **Skid particles in 380ESD**
Skid resistance

3M™ Stamark™ technical features and benefits

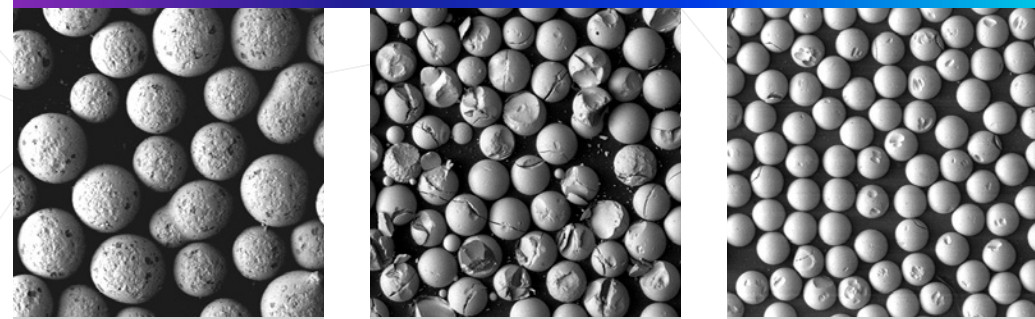
3M™ microcrystalline ceramic beads are tougher and more durable than glass beads.

Mechanical properties of beads

Bead type	Hardness	Crush strength
1.5 Index Glass	650 KHN	70-80,000 PSI
1.75 Index Glass	650 KHN	70-90,000 PSI
1.9 Index Glass	450 KHN	30-45,000 PSI
Sand	800 KHN	
Microcrystalline ceramic	1,000 KHN	>150,000 PSI

Sand will abrade the softer glass beads, causing them to become diffused, resulting in a less efficient optical system.

Sandblast bead durability test results



1.5 Index Glass beads

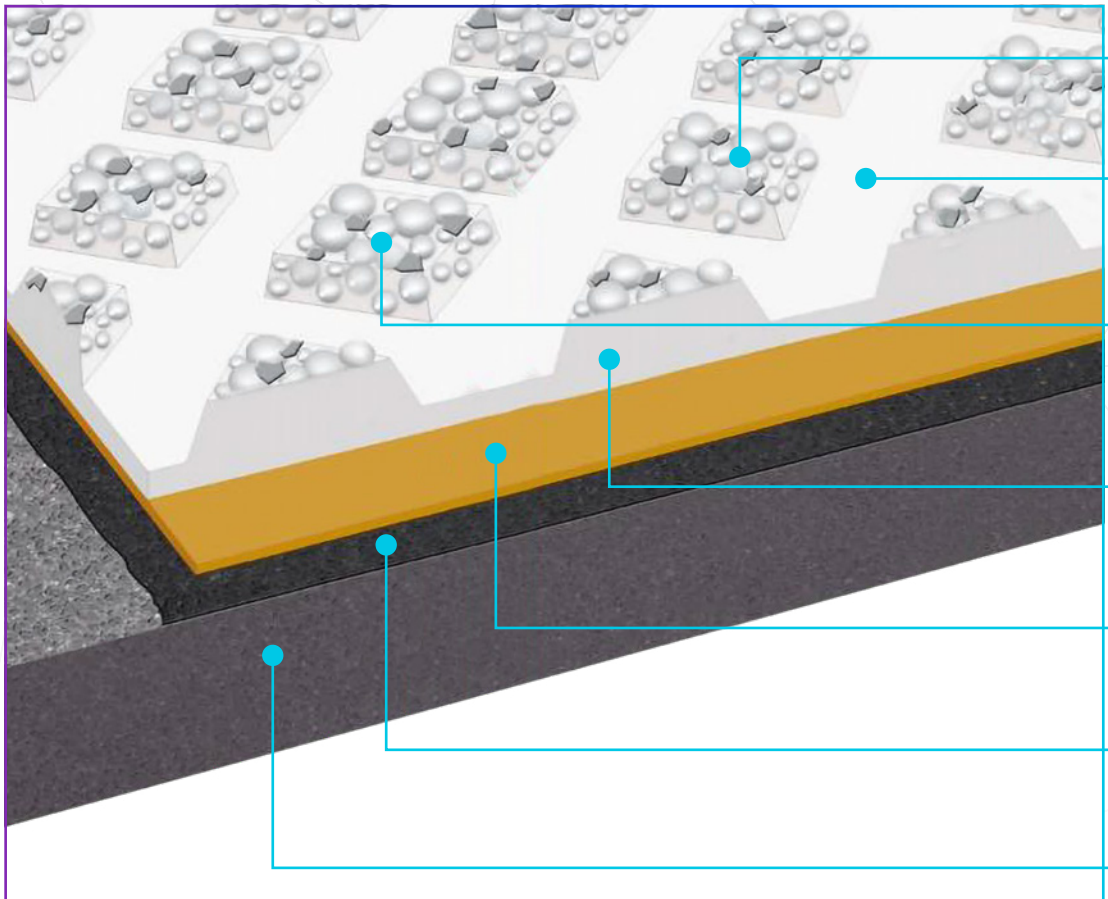
1.9 Index Glass beads

3M microcrystalline ceramic beads

Benefits of 3M™ microcrystalline ceramic beads

- ▶ Minimal pitting or cracking
- ▶ Maintains shape and structure during wear
- ▶ Tougher, more durable than glass beads

3M™ Stamark™ permanent marking tape A380ESD

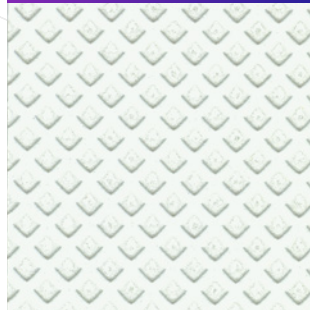


- Ceramic anti-skid particles
- Tough polyurethane topcoat
- 3M's tough, durable microcrystalline ceramic optics
- Exceptionally durable bead-filled polymer base
- Advanced pressure-sensitive adhesive
- Primer, if required
- Road surface

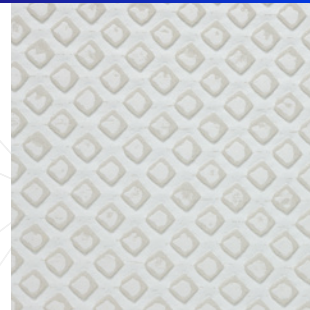
Current 3M™ Stamark™ product portfolio

Complete portfolio to match customer needs for many applications.

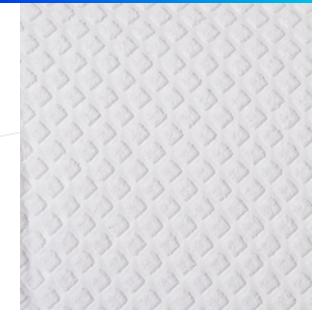
3 types of base materials



Series 380I ES



Series 380AW



Series 380ESD

	Series 380I ES	Series 380AW	Series 380ESD
Colours available	White Yellow	White Yellow	White
Widths available (cm)*	12, 24, 50	12, 15, 20, 25, 30, 50	10, 12, 15, 20, 25, 30, 50
Linered materials for symbols	Yes	Yes	Yes
Typical initial dry retro	500	500	500
High index optics for increased rain reflectivity (RR)	N	Y	N
Minimum initial skid resistance (BPN)	45	45	55

*Other widths available on request

3M™ Stamark™ permanent marking tape A380

3M™ Stamark™ pavement marking tape A380 is certified in European countries.



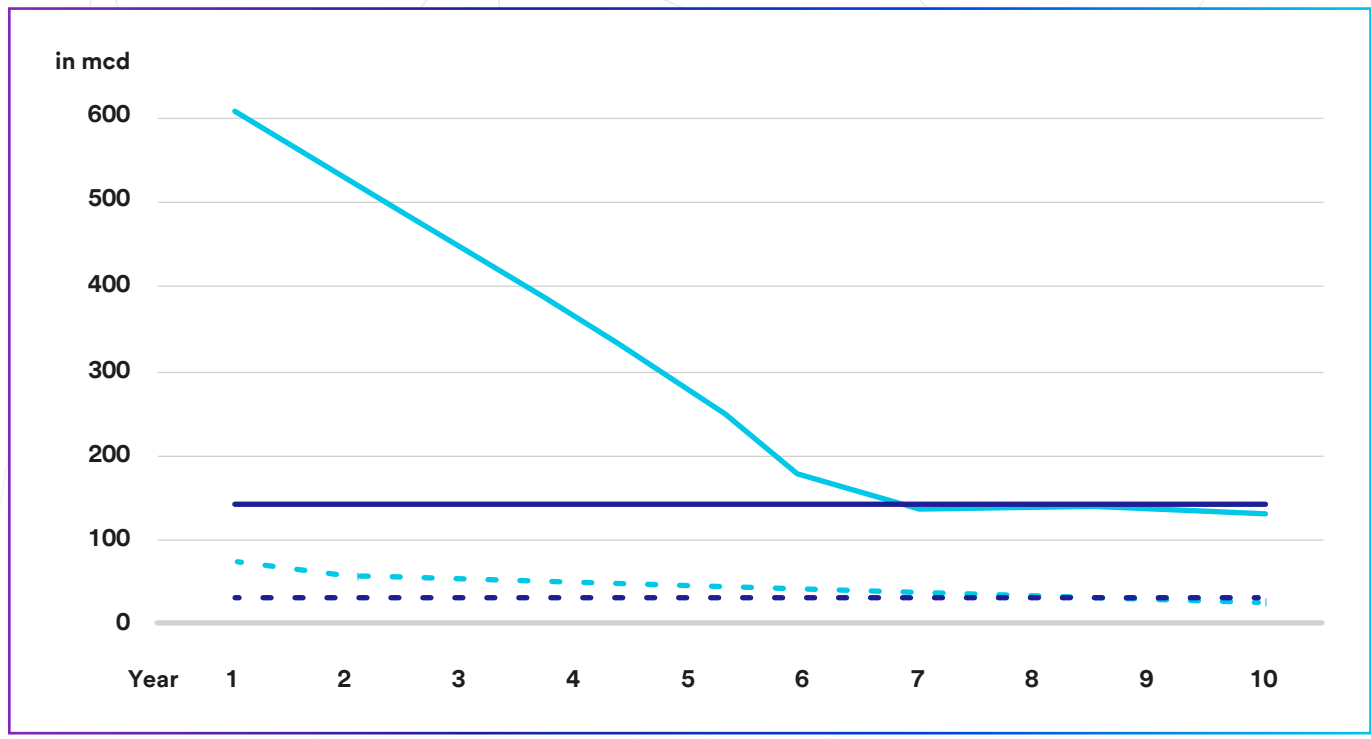
- ▶ BASt (Germany)
- ▶ ASQUER (France)
- ▶ BSI (UK)
- ▶ AETEC (Spain)
- ▶ Instytut Badawczy Dróg i Mostów (Poland)



3M™ Stamark™ permanent marking tape A380ESD

Safety and cost efficiency over the years.

Average measurements for retroreflection of A380 ESD in Germany.



A plus for safety and durability, with long-term compliance to high safety standards.

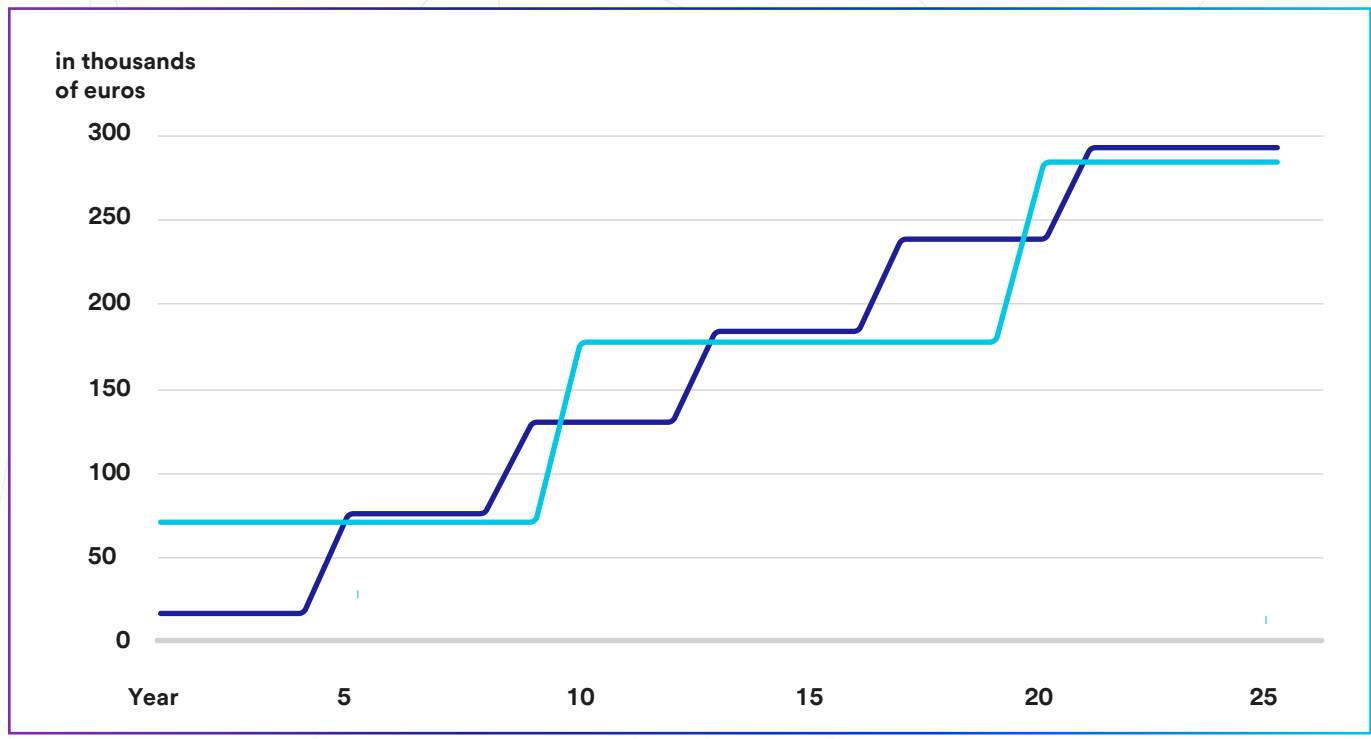
- Night visibility
- - - Night/wet roads
- Minimum requirements for night R3 class (150 mcd)
- - - Minimum requirements for night / wet roads RW2 (35 mcd)

Source: Quality measurements 3M Germany, sample from selected motorways throughout Germany

3M™ Stamark™ permanent marking tape A380ESD

Safety and cost efficiency over the years.

Comparison of the costs per year of alternative marking materials compared to 3M permanent marking tapes.



3M™ Stamark™ high-performance pavement marking tape series A380 ESD offers proven durability, optimises replacement intervals and saves maintenance costs over the entire life of the road surface.

- 3M™ Stamark™ markings
- Traditional liquid markings

Source: Empirical consideration of the overall cost over a period of 25 years

3M™ Stamark™ permanent marking tape A380

Why choose 3M™ Stamark™ permanent marking tape A380?



Less maintenance work



Less risk to road workers



Less congestion



Optimised maintenance cycles

3M™ Stamark™ permanent marking tape A380ESD

Active reduction of noise pollution on roads.

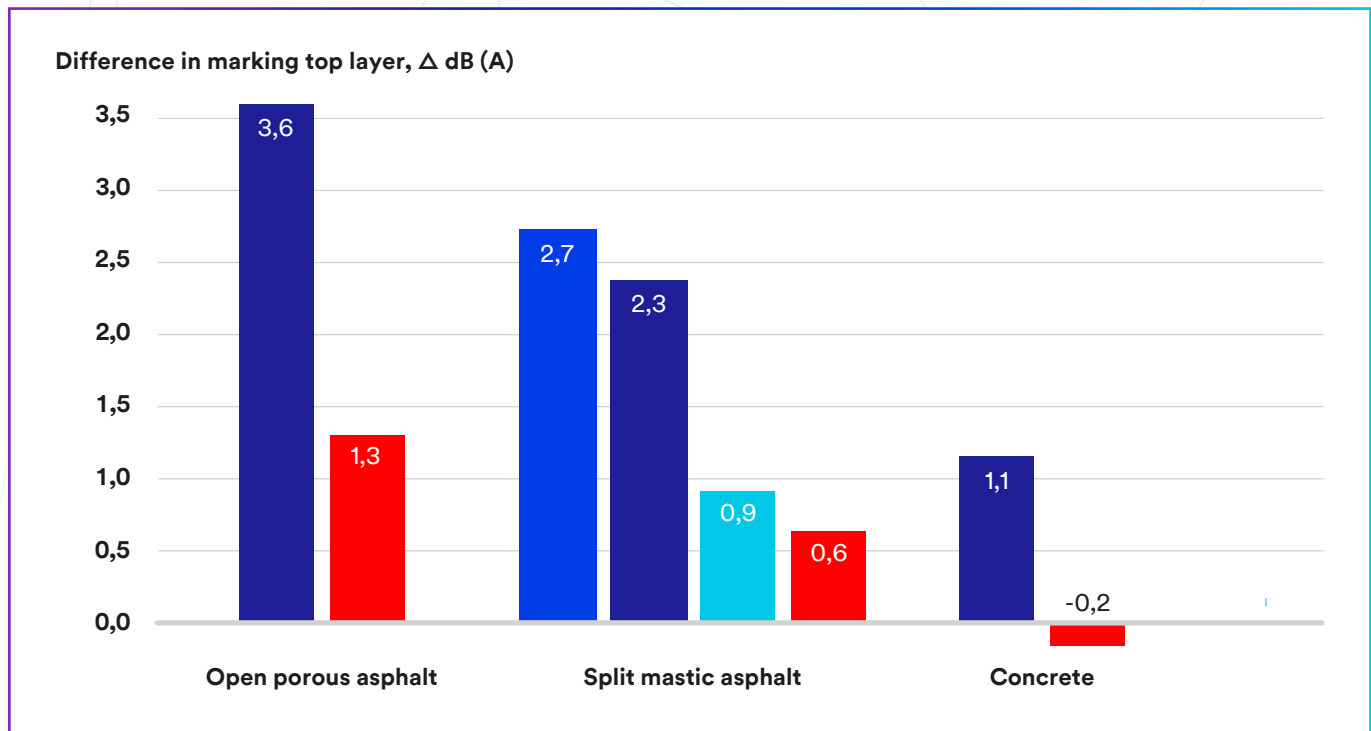
- ▶ 3M™ pavement markings can also be used as active noise protection measures to complement passive measures.
- ▶ Ideal combination: Noise reducing open asphalt and quiet, profiled marking tape.



3M™ Stamark™ permanent marking tape A380ESD

Reduce noise pollution on roads!

Comparison of the additional noise pollution created when driving over various marking systems.



Tape marking causes virtually no additional noise.

- Agglomerate stochastic
- Profiled tape 3M™ Stamark™ A380 ESD marking tape
- Agglomerate "Visidots"
- Cold spray plastic

Δ 3.0 dB (A): Perception corresponds to a doubling of the ADT*

Δ 1.0 dB (A): Corresponds to the perception threshold

* average daily traffic volume

Source: CPX measurements of pavement markings, Müller-BBM GmbH, report no. M82 085/1 of 17 November 2009, presentation by 3M Germany GmbH

3M™ Stamark™ permanent marking tape A380

Get your roads ready for the future!

Clear and bright marking tape ensures reliable lane readability by self-driving, automated vehicles.

**A study by the University of Dresden from 2020 shows:
Reflectivity of 3M's pre-manufactured pavement marking
tapes clearly improved machine readability measured
by a LiDAR sensor.**

Study by the Laboratory for Motor Vehicle Mechatronics at the University of Applied /Sciences (HTW) in Dresden



3M™ pavement markings

Helping to make roads safer – at all times.

- ▶ Long durability (warranty and tested in practical use)
- ▶ Less congestion due to quick application and long service life
- ▶ No need to interfere with the traffic flow for remarking work
- ▶ Can be applied during asphalt surfacing, minimising interruption and increasing safety for installation crews
- ▶ High visibility in all weather conditions
- ▶ Low noise emissions
- ▶ Meets and exceeds all statutory and regulatory requirements (EN 1436)
- ▶ Optimised and proven application on all common road surfaces
- ▶ Immediate rollover / no drying times
- ▶ Even under high traffic loads, 3M™ road markings need to be replaced much less frequently than traditional liquid markings



Installation, application, and training

Recommended standard A380 applications

High speed roads with free flowing traffic.



Free flowing expressway

- ▶ Lane Lines, edge lines, gore areas
- ▶ Lane ADT 5,000 – 25,000
- ▶ Black spots with limited overhead lighting

Note: Many factors influence field performance, always consult 3M Application Engineers (AE) for guidance.



Symbols and legends

- ▶ Arrows, symbols, letters, custom
- ▶ Positioned in areas with less shear

Note: Please contact your 3M representative for assistance with custom symbols and legends



Mid-block crosswalks

- ▶ Positioned in areas with free-flowing traffic
- ▶ Urban environments

Note: Crosswalk markings at the intersection are NOT recommended due to high shear

Recommended entry point A380 applications

Hazard areas where the cost of safety is higher than normal.



Tunnels

- ▶ Fatal crashes are 2x more likely in a tunnel than on a standard expressway⁷
- ▶ Driver lane discipline and lane changing is a major factor in crashes within tunnels⁸

 Turkey, Istanbul



Black spots

- ▶ Black spots are high risk areas or crash-prone sites
- ▶ Research suggests that adding wet reflective pavement markings or increasing levels of retroreflectivity can help reduce crashes^{10,11}

 USA, Minnesota

Bridges

- ▶ Crash risk in the approach zone to a bridge is higher than for roads in general⁹
- ▶ Bridges tend to be built with longer lasting materials like concrete



 Russia, Vladivostok

Showcase roads

- ▶ High profile infrastructure investments with large budgets
- ▶ Road authority is more likely to invest in premium pavement markings for a premium road



 Hungary - on the way to Budapest

Installation methods

Split mastic and open porous asphalt.

- ▶ Use on new/warm surfaces - lay using the inlay method during road surfacing

Split mastic, porous covers and concrete road surfaces, including exposed aggregate concrete.

- ▶ Use on existing/cold surfaces – Lay using primer P50

**The ideal installation method
for every road surface!**



Installation video

Installation of 3M™ Stamark™ A380ESD.

See the installation of 3M™ Stamark™ A380ESD in Germany on the A448 link road between the Sheffield Ring (L705) and the Bochum/Witten motorway junction (A43/A44).

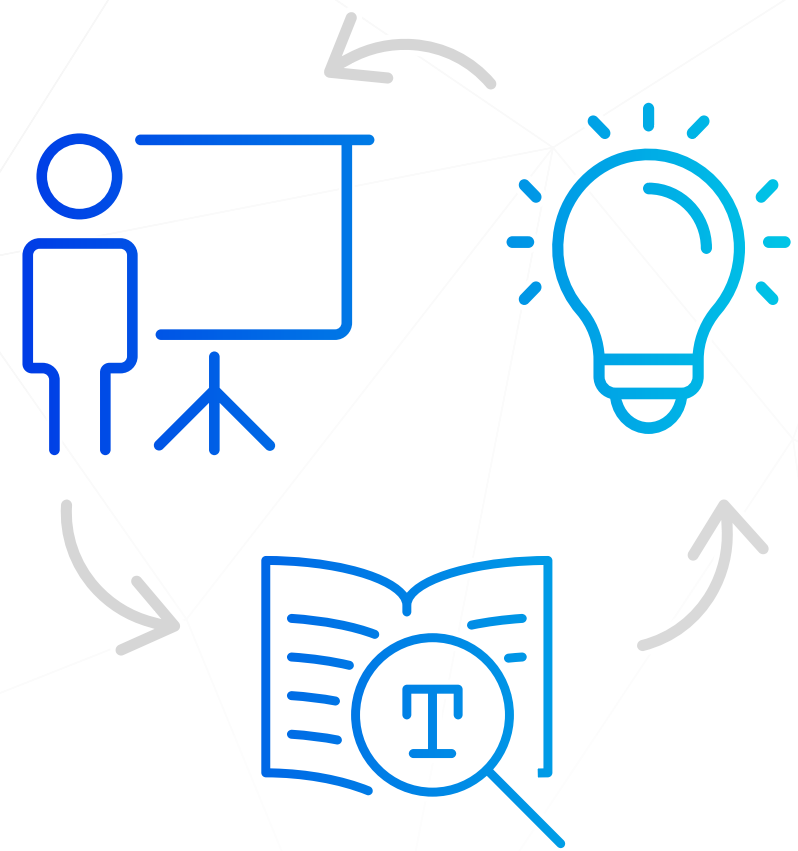


Training

High quality through consistent training and certification of our partners and installation crews.

Training is offered by 3M for local authorities and other customers of 3M road marking solutions.

Get in contact with us for more details.



Practical example

Use of high-quality marking tape on real highways: an example from Baden-Württemberg, Germany.

The often highly-congested dual carriage federal highway in Baden-Wuerttemberg required overall economic planning and management of maintenance work sites. When renewing road markings, major interference can be expected if the rules and regulations for the safety of work sites are observed.

In order to avoid congestion, it's often no longer enough to make the best possible use of low-traffic periods to carry out marking work. Instead, the aim should be to extend maintenance cycles by using high-quality pavement markings.



Case studies

A380 field performance data – USA

3rd party data helps substantiate 3M™ Stamark™ permanent marking tape A380 durability value proposition.

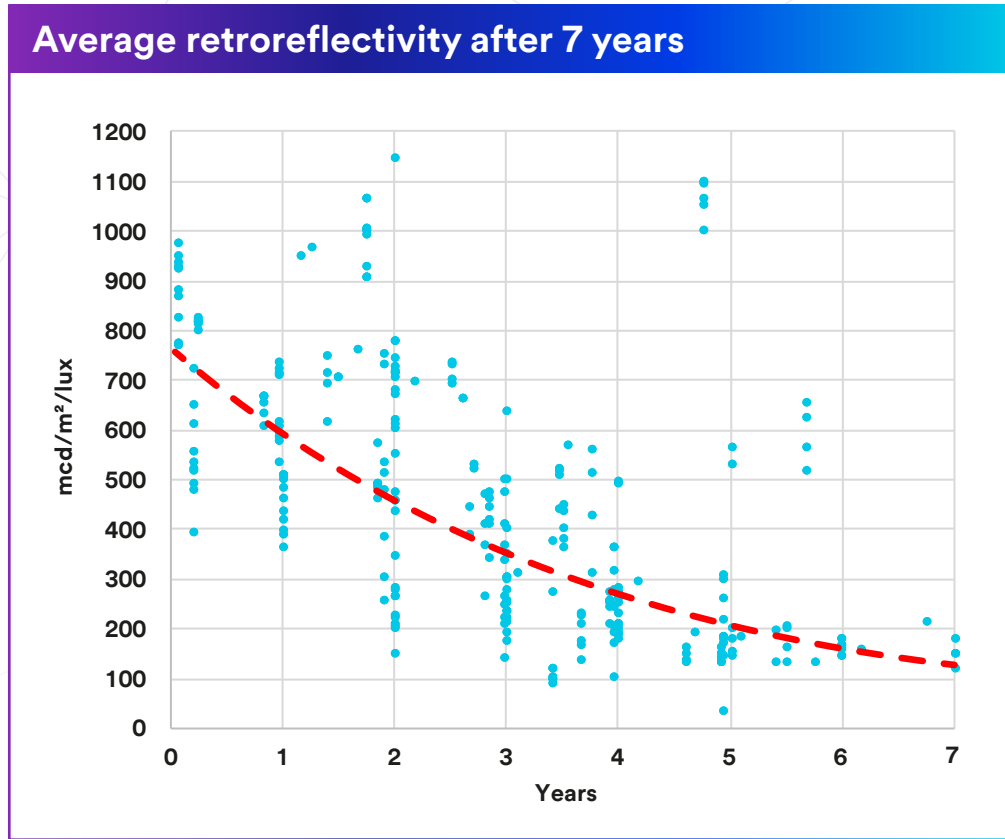
Locations 26 roads in 8 States

States

- ▶ Georgia
- ▶ Alabama
- ▶ Pennsylvania
- ▶ Wisconsin
- ▶ Arizona
- ▶ Arkansas
- ▶ Minnesota
- ▶ Idaho

Characteristics of road locations

Materials: A380I ES and A380AW	Site information
Measurement methodology: External Data collected by Beck Engineering with Vehicle Mounted LTL Mobile Retroreflectometer	▶ Expressway
	▶ Lane AADT range: 4,000 to 26,000
	▶ Skip line, right edge lines
	▶ Concrete and asphalt




Sources: Dataset maintained by 3M TSD Pavement Marking Lab and Marketing Teams

Note: Many factors influence field performance, always consult 3M Application Engineers (AE) for guidance.

A380I ES compared to thermoplastic – USA

Internal 3M data helps substantiate 3M™ Stamark™ permanent marking tape A380 durability value proposition.

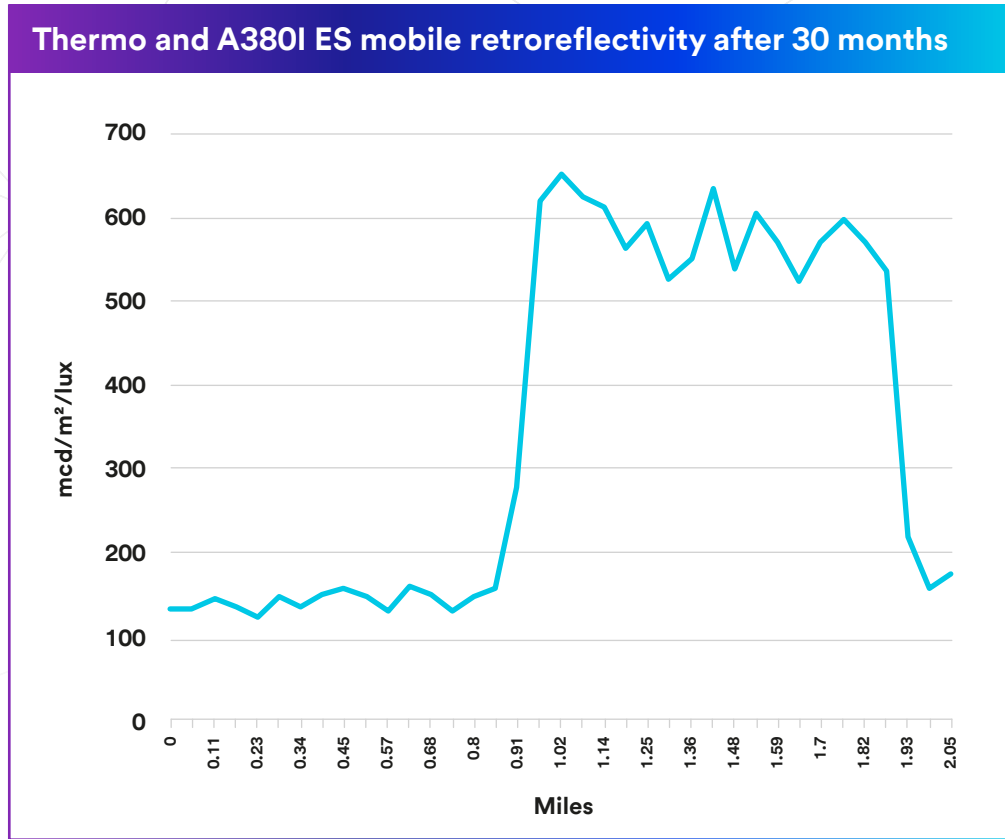
California, I-5, North of Williams



© Google Maps

Characteristics of road

Materials: A380 IES and thermoplastic installed on same day	Installation date: Oct 2012
Measurement methodology: Internal 3M Data collected with Delta's Vehicle Mounted LTL Mobile Retroreflectometer	Measurement date: Jul 2015
	Site information
	▶ Expressway (I-5), ~9,500 Lane ADT in California
	▶ Surface applied skip line



Sources: Delta LTL-M Mobile retro data collected by 3M Application Engineering in 2015, Data maintained by 3M TSD Global Pavement Marking Lab and Marketing

Note: Many factors influence field performance, always consult 3M AE team for guidance

A380I ES field performance data – USA

Internal 3M data helps substantiate 3M™ Stamark™ permanent marking tape A380 durability value proposition.

Alabama, I-59



Characteristics of road

Materials:
A380 IES

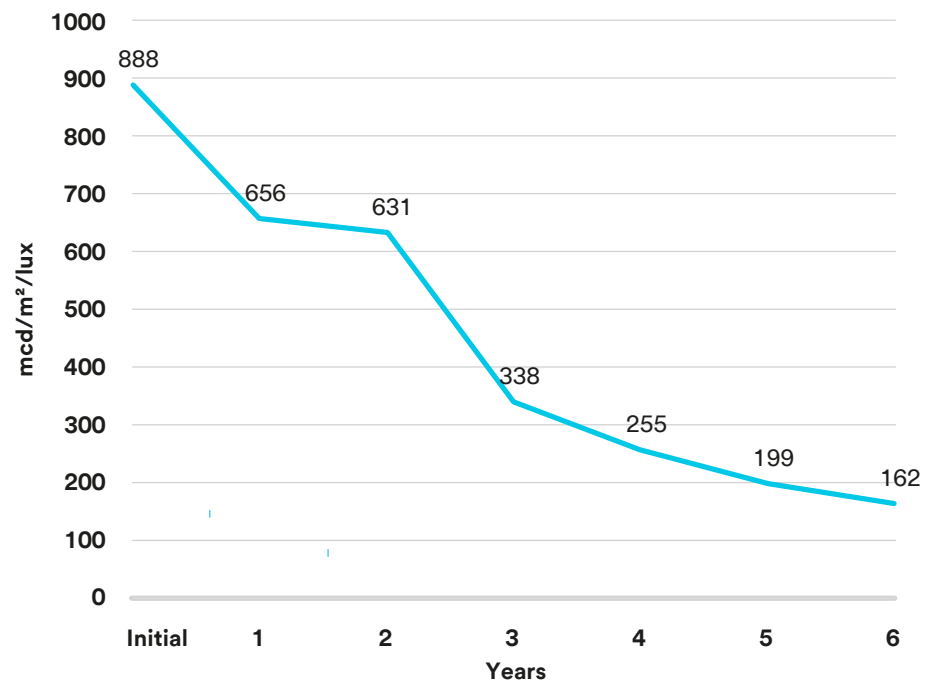
Measurement methodology:
External Data collected by Beck Engineering with Vehicle Mounted LTL Mobile Retroreflectometer

Installation date: Oct 2007

Site information

- ▶ Expressway, ~18,000 Lane ADT (~137,000 Road ADT)
- ▶ Surface applied skip line
- ▶ Concrete


Average dry retroreflectivity over 6 years



A380I ES field performance data – USA

3rd party data helps substantiate 3M™ Stamark™ permanent marking tape A380 durability value proposition.

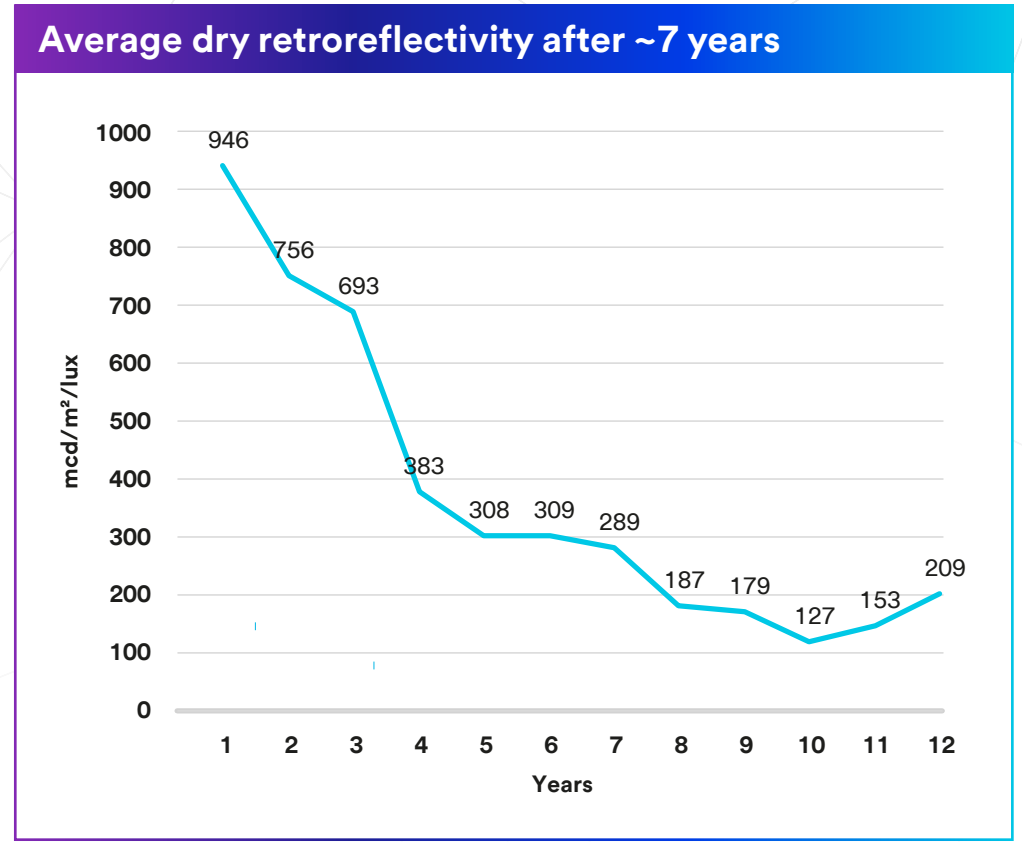
Pennsylvania Turnpike, I-76



© Google Maps

Characteristics of road

Materials: A380 AW	Installation date: Jul 2012
Measurement methodology: External Data collected by Beck Engineering with Vehicle Mounted LTL Mobile Retroreflectometer	Site information <ul style="list-style-type: none">▶ Expressway, ~6,000 Lane ADT (~24,000 Road ADT)▶ Grooved skip line▶ Asphalt



Sources: Pavement Markings Assessment, Spring 2019 Pennsylvania Turnpike Commission

Note: Many factors influence field performance, always consult 3M AE team for guidance

Additional solutions for transportation safety

Additional solutions for transportation safety



High visibility reflective traffic signage



Removable, temporary pavement markings



Effective conspicuity markings to keep vehicles visible

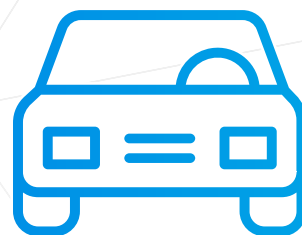
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Contact us

We're always available to offer help and answer any questions you have.

Access the contact form here



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