



Multifunctional color and solar interlayer solutions for advanced automotive glazing applications





Growing solar and color automotive glazing trends

The importance of glazing is growing as connected, autonomous, shared and electrified (CASE) technology trends transforms the automotive industry. Connected vehicles allow for improved communication between drivers, passengers and the surrounding environment, while autonomous vehicles provide a safer and more convenient driving experience. Shared mobility solutions make transportation more accessible and affordable, while electric vehicles reduce carbon emissions and improve sustainability. This will shape the future of transportation and automotive glazing for years to come.

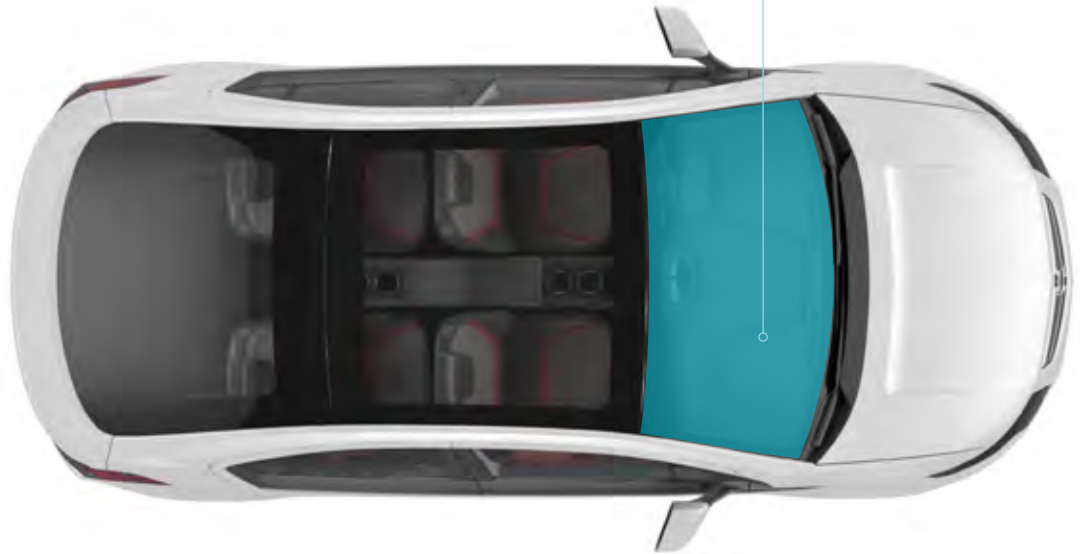
We're determined to stay ahead of the rapidly evolving industry and serve our customers.

Here's a summary of our application-focused approach:

1. Deeply understanding specific application requirements and enabling them with our multifunctional PVB interlayer portfolio
2. Focusing on the most critical requirements first
3. Being flexible and agile when customers require custom products

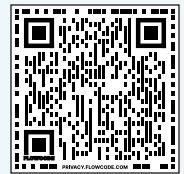
Learn how CASE technology and design trends impact different glazing positions and how Saflex provides solutions for each trend.

Windshield solutions



Windshields are multifunctional vehicle components with most features enabled by PVB interlayers. Features include safety, noise damping, UV absorbing, infrared (IR) blocking and head-up display (HUD). While some acoustic features are becoming part of our standard offering, for others, we're addressing the latest trends. They include:

1. Thermally stable cabin environments for reduced energy use from HVAC systems to enable electric vehicle (EV) range extension
2. Significant growth in automotive sensors related to advanced driver assistance systems (ADAS) and autonomous driving (AD)
3. Sensors inside the cabin or integrated in the windshield for accuracy, higher reliability and longevity

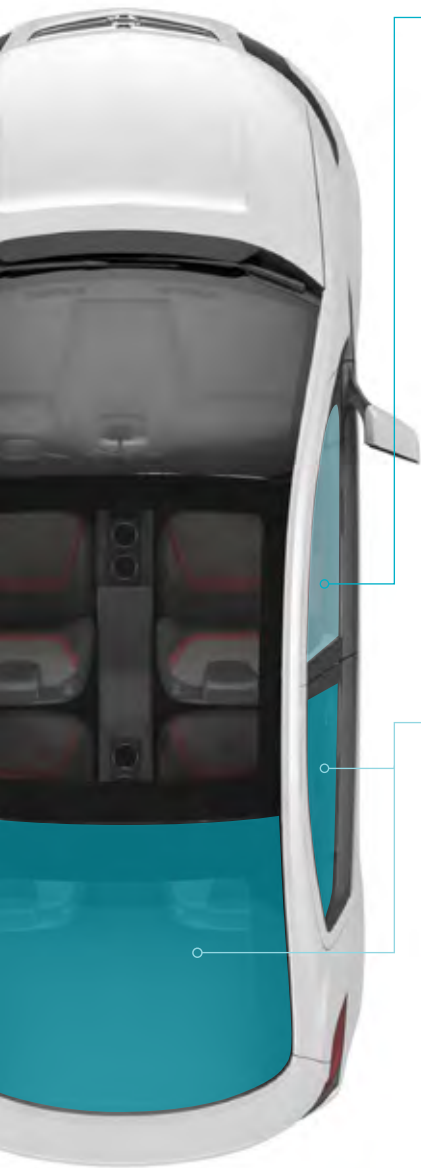


Scan the QR code to learn more about Eastman solutions for HUD.

	Saflex Solar Connect		Saflex S series
Technology	Infrared absorption via additive dispersion		
Solar performance	Good		Excellent
Sensor compatibility (NIR)	Good		Poor
Signal compatibility (RF)	Good		Good
Product variations	Solar	Solar + Acoustic	Solar + Acoustic + HUD
Typical products	QL51_0000T1		QL51_0000S4, QL51_0000S2

Saflex™ Solar Connect uses a tri-layer construction, positioning an acoustic damping layer between two solar-absorbing layers to improve cabin sound quality. With a greater demand for windshield capabilities, Solar Connect offers compatibility with both near-infrared and radio frequency (RF) devices such as rain sensors, electronic toll readers and traffic systems.

Saflex™ S series interlayers are designed for optimal infrared rejection in combination with good RF signal compatibility. It's a strong alternative to metal-coated infrared-reflective technologies, which create the potential for electromagnetic interference with mobile devices, GPS and other transmitters in the vehicle.



Front-door side windows

Laminated front-door glazing has gained popularity due to its remarkable benefits. Its enhanced safety, security and comfort features prevent shattered glass, minimize the risk of injury, discourage break-ins and reduce outside noise. Continued trends are related to improved cabin comfort and connectivity, namely:

1. Unique sound profile management of EVs with no engine noise and more prevalent wind and other external noises (e.g., bigger tires required to carry the extra battery load)
2. A thermally stable cabin environment for reduced energy use from HVAC systems to enable range extension
3. Low signal attenuation for better vehicle-to-vehicle and vehicle-to-infrastructure communication

The most effective way to address these trends is by combining solar and acoustic features into the same interlayer while ensuring no signal loss or electromagnetic interference with mobile devices and other transmitters in the cabin. Saflex S series interlayers, such as QL51_0000S2, are ideal to meet application requirements.

Privacy glazing

Privacy glazing is a must-have for all car models. It includes rear-door side windows, quarter windows and back windows. While tempered, colored glass may suffice, PVB interlayers are necessary to fully realize the benefits of privacy glazing. This space continues to evolve with these key trends:

1. Matching colors used for all privacy glazing positions, whether laminated or not
2. Adopting neutral gray colors (i.e., a* and b* close 0) in both reflection and transmission
3. Increasing performance and quality requirements for privacy colors (e.g., haze levels, long-term durability and production tolerances)

Color	Tvis (%)	Thickness	Formulation	De-airing
35 Privacy Grey	18, 23, 27	0.76 mm	Acoustic	Nip roll embossed (QP)
			Acoustic solar	Nip roll embossed (QM)

Note: Table is subject to change; contact your Eastman representative for more information.

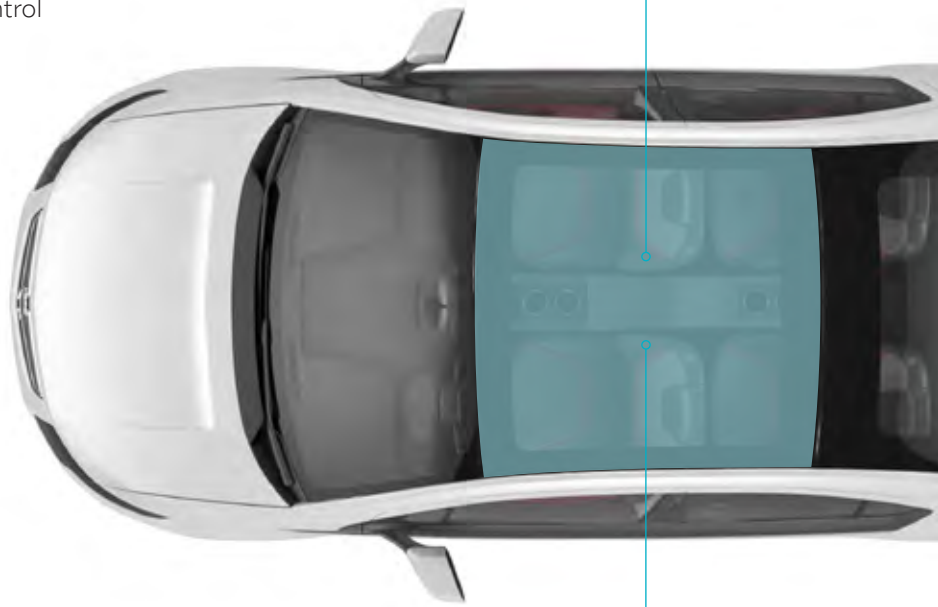
To address these trends, Eastman focuses the most on neutral colors in both reflection and transmission in our portfolio, namely, 35 Privacy Grey. This color family comes with a variety of light transmission levels, formulations and embossing levels to meet the demands of even the most discerning original equipment manufacturers (OEMs). The color is widely adopted in privacy glazing applications across multiple car models and regions. Understanding the importance of quality and product performance for OEMs' brand reputation, we focus on 35 colors for continuous improvement of haze, durability and production tolerances.

Panoramic and dynamic glazing sunroofs

Sunroofs are becoming one of the fastest-growing glazing application spaces. They come in various shapes and forms, ranging from conventional to modern panoramic (or canopy) types in both fixed and movable versions. The increasing size and curvature of modern sunroofs drives the need for glass lamination instead of relying on tempered glass. Major trends shaping this space are:

1. Higher seating position in EVs (due to battery underneath), which drives the need for increased headspace without impacting the overall aerodynamics
2. Adoption of dynamic glazing or solar control performance to serve the function of traditional roller shade
3. Merging canopies with windshields or backlites to create frameless design and improve aerodynamics

Sunroofs often incorporate colored PVB to create privacy and reduce glare. They need to follow the overall trend of neutral grey colors in reflection and transmission to match the rest of the privacy glazing.

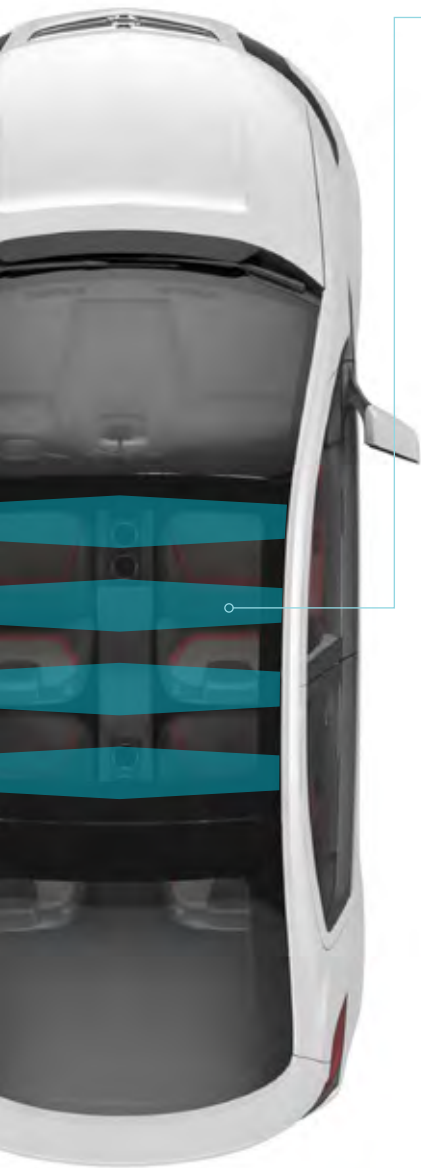


Large panoramic sunroofs

Color	Tvis (%)	Thickness	Formulations	Surface
52 Dark Granite	2, 6, 8, 13, 18 and 27	0.76 mm	Acoustic Solar	Vacuum embossed (QK)
			Solar	Random rough (SH)
				Vacuum embossed (SK)
			Acoustic	Vacuum embossed (QE)
			Monolithic	Random rough (RB)
				Vacuum embossed (RE)

Note: Table is subject to change; please contact your Eastman representative for more information.

Our 0.76-mm PVB portfolio for large panoramic sunroofs centers around the 52 color family. The color has been widely adopted across multiple car models, in different regions and in different sunroof glass configurations. This color is neutral both in reflection and transmission and comes in a broad range of light transmissions, product formulations and embossing levels that help provide sufficient flexibility to laminators when required to meet demanding OEM sunroof configuration requirements.



Dynamic glazing (multilayer) sunroofs

The automotive industry is increasingly adopting dynamic glazing technology for sunroofs that replaces conventional roller shades. The film used in these devices is based on three technologies commonly used today: polymer-dispersed liquid crystal (PDLC), suspended particle device (SPD) and electrochromic (EC) film. The use of two PVB interlayers is essential to protect and laminate this film in the sunroof, with customers often requesting a 0.38-mm thickness and at least one colored interlayer. The latter is required to help achieve OEMs' desired light transmission and reflection and transmission color of the total stack configuration.

Color	Tvis (%)	Thickness	Formulations	Surface
52 Dark Granite	18, 27 and 44	0.38 mm	Monolithic	Vacuum embossed (RE)
				Random rough (RB)

Note: Table is subject to change; contact your Eastman representative for more information.

Similar to large, fixed, panoramic sunroofs, the dynamic glazing portfolio is centered around color 52 in 0.38-mm thickness and a wide range of light transmissions and embossing levels. Focusing on the same color family helps laminators and OEMs maintain consistency between sunroofs that might be offered in both dynamic and non-dynamic versions. One of the most important performance characteristics of this portfolio is the embossing level required to de-air complex curvature and a minimum of four PVB surfaces.

Customization opportunities

The current trend for privacy and sunroof glazing involves a range of neutral gray shades with varying degrees of light transmission. However, with the constantly evolving glazing market and diverse needs of customers, we recognize that our existing 52 and 35 color portfolios may not always be sufficient. We see three areas where custom colors or custom light transmissions are needed:

1. Color compensation of unwanted tint from functional film or type of glass used
2. Development of special-edition glazing colors as part of OEM branding efforts
3. Use of custom light transmission in complex glass configurations where different glass coatings and functional films help meet OEM requirements

	Custom light transmission	Custom color
Color	Leverage existing 35 and 52 color families	New color coordinates (A* and B* values) meeting customer/application requirements
Tvis	New % (based on customer needs)	New % (custom by default)
Gauge	30 and 15	30 and 15
Formulations	Existing formulations and embossing levels	30 gauge: all formulations 15 gauge: monolithic

With our comprehensive range of services, we can confidently meet customer demands and provide the best possible solutions. Contact your Eastman representative for more information about our customization services.

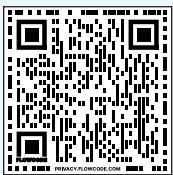
Appendix: additional supporting/technical data

Position	Product	Features	Thickness	Embossing	Hue (a^*/b^*)	Tvis, %	TTS,%
Windshield	QL51_0000T1	Solar-absorbing and sensor-friendly acoustic clear	0.82 mm	Vacuum	-2/1.7	87	73
	QL51-0000S4	Solar-absorbing acoustic clear	0.82 mm	Vacuum	-3.3/1.6	84	68
Front door	QL51-0000S2	Solar-absorbing acoustic clear	0.82 mm	Vacuum	-4.0/1.0	82	64
Rear door and backlite	QM47_3518S1	Solar-absorbing acoustic color	0.76 mm	Nip roll	-4.3/+1.7	18	36
	QP47_351800	Acoustic color	0.76 mm	Nip roll	-2.3/+2.5	18	45
Panoramic sunroof	QK47_5208S1	Solar-absorbing acoustic color	0.76 mm	Vacuum	-1.3/+0.8	8	32
	SK47_5208S1	Solar-absorbing color	0.76 mm	Vacuum	-1.3/0.8	8	32
	QE47_520800	Acoustic color	0.76 mm	Vacuum	0/+0.5	8	36
	RE47_520800	Monolithic color	0.76 mm	Vacuum	0/+0.5	8	36
Dynamic glazing sunroof	RE17_522700	Monolithic color	0.38 mm	Vacuum	-0.9/+1.0	27	—
	RE11_000000	Monolithic clear	0.38 mm	Vacuum	-1.7/1.5	89	—

Tvis, TTS, and hue a^ and hue b^* values are measured in clear/clear glass configuration and according to ISO 13837 and ASTM E1348 standards respectively. Acoustic values are available on request.*

Reported values are typical and subject to change; contact your Eastman representative for more information.





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with one of our experts.

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