



90/160 Light Control Film

SPF90/160/175PET

Technical Specification

Date: 3/10/13, Issue Number 1

Description

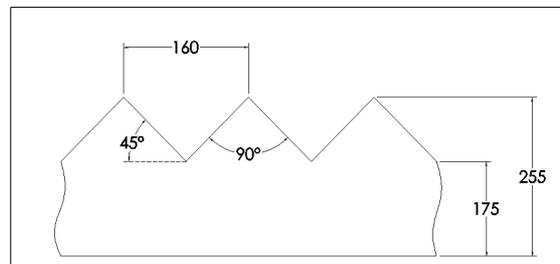
90/160 Light Control Film is a symmetrical prism structure with 90 degree top angle. The film is produced on the surface of a 175 micron PET base film using a UV casting process and an acrylic based, high refractive index lacquer.

Applications

The film exhibits unique properties in that it will either reflect or transmit light depending on the incident angle at which the light strikes the film. The film can be used to propagate light along a tube at high efficiency. By altering the angle at which the light hits the tube it is also possible to cause the light to exit the tube at any given point.

The film finds applications in light transmission devices (e.g. daylighting systems) and in lighting luminaire construction.

Structure



Parameter	Value	Tolerance	Remarks
Prism Height	80 microns	+/- 2 microns	
Prism Pitch	160 microns	+/- 1microns	
Top Angle	90 degrees	+/- 20 minutes arc	
Base film material	175 microns		PET
Total thickness	255microns	+/- 5 microns	
Refractive Index	1.58		Prismatic structure
Product format	On reel		Produced on reels (structure parallel to long edge)
Film width	<420mm		Can be slit to widths up to 420mm

Optical Properties

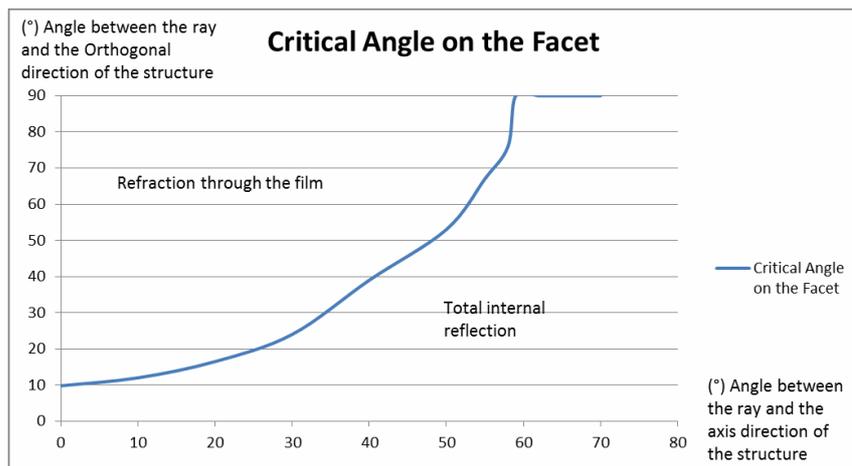
90/160 Light Control Film either reflects or transmits light depending on the incident angle at which light rays hit the film. The reflection is achieved via Total Internal Reflection (TIR) within the film. The losses associated with TIR are much lower than those seen with surface reflection. This enables the film to perform light reflection with much greater efficiency than mirror reflectors. Losses associated with a single reflection using TIR are theoretically zero. However some losses do occur as it is not possible to produce a perfect structure. These losses are normally less than 2% per interaction. In comparison a mirror reflector will cause losses in the range of 4% to 12% per reflection.

If the angle at which the light strikes the facets is modified to be more than the critical angle, the light will be refracted through the film and will exit at the bottom side. The light which is transmitted through the film is also turned through a significant degree to provide improved directional performance.

Light Reflection and Transmission Properties

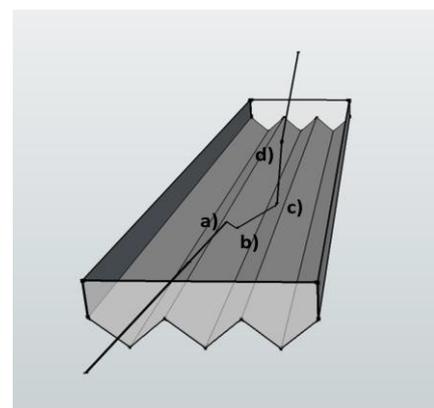
The figure opposite shows the relationship between the incident angle of the ray on the film and the critical angle on the facet.

- X axis is the angle between the ray and the axis of the structure.
- The Y axis is the angle between the ray and orthogonal direction of the structure.
- Any ray with an incident angle below the blue line will be reflected



The process of reflection is as follows:

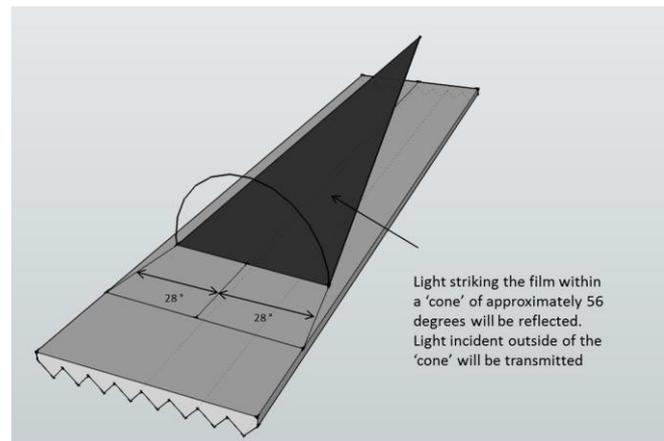
- Light enters the film and is refracted at the surface
- The ray strikes the first prism surface and is reflected
- The ray strikes the opposite prism surface and is reflected a second time
- The ray exits the film through the top surface



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The critical angle can also be approximately described as a cone.

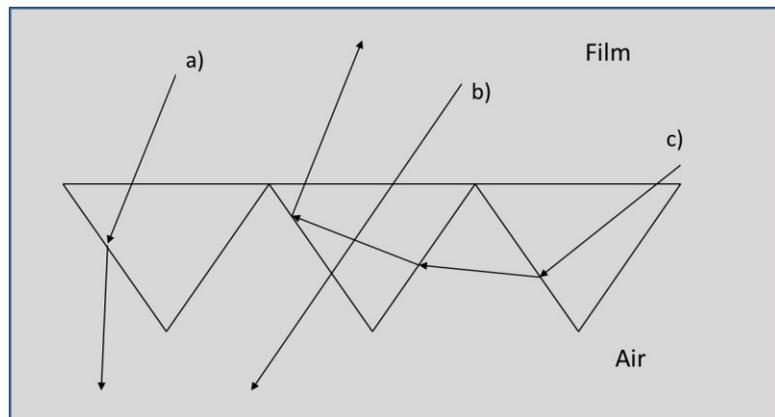
- a) Light rays from within the cone described opposite will be reflected.
- b) Light rays from outside this cone will be transmitted through the film.
- c) The angle of the cone is approximately 56 degrees.



Light Transmission Properties

The transmitting properties of the film are described as follows.

- a) Light incident at less than 45 degrees will be transmitted and refracted towards the vertical
- b) 45 degrees is the maximum angle at which light is transmitted. This ray passes straight through
- c) A ray with an angle greater than 45 degrees will be reflected

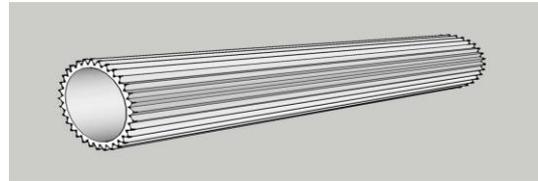


A FWHM angle of about 30 degrees can normally be achieved, but also depends of the light source and the reflector design.

Applications

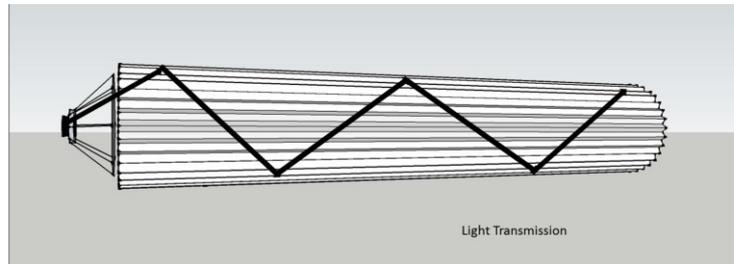
Light Transmission

Tubes constructed using this film will transmit light along the structure with high efficiency.



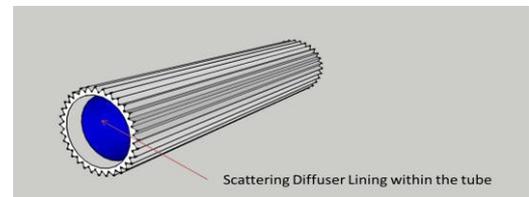
Note: Tubes need not be cylindrical. Can also be oval, square, rectangles etc.

- Light entering the tube will be transmitted along the length of the tube so long as the incident angle at which the light strikes any given facet is less than the critical angle.
- Losses at each reflection will be less than 2%.
- Consequently light can be transported over reasonable distances with relatively low losses.

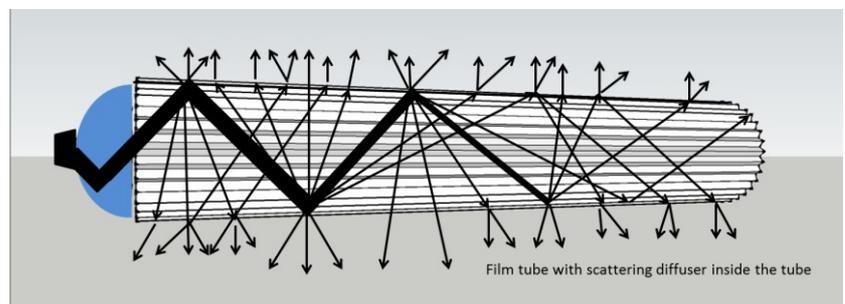


Light Emission.

If a layer of transmissive diffuser film is placed inside the prism film tube it is possible to facilitate a combination of transmission and extraction. By this method it is possible to produce a uniform light output along the length of the tube.



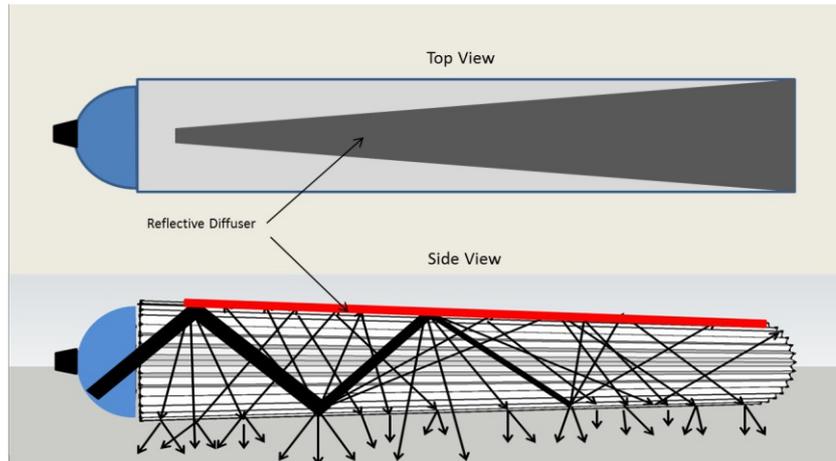
When passing through the diffuser the light is scattered to numerous angles before it interacts with the prism film. Consequently a proportion of the light will exceed the critical angle and pass through the prism film and exit the tube. The remaining light will continue along the tube.



On subsequent interactions with the diffuser / prism it will again either be reflected or transmitted. With careful control of the various variables it is possible to produce an even level of light emission along the length of the tube.

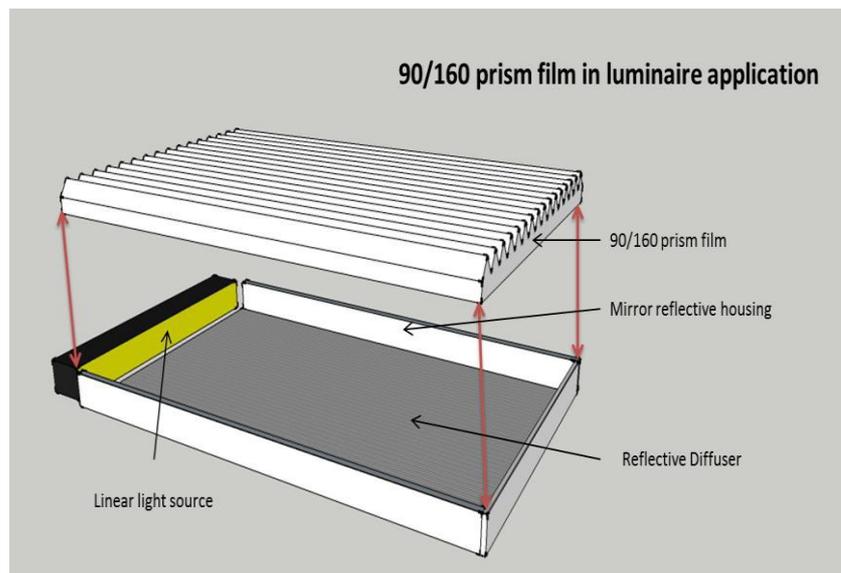
Directed Light Emission

If a reflective diffuser is placed inside the tube on only the top surface then this will prevent light being emitted on the top side whilst increasing output on the bottom side. By this method it is possible to produce a luminaire that provides down light only.



Rectangular luminaire design

A linear light source is emitted into a unit with highly reflective surfaces. The base of the unit is covered with a specifically designed reflective diffuser film to provide a uniform light distribution. The light reflected off the reflective diffuser then strikes the 90/160 film placed at the top surface of the unit. Light that strikes the film at less than the critical angle is emitted with a good level of forward direction. Light striking the prism film at greater than the critical angle will be reflected and recycled off the reflective surfaces until it strikes the prism film at angle less than the critical angle. At which point it will be emitted.



Handling

As with all precision optical films care should be taken when handling. Surgical gloves should be worn to avoid fingerprinting. Care should be taken to avoid scratching the film surface. Films should be handled in a clean, dust free environment with a liner used on surfaces to protect the structure. The film can be easily cut using a guillotine, sharp bladed knife or scissors.

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