Diamond Grade™ Conspicuity Markings for Rail Car Reflectorization

Series 983RR

Product Bulletin 983RR March 2006

Replaces PB 983RR dated February 2005

Description
3M™ Diamond Grade™ Conspicuity Markings Series 983RR are highly retroreflective microprismatic markings designed to mark rail cars and locomotives for enhanced visibility and detection. The reflective marking consists of prismatic lenses that are formed in a transparent, synthetic resin, sealed and backed with a pressure-sensitive adhesive and clear poly liner. Applied to properly prepared substrates Diamond Grade markings should provide ten year field performance.

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>983-21FRA</td>
<td>Fluorescent Yellow</td>
</tr>
<tr>
<td>983-71FRA</td>
<td>Yellow</td>
</tr>
<tr>
<td>983-10FRA</td>
<td>White</td>
</tr>
</tbody>
</table>

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.

Series 983-21 fluorescent yellow, 983-71 yellow and 983-10 white markings meet or exceed:
• ASTM D4956-01A Type VII
• FRA 49 CFR Part 224 requirements

Features
• High brightness
• Wide angularity
• Durable fluorescent yellow, yellow, and white
• 10 year warranty
• Pre-sealed edges
• Non-metallic construction - no corrosion

Easy to apply
• Aggressive pressure sensitive adhesive for application down to 35°F
• Available in 4 x 18 inch kiss cut pieces on a roll for easy application (50 yd. length)

Fluorescence
Fluorescent materials absorb short wavelength, invisible, incident radiation (solar energy) and re-emit the radiation as longer wavelength, visible light. This re-emitted energy continues as long as incident radiation is present.
• Fluorescent markings are especially effective during dawn, dusk, and overcast days.
• Fluorescence adds to daytime luminance and enhances the visibility and safety of rail cars when motorist headlights may not be in use.
**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.”

### Table A

**Typical Coefficient of Retroreflection (RA) for New Sheeting (cd/lux/m²)**

<table>
<thead>
<tr>
<th>Entrance Angle</th>
<th>Observation Angle</th>
<th>0.2°</th>
<th>30°</th>
<th>45°</th>
<th>0.4°</th>
<th>30°</th>
<th>45°</th>
</tr>
</thead>
<tbody>
<tr>
<td>983-21 Typical Values Fluorescent Yellow</td>
<td>400</td>
<td>220</td>
<td>120</td>
<td>150</td>
<td>75</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>983-71 Typical Values Yellow</td>
<td>600</td>
<td>420</td>
<td>225</td>
<td>350</td>
<td>180</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>983-10 Typical Values White</td>
<td>800</td>
<td>500</td>
<td>300</td>
<td>450</td>
<td>225</td>
<td>85</td>
<td></td>
</tr>
</tbody>
</table>

1. **Observation 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 an 0.2° observation angle).
2. **Entrance 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.

**Typical Physical Properties**

The following technical information should be considered typical only and should not be used for specification purposes.

<table>
<thead>
<tr>
<th>Property</th>
<th>Series 983RR Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness (Caliper)</td>
<td>0.014 inch - 0.018 inch (.36 - .46mm)</td>
</tr>
<tr>
<td>Gloss</td>
<td>100</td>
</tr>
<tr>
<td>Dimensional Stability</td>
<td>No measurable change on 9 x 9 inch panel</td>
</tr>
<tr>
<td>Flexibility - wrap around</td>
<td>No cracking</td>
</tr>
<tr>
<td>High pressure wash test</td>
<td>Passes</td>
</tr>
<tr>
<td>Adhesion</td>
<td>Passes</td>
</tr>
<tr>
<td>Minimum Application Temp.</td>
<td>35°F (1.7°C)</td>
</tr>
<tr>
<td>Chemical Resistance</td>
<td>Not affected by toluene, #2 diesel fuel, gasoline (leaded) kerosene, TSP detergent, xylene, dilute metal brighteners</td>
</tr>
<tr>
<td>Corrosion Resistance</td>
<td>No effect-1000 Hours</td>
</tr>
<tr>
<td>Impact Resistance</td>
<td>No damage outside impact</td>
</tr>
<tr>
<td>Cold temperature</td>
<td>No damage outside impact</td>
</tr>
</tbody>
</table>
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.
- 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 between cleaning jet(s) and markings.
- 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 rail car or other 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 Series 983 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 conditions. Durability can be reduced if recommended techniques are not followed, including:
- Improper application or surface preparation.
- Improper use of high pressure cleaning.
- Spillage of chemicals or solvents.

Warranty
3M warrants that 3M™ Diamond Grade™ Conspicuity Marking Series 983 sold by 3M to be used for markings in the United States and Canada will remain effective for its intended use for ten years. If the 3M reflective 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 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 material.

Conditions
Such failure 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 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 4.18 Application Instructions for 3M™ Diamond Grade™ Conspicuity Marking on Rail Cars Series 983

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.

Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

3M and Diamond Grade are trademarks of 3M. Used under license in Canada.

© 3M, 2006
All Rights Reserved
Electronic Only