

3M™ Wind Protection Tape 2.0

Application Instructions

W8750, W8780

3M™ Wind Protection Tape 2.0 can be used to help protect wind turbine blade surfaces from damage caused by minor impacts and erosion due to rain, sand, dirt, or other debris. It is made from an exceptionally tough, abrasion-resistant polyurethane elastomer that resists puncture, tearing, and erosion. This highly durable material has also been designed to be resistant to UV light.

3M™ Wind Protection Tape 2.0 Basics

When & where can I apply 3M Wind Protection Tape 2.0?

- 3M Wind Protection Tape 2.0 should be applied to the outer 1/3 to 1/2 section of the blade.
- 3M Wind Protection Tape can be applied between 10°C and 30°C, depending on prevailing conditions during the application.
- 3M Wind Protection Tape can be applied at the OEM facility or in an O&M situation, either on the ground or up-tower.
- Paints, coatings and fillers must be fully cured per manufacturer instructions before applying 3M Wind Protection Tape 2.0.
- Blades can be put into service after sufficient adhesion has developed. Depending on temperature and application process, this is usually 1-12 hours after tape application.

What can I apply 3M Wind Protection Tape 2.0 to?

- 3M Wind Protection Tape adheres well to two-part epoxy and urethane paints, epoxy primers and bare composites.
- Colored or opaque 3M wind protection tape can be applied directly to 3M™ Wind Epoxy Filler W3120 – eliminating a coating step and saving time while providing additional leading edge protection.
- 3M Wind Protection Tape 2.0 may be difficult to adhere to some low surface energy surfaces. Please contact a 3M Wind Application Engineer if there are questions regarding specific substrates.

What else do I need to know?

- The use of gloves is recommended during the application procedure. Respirators and safety glasses should be used for grinding during surface preparation.
- Damaging of 3M Wind Protection Tape 2.0 or blade surface with sharp tools should be avoided.
- New and sharp blades should be used to cut 3M Wind Application Tape 2.0. The tape should be cut in a

continuous and steady movement in order to obtain a clean and unimpaired cut edge.

- 3M™ Wind Protection Tape 2.0 is more conformable than conventional wind tapes (lower modulus). This helps to comply the tape with curved regions on the wind blade surfaces.
- 3M™ Wind Protection Tape 2.0 should be applied with the least amount of tension possible to get a flat lamination. Due to its lower modulus and soft behavior only little force is needed for lamination and squeeze-out of application fluid.

Recommended Application Supplies

Name
3M™ Vinyl Tape 471
Isopropyl Alcohol (IPA) 100%
IPA 25%/Deminerlized Water 75% Mix
3M™ Wetordry™ Rubber Squeegees, 107mm x 70mm
3M™ Wind Tape Adhesion Promoter W9910 (liquid), 1pt / 7 x 7 wipe
3M™ Wind Protection Tape Edge Sealer W2600, 50 cc
3M™ Scotch-Weld™ EPX™ Plus II Applicator, 50 cc
3M™ High Performance Cleaning Cloth
3M™ Tack Cloth
3M™ Scotch-Brite™ 7447
3M™ Protective Tape Application Solution
3M™ Wind Tape and Residue Remover W9900
3M™ Professional Panel Wipes
3M™ Random Orbital Sander
3M™ Clean Sanding Discs 236U P320

Establish Application Process

The following descriptions of surface preparation and tape application are intended as examples. The chosen process will depend on details of the specific customer manufacturing process or field conditions (during O&M applications).

The goal for surface preparation and application is to obtain a laminate which is free of air bubbles and water pockets. Also final adhesion should meet specifications. A good indication that maximum adhesion has been reached, is when the adhesive layer itself splits when the tape is removed (cohesive failure).

A proper surface preparation and application ensures sufficient time to reposition the tape after wet application (usually 2-5 minutes). The adhesion of the tape to the blade surface will then increase with time until the final value is obtained. Depending on the needs of the entire blade manufacturing process this may vary. For example,

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

Note: Outgassing from polyurethane fillers or coatings can cause bubbles under wind tape. Please see 3M.com/wind for additional information on 3M Wind Fillers.

Note: For the use of W9910 Adhesion promoter, W9900 Wind Tape and Residue Remover, isopropyl alcohol, cleaning solvents, and mixtures of isopropyl alcohol with water, please consult air quality regulations.

Refer to the Safety Data Sheet (SDS) for precautions and handling.

a subsequent step in the manufacturing process may require a faster adhesion build-up.

There are two levers for adjusting the time to reposition and adhesion build-up of 3M™ Wind Protection Tape 2.0:

1. Surface roughness of the blade (defined by sanding grit)
2. Use of an adhesion promoter

As a rule of thumb a rougher surface increases the time available to reposition the tape and delays adhesion build-up. The use of an adhesion promoter reduces the time to reposition the tape and accelerates adhesion build-up.

It is therefore highly recommended to perform some pre-tests with small pieces of tape on the blade in order to define a process which is compatible with the entire blade manufacturing process.

The preparation of the surface with grit 320 abrasive paper and the use of W9910 adhesion promoter (diluted with isopropyl alcohol: 20% W9910 / 80% isopropyl alcohol) has shown good results in many cases.

Surface Preparation

The surface on which 3M™ Wind Protection Tape 2.0 is to be applied can significantly influence tape performance. It must be fully cured and exhibit a smooth (e.g. 320 grit) and clean (no dust, debris or grease) condition. Furthermore, the surface should not show residual paint marks nor streaks like “orange peel” nor a large number of craters/pinholes.

1. Confirm that there is no damage to the leading edge of the wind blade. If damage is present, determine degree of damage and repair using the appropriate tools and products. If damage is minor and fiberglass reinforcement is not needed, 3M Wind Fillers may be an appropriate repair solution. Please see 3M.com/wind for information on 3M Wind Fillers.
2. Smooth the surface of the leading edge using 320 grit abrasive on a random orbital or dual action sander or by hand sanding. Be careful not to grind through the coating, especially on the leading edge.
3. Define the area where 3M Wind Protection Tape 2.0 is to be applied. You may use 3M™ Vinyl Tape 471 to mark the area.
4. Remove sanding debris using a 3M™ Tack Cloth, followed by isopropyl alcohol dipped 3M™ High Performance Cleaning Cloth (or a clean, lint-free cloth).



Use of 3M™ Wind Tape Adhesion Promoter W9910

For surfaces exhibiting low surface energy, more severe weather conditions during application, or need for fast adhesion build-up it is recommended to apply Wind Tape Adhesion Promoter W9910 to an appropriate part of the application area. It can be also used for challenging areas around the edges and the tip.

3M Wind Tape Adhesion Promoter W9910 is a physically drying polymer solution. It can be diluted with isopropyl alcohol. On a sanded surface (e.g. sanded with 320 grit sandpaper) the speed of adhesion build-up

can be controlled by the dilution. For fast adhesion build-up in critical areas (e.g. in curved regions of the blade) it can be used in its non-diluted form. However, in areas which require repositioning of tape for a few minutes it is recommended to use W9910 in a diluted form (e.g. 20wt.% W9910, 80wt.% isopropyl alcohol).

In general, 3M Wind Tape Adhesion Promoter W9910 is therefore recommended in the following situations:

- To increase tape adhesion on the outermost edge of the application, especially in curved areas where the tape edges have “tented”.
- To promote 3M Wind Protection Tape 2.0 adhesion to low surface energy coatings.

Application Instructions

1. Complete the surface preparation as previously described.
2. Apply a thin, uniform coating of 3M Wind Tape Adhesion Promoter W9910 to the surface using 3M™ High Performance Cleaning Cloth or a clean, lint-free cloth wetted with 3M Wind Tape Adhesion Promoter W9910 or its diluted form.
3. Allow adhesion promoter to dry for at least 5 min. and not more than 30 min. before applying 3M Wind Protection Tape 2.0. Avoid contamination of the surface by dirt or dust before tape application.

Note: Coating should be thin – applying excess promoter will not improve adhesion.

Caution: Using 3M Wind Tape Adhesion Promoter W9910 will make 3M Wind Protection Tape 2.0 removal more difficult. Do not apply 3M Wind Tape Adhesion Promoter W9910 to the adhesive side of the tape.

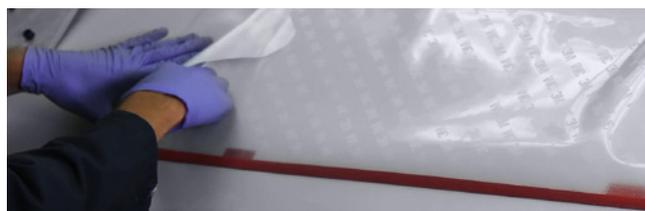
Tape Application

Wear protective gloves. Any dirt or oil from the skin will compromise the wind protection tape adhesion. Four-person teams have shown to be most suitable for an efficient application process when the blade is in horizontal position inside the shop floor (e.g. OEM site).

Recommended application method for long, straight sections of the wind blade

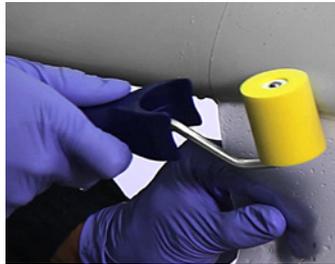
This method allows to apply the tape in consecutive steps by removing the liner and attaching the tape in approximate 1 meter sections along the leading edge.

1. Measure and cut a piece of 3M™ Wind Protection Tape 2.0 to the length required or work from the supply roll. Use scissors to round the tape corners.
2. Remove the liner from the first section of tape to be applied.
3. Wet the surface of the blade and the adhesive side of the tape with the application solution (25wt.% isopropyl alcohol, 75wt.% demineralized water).



- Align the 3M Wind Protection Tape to marked application area.
- Lay the 3M Wind Protection Tape 2.0 in position. Use a soft rubber roller and squeeze out application solution and air starting on the very leading edge for this section.

- Wet outer tape surface with application solution, squeeze out application solution and air with a rubber squeegee chord-wise upwards and downwards from leading edge towards tape edge. Movement of the rubber squeegee should always be in a pulling manner rather than pushing.



- Dry tape edges with cloth to prevent application solution ingress at tape edge. If there are water pockets or air bubbles, gently lift the tape for this area and lay it down again (it may be useful to re-apply some application solution). Squeeze out the liquid again. Dry tape edges and tape surface with cloth and inspect tape for water or air pockets.

- Repeat steps 2-7 for next section.

Alternative application method for long, straight sections of the wind blade

This method allows to align and fix the entire length of tape needed for a blade. The liner will then be removed in sections of about 1 meter length and the tape will be applied accordingly.

- Fix the required length of tape on one side to the blade by a strip of 3M Vinyl Tape 471. This creates a hinge by which the tape can be folded upwards.
- Fold the tape back along the hinge and remove the liner for a section of about 1 meter (starting from the root section).
- Wet the surface of the blade and the adhesive side of the tape with the application solution (25wt.% isopropyl alcohol, 75wt.% demineralized water). Always care for sufficient wetting of the adhesive surface in areas which are not yet ready to be bonded.
- Use a soft rubber roller and squeeze out application solution and air on the very leading edge for this section.
- Wet outer tape surface with application solution, squeeze out application solution and air with a rubber squeegee chord-wise upwards and downwards from leading edge towards tape edge. Movement of rubber squeegee should always be in a pulling manner rather than pushing.



- Dry tape edges with cloth to prevent application solution ingress at tape edge. If there are water pockets or air bubbles, gently lift the tape for this area and lay it down again (it may be useful to re-apply some application solution). Squeeze out the liquid again. Dry tape edges and tape surface with cloth and inspect tape for water or air pockets.

- Repeat steps 2-6 for next section.

Recommended application method for curved and contoured blade sections such as the tip

On curved or contoured blade sections, it may be useful to narrow down the width of the tape in order to avoid wrinkling by excess material or to reduce stresses.

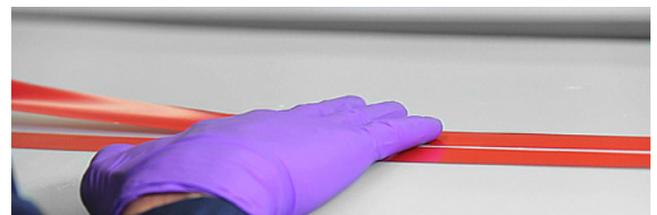
- Use scissors to “neck down” a short section of the long piece of tape for installation near the blade tip. The transition from the wide section to the narrow section should be a gradual curve as shown here.



- Depending on the required adhesion apply 3M Wind Tape Adhesion Promoter W9910 in its undiluted or diluted form to the blade surface.
- After liner removal apply the application solution (25% isopropyl alcohol, 75% demineralized water) onto the blade and the adhesive side of the tape.
- Hold the 3M Wind Protection Tape at one end. Wrap the tape around the contoured section while applying the center of the tape to the leading edge of the blade.
- After applying the application solution to the outer tape surface, use squeegee to remove air and application solution as described in the long straight sections.
- Extra material may “tent” along the edges of the 3M Wind Protection Tape, especially around curves. If this occurs, excess material in “tents” can be trimmed and the edges pressed into place. 3M Wind Tape Adhesion Promoter W9910 can also be used to tack down the edges if needed.

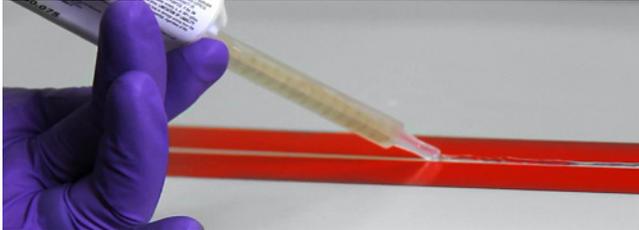
Edge Sealing

Application of 3M™ Wind Protection Tape Edge Sealer W2600 is recommended to smooth and protect the tape edge. Wear gloves when applying edge sealer. Surface and edges should be dry to touch and free from any excess application solution before applying edge sealer.



- For best appearance, mask the area to be sealed by placing a strip of 3M™ Vinyl Tape 471 across the top of 3M™ Wind Protection Tape 1/32 in. (1 mm) back from the edge. Apply a second strip of 3M Vinyl Tape 471 to the wind blade surface, 1/8 in. (3 mm) from the edge of the 3M Wind Protection Tape.

2. Insert cartridge into applicator gun and remove cap. Equalize the cartridge by releasing a small amount of product until both parts A and B dispense equally. Attach the nozzle. Dispense a small amount of material and discard.
3. Apply 3M Wind Protection Tape Edge Sealer W2600 to the surface between the strips of 3M Vinyl Tape 471. Properly applied 3M Wind Protection Tape Edge Sealer W2600 should be transparent with minimal air entrapment.



4. Using a body filler spreader, spread and smooth the sealant bead between the strips of 3M Vinyl Tape 471.
5. Remove the 3M Vinyl Tape 471 within 5 – 10 minutes.

Tape Splicing

A splice free application will give optimum protection. It is recommended that the customer validate the performance of their splice joints. An overlap splice is generally more durable than a butt splice.

Please contact your 3M Application Engineer for more information.

Removal Procedure

3M Wind Protection Tape 2.0 may need to be removed due to inappropriate application or damage during transport or in service.

Replacement Just After Application

Once the tape has been applied to the surface of a blade, the adhesive will rapidly develop adhesion. In case there are bubbles, dirt particles or wrinkles which cannot be removed, it is advisable to quickly remove the entire tape. Clean the surface with the application solution or IPA and re-apply new tape. In the case of adhesive residue, this must be removed by mechanical means or substrate compatible solvent. It is then necessary to apply the adhesion promoter again if used originally.

Removal After Adhesion Build-up

There may be occasions when major quality issues become visible a few hours after tape application (next day quality inspections). If this requires a removal of the entire tape there will be adhesive residue on the blade. For a removal of the adhesive residue it is recommended to use a sanding process or apply isopropyl alcohol or any other substrate compatible solvent and use a plastic scraper to remove the swollen adhesive after sufficient dwell time.

Again, adhesion promoters need to be re-applied afterwards.

This method can be always used if tape needs to be removed (either in the plant or in the field).

1. Lift at the tape edge and peel back at a 90° to 180° angle.
2. Adhesive residue left on the surface may be removed by applying isopropyl alcohol or any other substrate compatible solvent* to the surface. Allow some time for swelling and scrape off the adhesive with a plastic scraper and cleaning cloth.
3. If needed, gentle use of a Scotch-Brite™ General Purpose Hand Pad 7447 will help to remove stubborn adhesive residues.

Wallpaper Steamer

1. Direct a jet of low pressure steam from a wallpaper steamer at the tape or sealer peel point.
2. Use a phenolic scraper or plastic squeegee as a removal aid.
3. Remaining adhesive residue can be removed using acetone, isopropyl alcohol, or another substrate compatible solvent.

3M™ Wind Tape and Residue Remover W9900

3M Wind Tape and Residue Remover W9900 is a highly viscous paste which allows to reduce the adhesion of the tape to the blade for easier removal. This is done by substances migrating through the film and swelling the adhesive. In contrary to solvents* like isopropyl alcohol the paste does not easily evaporate and allows a longer lasting treatment. However, the ingredients may interact with the underlying coatings or blade materials. It is therefore recommended to check any possible interaction and use minimum dwell time.

1. Apply an approximate 3 mm thick layer of 3M W9900 to the tape surface.
2. Cover the 3M W9900 layer with some plastic food wrap or aluminum foil to prevent evaporation and cross contamination.
3. Allow to dwell until easy removal of tape is possible, approximately 4 hours.
4. After this dwell period, the tape can be pulled from the blade.
5. Adhesive residue left on the surface may be removed by another application of 3M Wind Protection Tape 2.0 and Residue Remover W9900, a substrate compatible solvent, or mechanically. Allow some time for swelling and scrape off the adhesive with a plastic scraper and cleaning cloth.

3M™ Wind Protection Tape Edge Sealer W2600 Removal

Removal of 3M Wind Protection Tape Edge Sealer W2600 can be done physically by scraping or sanding using a sander. It can also be softened with a small wallpaper steamer and scraped off with a phenolic scraper or plastic squeegee.

For more information on our wind manufacturing product line, contact 3M Renewable Energy at 800-755-2654 or visit us at 3M.com/wind.

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