Overview

This bulletin provides basic procedures for removing films manufactured or sold by 3M's Commercial Branding and Transportation Division from substrates. Users should also refer to the product bulletin for each product in their graphic construction for specific details that may affect the information in this instruction bulletin.

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Removal Factors

The ease with which a graphic can be removed depends on a variety of factors, covered below. Any one of these factors can significantly affect the speed and ease of removal. Different combinations of factors cause different results. For example, if one of two identical graphics is exposed to more UV light than the other over the same period of time, the graphic exposed to more UV light may be more difficult to remove. It is important to understand and assess each of these factors before estimating the time, labor, and related costs for removal.

Finished Graphic Construction

Graphic Film

Material properties and manufacturing differences affect the elongation and tear characteristics of a film. Cast films are typically thinner than Calendared films.

Inks

The type and amount of ink used affects the elongation and tear characteristics of printed film. UV-cured inks tend to stretch less, and can cause finished graphics to tear more easily during removal.

Graphic Protection

Thicker finished graphics are easier to remove since they will not break or tear under most conditions.

Adding an overlaminate or clear coat further affects a finished graphic's elongation and tear characteristics. Finished graphic constructions with overlaminates are thicker and may be easier to remove than a clear coated finished graphic.

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Adhesive

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. Whether a 3M Graphic Product is removable is largely, but not exclusively, a function of the adhesive. Adhesive removal and residue is only warrantable for approved 3M Graphics Products as defined under the 3M™ MCS™ Warranty.

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.

Table A. 3M™ MCS™ Warranty Adhesive Removal and Residue Table

This table describes the adhesive removal categories for 3M Graphics Products, including expectations of adhesive residue left on approved substrates, ease of removal, and methods for removing products from these categories. Only those products which are covered under the 3M™ MCS™ Warranty have warranted adhesive removal expectations. Refer to the product bulletins or the 3M Graphic Materials Product Catalog for specific details on a product's adhesive type. If the amount of adhesive residue that remains is higher than the percent indicated, a claim can be filed. 3M does NOT warrant the ease or speed of removal of any graphic film. See the 3M Graphics Warranties Bulletin for additional details.

Removal Category for 3M Graphic Film(s)	Ultra Removable	Removable with Heat	Removable with Heat and/or Chemicals	Not Removable
Removability*	Best (5)	Better (4/3)	Good (2)	Difficult (1)
Adhesive Removal and Residue Warranty**	Within the applicable Warranty Period, the 3M Graphic Film can be removed without any aids such as heat or chemicals with less than **5% adhesive residue** remaining on an approved substrate specified in the 3M Product and Instruction Bulletins.	Within the applicable Warranty Period, the 3M Graphic Film can be removed with heat leaving less than **10% adhesive residue** remaining on an approved substrate specified in the 3M Product and Instruction Bulletins.	**NO WARRANTY FOR ADHESIVE RESIDUE.** Films can be removed with the aid of heat and/or chemicals and may leave more than **30% adhesive residue**.	**NO WARRANTY FOR ADHESIVE RESIDUE.** Films are not designed to be removed. If they are removed, significant adhesive residue may remain.
Ultimate Adhesion Strength	Low	Medium	Medium/High	High
Primary Method of Removal	Unaided Removal	Heat	Heat and Chemicals	Heat and Chemicals
Secondary Method(s) of Removal	Heat	Heat and Chemicals	Chemicals or Mechanical	Mechanical
Primary Removal Angles	High	High	Low	Low

*3M does NOT warrant the ease or speed of removal of any graphic film. This information is provided as a guide for typical ease of removal. Removal is based on many contributing factors described in this bulletin. 5 denotes the best removal while 1 denotes difficult removal.

**3M warrants, under the 3M™ MCS™ Warranty, the expectations of adhesive residue left on a substrate. If the amount of adhesive residue that remains is higher than the percent indicated, a claim can be filed. See the 3M Graphics Warranties Bulletin for additional details

Substrate

Type of Substrate

- Removal of graphic films can be affected by the material composition and surface roughness. These characteristics dictate the substrates surface energy and therefore influence the finished graphic's adhesion. Graphics applied to low surface energy substrates (i.e. plastics) can easier to remove than graphics applied to high surface energy substrates (i.e. glass or bare metal).
- Substrates can be made up of multiple layers or coatings. The adhesive is applied to the outermost layer. If the integrity of the substrate is weaker than the adhesion to the outer layer, this can cause damage to that substrate.
- Surface roughness may lead to film tears, slowing down the removal process.

Condition of the Substrate at Application

Removing graphics from substrates that were in poor condition at the time of application may damage the substrate. 3M recommends installers discuss any concerns with their customers if they suspect removal will cause damage.

- Slightly oxidized (not chalked), painted substrates actually develop a much higher adhesion than newly painted substrates. Such substrates have a texture similar to anodized, bare aluminum, promoting higher adhesion. Graphic removal from such substrates may require more effort and is NOT covered by the fleet applications removal warranty.
- However *highly* oxidized substrates (such as chalked paint) have poor adhesion and graphics may remove more easily.
- Painted substrates must be dried and cured per the paint manufacturer's recommendations. Graphics applied to freshly painted substrates before the paint cures sufficiently are difficult to remove. Such applications are NOT covered by the application's removal warranty. Substrate damage may also occur.
- Surfaces with pre-existing damage, surfaces exhibiting oxidation or chalking, a repaired surface, surfaces with aged paint or metals, holes in the surface, body damage on vehicles, and unstable, uncured, improperly cured, or bonded, or unsound paint or surface finishes are not considered suitable substrates; and ii) substrates that demonstrate outgassing, or plasticizer migration are not considered suitable substrates.

> **NOTE**
>
> Adhesion failure due to the selection of improper substrates is NOT warranted.

> **NOTE**
>
> 3M does NOT warrant against damage to the substrate or to clear coats, paint, or other coatings on the substrate arising during installation, maintenance or removal of the Finished Graphic. Damage includes, but is not limited to, substrate or coating removal, ink bleed-through, fading, and staining.

Film Condition

A graphic's long term exposure to environmental conditions such as high temperatures, UV light (sunlight), and humidity affect removal. Prolonged exposure can make the film brittle—changing its tensile strength—and can increase the graphic's adhesion to the substrate. Such film may tear and break easily, making removal more difficult.

Damaged film (i.e. film with existing cuts or impact spots from rock chips) tears more easily, and tends to pull off in smaller pieces rather than large ones. This makes removal more difficult.

Ambient Temperature During Removal

The ambient temperature during removal can affect a finished graphic's ease of removability. Finished graphics can become brittle in cooler temperatures causing it to break into small pieces during removal. For the best results, remove finished graphics when the temperature is above 64.4°F (10°C). Generally, the higher the temperature, the better the results. Applying additional heat can aid in removal. See for more details.

Removal Angle and Speed

The speed and angle at which a graphic is removed may affect the amount of adhesive residue that remains on the substrate.

- "Ultra Removable" and "Removable with Heat" films usually require a high removal angle, such as pulling the film back onto itself, such as for 3M™ Controltac™ Graphic Films. A low removal angle is recommended for 3M™ Scotchcal™ Perforated Window Graphic Films and "Removable with Heat and/or Chemicals" 3M™ Scotchlite™ Reflective Films and Sheetings. Experiment with the angle until the best removal results are achieved. See Figure 1.

Figure 1. High Removal Angle   **Figure 2.** Low Removal Angle

- Generally speaking, removing the graphic slowly supports the film's integrity, resulting in less graphic tearing and less adhesive residue remaining on the substrate.

Removal Methods

The following are 3M's recommended removal methods. The factors described above can affect removal performance which may lead to users utilizing more than one of the methods described below. If the characteristics and history of the graphic are unknown, try the simplest removal techniques first, and proceed to more advanced techniques if the simpler methods are insufficient for removing a given graphic. The techniques are listed in order from easiest to most difficult.

> **NOTE**
>
> The applicator/remover must determine the appropriate tools, techniques, and safety precautions for each situation.

> **NOTE**
>
> 3M does NOT warrant against damage to the substrate or to clear coats, paint, or other coatings on the substrate arising during removal of the Finished Graphic. Damage includes, but is not limited to, substrate or coating removal, ink bleed-through, fading, and staining.

> **NOTE**
>
> Always follow the manufacturer's instructions on proper use to ensure safe use and to avoid damaging the substrate.

> **NOTE**
>
> Working in smaller sections can make film removal easier regardless of the removal method used. This can be done by cutting the graphic into 12 in. to 15 in. (30 cm to 38 cm) wide sections, or focusing your removal process on specific areas. Be careful to avoid damaging the substrate.

Unaided Film Removal

Unaided film removal does not require any aids such as heat, chemicals, or mechanical processes. Finished Graphics produced with 3M Graphic Products using an adhesive categorized as "Ultra Removable" can be removed without any aids using this process within its warranty period.

1. Lift a corner of the graphic with a razor, knife, or air release tool.
2. Pull the graphic off the substrate. See the for recommended product removal angles.

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.

1. Heat the applied graphic uniformly to 160°F to 200°F (72°C to 93°C) with an appropriate heat source such as heat lamps, industrial heat guns, steamers, hand torches, or weed burners. Exposure to the sun may be sufficient in certain situations.

   NOTE

   UV inks and UV clear coats can become brittle when heat is applied which can affect removal speed.

   NOTE

   Some substrates are heat sensitive. Composites bonded together with foam or adhesive may separate when heat is applied. Before using heat, ensure the heat will not damage the substrate. For example, DuPont® Lucite® SAR and GE Plastics Lexan® MRG windows should not be heated higher than 100°F (38°C).

2. Use a razor, knife, or air release tool to lift up a corner of the graphic.
3. Pull the graphic off the substrate. See the "Removal Angle and Speed" section on page 3 for recommended product removal angles.

⚠ **WARNING**

 Do NOT use the heat aided film removal method for graphics applied to glass as this can cause the glass to break, which may cause personal injury or property damage. See the "Detergent/Water Solution for Films on Glass Surfaces" section on page 8 for appropriate removal techniques.

NOTE

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.

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. Chemically-aided Film Removal is a more aggressive removal method. 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.

Not all chemicals are available in every area or region. 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.

3M™ Woodgrain and Stripe Remover System Part No. 08907 and 08908

This remover system is intended for general use removal and removal of decals.

> **NOTE**
>
> The 3M™ Woodgrain and Stripe Remover System may not be as effective on graphics printed with UV inks.

1. Follow the manufacturer's safe handling instructions, including wearing appropriate personal protective equipment such as rubber gloves and safety goggles.
2. Mask around the graphic. This helps protect the substrate from damage.
3. Make a drip tray using doubled over masking tape adhered immediately below the graphic. See Figure 2. This prevents residue from dripping around the graphic.
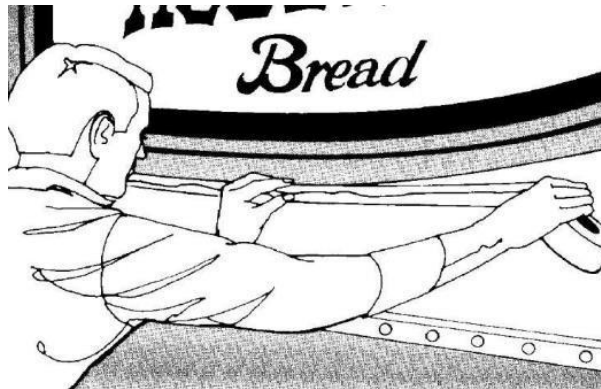

Figure 3. Creating a Drip Tray

4. Lightly spray the graphic with the remover.
5. Cover the graphic with an absorbent material such as paper towels.
6. Spray the remover onto the paper towels until they are thoroughly wetted.
7. Cover the saturated paper towels with polyethylene sheeting to reduce evaporation of the remover, especially if the substrate's environment is warm or windy.
8. Allow the saturated paper towels to remain in place for 3 to 4 minutes.
9. Carefully remove the paper towels. Most of the graphic will be removed with the paper towels.
10. Spray the remover on the adhesive residue.
11. Allow the remover to work for 3 to 5 minutes.
12. Scrape off the residue with a plastic scraper, cleaning the tool regularly with paper towels.
13. Repeat Steps 10 to 12 as needed.
14. Remove the masking tape.
15. Rinse the substrate thoroughly with clean water.
16. Dry the substrate.

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CitriStrip® Varnish Remover

This method is intended for removing 3M™ Envision™ Wrap Film LX480mC. Ink, laminate, and substrate selection may alter the effectiveness of this removal method.

1. Follow the manufacturer's safe handling instructions, including wearing appropriate personal protective equipment such as gloves and eye protection.
2. Clean the graphic surface with a mild detergent and water.
3. Dry the graphic surface thoroughly.
4. Mask around areas or remove vehicle parts to help protect the substrate from damage. This reduces the exposure of unprotected areas (headlights, chrome, plastic components, etc.) to the CitriStrip®.
5. Make a drip tray using doubled over masking tape adhered directly below the graphic. See Figure 2. This prevents residue from dripping around the graphic.
6. Working in small sections, thoroughly apply CitriStrip® to the entire graphic using a 3/8 in. (9.5 mm) nap paint roller. Areas not coated with CitriStrip® may be difficult to remove. Use a paint brush to apply the CitriStrip® to difficult to reach areas.
7. Wait 30 to 50 minutes (longer in cooler temperatures) to allow the CitriStrip® to penetrate the film. It will become chalky and the film will start to swell.
8. Test the graphic's removability by grasping a corner and pulling it from the surface at a low angle — less than 90 degrees. The film should come off with low to moderate force. If the film removes easily, proceed to remove the entire graphic.
9. If the film is still too brittle, apply a second coat of CitriStrip®, let it dry, and repeat the removal test. If it is still difficult to remove, a plastic applicator tool or rivet brush may be needed to remove the film.
10. Apply CitriStrip® or other citrus based adhesive removers to any remaining adhesive residue.
    See the "Removing Adhesive Residue from the Substrate" section on page 8 for details.
11. Allow the adhesive remover to penetrate the adhesive for 30 to 60 seconds.
12. Remove the adhesive with a plastic applicator or rivet brush. Wipe any remaining residue with a cloth saturated with adhesive remover and repeat this procedure as needed.
13. Remove the drip tray and masking tape.
14. Clean the entire surface with a solvent wipe.
15. Clean the entire surface with a mild detergent and water.
16. Dry the surface.

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.

Not all tools are available in every area or region. Check with local suppliers to determine a product's availability.

Abrasive wheel graphic removal works best to remove stripes, small letters or graphics, or the outside edges of large graphics. The following tools may not be suitable for large finished graphic removal.

3M™ Stripe Off Wheel

The 3M™ Stripe Off Wheel has a solid 5/8 in. (1.6 cm) thick wheel. It is designed to be used with common 3/8 in. (0.95 cm) pneumatic and electric tools with a 500 to 4,000 RPM range. The optimum performance is 2,000 +/- 200 RPM. See the 3M™ Stripe Off Wheel Operating Procedures for detailed usage instructions.

- 3M™ Stripe Off Wheel, 07498, 4 in x 5/8 in, with Mandrel, 5 ea/Case
- 3M™ Stripe Off Wheel, 07499, 4 in x 5/8 in, 5 ea/Case

Scotch-Brite™ Large Area Stripe Removal ("LASR") Disc

The LASR Disc has stacked, solid wafer construction, 8 in. by 5/8 in. (20.3 cm by 1.6 cm). This disc may be used with a variety of tools, including a die grinder or cordless drill. Do NOT exceed 3,000 RPM with this disc. It has a larger contact area than the 3M™ Stripe Off Wheel, so removal may take less time.

- Scotch-Brite™ Large Area Stripe Removal Disc, 7000120847

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Abrasive Wheel Usage Instructions

1. Use a portable 3/8 in. (0.95 cm) pneumatic or electric tool within the disc's RPM range.
2. Properly tighten holder in collect or chuck of tool.
3. Line up wheel and mandrel threads. Spin the wheel with low force until it contacts the mandrel flange. The wheel will self-tighten to adequate grip during use. Do NOT over tighten.
4. With tool running, lightly press the outer edge of the wheel to the finished graphic.
5. Move tool counter to the rotation direction of the wheel.
6. Using first horizontal and then vertical movements can help improve removal.
7. Residue from the Stripe Off Wheel removal can be removed with a clean, non-scratching, dry cloth and solvent such as 3M™ General Purpose Adhesive Cleaner (#08984) or isopropyl alcohol.

> **NOTE**
> 3M™ Stripe Off Wheels are NOT recommended for use on thermoplastic paints (acrylic or nitrocellulose lacquers) or thermoplastic parts.

Detergent/Water Solution for Films on Glass Surfaces

This method is intended for vinyl products like glass decorative films that have been on glass surfaces and are difficult to remove.

> **NOTE**
> Do NOT use heat sources or chemicals to remove film from glass.

1. Mix at least 2 tsp. of baby shampoo or detergent (i.e. Johnson's® Baby Shampoo or Joy® Dishwashing Liquid) with 1 qt (0.95 liter) of water in a spray container.
2. Wet the entire film surface with the detergent/water solution, ensuring there is enough solution to penetrate the film surface.
3. Cover the film surface with plastic sheeting (i.e. bubble wrap or cling wrap or a PET liner), achieving maximum contact between the sheeting and the film surface. This allows the detergent/water to penetrate into the adhesive, rather than drying out on the film.
4. Wait for a minimum of 2 hours and a maximum of 4 hours.
5. Remove the plastic sheeting. Pull off the film at a low removal angle, starting from one edge.
6. Cutting the sheet into smaller sections with a stainless steel razor blade can make removal easier. Blades made from something besides stainless steel may damage the glass surface.
7. A stainless steel scraper blade can be used to remove any remaining film pieces from the window.
8. Clean up the area.

Removing Adhesive Residue from the Substrate

Some adhesive residue may be left on the substrate after a finished graphic is removed. Always read and follow the safety data sheets for the products used.

Products Used In Residue Removal

> **NOTE**
> Test the selected adhesive remover in an inconspicuous area to ensure it removes the residue without damaging the substrate.

- 3M™ Citrus Based Industrial Cleaner
- 3M™ Woodgrain and Stripe Adhesive Remover 08908
- 3M™ General Purpose Adhesive Cleaner 08984 (several sizes are available)
- Xylol (xylene)
- ZEP® Big Orange - Liquid (Citrus Solvent Degreaser)

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General Residue Removal Steps

These steps may vary depending on the product being used.

1. Apply the remover as directed and wait the prescribed time for the chemical to penetrate the adhesive.
2. Remove the softened adhesive by scraping it with a plastic applicator or rivet brush.
3. Pick up the loosened adhesive with a cloth saturated with the adhesive remover.
4. Repeat Steps 4 through 6 as needed.

3M Related Literature

Read the most current 3M product and instruction bulletins before starting any job.

The information in 3M product and instruction bulletins is subject to change. Current bulletins are available at 3M.com/graphics. The techniques described in these bulletins are required when applying a 3M warranted graphic, but are also practical recommendations when using promotional materials for non-warranted graphics. Additional bulletins may be needed as indicated in the 3M Related Literature sections of the product bulletins of all 3M components used.

- 3M Graphics Warranties Bulletin

Health and Safety

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.

Tools and Equipment Usage

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

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.

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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