3M™ Wind Blade Protection Coating W4600 Technical Data Sheet and Application Guide

Product Description

3M™ Wind Blade Protection Coating W4600 is designed to help protect wind turbine blade leading edges from damage caused by sand and rain erosion and minor impact.

3M Wind Blade Protection Coating W4600 is a two-component polyurethane coating that provides excellent erosion protection in a single layer.

3M Wind Blade Protection Coating W4600 is intended for application in controlled OEM facilities. It is not recommended for use in O&M situations.

Typical Physical Properties

Material	Test Method	Typical Values
Recommended Applied Thickness	Dry Film	250-350 microns (0.010-0.014 inches)
Pot Life	DIN EN ISO 9514	See table
Viscosity Part A	Rheom. cone-plate C35/1°H, D=35 mm	4.1±0.6 Pas @ 10/s 4.0±0.6 Pas @ 100/s
Viscosity Part B	Rheom. cone-plate C35/1°H, D=35 mm	7.0±1.0 Pas @ 10/s 2.4±0.6 Pas @ 100/s
Density Part A	DIN EN ISO 2811	1.09 g/cm^3
Density Part B	DIN EN ISO 2811	1.38 g/cm^3
Gloss 20°/60°	ASTM D523	45/73
Glass Transition Temperature	DMTA, 2°C/min, 1Hz	-5°C

Performance	Test Method	Typical Values
Rain Erosion Resistance UDRI, U.S.A. Polytech, Denmark	ASTM G-73 Whirling Arm 135 m/s 123-151 m/s	 >10 hrs >9 hrs
Sand Erosion, Initial (Breakthrough in g/cm^2)	UDRI, 170-240 microns	>30 g/cm^3
Tensile Strength @ Break MPa, Initial	ASTM D882	37
Tensile Strength @ Break MPa, Aged	ASTM D882 QUV A, 1400 h	35
Elongation % @ Break Initial	ASTM D882	730
Elongation % @ Break Aged	ASTM D882 QUV A, 1400 h	760
Flexibility	ASTM D522 0.5 in diam cyl at RT 2.5 in diam cyl at -40°C	No cracks No blistering
Condensing H_2O Power Washer Test, Adhesion, Blistering	ASTM D4585	No Blistering
Pull-off Adhesion	ISO 4624	10-12 MPa
Adhesion (Tape) Cross-cut	ASTM D3359	5A
QUV A	ASTM G154 1400 h	Gloss (20/60):11/25, ΔE:0,5, no chalking, cross-cut 5A, Pull off Adhesion: 10-11, See Tensile Elongation
Surface Roughness	DIN EN ISO 4287	Ra=0,1 Rmax=1,5 Rz-1,0 Rt=2,1
Taber Abrasion (Loss in Grams)	ASTM D4060 CS17,1000 g wt CS10,1000 g wt	1000 cycles <30 mg Loss

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

Read and follow the precautions on label and MSDS before using product.

Typical Physical Properties (Continued)

Properties	W4600 Part A	W4600 Part B
Appearance	Clear and Colorless Liquid	Light Gray Liquid

W4600 is matched to RAL 7035 light gray.

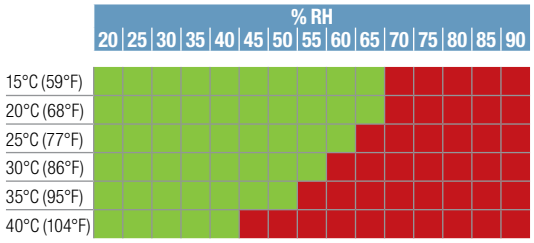
Application Information

3M Wind Blade Protection Coating provides excellent erosion protection in a single layer. Appropriate temperature and humidity conditions are critical to achieving full cure and maximizing erosion resistance.

Application Conditions

W4600 can be applied when the temperature and relative humidity of the facility are in the green zone.

Preliminary 3M Wind Blade Protection Coating W4600 Application Window



* Application window may be expanded with use of heating equipment in the application area. Contact 3M Technical Service to discuss options.

The W4600 product temperature should be >23°C at time of application.

The optimum temperature range for application is 20 – 25°C.

Coverage & Cure

Thickness: 300 +/- 50 microns **Coats:** One

If multiple coats are desired, contact your 3M Technical Service Engineer to discuss.

Theoretical Coverage Rate

	250 µ	300 µ	350 µ
Per Liter	4 m^2	3.3 m^2	2.4 m^2
Per 250 ml Cartridge	1 m^2	0.8 m^2	0.6 m^2

Mix Ratio

	W4600 Part A	W4600 Part B
Per Volume	150 parts	100 parts
Per Weight	100 parts	84.5 parts

Pot Life/Temperature

	15°C	23°C	40°C
Pot Life when mixed in container or hose (DIN EN ISO 9514)	TBD	90 sec	45 sec
Work life when applied directly to blade surface (DIN EN ISO 9514)	TBD	6 min	2.5 min

Cure Time/Temperature

At 50% RH	15°C	23°C	35°C
Touch Dry Time (DIN 53150) - No transfer of coating with a light touch	TBD	~50 min	~30 min
Hard Dry Time	TBD	~8 hrs	~4 hrs

Storage

Store in original sealed containers between 5°C (40°F) to 30°C (86°F).

At storage or transportation conditions below 23°C Part B may appear waxy due to crystallization of components. This is not a quality concern. Heating is necessary to fluidize the crystallized material.

Preparation

Product Prep

Place W4600 in a 40°C oven for a minimum of 8 hours (overnight) prior to use. Cartridges should be laid horizontal when placed in the oven.

Must not be exposed to temperatures above 40°C for longer durations. Make sure that the material will not be conditioned for less than 8 hours below 35°C.

Allow cartridges to cool to room temperature (~ 23°C) for 1 hour prior to use.

Area Prep

- **Check that temperature and humidity in the facility are within the acceptable range using the Application Window on page 1.**
- Place a dropsheet beneath the blade leading edge for ease of clean-up.

Surface Prep

- Use a 2 inch wide 3M masking tape to outline the leading edge area where W4600 will be applied.
- Abrade blade surface with 120 to 180 grit 3M abrasive.
- Wipe abraded surface with a tack rag to remove sanding debris.

Surface must be clean, dry and free from oil, grease and other contamination.

Application Tip:

Outline the “theoretical coverage area” for one cartridge with masking tape to help achieve the appropriate thickness. Note where each cartridge change should occur. Prepare all cartridges (equalize and attach nozzles) required for the leading edge and place them within easy reach of the blade.

Application

Confirm that temperature and relative humidity are in the acceptable range. Appropriate temperature and humidity conditions are critical to achieving full cure and maximizing erosion performance.

Load & Equalize the Cartridge

- Load the W4600 cartridge into the applicator and remove the cap.
- Dispense product and make sure it is coming out of both sides of the cartridge.
- Attach the nozzle to cartridge and secure retaining ring.
- Cut first 3–5 mm off nozzle to increase output (if desired).
- To ensure adequate mixing, “equalize” the cartridge by pointing it toward the ceiling and slowly dispensing coating into nozzle (to remove the air bubble).

Dispense & Spread the Coating

Work in teams of 2 people with 1 person dispensing and 1 person brushing.

- Dispense W4600 onto the leading edge surface.
- Distribute using 3M Brush and the following techniques:
  - Low angle
  - Smooth, consistent brush strokes
  - Brush motions parallel to the leading edge
- Use wet thickness gauge to confirm desired thickness.
- Remove masking tape as soon as application is complete to allow coating to flow to a tapered edge.
- Discard brush

3M Wind Blade Protection Coating Brush should be used to obtain a smooth W4600 finish and enable best performance. A new brush is recommended for each application.

Application Tip:

When applying beneath the leading edge (on a horizontal blade), a second “distribution brush” can be used to help dispense the coating onto the blade surface from below.

Finishing

Remove 3M masking tape as soon as possible to allow W4600 to flow to a tapered edge.

It may be possible to accelerate the cure with heat blankets or IR lights not to exceed 60°C.

Precautionary Information

Refer to Material Safety Data Sheet for health and safety information before using this product. For additional health and safety information, visit www.3M.com/msds.

Cleaning

- Discard brush once material has cured on it.
- All equipment must be cleaned immediately after use.
- Use a VOC-compliant cleaner.

Disposal

Dispose of 3M™ Wind Blade Protection Coating W4600 in accordance with local regulations. Cured material and uncontaminated accessories can be disposed of in a sanitary landfill.

Supplies

Supplies
3M™ W4600 Blade Protection Coating Part A & B, 250 mL Duopack Cartridge Part A, 18L Drum Part B, 18 L Drum
3M™ Wind Blade Protection Coating Brush
3M™ Wind Blade Protection Coating Manual Applicator – 250 mL – 1.5:1
3M™ Wind Blade Protection Coating Pneumatic Applicator – 250 mL – 1.5:1
3M™ Wind Blade Protection Coating Mixing Nozzle
3M™ Accessories: 3M™ Abrasives, 3M™ Random Orbital Sander, 3M™ Masking Tape

Other Supplies: Thickness gauge, dropcloth for floor, gloves, knife

Repair

For ease of repair, complete the repair as soon as possible after application.

Immediate – Before 3M W4600 is dry to touch:

- Remove as much W4600 as possible with a squeegee or spatula. Take care not to damage composite.
- Remove W4600 residue with a 3M™ Scotch-Brite™ pad and acetone, IPA or an alternative. Consult local air quality regulations for products used in removal process. Do not allow acetone or IPA to contact other areas of W4600.
- Assure the surface is smooth, clean and debris-free.
- Dispense W4600 directly onto the repair area and use a 3M brush to feather it into the surrounding area.
- Apply a second layer of W4600 (if necessary) to obtain the desired finish.

Intermediate – While finger can still make an impression / indentation on the 3M W4600 surface with pressure

- Cut through the W4600 around the repair area. Take care not to damage the blade surface.
- Using the cuts as a starting point, remove as much W4600 as possible with a squeegee or spatula. Take care not to damage composite.
- Remove W4600 residue with a 3M™ Scotch-Brite™ pad (on a random orbital sander, if needed) and acetone, IPA or an alternative. Consult local air quality regulations for products used in removal process. Do not allow acetone or IPA to contact other areas of W4600.
- Assure the surface is smooth, clean and debris-free.
- Dispense W4600 directly onto the repair area and use a 3M brush to feather into the surrounding area.
- Apply a second layer of W4600 (if necessary) to obtain desired finish.

After 8+ hours at 23C, 50% RH – Hard dry

Waiting until this stage to repair W4600 is not recommended because the coating is very difficult to remove.

- For minor repairs, the top portion of 3M W4600 can be removed using a 120 grit 3M™ 734U Clean Sanding Disc on a random orbital sander. To remove all 3M W4600 from the blade surface, use a 3M™ Scotch-Brite™ Roloc™ disc on a right angle grinder. Do not damage the composite surface below. Control tool speeds and heat generated so 3M W4600 does not “melt”.
- Assure the surface is smooth, clean and debris-free.
- Dispense W4600 directly onto the repair area and use a 3M brush to feather into the surrounding area.
- Apply a second layer of W4600 (if necessary) to obtain desired finish.

Shelf Life

These products have a shelf life of 12 months from date of manufacture when stored in the original, unopened container under the suggested storage conditions.

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

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