



RAYNO CRYSTAL SHIELD  
PROTECTION FILM

*Crystal  
shield*

# Crystal Shield

## ENJOY MORE SAFE AND COMFORTABLE DRIVING WITH CRYSTAL SHIELD PROTECTION FILM!

Crystal Shield Protection Film is a highly functional window film specially manufactured based on RAYNO's outstanding Optical Design Technology and advanced Coating Technology. Unlike conventional window films, Crystal Shield is applied to the outside of the vehicle windshield to provide much more safe driving against the impact of various external road hazards such as stone chips, doubling up windshield's strength. In addition, it prevents the scattering of glass fragments when the windshield is damaged due to strong impact, thus minimizing the secondary damage of the passengers. RAYNO Crystal Shield Protection Film aims to lead industry's standards with advanced hydrophobic, anti-fouling and scratch-resistance performance.

### Special Features of Crystal Shield Protection Film

- Doubling up windshield's strength, Crystal Shield helps absorb shocks caused by flying objects such as gravel, debris, etc., to minimize damages to the glass.
- Prevent scattering in case of windshield damage caused by strong impact to prevent secondary damage
- Excellent durability of hard coating layer that provides strong anti-scratch performance against windshield wipers
- Excellent hydrophobic property provides optically-clear visibility to the driver in rain or snow
- Anti-fouling performance provides easy cleaning of various contamination on the film
- 99% UV rejection to protect driver and passenger's skin and interior protection

### Specifications

Properties	Unit	Value	Tolerance	Test Method
Total Thickness (without R/F)	µm	120	±3	Micrometer
Visible Light Transmittance	%	91.1	±3	ISO9050
UV Rejection	%	99 ↑	±1	ISO9050
Haze (without R/F)	%	0.60	±0.1	ISO14782
Delta Haze				
After Steel Wool Abrasion Test (#0000, 500g, 1000 times)	%	0.10	-	Linear Scratch Tester
Adhesive Peel Strength	gf/inch	500	±100	ASTM D3330
Contact Angle (°)	degree (°)	110	±3	ASTM D7334
Break Strength	N/10mm	139	±50	ASTM D882
Elongation at Break	%	110	±10	ASTM D882

# CRYSTAL SHIELD PROTECTION FILM

- Test methods**
- **ASTM D7334** : Standard Practice for Surface Wettability of Coatings, Substrates and Pigments by Advancing Contact Angle Measurement
  - **ASTM D882** : Test Methods for Tensile Properties of Thin Plastic Sheeting
  - **ASTM D3330** : Test Method for Peel Adhesion of Pressure-Sensitive Tape
  - **ISO9050** : Glass in Building: Determination of Light Transmittance, Solar Direct Transmittance, Total Solar Energy Transmittance, Ultraviolet Transmittance and Related Glazing Factors
  - **ISO14782** : Determination of Haze for Transparent Materials

## EVOLUTION OF WINDSHIELD PROTECTION FILM

Limitations on visibility, functionality and performance of existing windshield protection products are solved through RAYNO's **Advanced Resin Formulation Technology and Hard coating Technology** to bring the evolution of windshield film!

### Break strength test of RAYNO Crystal Shield Film products and competitors' products (Steel Ball Drop Test)

RAYNO Crystal Shield product comes in with M8-size (4.5g) nuts at approximately 70km/hr, providing excellent strength to withstand impact without damage.

Steel Ball Drop Tester	Steel Ball weight (g): 300	Bare Glass (3T tempered glass)	Company A (3T tempered glass + windshield installation)	Company B (3T tempered glass + windshield installation)	RAYNO (3T tempered glass + windshield installation)
	<b>Test 1</b> Height: 10cm, potential energy: 294mJ, 4.5g nut flying speed: 41.2km/hr	Not damaged	Not damaged	Not damaged	<b>Not damaged</b>
	<b>Test 2</b> Height: 15cm, potential energy: 441mJ, 4.5g nut flying speed: 50.4km/hr	<b>Damaged</b>	Not damaged	Not damaged	<b>Not damaged</b>
	<b>Test 3</b> Height: 20cm, potential energy: 588mJ, 4.5g nut flying speed: 58.2km/hr	-	<b>Damaged</b>	<b>Damaged</b>	<b>Not damaged</b>
	<b>Test 4</b> Height: 25cm, potential energy: 735mJ, 4.5g nut flying speed: 65.1km/hr	-	-	-	<b>Not damaged</b>
	<b>Test 5</b> Height: 30cm, potential energy: 882mJ, 4.5g nut flying speed: 71.3km/hr	-	-	-	<b>Damaged</b>

### Visibility comparison of RAYNO Crystal Shield Film product and competitors' products \*

RAYNO Crystal Shield product offer superior visibility compared to competitors with Haze 0.60% (ISO14782)

	Company A	Company B	Company C	Company D	Rayno Crystal Shield
Haze (%)(without R/F)	1.3	0.7	1.0	0.8	<b>0.6</b>

\* Testing performed in ISO14782, and the lower number of results means the more transparent the product has.

### Scratch resistance performance comparison of RAYNO Crystal Shield Film product and competitors' products.

	Company A	Company B	Company C	Company D	Rayno Crystal Shield
Delta Haze (%) After steel wool test*	0.2	0.1	0.2	0.1	<b>0.1</b>

\*\*Test Method: Delta Haze Measurement after Linear Scratch Tester (rubbing 1,000 times of Steel wool #0000, 1kgf/cm<sup>2</sup>)

Crystal Shield film provides superior durability and hydrophobic function by improving scratch resistance and anti-fouling performance of the Hard Coating Layer constituting the surface. It provides excellent visibility to driver in case of rainy weather as usual, and provides ease of cleaning in case of various surface contaminations.

### Hydrophobic(Contact angle) performance comparison of RAYNO Crystal Shield Film product and competitors' products

	Company A	Company B	Company C	Company D	Rayno
Initial					
	90.4°	90.4°	90.4°	105.9°	<b>110.0°</b>

ISO 15989:2004 Plastics -- Film and sheeting -- Measurement of water-contact angle of corona-treated films

### Precautions on using Crystal Shield Protection Film

Crystal Shield provides protection for vehicle's windshield and prevents glass scattering in the event of damage. Please note that the amount of impact on windshield depends on driving speed of the car, the size and type of the object impacted, also the location of the impact. When its impact is strong enough, the windshield may be damaged even with Crystal Shield installed. Crystal Shield's protection function can be affected by installation quality, therefore, please ensure its installation is conducted by Rayno's authorized dealer following installation guidelines provided by Rayno Window Film and receive installation confirmation letter.