

# Heat shielding film

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## 1. Introduction

Our company developed a heat shielding film made from ultrafine antimony tin oxide grain. It is marketed under the name of RAYBARRIER film.

As introduced below, RAYBARRIER film is applied on the windshield of automobiles and glass windows in homes and buildings. Because of the high transparency, heat insulation and durability, RAYBARRIER will make a significant contribution to the realization of pleasant space, energy saving, and safety.

## 2. Product Features

### 2.1 Transparency

The product's transparency is excellent with the visible light transmittance of 78% or higher. This is well in compliance with the Security Standards for Road Trucking Vehicles (first legislated on July 28, 1951) that requires visible light transmittance of at least 70% when a shielding film is used on the driver's or front passenger's window of the vehicles. This differentiates RAYBARRIER from the conventional colored film or metallized film.

### 2.2 Heat Shielding

RAYBARRIER has sunlight radiation transmittance of 66% and cuts more than 80% of the near-infrared rays. When put on the windshield or windows, it suppresses temperature rise in the car or home. This increases the cooling efficiency of the air conditioner, thereby contributing to energy saving.

### 2.3 Durability

The ultrafine metallic oxide grain content contributes to the high weatherability, durability and heat resistance of RAYBARRIER. Unlike the organic absorbents or pigments, RAYBARRIER maintains its heat shielding capacity nearly infinitely.

### 2.4 UV Screening Effect

RAYBARRIER has UV transmittance of only 0.4%, which means it cuts as much as 99.6% of the UV radiation. This protects the human skin from sunburns and suppresses the progress of fading of the furniture.

## 2.5 Flying Preventive Effect

When glass is broken due to an accident or earthquake, RAYBARRIER prevents the broken glass pieces from flying.

## 3. Performance

### 3.1 Optical Characteristics

Figure 1 shows the spectroscopic transmittance curves of RAYBARRIER and the PET film used to prevent broken glass from flying. Table 1 shows the optical data.

### 3.2 Coat Hardness

The heat shielding film also has high hard coatability. Table 2 shows wear resistance and the film hardness.

### 3.3 Heat Insulation

To determine the heat insulating performance of the film, we measured temperatures in a car with all windshields covered with RAYBARRIER other than the driver's window, and in a car without RAYBARRIER film. Table 3 shows the test results. The film reduced the temperature rise by 13.6°C (directly exposed to sunlight radiation) and by 5.5°C (shaded areas).

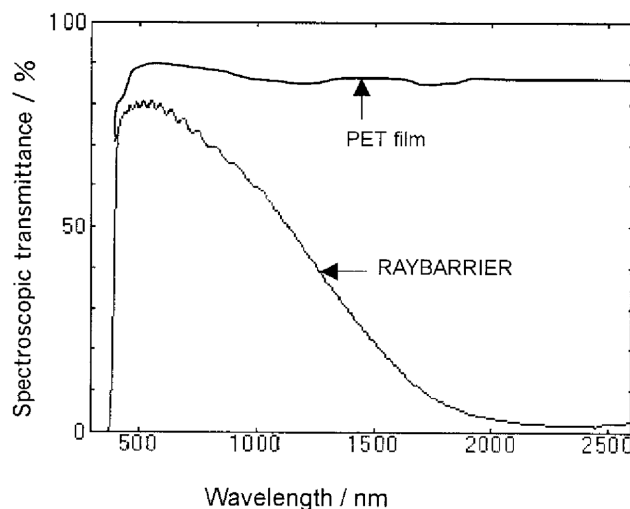


Fig. 1 Spectroscopic transmittance curves

## 4. Main Usage

RAYBARRIER can be used for the following and other applications:

- (a) Windows of automobiles, railway cars, ships, aircraft, etc.
- (b) Windows in stores, hotels, offices, houses, and other buildings

- (c) Clear portions of showcases, show windows, etc.
- (d) Packaging materials in general

RAYBARRIER film is available in various transmittance settings to meet the specific needs of the customer.

Table 1 Characteristics of RAYBARRIER film

Characteristics	RAYBARRIER FILM	RAYBARRIER FILM with 3mm glass plate	3mm glass plate
Visible radiation transmittance (%)	78.9	79.2	89.8
Sunlight radiation transmittance (%)	66.0	61.0	85.4
Sunlight radiation reflectance (%)	8.4	12.0	7.7
UV transmittance (%)	0.4	0.4	67.8
Screening factor (-)	0.8	0.8	1.0
Heat conductivity (kcal/m <sup>2</sup> h°C)	—	4.8	5.1

Table 2 Hardness of RAYBARRIER film

	Taber abrasion test ΔH(%)	Steelwool scratching test	Pencil hardness
RAYBARRIER FILM	4.9	○	2H
PET film	55.2	×	2B

### Taber abrasion test

Abrasion wheel : CS-10F  
 Load : 1000g  
 Abrasion cycle : 100 cycle  
 ΔH : haze difference of before and after test

### Steelwool scratching test

Steelwool : #0000  
 Load : 200g  
 Abrasion times : 200 back-and-forth  
 Evaluation :

- : not scratch
- △ : little scratch
- ×

### Pencil hardness

Load : 1000g

Table 3 Heat shielding effect of RAYBARRIER

(unit : °C)

	Without the film	With the film	Temperature decrease
In the sun	66.6	53.0	13.6
In the shade	50.1	44.6	5.5