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Diamond Grade™ Flexible Prismatic Markings

Series 973

Product Bulletin 973 November 2010

Description

3M™ Diamond Grade™ Flexible Prismatic Markings Series 973 are designed to mark a wide variety of vehicles for which enhanced visibility is needed. This highly retroreflective marking consists of prismatic lenses that are formed in a transparent, synthetic resin, sealed and backed with an aggressive pressure sensitive adhesive and paper liner.

Series 973 markings have excellent angularity that allows them to be seen at angles up to and beyond 45° from perpendicular. This feature is important in cross traffic, turning maneuvers and when parked along roadways.

Markings are available in standard size rolls of 1 inch, 2 inch, 4 inch and 6 inch widths by 50 yards.

Properties

Color: White 973-10
 Yellow 973-71
 Red 973-72
 Orange 973-74
 Blue 973-75
 Green 973-77

Adhesive: Pressure Sensitive
 Minimum Application Temperature: 50°F (10°C) (sheeting and substrate)
 Maximum Application Temperature: 100°F (38°C) (sheeting and substrate)

Coefficient of Retroreflection

The minimum coefficient of retroreflection values of these sheetings when new are given in Table A in terms of candelas per lux per square meter. Measurements are made in accordance with ASTM E-810 "Standard Test Method for Coefficient of Retroreflective Sheeting" and represent an average of values at 0° and 90° orientations. Sheeting should be applied to aluminum panels and conditioned at room temperature for 24 hours prior to measurement.

Table A. Minimum Coefficient of Retroreflection (R_A) for New Markings (cd/lux/m²)

Observation Angle ¹	Entrance Angle ²	White	Yellow	Red	Orange	Blue	Green
0.2°	-4°	360	270	65	145	30	50
0.2°	30°	170	135	30	68	14	25
0.5°	-4°	150	110	27	60	13	21
0.5°	30°	72	54	13	28	6	10

¹Observation Angle – the angle formed by the light beam striking the reflective surface and the light beam returning to the observer.
²Entrance Angle – the angle formed by a light beam striking a surface at a point and a line perpendicular to the surface at the same point.

Entrance Angularity Performance in Regard to Orientation

3M™ Diamond Grade™ Flexible Prismatic Markings are designed to be effective wide angle reflective markings regardless of the orientation on the substrate or vehicle. However, because the efficiency of light return from cube corner reflectors is not equal at all application angles, especially with increasing entrance angles, it is possible to get the widest entrance angle light return when the sheeting is oriented in a particular manner which takes advantage of increased performance at high entrance angles (>50°). When high entrance angle performance is a requirement for your markings you can obtain this performance easily by specifying the application angle of your markings so that the sheeting positioned at the 0° application angle (downweb direction perpendicular to the ground, ie, vertical). When the "primary groove line" (or, flat side of the diamond shape) is vertical, sheeting is said to be at a 0° application angle. When the "primary groove line" (or, flat side of the diamond shape) is horizontal, the sheeting is said to be at a 90° application angle. Unless the location and/or position of the marking requires extra wide entrance angularity performance, markings can be fabricated and installed using the application angle that most efficiently utilizes the reflective sheeting.

Typical Physical Properties

The following technical information should be considered typical only and should not be used for specification purposes. Any request for a custom specification can be submitted through your 3M sales representative. All test samples are conditioned for 24 hours at 73°F (23°C) and 50% relative humidity before testing.

Property	Series 973 Typical Value
Thickness (Caliper)	0.010 inch – 0.014 inch (.25 – .36mm)
Gloss ASTM D523 @ 85°	50 or greater
Dimensional Stability ASTM D4956	< 0.125 inch per side change on 9 x 9 inch panel in 24 hours
Flexibility – wrap around 0.125 inch mandrel @ 32°F (0°C)	No cracking
High Pressure Wash Test 45° angle, 1200 psi, 12 inch nozzle distance	Passes
Heat Resistance	Will retain at least 70% of original coefficient of retroreflection when applied to A1 panel and exposed to 170°F (77°C) for 24 hours in air circulating oven.
Chemical Resistance SAE J1967	Not affected by toluene, #2 diesel fuel, gasoline (leaded) kerosene, TSP detergent, xylene, dilute metal brighteners
Corrosion Resistance ASTM B-117 Salt Spray	No effect – 1000 hours
Impact Resistance Room Temperature 100 in-lbs., 5/8 inch tip	No damage outside impact area
Cold Temperature Impact 100 in-lbs. at 32°F (0°C)	No damage outside impact area
Adhesion (Instron 12 inch/min., 90° pull back)	≥ 4.0 lb./inch for degreased aluminum, Fruehauf painted panel, stainless steel and FRP

Application Procedure

These procedures should be followed to apply the markings to the cleaned surface within the proper application temperature range.

1. Apply markings no closer than 1/8 inch to door hinges, door hardware, ends and weld joints to avoid wrinkling or lifting. Markings must be cut 1/8 away from exterior posts and large bolts or rivets.
2. Peel the marking from the liner, position and align the marking on the car and tack down lightly to hold in position. Care should be taken not to stretch the marking.
3. Using a PA-1 applicator, press the marking to the surface using firm, vertical, overlapping strokes. Be sure **all** edges are adhered by resqueegeeing the edges.

Maintenance

Cleaning

Routine washing is recommended for maximum performance. The following cleaning methods are recommended:

- Wash with sponge, cloth or soft brush using water and detergent.
- Automatic vehicle wash or standard high-pressure hand spray:

Maximum pressure – 1200 PSI/80 bar.

Maximum water/wash solution temperature – 140°F/60°C.

Minimum of 12 inches/30cm distance between cleaning jets and markings.

Cleaning wand or jets are to be at **no greater** angle than 45 degrees from perpendicular to the marking's surface.

- When using metal brighteners, follow manufacturer’s recommendations for dilution. Thoroughly rinse from marking after soaking vehicle.

Storage

- Cool, dry area out of direct sunlight.
- Temperature 65-75°F (18-24°C)
- Humidity 30-50%
- Store rolls horizontally, in carton or in original packaging.

Shelf Life

Apply 973 markings within one year of receipt of material.

Health and Safety Information

Read all health hazard, precautionary, and first aid statements found in the Material Safety Data Sheet and/or product label of chemicals prior to handling or use.

General Performance Considerations

Series 973 markings will provide maximum durability when:

- 3M recommended procedures are followed.
- Markings are applied to vertical surfaces.

Actual durability will be based on actual customer use conditions. Durability can be reduced if recommended techniques are not followed, including:

- Improper application or surface preparation.
- Failure to cut markings around rivets, seams and body panels.
- Improper use of high pressure cleaning.
- Spillage of chemicals or solvents.

Warranty

3M warrants that 3M™ Diamond Grade™ Flexible Prismatic Markings Series 973 sold by 3M to be used for markings in the United States and Canada will remain effective for the intended use for 5 years. Angular exposure between 10° and 45° from vertical decreases the warranty period by two years. Exposure at angles greater than 45° from vertical is not warranted. If the 3M reflective marking is applied in accordance with

all 3M application and fabrication procedures, including the exclusive use of 3M recommended application equipment; and if the emblem or marking deteriorates due to natural causes, such as fading, cracking, peeling, lifting, or discoloration; 3M’s sole responsibility and purchaser’s exclusive remedy shall be that 3M will provide replacement of the 3M material per the following table:

Total Warranty Period	Full Replacement	Pro-Rata Replacement Period	Monthly Reduction in Allowance
5 yrs. (60 mos)	36 months	37th - 60th mo.	1/24
3 yrs. (36 mos)	24 months	25th - 36th mo.	1/12

Conditions

Such failures must be solely the result of design or manufacturing defects in the 3M reflective markings and not of outside causes such as: improper handling, maintenance or installation; use of application procedures not recommended by 3M; failure of substrate; exposure to chemicals, abrasion and other mechanical damage from fasteners used to mount the marking; collisions, vandalism or malicious mischief.

3M reserves the right to determine the method of replacement.

Replacement markings will carry the unexpired warranty of the markings they replace.

Claims made under this warranty will be honored only if 3M is notified of a failure within a reasonable time, reasonable information requested by 3M is provided, and 3M is permitted to verify the cause of the failure.

Limitation of Liability

3M’s liability under this warranty is limited to replacement as stated herein, and 3M assumes no liability for any incidental or consequential damages, such as lost profits, business or revenues in any way related to the product regardless of the legal theory on which the claim is based. THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM OR USAGE OF TRADE.

FOR INFORMATION OR ASSISTANCE

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