ReflecTech® Mirror Film

Simply Brilliant™

Frequently Asked Questions

Basic

1. What is ReflecTech® Mirror Film?

ReflecTech® Mirror Film is a highly reflective, glass-free, silvered polymer film for concentrating sunlight in solar energy arrays. It is commercially proven, ultra-lightweight, highly durable, and adhesive backed for easy application. Our newest product, ReflecTech®PLUS, has an Abrasion Resistant Coating (ARC).

2. What are the benefits of ReflecTech® Mirror Film?

ReflecTech® Mirror Film is:

- highly reflective (93% solar-weighted hemispherical reflectance and 94% specular reflectance, measured at 1.4° acceptance angle and 660nm);
- commercially proven, ultra-lightweight and durable in outdoor solar energy applications;
- constructed with unique properties, including a specialized coating, that make it ideal for solar concentrators;
- demonstrated to be stable under ultraviolet (UV) light, a key attribute for the severe outdoor environments of solar installations;
- resistant to moisture: demonstrates excellent mechanical stability in water immersion tests at the National Renewable Energy Laboratory, 60 days with no signs of delamination or tunneling;
- adhesive backed for easy application to aluminum; and
- will never shatter like glass reflectors, which can damage the system.

3. Who invented ReflecTech® Mirror Film?

ReflecTech® Mirror Film was developed by ReflecTech, Inc. in partnership with the National Renewable Energy Laboratory (NREL) in Golden, CO. The technology rights for all mirror applications are owned by ReflecTech, Inc.

4. What O&M costs are associated with ReflecTech® Mirror Film?

Periodic cleaning is the only notable O&M cost. Standard ReflecTech® can be cleaned by power washing with de-mineralized water and ReflecTech®PLUS can also be cleaned with soft/wet brushes.

5. Can ReflecTech® Mirror Film be used to generate heat or electricity directly?

ReflecTech® Mirror Film serves the same purpose as glass mirrors at reduced cost. It is used for concentrating sunlight to where you want it, whether that be a receiver filled with heat transfer fluid, as in Concentrating Solar Power (CSP) and solar thermal applications; or a photovoltaic cell, as in Concentrating Photovoltaic (CPV).

6. Is ReflecTech® Mirror Film covered by a warranty?

Yes, ReflecTech, Inc. provides a limited ten year warranty on reflectance for commercial quantities.

7. What is the recommended shelf life of ReflecTech® Mirror Film?

The recommended shelf life of ReflecTech® rolls is one year when stored in a clean, dry environment with an ambient temperature below 100°F (37°C).

Supply

8. How much does ReflecTech® Mirror Film cost?

For quote, please send request to info@ReflecTechSolar.com.

9. How is ReflecTech® Mirror Film distributed?

The film is only available directly from ReflecTech, Inc., headquartered in Arvada, Colorado, USA.

10. Can I order ReflecTech® Mirror Film in a larger width?

The largest width we currently manufacture is 60″. For wider applications, two pieces may be used side-by-side.

11. Is ReflecTech® Mirror Film available in large quantities?

ReflecTech, Inc. can produce large quantities of film to fill almost any order size. Supply agreements are available to provide product on a predetermined schedule.

Cleaning

12. How is ReflecTech® Mirror Film cleaned?

Use brushless pressure wash to clean standard ReflecTech®. Use only de-ionized or demineralized water, as untreated water causes spots. Never use solvents on ReflecTech® Mirror Film. For ReflecTech®PLUS, soft brushes may be used to clean the surface in conjunction with water.

Application

13. To what surfaces can ReflecTech® Mirror Film be applied?

ReflecTech® Mirror Film can be applied to any clean, smooth, non-porous surface that has a sufficient surface energy for the adhesive to bond and free of sulfur, chlorides or residues. Lamination should only be performed using a laminator with rubber rollers.

14. The application instructions call for use of a "tack cloth" on the substrate immediately before laminating. What is a "tack cloth"?

A tack cloth resembles a cheese cloth permeated with a tacky substance that adheres to particles and dust without leaving a residue behind and can be found in the paint supply section of your local department store.

15. What is the proper method for applying ReflecTech® Mirror Film to a substrate?

As described in the User's Guide (www.reflectechsolar.com/pdfs/UsersGuide(ReflecTech).pdf) roll lamination is the proper method for applying ReflecTech® Mirror Film. To avoid air bubbles, start with a clean, flat substrate with no scratches, pitting, etc. Any pitting or scratches will appear as bubbles or raised profile. Use pre-cleaned sheets or prepare the sheets with a solvent such as isopropyl alcohol to remove any residue. Use a tack cloth just before laminating. To avoid dust entrapment that appears as bubbles, lightly apply a tack cloth over the sheet before the sheet enters the nip of the roller. Any bubbles that form using this method are typically from pits or scratches in the substrate.

16. What are the lamination options for ReflecTech® Mirror Film?

a. Companies that make film laminators equipped with rubber rollers can supply equipment for laminating ReflecTech® Mirror Film. Companies that make production grade equipment include Black Brothers (www.blackbros.com) and Walco (www.walcomachine.com).

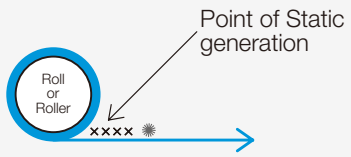
b. Another option is to visit sign lamination shops to determine what equipment is available locally. The use of outside services must be monitored to ensure a clean, dust-free substrate and clean rollers.

c. ReflecTech, Inc. provides lamination service onto aluminum sheets in widths up to 61″ and as thin as 0.025″.

17. How can static electricity buildup on ReflecTech® Mirror Film be avoided during lamination?

Static buildup on the film attracts airborne contaminants and can shock operators. It can be removed using anti-static tinsel:

Positioning Anti-Static Tinsel for Best Results



Attach tinsel 1/8″ to 1/4″ from static laden surface, and immediately after any points of contact or separation of material from rolls, rollers or guides. The tinsel should be attached to the grounded machine frame or similar electrical ground. The tinsel is used most effectively when it does not touch the product or material to be neutralized; however, when lower static charges are present, the anti-static tinsel may need to actually touch the surface to be neutralized.

18. After lamination, what is the best way to proceed with forming the reflector?

ReflecTech® Mirror Film should be laminated to a flat substrate which can then be formed or held in shape by the collector frame. To see how easily laminated sheets can bend to fit the shape of a frame, observe the last part of the video (www.ReflecTechSolar.com/video.html) that shows operators pulling a laminated sheet onto a pallet. ReflecTech recommends curving the laminated panel in only one axis.

19. If I drill through the mirror film and the substrate, how do I seal the holes to prevent oxidation of the silver?

Holes should not be drilled through ReflecTech® Mirror Film. Edge tape is required on all exposed film edges.

20. Is it necessary to use edge tape?

The use of edge tape is required to assure that the film is well protected at the borders, the area most susceptible to moisture or mechanical damage.

Performance / Durability

21. Do you have ReflecTech® Mirror Film installed in the field?

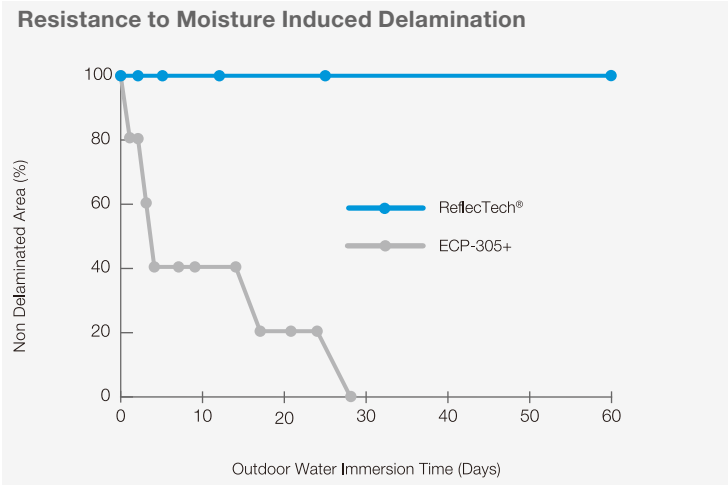
ReflecTech® Mirror Film has been installed by our customers in many commercial applications around the world.

22. How long does ReflecTech® Mirror Film last?

ReflecTech® Mirror Film was developed with the intent to meet the 20+ year lifetime of a typical solar energy system. Samples exposed to over 30 years' equivalent accelerated testing with concentrated UV show no significant loss in solar-weighted reflectance. Durability test information is illustrated in our brochure – www.ReflecTechSolar.com/pdfs/Brochure(ReflecTech).pdf.

23. How does ReflecTech® Mirror Film stand up to water and humidity?

ReflecTech® Mirror Film has proven to be resistant to humidity and water in laboratory and installed CSP environments. Results of testing by the National Renewable Energy Laboratory are shown in the chart.



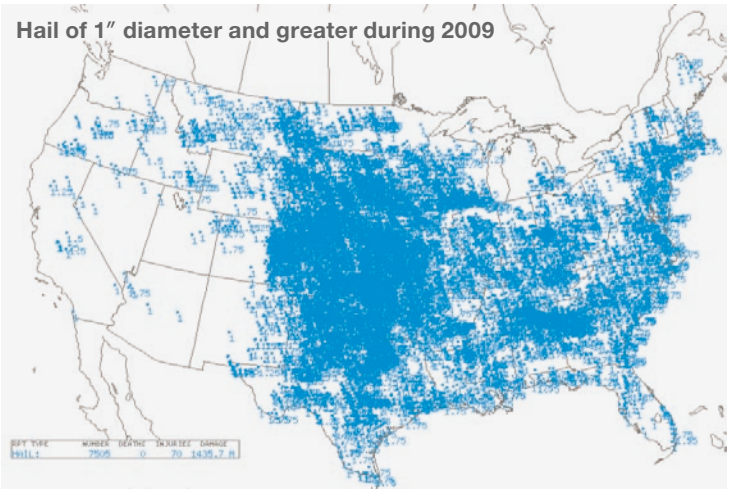
Samples of ReflecTech® film were immersed in water to test for delamination and tunneling. The 3M ECP-305+ (now discontinued) had significantly delaminated after only 4 days; no delamination occurred with ReflecTech® film after 60 days. The use of edge tape is required to seal and protect all borders of the laminated film.

24. How durable is ReflecTech® Mirror Film to blowing sand?

Even in extreme events such as sand/dust storms, particle size at the height of typical trough reflectors is too small to cause damage. During high-wind events, parabolic trough collectors are placed into the stow position, which puts the ReflecTech® film facing downward. Windborne particles have never abraded polymer reflectors in any operating parabolic trough system. For further details, please see the White Paper entitled "Scratching of Polymer Reflectors" at www.reflectechsolar.com/pdfs/ScratchingofPolymerReflectors.pdf.

25. How does ReflecTech® Mirror Film stand up to hail?

Hail testing with ice balls of 0.75″, 1.00″, 1.25″, and 1.5″ conducted by NREL shows that ReflecTech® film is robust to frontal impacts of hail up to 38 mm (1.5 inch) diameter launched at 76 mph. Impacts to the back of 0.050″ aluminum substrate caused small localized tension lines on the film with ice ball diameters at and above 32 mm (1.25″) launched at 72 mph. As shown in the figure below, hail of 1-inch diameter and larger is very rare in desert states where large CSP power plants are typically installed.



26. What kind of weather protection is needed to prolong the life of ReflecTech® Mirror Film outside?

ReflecTech® Mirror Film was developed to withstand sunlight (UV) and moisture in outdoor environments without added weather protection. The borders and seams of the laminated film must be protected with edge tape to ensure the life of the reflector.

27. What is the minimum operating temperature?

We have not established the minimum operating temperature; however, our film is used in outdoor applications in northern latitudes including Sweden with no performance issues, and has passed ASTM D6944–03 freeze/thaw testing to -40°C with no delamination.

28. What is the maximum operating temperature?

ReflecTech® film is designed to withstand the hottest outdoor ambient temperatures on earth. The maximum working temperature of the film is 60°C (140°F). The viability of ReflecTech® film for processes that require higher temperatures depends on multiple factors including ambient and substrate temperature, dwell time, etc. Please speak with a ReflecTech representative to determine if your application is suitable for the film.

29. Has the Film ever been tested above 60 °C?

ReflecTech® Mirror Film has been tested 60°C, a temperature slightly higher than the highest ambient temperature recorded on Earth. Because 93 % of incident radiation is reflected, a reflector made using ReflecTech® Mirror Film will show no appreciable temperature difference relative to the ambient temperature unless it is very close to or enclosed with a surface that absorbs solar energy.

30. Can the surface of ReflecTech® Mirror Film conduct a static charge without harm?

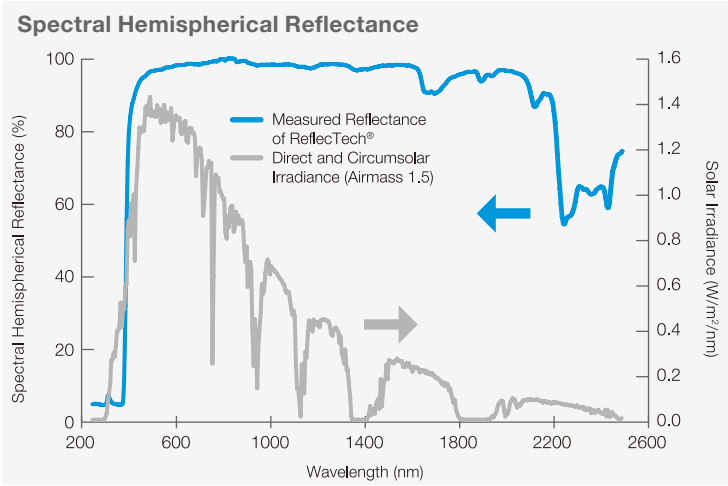
There have been no health or safety issues related to static charge of any installed ReflecTech® Mirror Film. During lamination of film, it is best practice to use a static bar or copper tinsel to dissipate any static charge buildup.

31. Does the surface of ReflecTech® Mirror Film stand up well to having salt water vapor deposited on it?

ReflecTech® film has been tested in Florida with no concerns or issues associated with salt air / spray with regular power spray cleanings.

32. Please explain "Solar-Weighted Hemispherical Reflectance" as shown on the website.

Solar-weighted hemispherical reflectance represents an average of hemispherical reflectance weighted by the strength of the solar radiation at each wavelength (see graph below). The reflectance values at wavelengths where the solar spectrum is highest are the most important. This is an appropriate indication of how well a reflective material performs in solar applications. The solar spectrum varies with location of measurement; this spectrum is measured at air mass 1.5, which represents 1.5 thicknesses of atmosphere. For further details, see "Solar-Weighted Hemispherical Reflectance", available for download at www.ReflecTechSolar.com/Downloads.html.



33. Is ReflecTech® Mirror Film appropriate for use in Power Tower (i.e. Central Receiver) applications?

The reflectance of our film is sufficiently specular for parabolic trough concentrator geometry – greater focal lengths require specific analysis or trial. We have a reference available for reflectance as a function of target size and focal length.

Comparisons

34. How does ReflecTech® Mirror Film compare to aluminum reflectors?

The total reflectance of aluminum is about 88 %, and the specular reflectance of aluminum is generally quite low – less than 85 % (compared to 94 % for ReflecTech®). In addition, ReflecTech® was designed for long term outdoor weatherability in harsh desert environments, and we have conducted extensive testing with the U.S. National Renewable Energy Lab to confirm the film's performance.

Test results are provided in our brochure, which can be downloaded at www.ReflecTechSolar.com/pdfs/Brochure(ReflecTech).pdf.

Aluminum foil is not known for maintaining reflectance after prolonged outdoor exposure.

35. How does ReflecTech® Mirror Film compare to polished stainless steel?

Although highly polished stainless steel can be reasonably specular, the solar-weighted hemispherical reflectance of polished stainless steel falls into the 60-65 % range, which is not practical for solar applications. Similar performance is observed for chrome and nickel.

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