

Materials

Modern “glasses” are no longer made of glass

Mastering the production process

■ **Essilor buys its raw materials**—monomers and granules—from the chemical industry. But our own engineers have developed polymerization and injection on an industrial scale, with know-how that enables them to narrow production tolerances and obtain constant optical quality. The first quality criterion is a perfectly homogeneous structure; the second is consistency around the world. One of Essilor’s strengths is the development of performance-control methodology that encompasses more than thirty parameters, including material aging and durability.

Know-how that drives performance

■ **Since the launch of the first plastic lenses under the Orma® name, Essilor R&D has worked to increase the refraction index of the materials used.** We have gone from index 1.5 for CR 39 to 1.6 (in particular for polycarbonate) and now, thanks to processes perfected in Japan, index 1.67 and soon 1.74, both of which have been developed by our joint venture with Nikon. High-index lenses require less material to correct vision but, except for polycarbonate, their density is greater. The essence of the engineering challenge is to find the best trade-off between volume reduction and density increase—or, from the wearer’s point of view, between the comfort of a light-weight lens and the esthetics of a thin lens. That is, for example, the dual advantage of polycarbonate, which also possesses high shock resistance and, thanks to Essilor expertise, is scratch-proof and totally transparent.



Stylis®

Even thinner and more transparent

Essilor has used its advanced high-index technology to produce Stylis®, a 1.67 index lens that is far thinner and flatter than a standard lens. It offers 100% protection against UV A and B—and perfect transparency thanks to the Crizal® anti-reflective, anti-scratch, and anti-smudge coating.

2001 Stylis® launch campaign

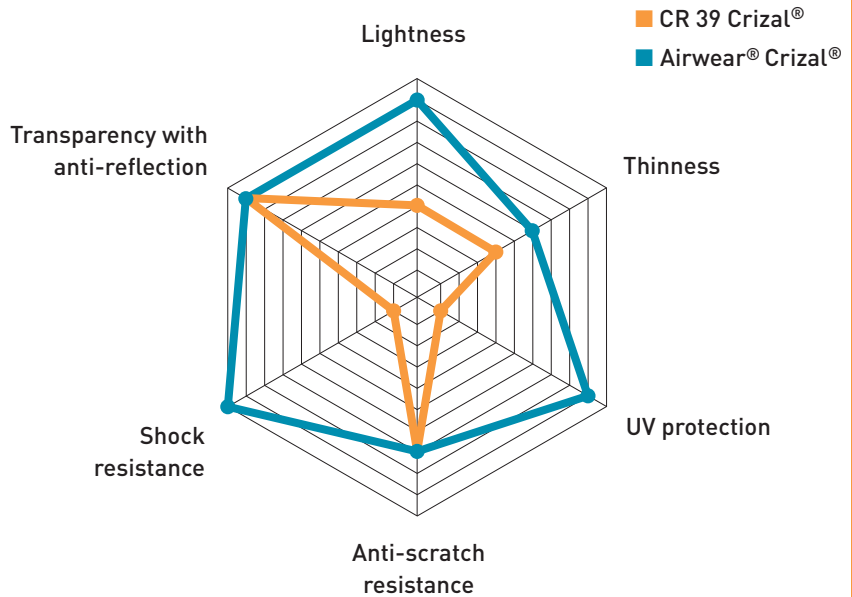
Basic materials are often developed by industries whose output volume justifies heavy R&D investment. This was the case with polycarbonate, whose purity and stability was improved by compact-disc manufacturers to the levels required by the optical industry. But, to use a new material as a medium for corrective lenses, Essilor has to meet three further challenges: mastering a new production process, enhancing all characteristics simultaneously (such as weight, thinness, strength, and color), and ensuring consistent performance.

THE SEARCH FOR THE BEST TRADE-OFF

Key lens performances are obtained by subtle compromises that take into account the chemical structure of the materials.

Here, the comparison of two materials illustrates the differences in performance and the progress obtained through technological advances.

Essilor's ongoing objective is to better control the trade-offs that determine the materials' performances, in order to offer wearers thinner, more attractive, lighter and more resistant lenses.



Comparative performances of CR 39 and polycarbonate materials



Airwear®

Scratch-resistant polycarbonate

Using exclusive methods, Essilor has developed a super-hardening coat for polycarbonate, a high-index material with extreme resistance to impact. The new treatment makes polycarbonate as scratch-resistant as glass. Under the Airwear® brand, and with a suitable anti-reflective coating, polycarbonate has thus become a high-end product, also available in a photochromic version (Airwear® Transitions®).

Illustration from the Airwear® brochure

Design

Engineering and producing complex surfaces

A substantial head start

■ **Progressive lenses**, in their replacement of bifocals, have enabled considerable progress in visual comfort for presbyopes, while at the same time improving the attractiveness of corrective lenses. Essilor's successive innovations have made it possible to produce lenses with no surface discontinuity, and Varilux® Panamic®, the fifth-generation Varilux® lens developed by Essilor, is the consecration of forty years of research. Essilor's engineering expertise has led to development of a product posting performances that have been validated by physiological and clinical tests on wearers, both in the company's R&D units or in cooperation with external universities and hospitals.

Surfaces produced point by point and tested to 1/100th of a diopter

■ **Conventional surfaces were manufactured by a simple mechanical motion** that could only produce spheres or tori ("donuts"). By contrast, surfaces of aspherical or progressive molds are machined point by point using numerically controlled tools, and advances in surface metrology, also developed by Essilor, now allow stringent production inspection. This is performed with measuring instruments that use the latest laser technology to offer precision on the order of 1/100th of a diopter.



Illustration from Varilux® advertising in the U.S. trade press

A special R&D capability The optics industry handles "small" volumes.

As an example, it uses 2,000 metric tons of polycarbonate a year compared to 90,000 for the laser-disc industry. Except in a few specialties, therefore, it does not have the technological initiative. Essilor's 450 scientists accordingly engage in an active technology watch, involving patent analysis, literature review, technical monitoring, collection of information via the EWR (Essilor Watch Report) network, and dissemination of findings throughout the company. Thanks to this approach, our research staff has produced advances in ophthalmic optics by adopting and adapting technologies from other industries with seemingly unrelated priorities.

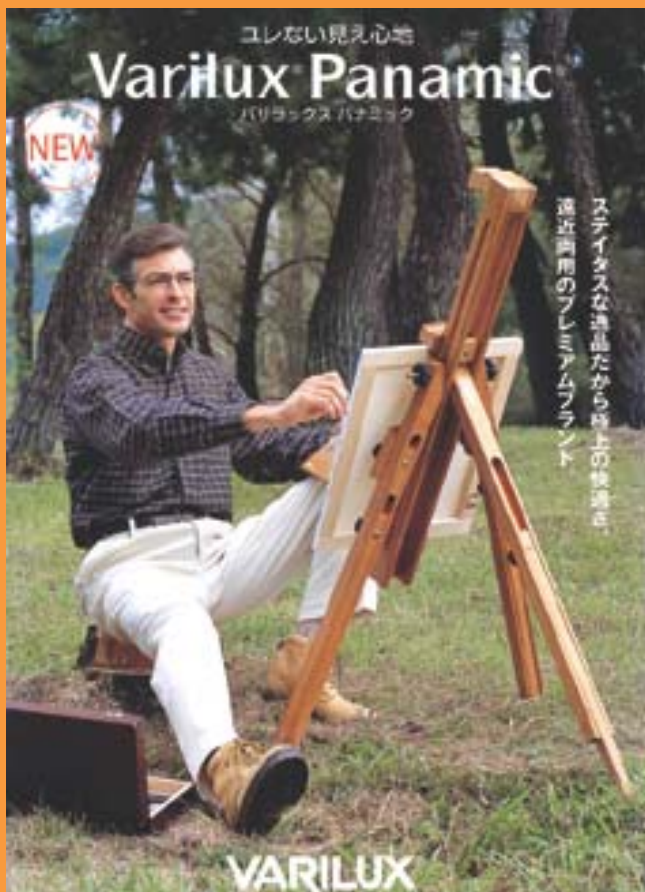
Essilor, with its Varilux® brand, is the inventor of progressive lenses for the correction of presbyopia. Its technological innovations have been made possible by advances in three disciplines where Essilor holds a decisive lead: surface engineering, surface production, and metrology (measurement and control instruments).

THE VARILUX® PANAMIC® LENS

Varilux® Panamic® is a high-end optical surface that ensures excellent peripheral vision as well as easy and rapid adjustment by minimizing such phenomena as the “swimming effect.”

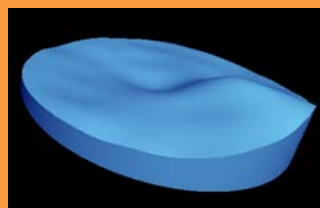
Launched in February 2000, it is the only progressive lens that respects the wearer’s visual field while restoring non-presbyopic vision, and can be produced in 13 different materials, including a high-index 1.67.

This surface confirms Essilor’s supremacy, going back more than forty years, in the presbyopia market.



Power functions

This topographical representation of power changes shows the Varilux® Panamic® design’s unrivalled regularity and smoothness, which translates into a



seamless change in power between near and distance vision not only along the meridian but also on the periphery of the lens. The power profile thus changes

without inverting the slope on the entire lens surface. This design is protected by eight patents.

2001 launch of Varilux®
Panamic® index 1.67 in Japan

Treatments

How plastic lenses outperform glass lenses on their own ground

Anti-reflective coating

■ **More than one-fourth of all lenses sold in the world are treated against reflection.** Eliminating reflected light has several benefits: first, esthetic enhancement, by giving more direct “presence” to the wearer’s eyes; second, sharper vision, by restoring the same visual contrast that would be obtained without lenses; and third, safety, by ensuring a quicker return to normal vision after exposure to dazzle.

The treatment consist in stacking four to six layers of glass with alternating high and low indices. Essilor’s lead in this field is underpinned by two key assets: its software for calculating layer indices and thicknesses, and its technological process for depositing “thin” layers on the order of a millionth of a millimeter or nanometer (10^{-9} meters). Vacuum evaporation technology, which was developed for microprocessors, has been taken over and then adapted by Essilor to multi-layer treatments on complex surfaces.

Smudge-proofing

■ **Smudges are unattractive, deteriorate vision and are even more visible on anti-reflective coated lenses,** leading to the importance of developing “top coats” that prevent smudges from clinging or lessen their impact and make cleaning easier. “Top coat” treatments are based on fluorine, a molecule whose property is to reduce grease and water adherence coefficients. They have been used in our industry for six years now, and the main development challenge has been to find a way to make the molecule cling to the anti-reflective substrate.

Safety

■ **Impact resistance is highly dependent on three factors:** lens material, thickness, and coating. In the past three years, Essilor has developed a shock-proofing primer coat. Our polycarbonate lenses comply not only with ophthalmic-lens standards but also with safety-lens standards.



Point-of-sale advertising for Transitions® Next Generation lenses in the United States

Next Generation Transitions®

More specifically designed for sensitive eyes, Next Generation Transitions® lenses, launched in early 2002, embody yet another advance in the Transitions® process, which imparts photochromic properties to plastic lenses. They provide more clarity in a normal atmosphere (up to 89% transmission), greater protection in strong light (up to 85% tinting), and faster activation (up to 70% in 30 seconds).

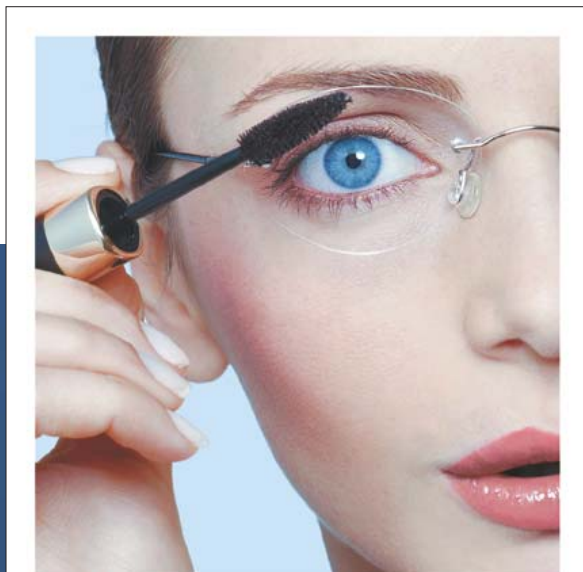
Plastics are far more resistant to impact than glass lenses. However, until the treatments developed by Essilor, they were not sufficiently scratch-resistant, nor could they undergo anti-reflective treatment. These treatments are often more complex and more expensive than the production of the lenses themselves. Essilor, through its proficiency in chemistry (coatings) and manufacturing (thin-layer application processes), has acquired a substantial lead in this area that offers substantial benefits to wearers.

Scratch-proofing

■ **Scratches are not only unaesthetic:** they diffuse light and deteriorate lens transparency. Plastic lenses have tender surfaces and, to protect them, Essilor has developed a combined plastic and glass treatment: a nanocomposite coating that combines the hardness of glass with the elasticity of plastic compounds. Essilor handles all the chemical stages of the coating operation, from R&D to production.

Photochromism

■ **Since the creation of the Essilor PPG joint venture in 1991,** Transitions® photochromic plastic lenses have reached their fourth generation, which provides further improvement in light transmission in the two clear and dark states of the lens.



Lentes Crizal. Totalmente transparentes.

As Lentes Crizal são tão invisíveis que você pode esquecer que está de óculos. Isso porque elas possuem a mais avançada tecnologia em anti-reflexo. Sua camada de zircônio torna as lentes ultra resistentes a arranhões e muito mais duráveis. E, finalmente, o tratamento Top Coat, que facilita muito a limpeza das lentes. Com Crizal, você vê e é visto com muito mais clareza. Use Lentes Crizal, porque certamente o seu olhar vai estar em evidência.



www.crizal.com.br



CLEAN LENSES: IT'S MAGIC, BUT IT DOESN'T NEED WITCHCRAFT!



At last, children can finally access the best of optical technology in an entertaining way, thanks to Essilor “Harry Potter” lenses: an Airwear® polycarbonate that offers UV protection and solidity 12 times that of conventional lenses, yet is very lightweight. Essilor “Harry Potter” lenses are also fully treated to be anti-reflective, anti-smudge, and anti-scratch. And there’s the magic touch: the “HP” initials appear when the lenses are misty or too dirty to ensure clear, comfortable vision.



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Crizal®

A “three-in-one” process, Crizal® treats lenses against reflections and protects them from scratches and smudging. This is the “full security” treatment for corrective lenses. An exclusive Essilor process, Crizal® is always applied by Essilor’s own laboratories and only on selected Essilor lenses.

Advertising campaign for Crizal® in Brazil