Overview

This bulletin details procedures for the application and maintenance of films manufactured or sold by 3M Commercial Branding and Transportation Division for use in rail applications. These procedures help maximize the life of the graphic. Refer to the product bulletins for each product in a graphic construction for specific details that may influence the information in this instruction bulletin.

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Pre-Installation Inspection Record Requirement

3M requires a properly executed and signed Pre-installation Inspection Record be completed before any application of 3M Graphic Films to a railcar. This record, which identifies any potential problem areas, is mandatory for any warranty claim made in the future. Make a copy of the appropriate record, at the provided link, for each railcar. 3M recommends that graphics manufacturers clearly define mutual obligations between railcar operating companies and themselves, and strongly suggests that graphics manufacturers seek written limitations of claims or liabilities on individual railcars for unsound paint, whether using warranted or unwarranted products.

Substrate Requirements

To obtain a high-quality, long-lasting graphic, use the proper preparation and application techniques for each type of substrate. Films can be applied to most substrates that are:

In Good Condition

Substrates that were not in good condition at the time of application may result in substrate damage. 3M recommends discussing any concerns with the end customer if the possibility of damage is suspected. Some important considerations are listed below:

- Slightly oxidized painted substrates (not chalked) actually develop a much higher adhesion than newly painted substrates. Such substrates have a texture similar to anodized, bare aluminum, which promotes higher adhesion.
- Highly oxidized substrates, such as chalked paint, have poor adhesion and graphics may be removed more easily.
- Painted substrates must be dried or cured per the paint manufacturer's recommendations. Graphics applied to freshly painted substrates, before the paint had sufficient time to cure, make removal difficult, and are NOT covered by the application's removal warranty. Substrate damage may also occur. Refer to the paint manufacturer's specifications for drying and curing times. Note that these times can be affected by the temperature and humidity of the ambient environment.

Clean

All substrates must be considered contaminated and must be cleaned prior to application of film or sheeting, with the last cleaning step being done immediately before application. A freshly cleaned or painted substrate can quickly collect dust.

NOTE

Before application, clean all surfaces including, but not limited to, corners, edges, and recesses where dirt and debris can accumulate. Poor adhesion to unclean areas can cause the film to lift and fail prematurely. These areas are easily overlooked.

Dry

Any moisture trapped beneath the graphic can cause the graphic to fail prematurely. Moisture prevents the adhesive from adhering correctly, can cause bubbles, and can expand or freeze in cold environments. Moisture results from:

- Inadequate drying after cleaning
- Condensation at low temperatures
- High-humidity environments
- Porous materials absorb moisture. Provide adequate time and conditions for drying.

It is impossible to keep the substrate dry if graphics are applied in high ambient humidity. Because of the difficulty in removing all of the moisture, wet application is NOT recommended on vehicles or non-flat surfaces. Moisture is also difficult to remove from beneath 3M™ Controltac™ Graphic Films and 3M™ Scotchlite™ Reflective Graphic Films, with or without Comply™ adhesive.

Relatively Non-porous

Porous materials absorb moisture, affecting the ability of the film or sheeting to adhere to the surface.

Smooth

It is more difficult for the adhesive to make good contact with textured surfaces rougher than 150-grit sandpaper. Refer to 3M Instruction Bulletin Application: General Installation Techniques for application techniques specific to rough surfaces.

Adhesion Testing Procedure

Prior to the installation of 3M graphic films, 3M recommends conducting an adhesion test to determine which film is best for the intended application. The 3M™ Graphic Film Adhesion Test Kit can also be used to determine if a substrate is sound and ready for graphic application.

Tools

- 3M™ Plastic Applicator (squeegee) gold PA-1[1]
- 3M™ Protection Buffer[1]
- 3M™ Rivet Brush RBA-1[1] or RBA-3[1]
- 3M™ Air Release Tool 391X[1]
- 3M™ Roller L and Roller S[1]
- Snap-off cutting knives or razor blades in safety holders
- Industrial heat gun or infrared heater capable of maintaining at least 500°F (260°C)
- Infrared thermometer
- Liner cutter
- 3M™ Tape Primer 94
- One of the following 3M edge sealers:
  - 3M™ Edge Sealer 3950
  - 3M™ Edge Sealer 4150S
  - 3M™ Edge Sealer ES2000
  - 3M™ Edge Sealer Tape
  - 3M™ Scotchcal™ Graphic Film Series 100-114
- Scotch™ Masking Tape
- 3M™ Knifeless™ Tape Tri Line
- Laser level
- Tape measure
- Wrap gloves
- Lint-free cloth or Scotch-Brite™ Perfect-It Microfiber Wipes 2022 or 3M™ Perfect-It™ Detailing Cloths 06017

[1] Available from 3M™ Commercial Branding and Transportation Division authorized distributors

General Cleaning Procedure

The general steps for cleaning a substrate in preparation for graphic film application are listed for convenience. Refer to 3M Instruction Bulletin Application: Substrate Selection and Preparation for the recommended cleaning methods and specific steps needed to clean a particular substrate, as every step listed below may or may not be required. Improperly prepared substrates void any 3M warranty. The following list of cleaners for each step is also provided for convenience; other acceptable cleaners may be available. 3M does NOT endorse any chemical manufacturer or supplier.

NOTE

See 3M Instruction Bulletin Application: Substrate Selection and Preparation for recommended cleaning methods on specific substrate types.

NOTE

Test cleaners in an inconspicuous area before using. Some cleaners may dull the substrate or leave contaminants on it. Cleaners with low solvent content may not remove certain contaminants. Clean the substrate immediately before applying film. Dust and other contaminants can collect quickly on substrates, preventing film from adhering properly. 3M does NOT warrant failures that result from an improperly cleaned and prepared substrate.

Method 1: General Cleaning

1. Use detergent and water to clean the substrate.
   - For most surfaces, interior or exterior, wash the substrate with1 oz (30 ml) of synthetic detergent per gallon (3.8 liters) of lukewarm water.
   - Avoid soaps or preparations that contain waxes, oils, or lotions.
   - Be aware that some window cleaners contain waxes.
   - Be aware that the chemicals used in some automated vehicle washing equipment may interfere with adhesion.
   - **For interior walls where grease and/or oil is present on the substrate:** Wash the substrate with a solution of trisodium phosphate (TSP) and lukewarm water, prepared according to the manufacturer's written instructions.
2. 2.Dry the surface thoroughly with clean, lint-free toweling. A heat gun may be used to apply moderate heat and accelerate the drying. Moisture prevents proper adhesion, can cause bubbles, and can freeze in cold environments. Moisture trapped beneath the graphic is likely to cause premature failure.

⚠ CAUTION

Ventilation

Always provide adequate ventilation to remove emissions that may result from the use of heat. Failure to provide adequate ventilation can result in operator exposure.

Method 2: Solvent Cleaning

Wash substrates where grease and/or oil are present on the substrate with a solvent-based cleaner/degreaser to remove the contaminant. Prepare the solution according to the manufacturer's written instructions. Grease and oil prevents film from adhering properly. Test the solvent cleaner before application to ensure the cleaner does not damage any finish on the railcar.

NOTE

Use a solvent-based cleaner to thoroughly remove any waxy residues.

1. Saturate a clean, lint-free towel with a solvent. See the lists below for suggested cleaners.
2. Wipe the surface with a lint-free paper towel before the solvent evaporates from the substrate. Discard paper towels as they become dirty. Dirty towels do not remove debris.
3. Ensure the substrate is completely dry. If necessary, use a heat gun to dry any retained moisture.

The following lists of cleaners are provided for the user's convenience; other acceptable cleaners may be available. 3M does NOT endorse any chemical manufacturer or supplier. Check with your local 3M representative for lists of suggested cleaners available in your region.

Cleaner with Low Solvent Content

- 3M™ Surface Preparation System
  - 1 gal. (3.8 L) container, 08983

Cleaners with Petroleum Distillate

- 3M™ General Purpose Adhesive Cleaner
  - 1 qt. (0.95 L) container, 08984 Adhesive Cleaner
  - - 5 gal. (19 L) pail, 08986
  - 20 oz. (0.6 L) aerosol can, 08987 Citrus Cleaner
- 3M™ Surface Preparation System
- DuPont™ Prep-Sol™ Solvent Cleaner 3919S

Method 3: Isopropyl Alcohol Cleaning

1. 1.Saturate a clean paper towel with a mixture of 70% isopropyl alcohol and 30% water (IPA).
   - Isopropyl alcohol evaporates quickly: the user must wipe the substrate dry before it evaporates. The evaporation rate increases in warm and/or windy environments.
2. 2.Wipe the substrate with lint-free paper towels before the IPA evaporates from the substrate. Discard paper towels as they become dirty. Dirty towels do not remove dirt.
3. 3.Ensure the substrate is completely dry. If necessary, use a heat gun to dry out any retained moisture.

NOTE

This should be the final step before applying graphics, as this will remove any residue left behind by solvent-based cleaners. Apply the graphic immediately. If dust, loose particles, or debris appear on the substrate prior to installation, proceed to complete Method 4. These types of contaminants prevent the adhesive from performing as expected.

Method 4: Dust and Dry Particle Cleaning

Use this method when the surface has no contamination other than dust or other loose particles or debris. Dust and loose particles may interfere with film adhesion.

Smooth Surfaces

Wipe down the entire surface with a clean Scotch-Brite™ High Performance Cleaning Cloth. Follow the product directions for cleaning the cloth.

Rough or Textured Surface

- Vacuum the entire surface with a soft-bristled vacuum head to dislodge and remove any loose particles or dust (preferred method)
- Brush the entire surface with a soft-bristled broom to dislodge any loose particles or dust (alternate method)

NOTE

See 3M Instruction Bulletin Application: Substrate Selection and Preparation for recommended cleaning methods on specific substrate types.

Adhesion of 3M graphics can vary significantly based on the type of surface and adhesive used. Performing an adhesion test using the 3M™ Graphic Film Adhesion Test Kit can help select a film.

Contact your local 3M sales representative for more information.

3M™ Graphics Application Restrictions

Do NOT apply any graphic film to these substrates:

- **Unpainted plastic substrates:** 3M does NOT warrant the application of graphic film to textured plastic substrates under any circumstances. However, using heat and a rivet brush to conform graphic film to the texture may help provide satisfactory adhesion for an unwarranted application.
- **Rubber, silicone or flexible plastics:** The adhesives on the recommended products do NOT adhere to these materials.

NOTE

Never allow film or overlaminate to touch the rubber window molding.

3M™ Graphic Considerations for Windows

Do NOT apply any graphic film to these substrates:

- When the film in any way restricts the safe operation of emergency window exits
- When an operator's view is obstructed by the film
- Windows with windshield wipers
- Where local laws prohibit its use
- Windows that crank or roll down, have rubber moldings, or have window gaskets

Application Temperature and Environment

Best Application Temperature

Apply the graphics when the air and railcar surface are both above 61°F (16°C). See your film's product bulletins for more specific installation temperatures.

Cool Application Conditions

When film is applied below the recommended minimum application temperature:

- It will cool too quickly, and will not maintain the needed temperatures for uniform stretching.
- The initial adhesive bond may be insufficient to ensure the film remains adhered after application.
- Moisture may condense on the railcar surface at temperatures below the local dew point.
- In very humid conditions, it may be difficult to keep the substrate dry.

Very Warm Application Conditions

When the film is applied above the recommended maximum application temperature:

- Graphics may pre-adhere and trap air.
- The adhesive will be more aggressive.
- Controltac™-brand films may lose their positionability feature.
- The film may stretch.

Post-Application Conditions

To develop the best film bond, keep the surface temperature above 61°F (16°C) for at least 12 hours after application before exposing the railcar to either a cold or wet climate. Subjecting the film to conditions outside of its specifications can cause premature graphic failure.

General Application Techniques and Standard Operating Procedures

For rail-specific installation techniques, see the Standard Operating Procedures.

1. Use overlapping squeegee strokes to ensure all areas are applied. Firm, consistent pressure with an applicator tool must be applied over all parts of the graphic to bond the adhesive to the substrate. Missed areas leave bubbles in the applied film. These are areas where premature film failures may occur.
2. Strive for a bubble-free application. Although puncturing air bubbles improves the appearance of the graphic, it can contribute to premature graphic failure if the film is torn or cut rather than neatly punctured.
3. Carefully cut the film at all seams in railcar body panels, taking care to avoid scratching the paint. Seams on railcars flex as the railcar moves. If they are not cut, the graphics will pull away from the seam, resulting in premature failure.
4. Re-squeegee all edges and overlaps to ensure good adhesion before releasing the railcar for use.

Overlapping Film

Environmental conditions (wind, rain, and blowing debris) stress the overlapped edges of graphics. Use careful planning for both vertical and horizontal film overlaps to reduce stress and damage. Overlaps greater than 1/2 in. (12.7 mm) may contribute to edge lifting.

Vertical Film Overlaps

Vertical overlaps must face away from the front of the railcar. Apply the first piece of film at the rear of the railcar. Work to the front, overlapping each additional piece by 1/4 to 1/2 in. (6.4 to 12.7 mm). Repeat for the opposite side, again working from back to front.

Horizontal Film Overlaps

Apply the lower piece of film first. Work toward the top, overlapping each subsequent piece by 1.4 to 1/2 in. (6.4 to 12.7 mm).

NOTE

Horizontal seams are preferred for railcars that travel in both directions along the track.

Post-Heating

After the film has been applied, heat the graphic to reduce the internal stress in the vinyl film, especially in areas where the graphic has been stretched.

1. Heat the film temperature is at or near 200°F (93°C), moving the heat source slowly across the stretch film surface.
2. For best performance, press the stretched areas of the film with 3M™ Roller S while the material is still hot. This helps fully wet out the adhesive onto the substrate and reduces the risk of lifting after application.

Adhesion Promoters

Adhesion promoters increase the adhesion of the graphic film. It is considered an extra level of insurance to help prevent film lifting. Repositionability and removability will be lost in areas where adhesion promoters are used. 3M offers different adhesion promoters to build higher adhesion to the substrate.

3M™ Tape Primer 94

- Can be used to improve the overall adhesion of tape, film, and vinyl graphics to polyethylene, polypropylene, ABS, PET/PBT blends, concrete, wood, glass, metal, and painted metal surfaces
- May be applied with a brush, swab, pressurized flow gun, knurled roller, or similar equipment
- Can be removed with isopropyl alcohol (vigorous scrubbing may be required)

3M™ Adhesion Promoter 111

- Fast-acting
- Isopropyl alcohol-based solution designed to promote better and faster adhesion
- Works particularly well for adhesion to high surface energy substrates, such as bare metals and painted surfaces

3M™ VHB™ Tape Universal Primer UV

- Promotes adhesion to polypropylene, ABS, PET/PBT blends, and other difficult to stick to substrates
- Improved environmental, health, and safety profile compared to 3M™ Tape Primer 94
- UV indicator verifies primer application, reducing priming errors and increasing quality control
- Quick dry time speeds the process and increases throughput
- Can be applied with brush, swab, felt-tipped dauber bottle applicator, knurled roller, or similar equipment
- Can be removed with acetone

Edge Sealing

Edge sealing improves a graphic's resistance to environmental damage and enhances its durability. 3M recommends using one of these options on graphic edges:

- 3M™ Edge Sealer 3950 ("3950")
- 3M™ Edge Sealer 4150S
- 3M™ Edge Sealer ES2000 ("ES2000")
- 3M™ Edge Sealer Tape
- 3M™ Scotchcal™ Graphic Film Series 100-114

NOTE

Improper application may result in edge lifting. Apply the edge sealer consistently along the length of the exposed edge, and then allow the edge sealer to fully cure.

The edge sealer also increases the graphic's resistance to fluids at the film edges.

Other edge sealers may be used on a customer test-and-approve basis. Some customers have had success using a clear coat of the paint system used on the railcar. Problems attributed to such test-and-approved materials are NOT covered by any 3M warranty. Always follow the manufacturer's recommendations on usage.

3M recommends the following areas be edge-sealed:

- Leading edges of the graphic
- Edges where the graphic has been cut for doors, access panels, and similar items
- Any cut-out repair areas where new film overlaps the original graphic

NOTE

For high-speed applications, 3M requires the use of an edge sealer for all exposed edges.

Option 1: Application of Edge Sealers and 3M™ Edge Sealer Tape

See the Standard Operating Procedures for instructions on the application of edge sealers and 3M™ Edge Sealer Tape.

Option 2: Apply Oversized Piece of Overlaminate

This method is for use by experienced applicators and only on graphics that cover just part of a window or have irregular shapes.

1. Cut 3M™ Scotchcal™ Gloss Overlaminate 8518 so it is at least 1/4 in. (6.4 mm) larger than the graphic.
2. Apply the overlaminate so it overlaps all edges of the perforated film.
3. Contact 3M for more details, if needed.

General Edge Sealing Instructions

1. Clean the surface.
2. Apply 3M™ Knifeless™ Tape Tri Line 6 mm so that the middle filament follows the seam or butt joint. See Figure 1.
3. Clean the surface, including the tape surface, with IPA.
4. Apply masking tape so that it overlaps/exceeds the area to be sealed off.
5. Ensure the masking tape is firmly applied so the lines/ contours are clearly visible. See Figure 2.

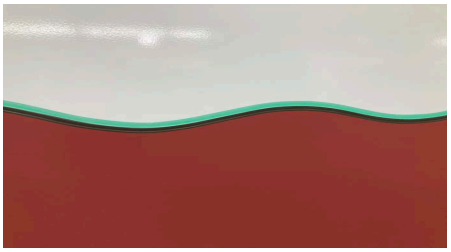


Figure 1. 3M™ Knifeless™ Tape Tri-Line Application

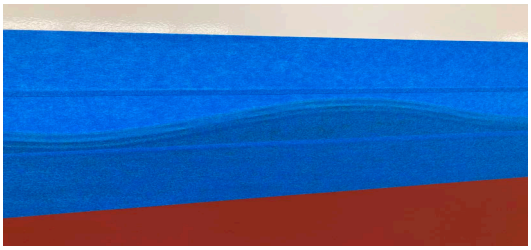


Figure 2. Masking Tape Applied Over 3M™ Knifeless™ Tape Tri-Line

6. Pull the two outer filaments to open the area. See Figure 3.
7. Remove the middle filament and all carrier tape.
8. Re-apply the masking tape firmly at all cut edges and ensure 100% surface contact.
9. Clean the sealing area and surface with IPA.
10. Apply the liquid with brush, felt dauber, or 3M™ Scotch-Weld™ EPX Applicator (for 3950 or ES2000 only). See Figure 4. Evenly distribute the edge sealer as needed.

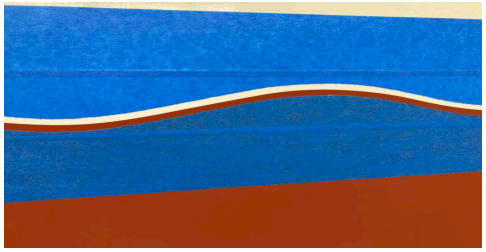


Figure 3. Cuts Made in Masking Tape

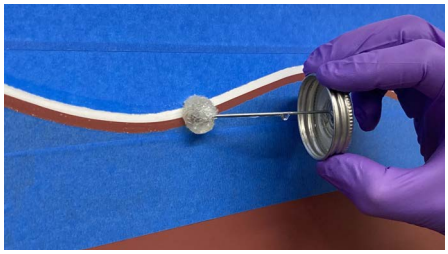


Figure 4. Applying Edge Sealer

11. Remove masking tape prior to the edge sealer fully curing.
12. Use heat to enhance the curing of the sealing liquid.



Figure 5. Cured Edge Sealer

Special Considerations for Window Applications

Application Tapes

Do NOT use an application tape (premasking or prespacing) on film that has been laminated with 3M™ Scotchcal™ Gloss Overlaminate 8518. The adhesive of the application tape can pull the overlaminate off the graphic.

Application Temperature

- Do NOT apply window graphics if the air or surface temperature is less than 39°F (4°C).
- Do NOT use a heat gun or torch to heat the window. Uneven heat could cause glass breakage.

Safety Guidelines for Applying Graphics on Emergency Exit Windows

Before starting the application, check that local regulations permit the application of graphics to exit windows, and identify any guidelines or requirements related to the installation of such graphics.

- Before applying film, open all emergency exit windows to determine exactly where graphics must be trimmed to ensure the graphics will not interfere with the operation of these windows.
- Always trim the products 1/4 in. (6.4 mm) away from all rubber gaskets. Do NOT apply film over rubber gaskets.
- Do NOT allow any graphic film, whether applied to windows or to the railcar body, to overlap the opening of an emergency window exit.
- Ensure all emergency window exits are fully functional after graphic installation is completed.

Sizing the Window

1. Measure the window opening and the graphic to ensure it fits on the window.
2. Apply the graphic.
3. Cut away a margin of 1/4 in. (6.4 mm) all around the graphic.
4. Do NOT apply any film to any rubber gaskets or rubber parts on the railcars. This minimizes the chance of the graphic lifting, or absorbing water that may collect in the window edge.
5. Do NOT allow any film to overlap the openings for any emergency window exits, as this can prevent the window from operating properly in an emergency.
6. Refer to 3M Instruction Bulletin Application: Signage for information regarding:
   - Graphic placement
   - Making film overlaps
   - Registering the graphic
   - Removing the adhesive's liner

Applying Perforated Window Graphic Film

NOTE

Understand what method of edge sealing will be used before starting to apply film. See the "Edge Sealing" section on page 7 for details.

1. Clean the entire glass surface before starting installation. Some glass has coatings that can prevent the graphic from adhering adequately. See 3M Instruction Bulletin Application: Substrate Selection and Preparation for details on cleaning and how to determine whether there is a coating.
2. Always use a dry application method. Refer to 3M Instruction Bulletin Application: General Installation Techniques.
3. Use a low-friction sleeve on the plastic applicator to prevent scratching.
4. During application:
   - Do NOT stretch the film into the window well or onto the window itself. This can cause tension, resulting in the graphic shrinking and its edges curling.
   - Cut the film to the approximate shape of the window before squeegeeing it. To do this:
     - Tack down the film in the center of the window.
     - Cut the graphic to shape.
     - Squeegee the cut film to the window.
   - Do NOT use a heat source directly on the window. This can cause the film to shrink and its edges to curl, and can cause the glass to break.
5. When the application is completed and all window film has been trimmed, re-squeegee all edges to ensure the best adhesion.

Painted Metal Surfaces Between Windows

If window graphic film is applied to narrow painted metal surfaces between windows, the image may not look consistent. To maintain a consistent image, an opaque 3M vinyl film may be applied to the surfaces between windows before the perforated film is applied. The best color of the vinyl film for such an application depends on the desired image.

Seaming Side-by-Side Panels

When two panels are designed to meet side by side on a window, carefully trim the images so the panels meet and form a butt seam. Do NOT overlap the panels. Always trim before starting the application. Do NOT cut the film while it is on the window as this may permanently scratch some window surfaces.

Special Considerations for Applications Over Existing Graphics

A finished graphic (either a single layer of film, or a fabricated multilayer construction) can be applied on top of one existing finished graphic, as long as the application meets the requirements below.

Warranty and removal specific warranty details and limitations for each film are in its Product Bulletin. If the requirements below are not met, no finished graphic warranty will be honored.

Requirements Condition of Bottom Graphic

The bottom graphic must be in good condition and well adhered to the substrate.

Size and Edge Gap

One of the following two statements must be true:

- The top graphic is larger than the bottom graphic, and it extends beyond the edge of the bottom graphic by at least 1/2 in. (12.7 mm) along the entire edge of the bottom graphic.
- The top graphic is smaller than the bottom graphic, and all its edges are at least 1/2 in. (12.7 mm) inside the edges of the bottom graphic.

Refer to 3M Instruction Bulletin Removal before removing part or all of an existing graphic.

Compatibility with Substrate Material

The bottom graphic must be recommended for application to the substrate.

If the top graphic is larger than the bottom graphic, the top graphic must also be recommended for application to the primary substrate.

Compatibility with Substrate Shape

The top and bottom graphics must both be recommended for application to the shape of the application surface (e.g., corrugated surfaces).

Removal

Removal of only the top finished graphic in this type of application is NOT warranted unless:

- The top finished graphic has an ultra removable adhesive, and
- The bottom finished graphic has a "Removable with Heat" adhesive, "Removable with Heat and/or Chemicals" adhesive, or a "Not Removable" adhesive

Cleaning Procedure

Exterior Applications

- Method 1: General Cleaning; followed by Method 2: Solvent Cleaning; AND then, followed by Method 3: Isopropyl Alcohol Cleaning.

Interior Signage

- Method 1: General Cleaning AND then, followed by Method 3: Isopropyl Alcohol Cleaning

Quality Inspection of Graphic Films for Railcar

Perform a quality inspection after completing the graphic installation. Use the Quality Inspection Guidelines for Exteriors as a reference.

Inspection Conditions for Graphic Films / Inspection Environment

Inspect the finished graphic on the production site or inspection station. The site or station and inspection methods should meet the following conditions:

Unaided Eye

The visual inspection must be conducted with the naked eye, with visual corrections if necessary. The use of a magnifying glass is NOT allowed. Clearly label any defects.

Luminosity

Inspections should be conducted with outdoor, cloudy, natural daylight or (if necessary) using an artificial light source providing similar conditions with 400 lux ± 20 measured at 6.56 ft (2 m) from the platform inspection spot.

Distance

Inspections should be conducted at a distance of 3.28 ft to 4.92 ft (1m to 1.5 m) from the finished graphic.

Walking Speed and Height

Inspections should be carried out at station platform height, walking along the aisle at a continuous pace of 3.3 ft (1 m) per second.

Allowed Measurement Equipment

Gloss and color should be specified before the final inspection with the use of a gloss meter and colorimeter.

Aesthetic Acceptance Criteria for Graphic Films - Exterior Surfaces Excluding Glass

Aesthetic acceptance criteria relevant to finished film-coated surfaces are listed in the Quality Inspection Guidelines for Exteriors. This content details the minimum acceptable criteria as defined by 3M Commercial Branding and Transportation Division. Other criteria may be integrated if some difference is required by the contract; these variations should be described in a separate document written for the project by the engineering department.

3M™ Graphic Films Installation Completion Certificate Requirements

The Graphic Films Installation Completion Certificate should be completed along with every graphic installation.

1. Complete the Pre-Installation Inspection Record.
   - Carefully and thoroughly examine each railcar and record all potential problem areas prior to installing the graphics. 3M recommends washing the railcar so that potential problem areas are easily seen.
2. Complete a Post-Installation Quality Inspection.
3. Make and distribute copies to all signing parties.
4. Maintain a file with the signed form and photographs.

Graphic Maintenance

Always refer to the film's product bulletin for information on its removability.

For complete details, read 3M Instruction Bulletin Maintenance which contains details on cleaning a variety of graphic constructions, cleaning adhesive residue from the substrate, and disposal of removed graphic material.

The following is a brief overview:

Cleaner Selection

Test cleaners on an inconspicuous area of a graphic before using. Some cleaners may dull the substrate or leave contaminants on it. Cleaners with low solvent content may not remove certain contaminants.

- **For Graphics with a Screen Print Clear or Overlaminate:** The cleaner must be free of strong aromatic solvents, chlorinated solvents, and ketones such as acetone and methyl ethyl ketone
- **For Digitally-Printed Graphics with a Clear Coat:** The cleaner must NOT contains ANY solvents or alcohol

Power Washing or Automatic Brush Washing

Power washing or washing with an automatic brush may be used with caution. Aggressive washing can damage the graphic, and perforated window graphic film is especially susceptible to damage. It can also loosen graphics, which may become a hazard.

Excessive pressure during power washing can damage the graphic by forcing water underneath the graphic. Water lessens the graphic's adhesion to the substrate, allowing the graphic to lift or curl. These problems are magnified by the wind. Do NOT pressure wash perforated window graphic films without edge sealing tape.

To avoid edge lifting or other damage to the graphics, follow these important steps:

- Use a spray nozzle with a 40 degree or wider spray pattern.
- Ensure the spray nozzle includes a nozzle protector (tip guard).
- Use a maximum pressure of 1,200 psi (82.7 bar).
- If the system is heated, limit the water temperature to 140°F (60°C) or less.
- Hold the nozzle at least 12 in. (30 cm) away from and perpendicular (90 degrees +/- 10) to the graphic or a minimum of 39 in. (1 m) away from the graphic at a 60° angle, or higher.
- Do NOT direct the water stream between 0° and 60° to the edge of the graphic.

  NOTE

  Loose graphics could tear away from a moving vehicle or a building and cause an obstruction to motorists and pedestrians.

- After washing, check all the graphics carefully for edge lifting, and repair, remove or replace damaged graphics.

  NOTE

  Before using a high pressure sprayer, read the manufacturer's instructions for details on safe operation.

Removing Tar, Oil, Diesel Smut, or Bituminous Material

1. Wipe the graphic with 3M™ Citrus Base Cleaner or a rag dampened with kerosene, mineral spirits, or heptane. Do NOT use other solvents.
2. Rinse thoroughly with clean water.
3. Dry the graphic.

Removing Graffiti

3M™ Graffiti Remover GR1500

NOTE

This product is ONLY designed for use on Scotchgard™ Graphic and Surface Protection Film Series 8993 and 8995, as well as 3M™ Anti-Graffiti Overlaminates 8588G and 8590M.

1. Apply masking tape surrounding the graffiti, in order to avoid drip-through to the rest of the graphic film.
2. Apply 3M™ Graffiti Remover GR1500 using a soft brush, rag, or sponge. Ensure that the entire graffiti surface is covered.
3. Allow the product to dwell on the surface for 3 to 5 minutes.
4. Thoroughly wipe the surface with a damp rag, damp sponge, or damp cloth.
5. Rinse thoroughly with water.
6. Dry the surface with a clean, dry rag or towel

3M™ Graffiti Remover System

NOTE

This product is designed for use ONLY on Scotchgard™ Graphic and Surface Protection Film Series 8993 and 8995.

1. Apply masking tape surrounding the graffiti to avoid drip-through to the rest of the graphic film.
2. Apply 3M™ Graffiti Remover System using a soft brush, rag, or sponge. Ensure that the entire graffiti surface is covered.
3. Allow the product to dwell on the surface for 5 to 10 minutes.
4. Thoroughly wipe the surface with a damp rag, sponge, or cloth.
5. Rinse thoroughly with water.
6. Dry the surface with a clean, dry rag or towel

Graphic Repair

It is impossible to restore a graphic to its original state once it has been exposed to outdoor weathering. Repair is possible if the user does not care about restoring the color and/or gloss. 3M recommends replacing entire components or the full wrap for vehicle wrap maintenance.

Visible differences are likely to occur even when graphic damage is repairable. Repaired graphics are NOT warranted. These procedures are for informational purposes only.

For graphic repair procedures see the Standard Operating Procedures and 3M Instruction Bulletin Maintenance.

Edge Damage

1. Trim loose edges back to the point where the adhesive is firmly adhered to the substrate.
2. Apply an edge sealing tape that matches the gloss level of the existing graphics. An edge sealer can also be used instead.

Removal

3M uses four removal categories to describe the removal characteristics of its adhesives for its Graphics Products: "Ultra Removable," "Removable with Heat," "Removable with Heat and/or Chemicals", and "Not Removable." These categories indicate how easy or difficult it is to remove the 3M Graphic Product from smooth, properly prepared, sound, flat substrates, and how much adhesive should remain on the substrate after removal. Any other substrate may give other results.

To comply with the 3M™ MCS™ Warranty, finished graphics made with "Ultra Removable" or "Removable with Heat" adhesives should be removed within the time period specified in the warranty matrices found on 3M.com/graphicswarranties. Finished graphics made with "Removable with Heat and/or Chemicals" adhesives can be removed with the aid of heat and/or chemicals and may leave more than 30% adhesive residue, however removal of finished graphics with these adhesives is NOT warranted. Results will vary when removing any graphic from non-flat, non-smooth surfaces. Finished graphics made with "Not Removable" adhesive are NOT designed to be removed. If they are removed, significant adhesive residue may remain.

Warranted removal for railcar applications as part of the 3M™ MCS™ Warranty depends upon: (A) substrates that were in good condition at the time of the application, (B) use of 3M's recommended removal methods, and (C) notification to 3M no later than five business days after the attempted removal so that 3M may assist in or verify the removal method.

Read 3M Instruction Bulletin Removal before starting to remove a rail graphic.

Glass Breakage

3M is NOT responsible for glass breakage due to the application or removal of film, or damage caused to a substrate due to incorrect removal techniques.

Unaided Film Removal

Unaided film removal does not require any aids such as heat, chemicals, or mechanical processes. See page 4 of 3M Instruction Bulletin Removal for details.

Heat-aided Film Removal

Heating eases removal of almost any film, even films that can typically be removed without aids. Heat softens the adhesive, reducing the force needed to remove film. "Removable with Heat" films usually come off with just the aid of heat within the time period specified in the film's product bulletin. See page 5 of 3M Instruction Bulletin Removal for details.

Chemically-aided Film Removal

Chemical aids may be needed for removing 3M Graphic Products categorized as "Removable with Heat and/or Chemicals" if they cannot be removed using the Heat-aided Film Removal procedure. This method may also be necessary for removing finished graphics which have been exposed to excessive environmental conditions or which have remained on the substrate longer than intended.

See pages 6 and 7 of 3M Instruction Bulletin Removal for details.

Not all chemicals are available in every country. Check with local suppliers to determine a product's availability.

There are several chemical film removal methods available, some of which require special precautions to use in a safe, environmentally-responsible manner. The user must obtain, read, and follow the safety data sheet for any chemical used.

Some chemicals may damage the substrate or its finish. Always test the chemical in a small, inconspicuous area.

NOTE

3M is NOT liable for damage caused to the substrate from chemical-aided removal.

Mechanically-aided Film Removal

Mechanical removal techniques may result in substrate damage. Tools such as scrapers, abrasive wheels, and particle blasting devices are difficult to control in a way that removes only the graphic. Always test such techniques in an inconspicuous area prior to removing an entire finished graphic. See pages 7 and 8 of 3M Instruction Bulletin Removal for details.

Removing Adhesive Residue from the Substrate

Refer to pages 8 and 9 3M Instruction Bulletin Removal for details on removing adhesive residue from a substrate surface following removal of a graphic.

3M Related Literature

In addition to other 3M bulletins specified in this document, the following bulletins provide details users may need to successfully apply a graphic.

- 3M Instruction Bulletin Application: General Installation Techniques
- 3M Instruction Bulletin Application: Substrate Selection and Preparation
- 3M Instruction Bulletin Maintenance
- 3M Instruction Bulletin Removal
- 3M Instruction Bulletin Application: 3M™ Knifeless™ Tape
- Standard Operating Procedures
- Quality Inspection Guidelines for Exteriors
- Graphic Films Installation Completion Certificate
- Pre-installation Inspection Record
- Post-Installation Quality Inspection

Health and Safety

Tools and Equipment Usage

When using any equipment, always follow the manufacturer's instructions for safe operation.

Chemicals

When handling any chemical products, read the manufacturers' container labels and the safety data sheets (SDS) for important health, safety, and environmental information.

Follow this link to obtain SDS sheets for 3M products.

Follow this link to obtain information about substances of very high concern (SVHC) for EU products.

Air Quality Regulations

Country, state, or regional volatile organic compound (VOC) regulations may prohibit the use of certain chemicals with VOCs in graphic arts coatings and printing operations. Check with local environmental authorities to determine whether use of this product may be restricted or prohibited.

⚠ **CAUTION**

Ergonomics

Any activity performed for a long period of time in an awkward position or with a high amount of force is potentially a risk for causing musculoskeletal strain, pain or injury. When applying or removing graphics, follow these practices to improve comfort and avoid injury:

- Alternate your tasks during the application.
- Schedule regular breaks.
- Perform stretches or do exercises to improve circulation.
- Avoid awkward reaching.

Warranty Information

Technical Information

Technical information, guidance, and other statements provided by 3M are based upon records, tests, or experience that 3M believes to be reliable, but the accuracy, completeness, and representative nature of such information is not guaranteed. Such information is intended for people with knowledge and technical skills sufficient to assess and apply their own informed judgment to the information. No license to any intellectual property rights is granted or implied with respect to this technical information.

Product Selection and Use

Many factors beyond 3M's control and uniquely within user's knowledge and control can affect the use and performance of a 3M product in a particular application. Customer is solely responsible for evaluating the product and determining whether it is appropriate and suitable for customer's application, including conducting a workplace hazard assessment, reviewing all applicable regulations and standards, and reviewing the product label and use instructions. Failure to properly evaluate, select, and use a 3M product in accordance with instructions or to meet all applicable safety regulations may result in injury, sickness, death, and/or harm to property.

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