



Diamond Grade™ Conspicuity Markings

983-71 For School Bus Safety Markings

Product Bulletin 983-71

March 2006

Replaces PB 981-71 dated September 1999

Description

3M™ Diamond Grade™ Conspicuity Markings 983-71 for school buses are designed to mark emergency exits, and the perimeter (sides and rear) of school buses for enhanced visibility and detection. This highly retroreflective marking consists of prismatic lenses formed in a durable transparent resin, sealed with a white synthetic film and backed with an aggressive pressure sensitive adhesive with a clear liner to protect the adhesive prior to application.

3M's 983-71 markings have excellent angularity that allow 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.

Series 983-71 meets or exceeds all FMVSS-217 requirements.

Markings are available in standard size rolls of 1 inch, 1-3/4 inch, and 2 inch widths by 50 yards.

Properties

Color:	Yellow 983-71
Adhesive:	Pressure Sensitive
Minimum application temperature:	50°F (10°C) (sheeting and substrate)
Maximum application temperature:	100°F (30°C) (sheeting and substrate)
Liner:	Clear Poly

Coefficient of Retroreflection

The typical 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" in terms of candlepower per foot-candle per square foot (cd/lux/m²).

Table A. Typical Coefficient of Retroreflection³ (R^A) for New Marking (cd/lux/m²).

	Observation Angle ¹	
	0.2°	0.5°
Yellow 983-71		
Entrance -4°	645	360
Angle ² 30°	420	180
45°	235	65
FMVSS-217		
Entrance -4°	170	62
Angle ² 30°	100	45

¹Entrance 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.

²Observation Angle - the angle formed by the light beam striking the reflective surface and the light beam returning to the observer (from 800 feet, a motorist normally views a marking at approximately a 0.2° observation angle).

Health and Safety Information

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

Exceptions

1. Continuous exposure in the hot desert region of West Texas, New Mexico, Arizona, Nevada and parts of California should provide performance for a minimum of five years.
2. Angular exposure greater than 30° from vertical may decrease performance life by two years.
3. Horizontal exposure is not recommended.
4. The sheeting must be completely cut around rivets and between seams for optimum adhesion.
5. Open cells along the edge of the marking may collect dirt but will not reduce the performance of the marking.
6. Damage due to external conditions may show loss of adhesion and reflectivity in the immediate area.

Physical and Chemical Properties

Values given are typical and are not for use in specifications. If a specification is desired, a custom specification will be prepared upon request. Any request for a 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.

Physical Properties

Property	Test Method	Results
Thickness (unprinted)	Micrometer	0.014 inch - 0.018 inch
Dimensional Stability	9 inch x 9 inch sample, adhesive side up	(.36 - .46 mm) Less than 1/8 inch (3.2mm) change in all directions in 24 hours.
Performance Range	No delamination or release from surface, crazing, or cracking or facing when exposed to temperatures within range specified and applied per 3M recommended procedures.	
Impact Resistance	Applied to test panel of alloy 6061-T6 .040 inch (1.10cm) Subjected to 100 in./lbs. (1.13cm) with 5/8 inch (15.8cm) diameter rounded tip weight. Impacted on face of marking at 32°F (0°C) and 73°F (22°C).	No cracking, delamination or peeling beyond impact area.
Gloss	ASTM D523 85° gloss meter	50 or greater
Heat Resistance	Applied to aluminum panel and exposed to 170°F (77°C) for 24 hours in air circulating oven.	Will retain a minimum of 70% of original coefficient of retroreflection.

Adhesion (Instron 12 inch/min. 90° pull back)

Degreased Aluminum	5.2 lb./in. (0.93 kg/cm)
Fruehauf Prepainted Panel	4.0 lb./in. (.72 kg/cm)
Stainless Steel	6.0 lb./in. (1.1 kg/cm)
FRP	6.0 lb./in. (1.1 kg/cm)
FRP/Tedlar	3.8 lb./in. (0.68 kg/cm)

Chemical Resistance

Markings are applied to aluminum panels conditioned for 24 hours at 73°F (23°C) and 50% relative humidity. Panels are immersed in chemical for 10 seconds and removed for 20 seconds for 10 cycles.

Reference Fuel	No effect
Diesel Fuel	No effect
Gasoline Leaded	No effect
Kerosene	No effect
TSP Detergent	No effect

Corrosion Resistance

5% concentrated salt spray at 95°F (35°C) per ASTM B-117.

1000 hours	No effect 80% of original brightness retained
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Product 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 truck/car/bus 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/ 30 cm distance of cleaning jet(s) from marking.
Spray nozzles must spray at a 15 degree flat water fan type pattern.
Cleaning wand or jets to be at **no greater** angle than 45 degrees from perpendicular to the markings 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 983-71 markings within two years of receipt of material.

General Performance Considerations

Series 983 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, field testing, exterior exposed testing and artificial weathering testing.

Durability can be reduced if recommended techniques are not followed:

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

Warranty

3M warrants that 3M™ Diamond Grade™ Conspicuity Marking Series 983-71 for School Buses sold by 3M to be used for emblems and markings in the United States and Canada will remain effective for their intended use, subject to the following provisions:

³Warranty Period-Years

Canada and U.S. Except
Desert Southwest (AZ,
NM, and desert areas
of NV, CA, UT, and TX)

Desert Southwest

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³Angular 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 marking is applied in accordance with all 3M application and fabrication procedures provided in 3M's product bulletins, information folders, technical memos (that will be furnished to the agency upon request), 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 and user's exclusive remedy shall be that 3M will provide replacement of the 3M materials per the following table:

Total Warranty Period	Full Replacement	Pro-Rata Replacement Period	Monthly Reduction in Allowance
7 yrs. (84 mos)	52 months	53rd - 84th mo.	1/32
5 yrs. (60 mos)	36 months	37th - 60th mo.	1/24
4 yrs. (48 mos)	30 months	31st - 48th mo.	1/18
3 yrs. (36 mos)	24 months	25th - 36th mo.	1/12
2 yrs. (24 mos)	18 months	19th - 24th mo.	1/6

Conditions

Such failure must be solely the result of design or manufacturing defects in the 3M 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 emblem or 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 and 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.

Literature Reference

IF 4.10 Application Instructions for Reflective Sheeting to School Buses

FOR INFORMATION OR ASSISTANCE

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1-800-553-1380**

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1-800-265-1840**

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1-800-887-3238**

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www.3M.com/tss**

3M assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where reference is made in literature to a commercially available product, made by another manufacturer, it shall be the user's responsibility to ascertain the precautionary measures for its use outlined by the manufacturer.

Important Notice

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith.

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