

English

Trosifol®

Spallshield® CPET

kuraray

Trosifol®



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Trosifol® Spallshield® CPET

Composite hardcoat

Trosifol® Spallshield® CPET is a two layer composite structure of PET/hardcoat. The hardcoat is highly durable, chemically resistant, and virtually indistinguishable from glass. Trosifol® Spallshield® CPET provides superior lightweight anti-spall properties to glazing structures.

THE PET AND HARDCOAT HELP provide an inner shield to protect occupants from glass spalling and lacerations. Spalling is the term used to describe the action of glass splintering and flying inward after the glazing is struck by an object or bullet from the outside.

Trosifol® Spallshield® CPET helps create a protective barrier between people and glass.

Because Trosifol® Spallshield® CPET laminates are glass/plastic all of the best features of glass are combined with those of plastic. The result is a glazing which is very lightweight, thin, and strong.

KEY BENEFITS

- **No spalling**
Anti-spalling feature of Trosifol® Spallshield® CPET composites helps provide safety to occupants of buildings, trains or autos when an object impacts the glass side of the glazing.
- **Weight reduction**
Trosifol® Spallshield® CPET laminates only require one lite of glass, making them lightweight.
- **Stronger**
Significantly higher penetration resistance with thinner glass vs. any other comparable laminated or monolithic glass constructions.
- **All the benefits of standard laminated glass**
UV protection, noise reduction, IR control when combined with special films or coated glass.
- **Excellent optics**
Glass + Trosifol® Spallshield® CPET composites meet all the automotive optics requirements.
- **Glass-like durability**
Highly abrasion, chemical and scratch resistant. Outstanding weathering.

Typical glazing construction using Trosifol® Spallshield® CPET

CPET is on the inside as the protective layer from spall.

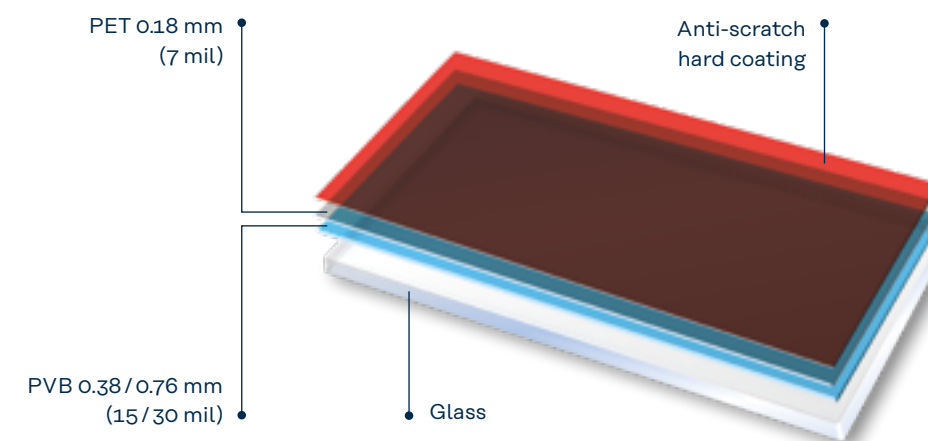


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Applications

Trosifol® Spallshield® CPET is used in applications where light weight, penetration resistance and anti-spalling are desired attributes. Applications for Trosifol® Spallshield® CPET include:

BULLET RESISTANT GLAZING

Traditional bullet resistant glazing performs as it is designed to perform which is to stop full penetration of a bullet; however, it does not prevent the spalling of glass, which can severely lacerate. Using Trosifol® Spallshield® CPET composite in bullet resistant glazings prevents this dangerous spalling of glass.

TRANSPORTATION GLAZING

Trosifol® Spallshield® CPET composites help protect occupants of moving vehicles. An object hurled into the glazing of a moving vehicle can be tragic even if the object does not penetrate the window. This is because, at that instant, the driver and passengers could become lacerated by the spalling glass. Traditional laminated glass does not offer this protection. Only Trosifol® Spallshield® CPET can help.

INTRUSION RESISTANT GLAZING

CPET improves the performances of laminated safety glass and avoids spall. This makes Trosifol® Spallshield® CPET ideal for use in high crime areas and storefront glazing by preventing the "smash and grab" crime.

TORNADO RESISTANT GLAZING

Trosifol® Spallshield® CPET enables laminated glass systems to meet the no spall requirements of FEMA 361 for EF tornado protection.

Trosifol® Spallshield® CPET – product availability

Product	Thickness		Roll widths		Roll lengths	
	[mm]	[mil]	[mm]	[in]	[m]	[ft]
Trosifol® Spallshield® CPET	0.18	7	1530	60	50/250	164/820

TAB 1 •

SKYLIGHTS

Trosifol® Spallshield® CPET provides protection of building occupants from spall which may occur from impact of falling object on the laminated safety glazing of the skylight.

SIDELITES, WINDSHIELDS, BACKLITES

Trosifol® Spallshield® CPET can be applied directly on tempered or annealed glass without significantly increasing the thickness and weight, which allows easier installation into sidelite, windshield and backlite framing.

SUNROOFS

Sunroofs are not only becoming standard equipment on more and more vehicles, but are also getting larger. The market for large panoramic sunroofs is growing at 30% per year. This raises safety concerns over the use of tempered glass. Trosifol® Spallshield® CPET is an excellent choice for sun-roof applications. Laminates made from Trosifol® Spallshield® CPET composites are lighter weight than traditional safety glass and provide markedly improved impact resistance over other choice of most other glass constructions.

ARCHITECTURAL GLAZING

The anti-spalling and features of Trosifol® Spallshield® CPET composites make it an excellent choice in laminated glass glazing systems for embassies and other high risk public buildings. Trosifol® Spallshield® CPET helps protect occupants of a building from glass splinters even after a bullet or missile has been stopped, helping to keep people in the protected space from injury.

Physical properties

Technical data

Property	Test method	Unit	Trosifol® Spallshield CPET
Density	-	g/cc	1.4
Tm	DSC	°C (°F)	251 (483)
Self Ignition Temp	ASTM 1929	°C (°F)	460 (860)
Refractive index	-	-	1.44
Tear Propagation Machine Direction Transverse Direction	ASTM D2582	Tear Resistance (Newtons/Pounds-Force)	47.5 /10.6 40.3/9.08
Graves Tear Machine Direction Transverse Direction Machine Direction Transverse Direction	ASTM D1004-8 ASTM D1004-8 ASTM D1004-8 ASTM D1004-8	Max Force (Newtons/Pounds-Force) Max Force (Newtons/Pounds-Force) Extension (mm/in) Extension (mm/in)	90.8/20.4 94.2/21.1 9.24/36 9.11/36
Tensile Modulus Machine Direction Transverse Direction	ASTM D882-02	Mpa (KPSI)	3884 (563) 5483 (795)
Tensile Strength Machine Direction Transverse Direction	ASTM D882-02	Mpa (PSI)	156 (22) 205 (30)
Yield Stress Machine Direction Transverse Direction	ASTM D882-02	Mpa (PSI)	103 (14.9) 123 (17.8)
Yield Strain Machine Direction Transverse Direction	ASTM D882-02	%	6.97 6.66

TAB 2 •



OPTICAL AND UV PROPERTIES

Optical properties of Trosifol® Spallshield® CPET are equivalent to glass, resulting in clear, non-yellowing, very low haze laminates that are flat and free of wavy distortions. Trosifol® Spallshield® CPET provides superior UV protection over standard glass. Typical data is shown in tables: no iridescence can be seen. Iridescence is not seen under normal fluorescent lighting or outdoor lighting. This iridescence is not a defect but a phenomenon seen under specific lighting conditions.

ADHESION OF PET / PVB AFTER AUTO-CLAVE

When properly laminated, Trosifol® Spallshield® CPET has excellent adhesion to Trosifol® PVB interlayers. The laminates have excellent PVB to PET adhesion and PVB to glass adhesion is equal to or greater than traditional laminated glass structures. This ensures long term integrity of the final glass/plastic composite structure.

Optical properties and UV transmission data

Product	With PVB		Tvis	YID 1925 (2/c)	UV transmission ISO 9050
	[mm]	[mil]	[%]		282.5-377.5 nm
3 mm Float glass	-	-	92.2	- 0.59	64.37
Trosifol® Spallshield® CPET	0.76	30	91.3	1.35	0.48

TAB 3 •

CHEMICAL AND SOLVENT RESISTANCE, SCRATCH RESISTANCE

Trosifol® Spallshield® CPET laminates have superior chemical and solvent resistance to polycarbonate and acrylics. All samples were abraded with the Taber Abrader (ANSI Z26.1-1996 Test 17) and stressed to simulate actual end-use conditions. The abraded area was then exposed to solvents, wiped clean and graded.

TROSIFOL® SPALLSHIELD® CPET CARE AND HANDLING

Trosifol® Spallshield® CPET composites require some special care and handling to give optimum performance. This is outlined in the lamination guide.

Trosifol® Spallshield® CPET – chemical resistance

Chemical	Polycarbonate	Acrylic	Trosifol® Spallshield® CPET laminate
Methanol	No effect	Small cracks	No effect
Toluene	Deep cracks	Destroyed	No effect
Acetone	Destroyed	Many cracks	No effect
MEK	Cracks / tacky	Many cracks	No effect
Methylene chloride	Tacky	Cracks / tacky	No effect
Gasoline	Destroyed	Many cracks	No effect

TAB 4 •



• SHUM YIP UpperHills LOFT, Shenzhen, China

Trosifol® Spallshield® CPET Tests

Trosifol® Spallshield® CPET is a two-layer composite structure of PET and hard coat. The hard coat is a proprietary formulation developed by Kuraray with the following features:

HIGHLIGHTS OF TROSIFOL® SPALLSHIELD® CPET

- Highly scratch resistant
- Chemically resistant
- Very durable
- Superior optical quality, indistinguishable from glass

Taber Abrasion Resistance

Plastic sheet type	Delta haze without coating [%]	Delta haze with coating [%]
Polycarbonate	27.5	1.8
Acrylic	23.9	1.4
Trosifol® Spallshield® CPET	30.2	0.7
Glass	0.1	not applicable

TAB 5 •

Trosifol® Spallshield® CPET have superior abrasion resistance compared to acrylics and polycarbonates.

IRIDESCENCE

Iridescence is caused by light being refracted off of thin coatings. The hard coat applied to Trosifol® Spallshield® CPET is a very thin coating with micro variations in coating thickness. This will cause the hard coat to iridesce under certain types of indoor fluorescent lighting and is only visible under reflective lighting. If the composite is viewed at a 90-degree angle no iridescence can be seen. Iridescence is not seen under normal fluorescent lighting or outdoor lighting. This iridescence is not a defect but a phenomenon seen under specific lighting conditions.



• Glass room in former US Embassy

COFFIN TESTS

Trosifol® Spallshield® CPET laminates are exposed to 50 °C (122 °F) at 95 % RH for a period of 2 weeks. After the test, the hard coat adhesion remained at 100%. Optical appearance remained unchanged.

BOIL TESTS

Conducting 6-hour boil testing per ANSI Z26.1 test method tests durability of hard coat. Tests are conducted on laminates autoclaved at 135 °C (275 °F) for 30 minutes. The hard coat is evaluated for adhesion and appearance.

Trosifol® Spallshield® CPET composites have 100% hard coat adhesion after the six hour boil. Hard coat appearance remains excellent.

CYCLING TESTS

Cycling tests are conducted to predict the effects of exposing the Trosifol® Spallshield® CPET composite to extreme temperatures and humidity. Trosifol® Spallshield® CPET composites were tested by the PV1200 protocol. Trosifol® Spallshield® CPET composite is placed in a chamber and exposed to the following cycle 10 times:

Peel tests were measured after equilibrium of 21 hours at 20.5 °C (69 °F). Used Permalel 1.13 kg (40 oz.) tape for peels.

Hardcoat adhesion performance (ASTM 3359)

Autoclave temps [°C]	Autoclave temps [°F]	Crosshatch – Scribed	Unscribed	X Scribed	Adhesion rating
125	257	100/5B	100	5/5	100
135	275	100/5B	100	5/5	100
150	302	100/5B	100	5/5	100

TAB 7 •

TROSIFOL® SPALLSHIELD® CPET CYCLING TESTS

- 60 minutes heat up to 80 °C from 23 °C (up to 176 ° F from 73 °F)
- 240 minutes at 80 °C (176 °F) and 80% RH
- 120 minutes to cool down to – 40 °C (-40 °F)
- 240 minutes at – 40 °C (-40 °F)
- 60 minutes to 23 °C (73 °F)

Trosifol® Spallshield® CPET coffin tests

Hard coat	Adhesion [%]
Unscribed	100
6 Line Scribed	100
X-Scribed	100

TAB 6 •

Weathering data

Trosifol® Spallshield® CPET composites have excellent weathering durability. Sidelites made from Spallshield® composites were installed in a test vehicle 20 years ago and they still look outstanding!

Trosifol® Spallshield® CPET composites have undergone extensive weathering testing. The following weathering tests have been conducted on Spallshield® composites:

TROSIFOL® SPALLSHIELD® CPET WEATHERING TESTS

- EMMA
- Natural Florida
- XENON-ARC SAE-J1960

EMMA

	b color	Tvis [%]	Haze [%]	ISO 9050 UV transmission [%]
0 mega-joules of UV radiation per m ²	1.42	91.7	0.97	0.46
2000 mega-joules of UV radiation per m ²	1.62	91.4	0.78	0.68

TAB 8 •

2,000 mega-joules is equivalent to nine years Arizona. Laminates autoclaved at 135 °C (275 °F) for 30 minutes.

Natural Florida

	YID	b color	Haze [%]	Tvis [%]
Initial	2.8	2.35	0.62	91.7
2 years exposure	1.76	1.67	0.63	91.7

TAB 9 •

Samples were exposed two years in Florida.

XENON-ARC SAE J1960

	Laminate haze [%]	Laminate Tvis [%]	Laminate b color	PET/PVB adhesion [lb/in]
Initial	1.91	91.7	1.12	24.8
2,500 MJ	2.1	91.6	1.42	22

TAB 10 •

All samples were coated in the lab. Commercially produced Trosifol® Spallshield® CPET. Composite has haze value of < 1.

Technical data

Trosifol® Spallshield® CPET with 0.76 mm (30 mil) PVB laminated to 2 mm glass ANSI Z26.1 tests

Test	Name	Description	Measures	Requirement	Trosifol® Spallshield® CPET results
16	Luminous transmittance and weathering	Tvis is measured after exposing samples to type D twin enclosed (violet arc) chamber under standard operation for 1667 hours.	Tvis Change %	Less than 5%	-4.91%
1	Light stability and luminous transmittance	Samples exposed to a UV Arc test radiation for 100 hours	Tvis retention %	70%	99.70%
26	Ball drop	5 lb ball drop from 3.7 m (12 ft) at room temperature	Penetration	No penetration	No penetration
12	Ball drop	1/2 lb ball dropped 9 m (30 ft) at room temperature	Penetration	No penetration	No penetration
9	Dart test	0.2 kg (7 oz) steel dart dropped from 9 m (30 ft) at room temperature	Penetration	No penetration	No penetration
19	Chemical resistance	Laminated specimens are exposed on the plastic sides both in non-stressed and stressed conditions to five different specified chemicals for 10 min each using separate specimens in each case. The laminate must show no signs of tackiness, crazing, or cracking.	Haze %	4%	< 4%
24	Flammability	Three laminated specimens measuring 1.3 x 15.2 cm (0.5 x 6 in) are inclined at a 45 degree angle and are subjected to a flame on the plastic side at the lower end. Once the flame is removed, the burn rate must not exceed 8.9 cm/min (3.5 in/min).	Burn rate in/min	Max. 8.9 cm/min (3.5 in/min)	< 8.9 cm/min (< 3.5 in/min)

TAB 11 •

Contact



FOR FURTHER INFORMATION

on products from Kuraray, please visit www.kuraray.com.

You can find further information on our Trosifol® and SentryGlas® products at www.trosifol.com.

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