

# Laminated glass

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**Laminated glass** is a type of [safety glass](#) that holds together when [shattered](#). In the event of breaking, it is held in place by an [interlayer](#), typically of [PVB](#), between its two or more layers of glass. The interlayer keeps the layers of glass bonded even when broken, and its high strength prevents the glass from breaking up into large sharp pieces. This produces a characteristic "spider web" cracking pattern when the impact is not enough to completely pierce the glass.



Automobile windshield displaying "spider web" cracking typical of laminated safety glass.

Laminated glass is normally used when there is a possibility of human impact or where the glass could fall if shattered. Shopfront glazing and [windshields](#) are typically laminated glasses. The PVB interlayer also gives the glass a much higher sound insulation rating, due to the damping effect, and also blocks 99% of transmitted UV light.

Laminated glass was invented in [1903](#) by the [French](#) chemist [Edouard Benedictus](#), inspired by a laboratory accident. A glass flask had become coated with the plastic [cellulose nitrate](#) and when dropped shattered but did not break into pieces. Benedictus fabricated a glass-plastic [composite](#) to reduce injuries in [car accidents](#). However, it was not immediately adopted by [automobile](#) manufacturers, and the first widespread use of laminated glass was in the eyepieces of [gas masks](#) during [World War I](#).

Today, laminated glass is produced by bonding two or more layers of ordinary annealed glass together with a plastic interlayer, usually [polyvinyl butyral](#) (PVB). The PVB is sandwiched by the glass which is passed through rollers to expel any air pockets and form the initial bond then heated to around 70 °C in a pressurized oil bath. The tint at the top of some car windshields is in the PVB.

A typical laminated makeup would be 3 mm glass / 0.38 mm interlayer / 3 mm glass. This gives a final product that would be referred to as 6.38 laminated glass.

Multiple laminates and thicker glass increases the strength. [Bulletproof glass](#) is often made of several float glass, toughened glass and Perspex panels, and can be as thick as 100 mm. A similar glass is often used in airliners on the front windows, often three sheets of 6 mm toughened glass with thick PVB between them.