KODAK Lens

Technical Reports

KODAK Lens

The purpose of this document is to explain the evolution of the different technologies that have been designed and utilized to increase the level of performance in the KODAK Lens range.

The document is made up of 3 sections covering:

Progressive Lens Design

Anti-reflective Coatings

HEV Blue-light Filtering

The beginning...

KODAK Lenses have been available since 1992 with a focus on bringing innovation by leveraging digital technologies to develop prescription lenses, especially progressive lenses.

The KODAK Lens designers have worked very hard and continue to develop a portfolio that offers various levels of technology as well as adapt to the ever-evolving lifestyles of lens wearers.

The initial progressive lens designs that carried the KODAK name were cast progressives, meaning material was poured into individual progressive molds. These molds were designed for all possible prescriptions including add powers. A limited number of corridors were available, usually a maximum of two, to accommodate one short corridor for smaller frame designs and one standard corridor to accommodate standard frame designs.

Cast progressive technology has been superseded by utilizing technologies where a complex surface can be directly machined onto a semi-finished lens blank. This increased the performance and the viewing capabilities of progressive lenses leading to a decrease in non-adapts and an increase in the viewing area...and the first KODAK Digital Progressive Lenses were invented.

Digital lenses rely on computer software programs to apply the design to the lens blank during the surfacing process. The ability to leverage a consistent blank for several different designs enabled the production process to be improved and enhanced service to the eye care professional.

Since the signing of the initial licensing agreement with Eastman Kodak Company in 1993, 24 million pairs of KODAK Progressive Lenses have been sold throughout the world.

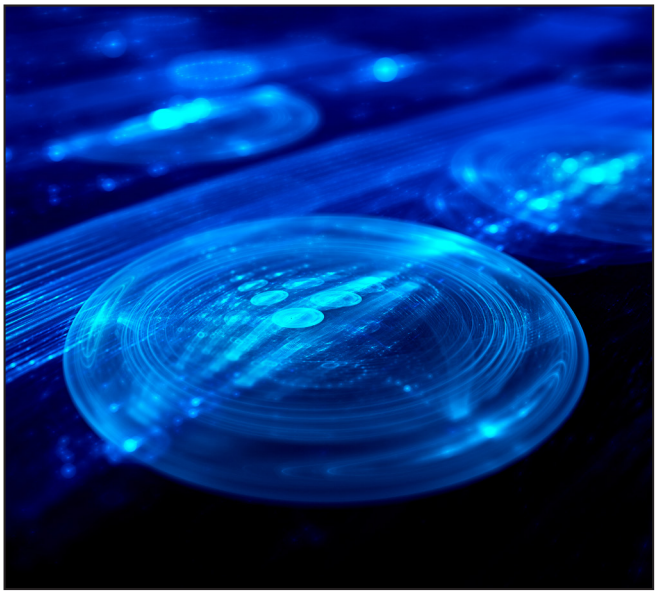
How are KODAK Digital Lenses made?

Digital freeform is a manufacturing process which allows the production of complex surfaces and designs. Processing is achieved via a single point diamond tool, precisely guided by a computer software program allowing three-dimensional surfacing along x, y and z coordinates. As the lens spins, the diamond cutting tool tracks across the lens, providing an ultra-smooth finish to the lens design, which can be polished using a conformable pad.

As with many other digital devices like smartphones and televisions, the advantages to digital lens development are vast and offer many benefits to everyone involved, from the manufacturer to the lab, eyecare professional and patient through flexible bespoke designs.

The manufacturer no longer needs to carry an excessive inventory to accommodate all prescriptions and therefore the potential degradation of the lens mold over time.

Simplifying the production base has enabled a greater range of materials to be offered as standard and become more appealing to consumers' individual lifestyles. Multiple corridor lengths become available for all frame sizes. The direct application of the patient's prescription to the lens surface allows for greater accuracy and thus better vision.



Advantages of Digital Lenses

Greater lens design and material availability

Increased innovation availability

Option for prescription customization

Reduction of lens blank stock

More accurate alignment of prescription and progressive design

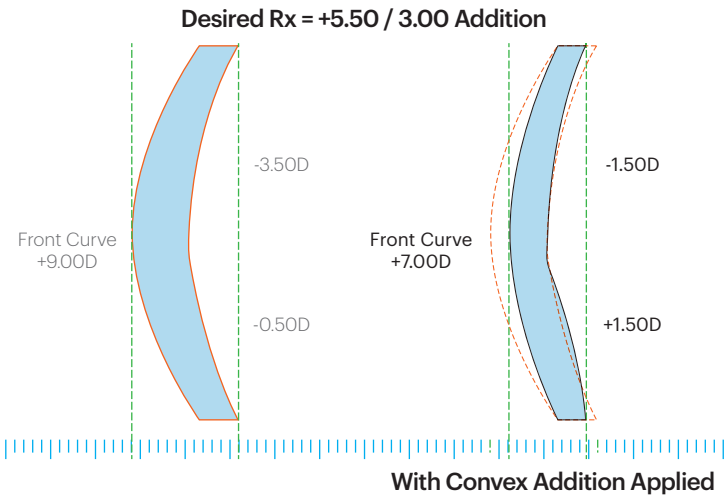
Easier frame selection and a wider choice of frames

Suitable for all lifestyles

The introduction of the original KODAK Unique Lens in 2006 presented an overwhelming success in introducing a full backside, digitally-created and easy to adapt progressive design. Because of its full-backside design and proprietary technology, KODAK Unique Lens was able to offer many features and benefits to the eyecare professional and especially to the patient. Multiple corridor options, a vast amount of materials as well as clear vision at all distances while helping to minimize any possible swim-effect.

Special Curve Control

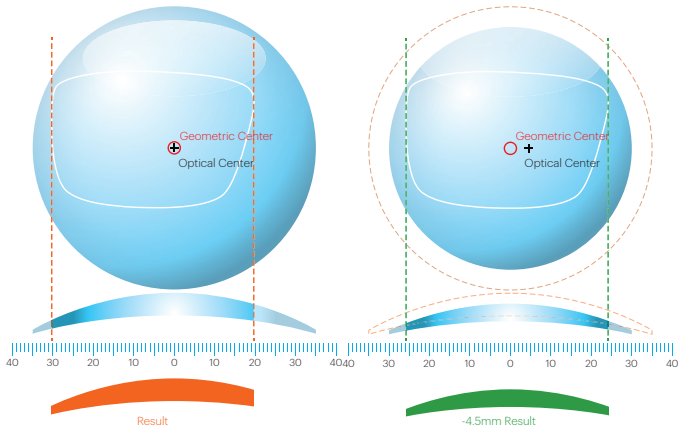
Freeform machinery and computer software are able to control and design complex 3D surfaces, meaning for some prescriptions, the power can be created using a flatter base. The ability to produce a convex curve while cutting on a concave surface allows a flatter base curve and will produce a more aesthetically pleasing lens (e.g. less bulbous).



Variable Decentration

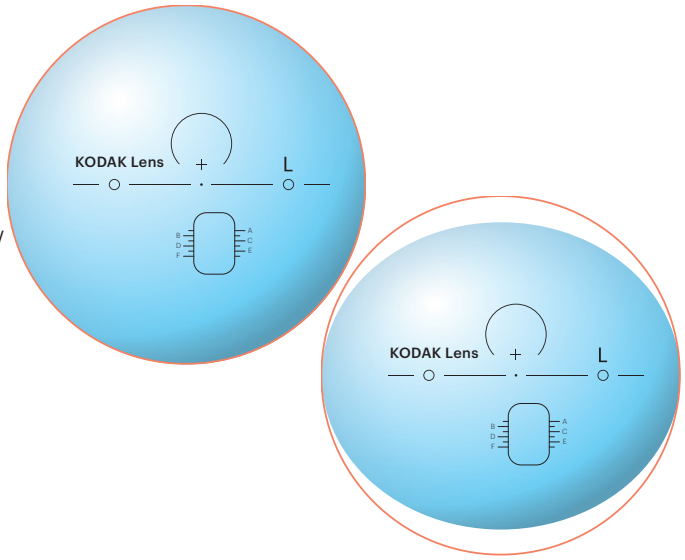
Freeform allows the computer software to recalculate and move the optical center of the lens design away from the geometric center of the blank.

This means that a smaller lens blank may be used, which results in a thinner lens.



Elliptical Cribbing

The best optimized lenses, in terms of thickness and aesthetics, require the frame shape, dimensions, mono pupil distances and heights. When frame data is provided, KODAK Lens digital technology can review the prescription and where necessary, create an elliptical lens shape as an uncut lens ready for edging and mounting. This improves the lens cut in the frame when compared to the traditional spherical shape.



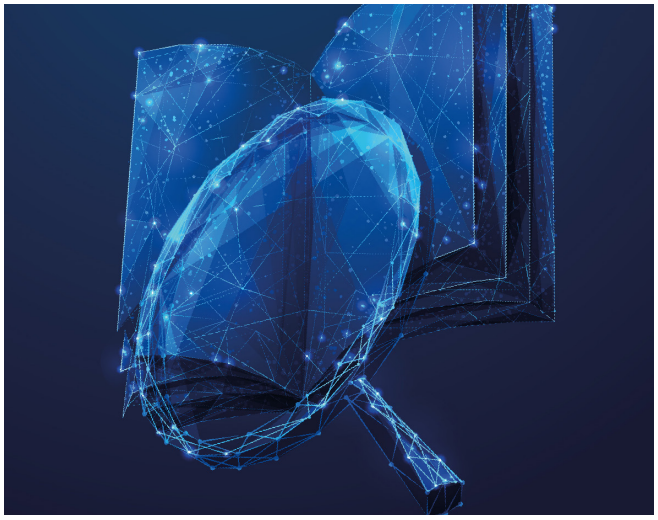
Leveraging the highly advanced freeform generators and utilizing cutting-edge computer software has meant ongoing development and availability for new lens designs. Development time has significantly decreased compared to previous cast progressive lens....and the ability to create technologies that customize and adapt to the individual patient's viewing needs become more prevalent.

Vision First Design™

As the eye travels across any horizontal area in the lower portion of a progressive lens, it will normally encounter many changes to the mean power. Vision First Design increases prescription accuracy with an incredibly smooth gradation of power across the lens surface that eases the wearer's adaptation resulting in clear, comfortable vision.

The philosophy of Vision First Design starts with the end in mind – the desired optical performance is specified, then the calculations needed to provide optimum results are calculated. This is opposite to how traditional progressive lenses are designed; firstly defining the geometry of the surface then analyzing the optical performance. If the performance is not satisfactory, the process is repeated.

Vision First Design was first introduced into the lens mold in the development of the original KODAK Precise® Lens. Since then, we have been able to include Vision First Design in the lens design software so its benefits have become a building-block for the following generations of KODAK Progressive Lenses.



Vision First Design offers:

Premium progressive lens design

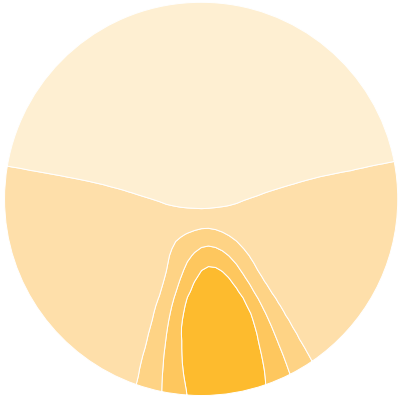
Smooth gradation of power across the surface of the lens to ease patient adaptation

Superior visual comfort

Minimizes blurring or 'swim effect'

Improves peripheral viewing performance

Traditional Progressive Design
Mean Power Plot



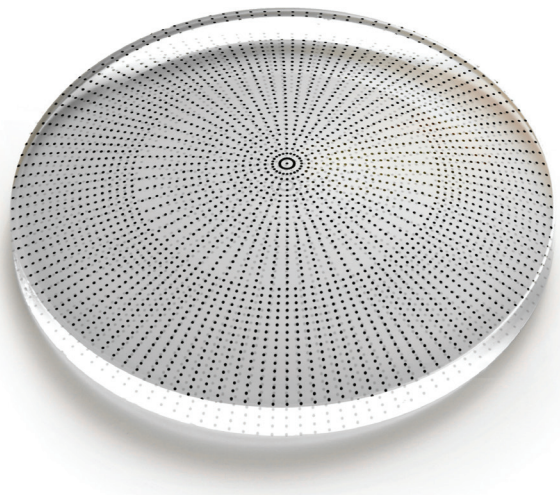
Vision First Design™
Mean Power Plot

i-Sync™

i-Sync Technology was originally introduced as a digital enhancement to the backside of traditional cast lenses. This technology reduces oblique optical errors when viewing away from the optical center. The optical performance of the base lens design is assessed using eyepoint raytracing techniques. The lens design is then fine-tuned and optimized on a 360 degree point-by-point basis applied directly to the lens surface; up to 4,000 points are reviewed across the lens surface.

The application of i-Sync is able to maximize clarity in the peripheral areas of the lens and reduce distortion to the lens edge. This increases clarity in the principle viewing areas of the lens for all patients while also accommodating specific vision needs of hyperopes and myopes

Since the use of i-Sync in cast progressive lens design, it has also been developed to be included in the software for specific digitally-created KODAK Lens designs.



4000 Point Surface Analysis

i-Sync offers:

More consistent optical performance over the range of prescription power

Wider near viewing areas for hyperopes

Improved distance area for myopes

Improved image quality in principal viewing areas

Flatter base curve capabilities

The table below demonstrates how i-Sync™ Technology effects the area of vision. As you can see, the unwanted astigmatism has disappeared from the distance area and the astigmatism-free reading area has widened.

	Surface Analysis	What the patient will actually see	What the patient will see after the i-Sync™ applied
+5.00			
-5.00			

Dynamic Reading Optimization™

Introduced to meet the lifestyle of the modern presbyope who regularly views multiple devices at different distances, at the same time, Dynamic Reading Optimization™ (DRO) improves the overall optical performance of the lens while significantly reducing oblique astigmatic errors in the reading area.

The best performance in the viewing distance is reached by localizing the necessary adjustments. To better target the needed corrections for each viewing area, software splits the lens into three areas: distance, intermediate and near. Once individual viewing areas are adjusted, the three areas are merged back to create a highly-optimized viewing experience. This technology greatly reduces viewing errors, allowing the eyes to focus in the reading area for longer periods of time. For all prescriptions, DRO significantly reduces the oblique astigmatism in the reading zone as illustrated in the diagram below which compares a design with i-Sync to one with DRO.

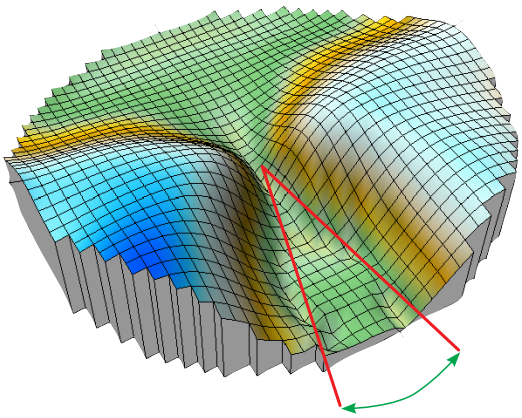
For more information regarding DRO, please reference the Dynamic Reading Optimization technical document.

An average increase in effective reading area of 17% over a range of prescriptions [1]

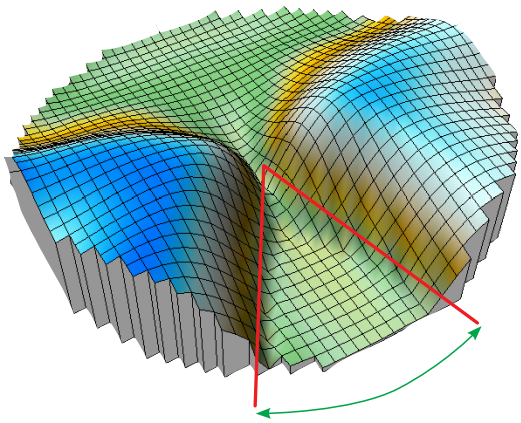
An average of 54% reduction in total oblique astigmatic errors in the reading zone [2]

1 (Based on an analysis of KODAK Unique II Lens compared to KODAK Unique Lens designs having 2.00D addition, with prescriptions ranging between +8.00D to -8.00D. Reading area determined as the area having >1.88D addition and <0.50D oblique astigmatism.)

2 (Based on an analysis of KODAK Unique II Lens compared to KODAK Unique Lens designs having 2.00D addition, with prescriptions ranging from +8.00D to -8.00D. Total oblique astigmatic error determined as the sum of errors at gaze angles ranging from 0-40 degrees in 5 degree steps.)



Standard Digital Design
Oblique Astigmatism Plot



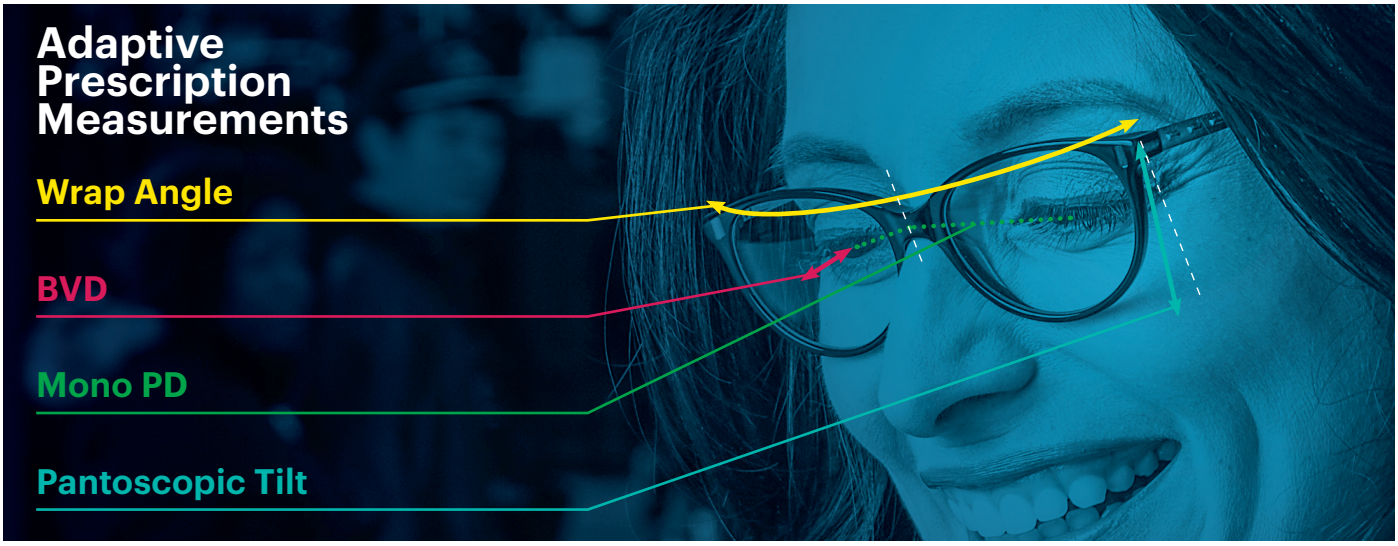
Useable reading area increased with application of DRO
Oblique Astigmatism Plot

Adaptive Prescription

When glasses are worn, the way a patient's chosen frames sit on his/her face can dramatically alter the viewing experience through the prescribed powers.

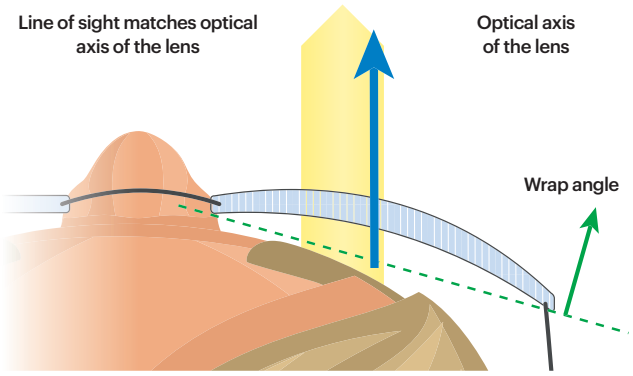
Adaptive Prescription is the ability to adjust a progressive lens design based on Point-of-Wear measurements to more highly adapt the lens to the individual patient's viewing needs.

Adaptive Prescription has been introduced in the highest tier of KODAK Progressive Lenses to calculate a compensated design which has been optimized for the individual patient.



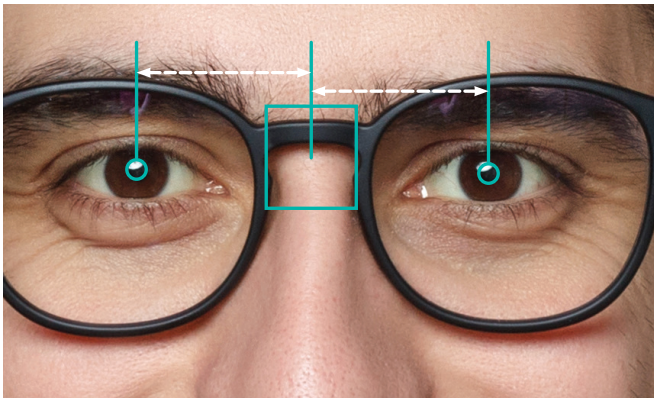
Wrap Angle

This refers to how much the frame is bowed. For a frame with a large bow, such as a wrapped frame, the wearer will notice a significant reduction in viewing through the correct prescribed power and that the optical centers will need to be readjusted accordingly.



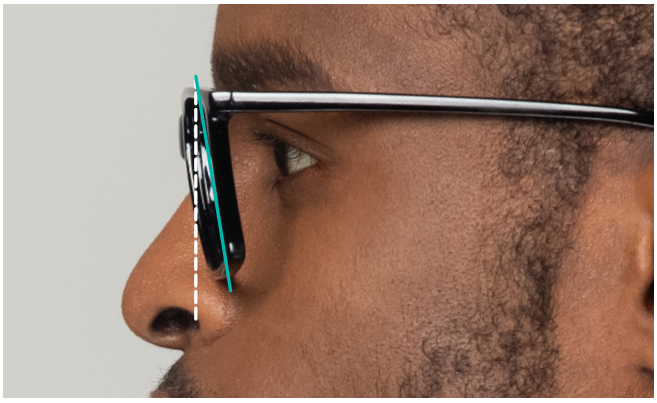
Back Vertex Distance

Slight modifications will be needed based on how close or far the wearer's eyes are to the back lens surface. A proper vertex distance allows the wearer the full benefit of width of the lens corridor.



Monocular PD

Measurement from the point where the line of sight intersects the lens to the center of the bridge of the frame. Even if the nose is symmetrical and centered, the wearer's eyes may not be equidistant from the centerline of the nose.



Pantoscopic Tilt

Depending on whether the frame sits flat to the face or at an angle will determine the necessary compensation needed to position the correct prescribed power in front of the eye.

Variable Inset

Reading habits of the individual patient are also important in creating a comfortable wearing experience for the patient.

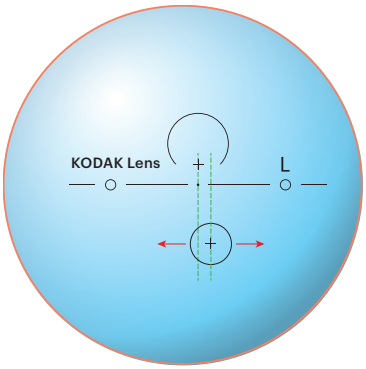
The variable inset allows the optimum reading area for the patient to match their convergence requirements based on the following parameters:

Near Reading Distance

Back Vertex Distance (BVD)

Lens Power

Monocular PD



Adaptive Prescription offers:

Customized wearer's experience

Greater field of view

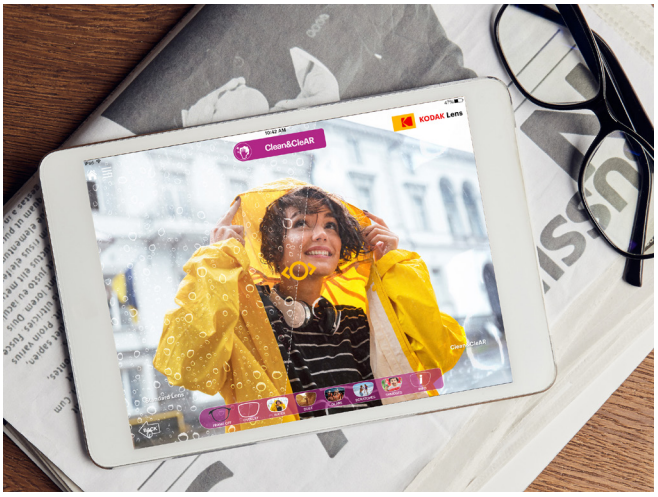
More accurate prescription

Wider frame choice for the patient

Thinner lenses on plus powers

Easier adaptation when changing design

NEW Lifestyle-Driven Technology



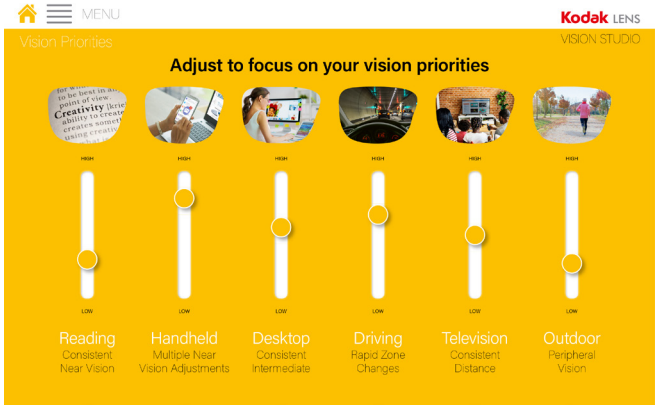
Consumers and lifestyles are constantly changing and therefore choosing a "one size fits all" type of progressive lens may not be the most suitable. New innovations in the KODAK Progressive Lens portfolio have been developed to meet these emerging needs and trends to give a much more personalized shopping and ultimately, viewing experience.

KODAK Create™ Lens with L.I.F.E. Technology
(Lifestyle Interactive Focused Experience)

Developed by applying advanced technology that provides outstanding performance while at the same time, making the complex simple and the inaccessible, accessible. These new lenses are user-friendly and are personalized to the wearer's needs by a simple 3-step process. This process is delivered via the use of the KODAK Lens Vision Studio™.

The KODAK Lens Vision Studio takes the patient along with the eyecare professional through these steps and questions to match the patient with a highly-customized design.

Step 1) What is the patient currently wearing today (if anything)?



Step 2) What is the patients vision preferences in terms of prioritizing their vision zones?

Step 3) Are there any changes to the design in real time to take into account any previous experience and improvements required?

In essence, the patient's current lenses and visual needs are assessed. Frame measurements along with other fitting parameters such as face shape and prescription are acquired.

The patient describes his/her general lifestyle and specific visual requirements to select a general gauge of distance to reading balance. To elevate the process, the ECP along with the patient are able to fine tune the design for greater customization.

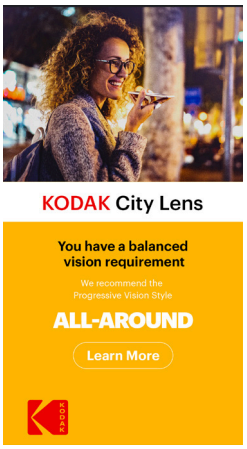
KODAK City Lens

Based on the same philosophy of lifestyle-driven technology but not carrying the same extent of customization, KODAK City Lens is a family of lenses to cater to the rigors of modern city living. Originally available as a single vision, KODAK City Lens Progressive Vision Styles have been developed into four lifestyle-orientated progressive lens designs keeping in mind a simple dispensing protocol.

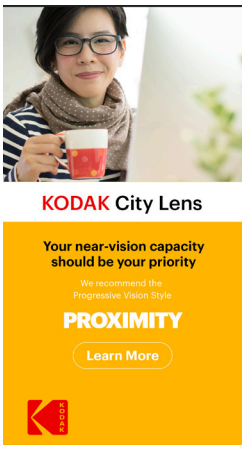
The patient completes a simple questionnaire to indicate the most ideal design.

Four Progressive Vision Styles

All-Around: A balanced design, with smooth transitions between all viewing zones, for active, all-day comfort.

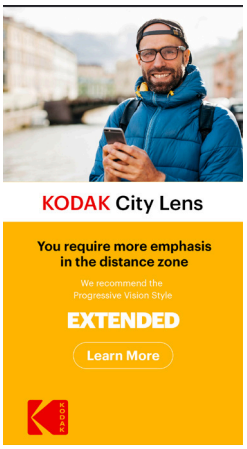


Proximity: Comfortable design with a broad near vision and smooth transition through the viewing corridor. Great for someone who spends a lot of time reading.



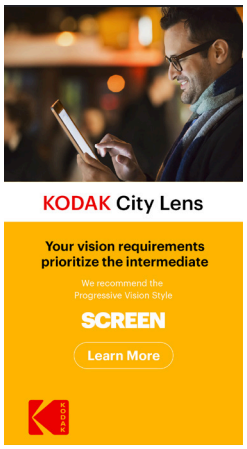
Extended: Large emphasis on distance and mid-vision zones.

Ideal for someone who works outdoors and/or spends a lot of time driving.



Screen: Maximizes mid-vision perception with minimal compromise in near and distance.

Ideally suited: Office-based life with a large proportion of the day viewing screens



To learn more about the performance of KODAK City Lens Progressive Vision Styles, please review the KODAK City Lens Progressive Vision Styles Technical Report.

By showing the historic development of KODAK Lens technologies and designs, the continued drive for advancement is apparent. The KODAK Digital Progressive Lens range today consists of many unique and advanced technologies while continuing to introduce lens designs that are easy to use, improve the wearer's quality of vision and thus, quality of life.

	Surface			Corridor (mm)	Vision First Design™	i-Sync™	DRO™	Adaptive POW	LIFE Lifestyle Interactive Focused Experience
	Back	Dual	Cast						
Create	●			13 to 18	●	●	●	●	●
Unique II/DRO HD	●			13 to 18	●	●	●	●	
Unique II/DRO	●			13 to 18	●	●	●		
Unique HD	●			13 to 18	●	●		●	
Unique	●			13 to 18	●	●			
City	●			13, 14, 16, 18	●	●			●
Network/Atlas	●			13, 14, 16, 18	●	●			
Easy+	●			13, 14, 16, 18	●				
Easy	●			13, 14, 16, 18					
Precise Digital	●	✚		13, 17	●	●			
Precise PB	●			13, 17	●				
Precise			●	13, 17	●				
Intro	●			18					

✚ U.S. Only

KODAK Anti-Reflective Lens Coatings have experienced an evolution over the years, introducing a progression of new features that benefit the lens wearer's vision as well as the cosmetic appearance of the lens.

The world of lens coatings involves continual testing for performance, protection and quality. KODAK Lens continues to work at offering Anti-Reflective Lens Coatings that align with the quality associated with the KODAK name as well as meet and exceed current tests and regulations.

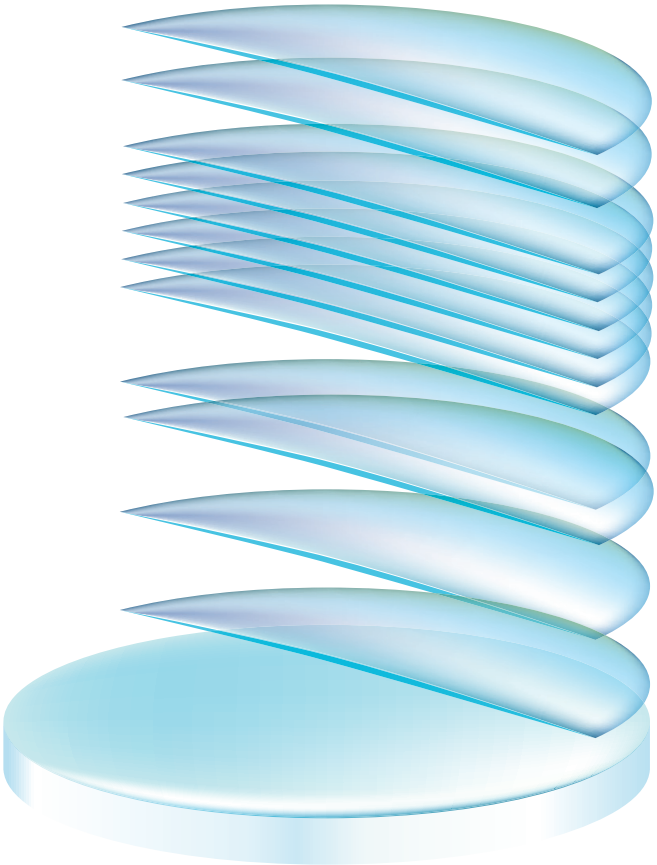
This document presents the technology, process and features available along with the various tests performed to verify the quality of KODAK Anti-Reflective Lens Coatings.

Purpose – Transmitting Light

KODAK Anti-Reflective Lens Coatings were originally developed to increase the transmission of light for the lens wearer. The more light transmitted into the eye, the clearer the vision.

An AR lens coating involves applying extremely fine layers to the surfaces of the lens to minimize reflections and maximize transmission. Multiple layers build on each other to provide a series of benefits with reduction of reflections being only one of many.

It is also important to note that although it may seem that the more layers, the higher the quality, this not necessarily true in the development of AR Lens Coatings. What is more integral to the performance of the AR lens coating is how the layers are stacked and how they have been formulated to interact with each other.



The process and procedures used for KODAK Anti-Reflective Lens Coatings are highly regulated and tested since the application of these AR Coatings are incredibly complex and monitored to make sure integrity is maintained.

KODAK Anti-Reflective Lens Coatings undergo rigorous testing both in-house as well as using a third-party testing facility.

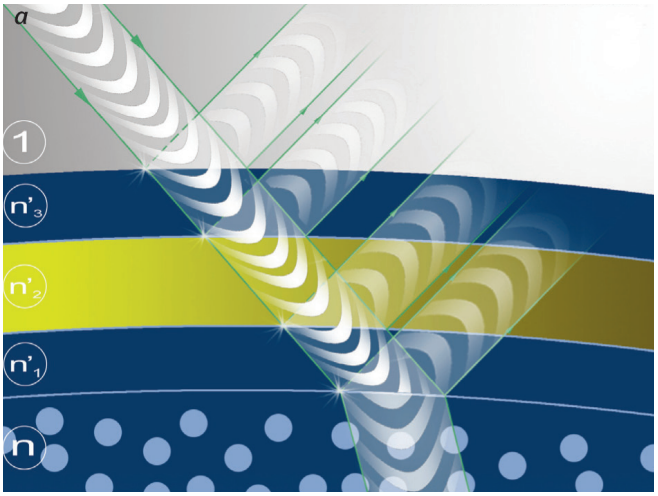
The effectiveness of an AR lens coating is measured by its reflection spectrum. The reflection spectrum is the intensity of the reflected light as a function of the wavelength.

Efficiency	Reflection Per Surface	Transmission
High	0.3–1.0%	97.5–99.0%
Medium	1.0–1.8%	96.0–97.5%
Low	1.8–2.5%	94.5–96.0%

More Light, Less Reflections

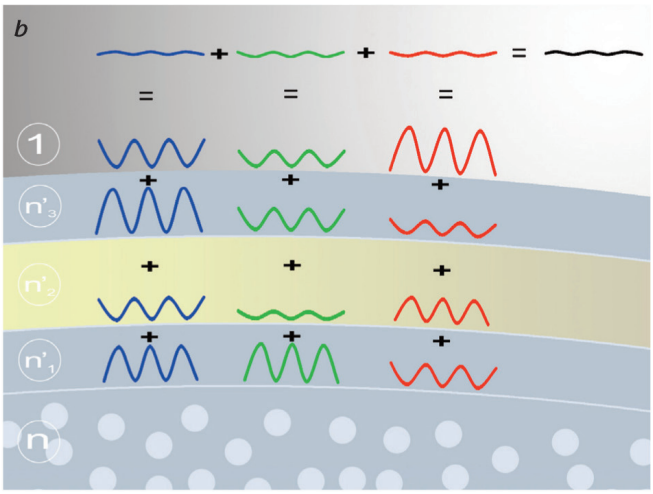
The original purpose of an anti-reflective lens coating is to minimize distracting reflections while maintaining maximum light transmission. The application of a KODAK Anti-Reflective Lens Coating minimizes or eliminates reflections of all kinds, during the daytime and also at night. This is incredibly helpful to all lens wearers and is an added benefit to the lens design and durability.

Because of the tendency of a lens to reflect all types of light, this can lessen and impair the lens wearer's vision. High index materials can experience an even higher level of reflected light, making a high-performing anti-reflective lens coating a greater necessity.



Principle of "multilayer" anti-reflective coating: Multiple interferences

Because the lens material is a three dimensional item, light reflects off the front surface, passes through the lens and reflects again from the back of the lens. This results in reducing the intensity of the light that is transmitted through the lens.



Principle of "multilayer" anti-reflective coating: Cancellation of reflected waves

The higher the refractive index of the material, the greater the reflected light. The loss of light transmission can be up to 15-20% on high index lens materials.

FEATURES

Glare
Eliminates distracting reflections and glare visible to others

Night-time Reflections
Reduces reflections for more comfortable night driving

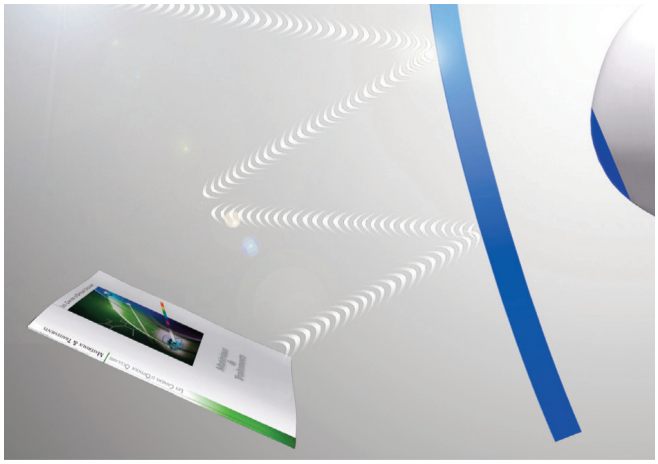
Scratch Resistant
Protects from scratches so lenses last longer and look better

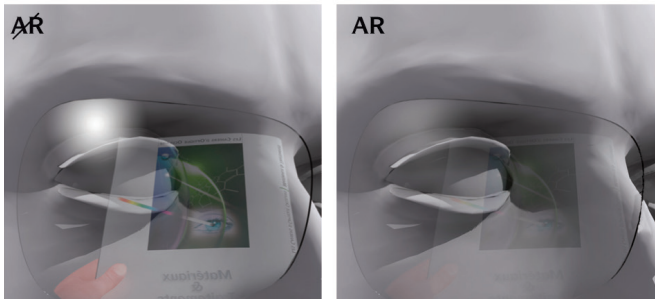
Easy To Clean
Resists oily smudges, dust and dirt

Water Repellent
A super-slick hydrophobic layer seals the lens, repels water and dust

Types of Reflections

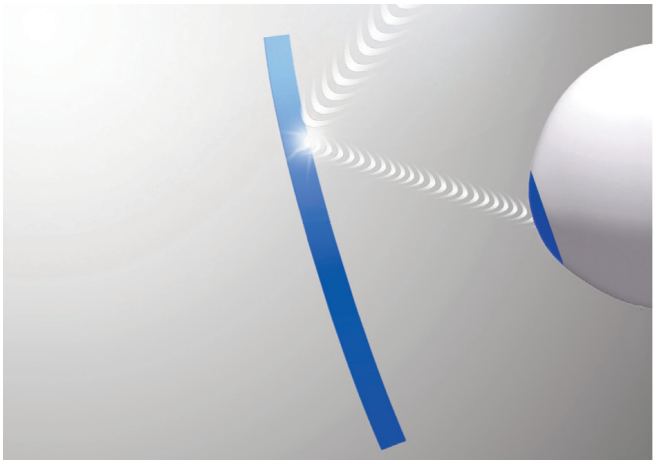
There are three different types of reflection. All three types reduce the transmission of light through the lens and cause reflections to the wearer as well as those looking at the wearer.

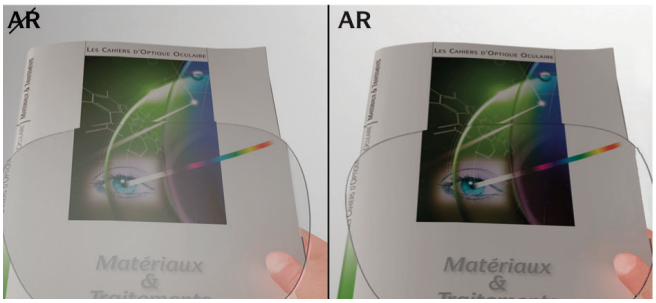




Front-Surface Reflections

Reflection from the front surface of the lens can cause a mirror effect. This results in the person looking at the front side of the lens to see a mirror image. This primarily cosmetic benefit has long been touted in the development of AR lens coatings. Though in the order of importance for AR Lens coating benefits, it is the least beneficial directly to the lens wearer.

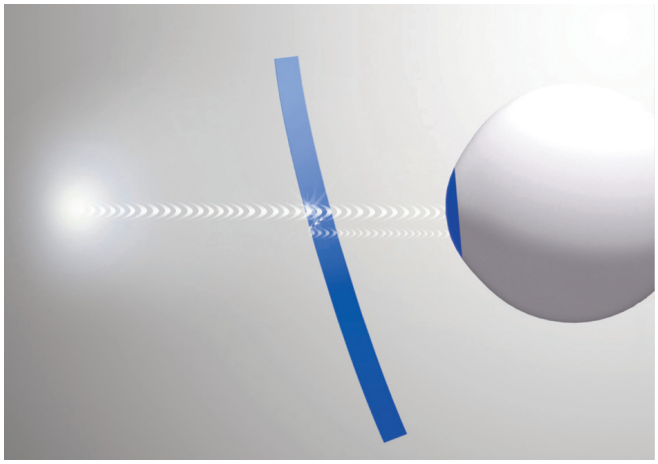


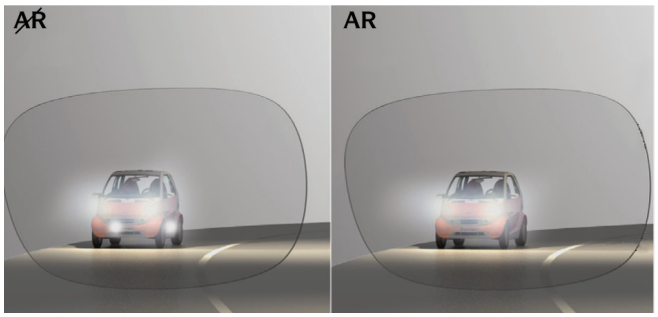


Back-Surface Reflections

Reflection from the rear surface is when light comes from behind the lens wearer. A majority of times, these involve low-light conditions such as night driving. Reflected light can be superimposed over the light from the scene being observed and cause a reduction in contrast and in the quality of vision. Rear reflections may also cause glare.

When KODAK Anti-Reflective Lens Coatings is used in this type of situation, it is possible to significantly reduce the effect on the wearer's visual contrast and minimize glare. This is an incredible benefit especially in potentially dangerous situations that require the ability to identify potential hazards.





Internal Reflections

Internal reflection involves double image. Through a series of refractions and reflections of light as it encounters the surfaces of the lens, a second less intense and slightly displaced image can appear. This double image can be reduced by applying KODAK Anti-Reflective Lens Coatings to both surfaces of the lens.

When a KODAK Anti-Reflective Lens Coating is applied, it is possible to reduce the loss of light transmission to less than 1%.

Scratch Resistance

Scratch resistance is a necessary feature of KODAK Anti-Reflective Lens Coatings. This benefits the lens wearer's vision while also increasing the durability and longevity of the lens.

There are two types of scratches: fine scratches, where small particles rub against the lens surfaces, and large scratches, where large particles rub against the lens surfaces or the lens comes in contact with a damaging surface. The application of scratch-resistant properties works to counteract any possible damage from both fine and large scratches.

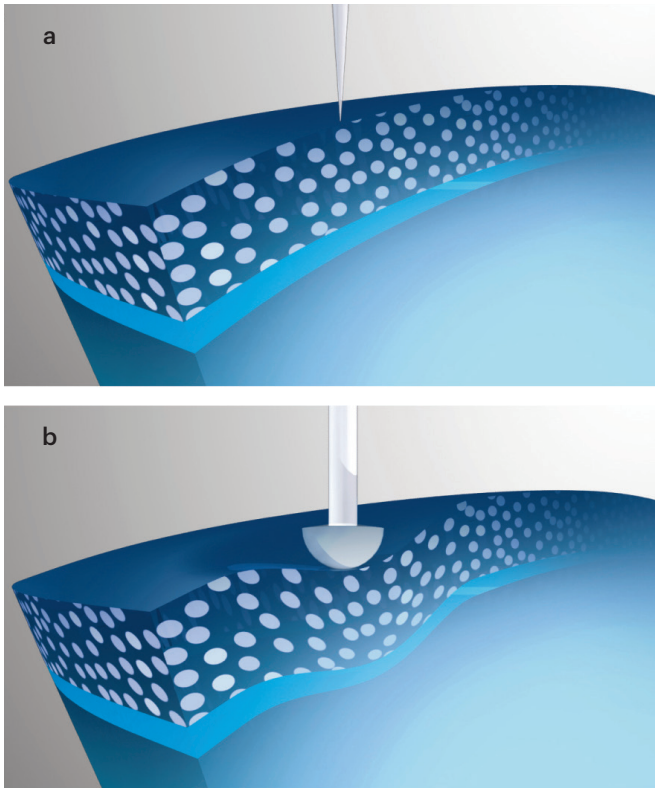
KODAK Anti-Reflective Lens Coatings undergo various tests that simulate abrasions and scratches. The three possible tests are:

Bayer Test: sample lens is moved back and forth in a container with an abrasive substance.

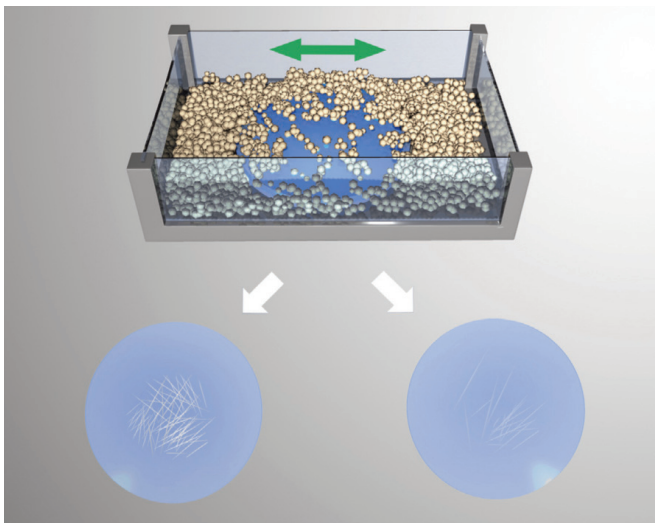
Abrasimeter Test: a sample lens is rubbed with a particle-encrusted tape multiple times under a degree of pressure.

Steel Wool Test: a sample lens is rubbed with a fine steel-wool pad, either manually or with some type of machine.

In all three tests, the sample lens is then compared to a controlled sample lens to calculate performance.



Principle of anti-scratch coating:
a) Fine scratches b) Large scratches



Measuring abrasion-resistance performance using the Bayer Test

Smudge Resistance

Fingerprints as well as oily transfers onto the lens are a nuisance to the lens wearer.

When a KODAK Anti-Reflective Lens Coating includes a smudge-resistant top coat, it repels oily matter and reduces the ability for it to adhere because of the slippery surface, making the lens easier to clean.

The application of an AR coating to a lens surface, makes the lens highly susceptible to microscopic dirt particles that are more visible on a very transparent lens. An extra layer is added to provide the benefits of oil and water resistance.

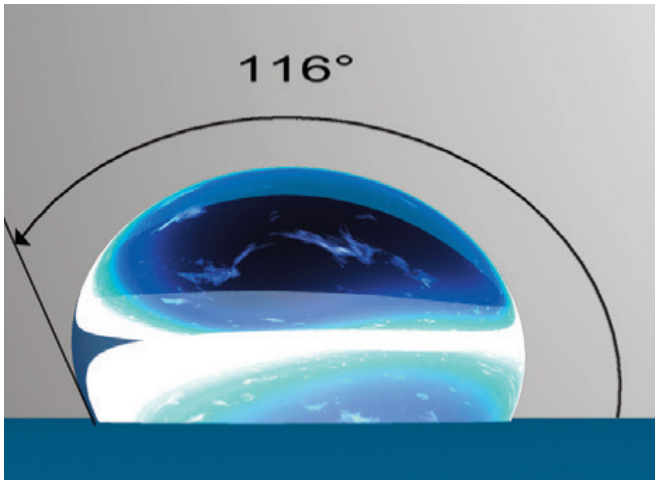
An oleophobic and hydrophobic coating functions in three ways:

- Repels molecules of oily matter and reduces the ability for the oily matter to adhere to the lens surface.
- Protects against oily matter settling into the AR lens coating.
- Allows easy removal by making the lens surface very slippery.

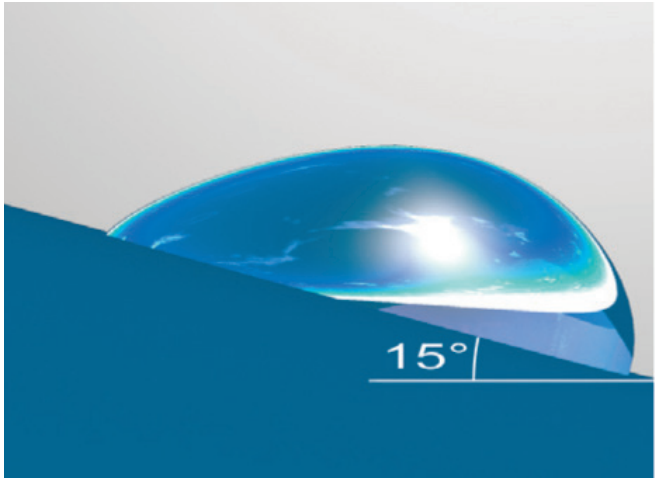
The application of an oleophobic and hydrophobic layer does not impact the performance of the AR lens coating.

The quality of an anti-smudge coating is measured by the "contact angle." The angle is the one between the lens surface and the tangent at the end of the drop.

The greater the contact angle, the greater smudge resistance of the lens coating.



Contact Angle

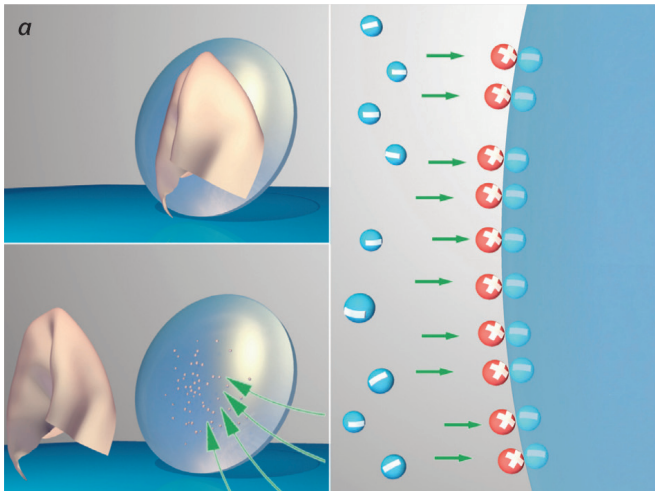


Slide Angle

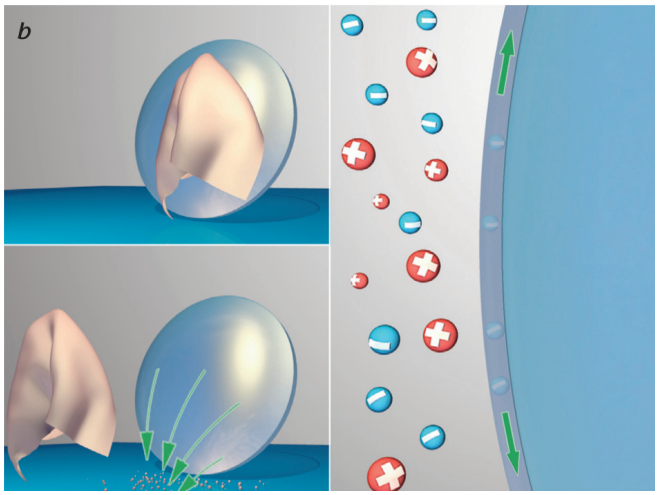
Dust Resistance

Dust accumulation on lenses is another nuisance that a lens wearer may encounter. KODAK Anti-Reflective Lens Coatings with dust-resistance involve the stacking of layers so dust particles are less likely to cling to the lens.

When the lens surface is rubbed, it causes an electrostatic charge. This can cause an accumulation of dust and lint on the lens surface. The anti-static coating helps minimize the collection of dust and lint on the lens surface as well as makes removal of any dust quick and efficient.



Principle of electrostatic attraction of dust



Repulsion of dust by a coated lens

Performance and Protection

Some may view the minimizing of distracting reflections as mainly a cosmetic benefit, which is not the case. The main benefits of KODAK Anti-Reflective Lens Coatings are visual clarity and the protection of both the lens wearer's vision and the lens itself.

Increasing Lens Longevity

KODAK Anti-Reflective Lens Coatings are also a protective factor against yellowing. The lens coating does this by acting as a barrier against oxygen, which stimulates lens aging. An AR-coated lens has a decreased tendency to yellow than an untreated one.

Testing

The following is a list of various tests that are used to determine the quality and performance of KODAK Anti-Reflective Lens Coatings. Other tests can be used but the following have been selected because they are the most-widely used.

Cary 60 for UV Protection and Appearance – Cary 60 is a spectrophotometer that measures for UV protection (measured in nanometers). The Cary 60 is also used to measure the level of glare on the lens which impacts the appearance of the lens (measured in percentage of transmission).

Bayer Test for Scratch Resistance – A coated lens and an uncoated lens are moved back and forth in a container with an abrasive substance. After a set number of cycles, the haze gain is measured on both lenses. The ratio of haze gain of the uncoated lens to the coated lens is the Bayer Ratio. A Bayer Ratio of "1" means that the coating has equivalent abrasion resistance to uncoated CR-39. A Bayer Ratio of "5" means that the uncoated CR-39 standard had five times the haze gain as the coated lens. A common standard Bayer Ratio equal to "4" or greater is considered by the industry to be a premium coating.

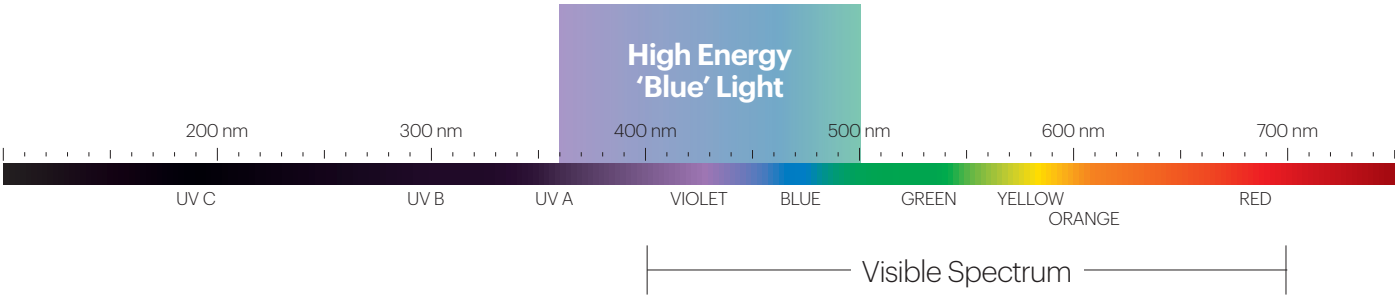
JCI Test for Dust Repellence – Static electricity is used to measure how quickly a deposited charge dissipates. Passing result is recorded with 'OK.'

Ink Test for Oleophobic/Hydrophobic – Sample lens is marked with an ink pen. An 'OK' on this is noted when the ink can be easily wiped off.

Creating products that help in the filtering of potentially Harmful Blue Light while harnessing the power of good blue light has been a specific area of innovation and focus for the development of the KODAK Lens portfolio. The purpose of this document is to explain the interaction of vision with color and specifically, the benefits of KODAK Lens products that target sections of the color spectrum that could be potentially harmful to the lens wearer's eyes.

Visible Spectrum

The visible light is the portion of the electromagnetic spectrum that is visible to the human eye. The visible spectrum is created by different energy wavelengths measured in nanometers (nm). Blue Light is the portion of the electromagnetic spectrum with wavelengths between 380 and 500nm. Blue-turquoise light ranges from 465-495nm and it serves many benefits to humans including regulation of the sleep cycle. As wavelengths increase in distance, their energy diminishes. The short wavelengths at the blue end of the spectrum have the most energy. The high energy end of the visible light spectrum is known as High Energy Visible (HEV) Blue Light. Studies have shown that HEV Blue Light between 415 and 455nm is the most harmful. These same studies showed maximum cell damage from 415-455nm, with a peak at 435nm.[1]



1 Barrau C, et al. Blue Light Scientific Discovery. Essilor White Paper 1.0, 2013. Arnault E, Barrau C, Nanteau C, Gondouin P, Bigot K, et al. Phototoxic Action Spectrum on a Retinal Pigment Epithelium Model of Age-Related Macular Degeneration Exposed to Sunlight Normalized Conditions. PloS One,23 August 2013, 8(8)

Blue Light and The World Around Us

Although a large amount of blue light exposure comes from the sun, the increasing prevalence of blue light emitting devices has introduced the potential for another level of vision protection. Technology has made a large impact not only on how we communicate and keep in touch with the world, but also the amount of devices and time we spend using them.

We may spend a majority of our days being exposed to potentially Harmful Blue Light without even knowing it. It is common knowledge that we need protection against UV rays, not only for our skin, but for our eyes. In recent years, increasing numbers of eye health specialists are suggesting we need protection from our digital devices.[2]

Ultraviolet Light

As well as the potential damage of HEV Blue Light is the known concern of Ultraviolet light.

We are all aware of the importance of applying sunblock to our skin to prevent sunburn. Those same harmful UV rays may have an impact on eye health, accelerating eye aging and may also contribute to a variety of severe eye conditions, including cataracts.

HEV Blue Light

Specifically, the prolonged usage of digital devices has increased the average person's exposure to HEV Blue Light. It is not clear what long-term damage HEV Blue Light causes, but various studies have shown a potential link with AMD (Age-Related Macular Degeneration), Digital Eye Strain and disrupted sleep patterns. [3]

2 Barrau C, Villette T, Cohen-Tannoudji D. Blue light: Scientific discovery. Essilor. 2013 February; 1-49. Blue Light Hazard: New Knowledge, New Approaches to Maintaining Ocular Health, Report of a Roundtable, 2013

3 www.health.harvard.edu/staying-healthy/blue-light-has-a-dark-side

Sources of UV and HEV:

Daylight

Sunlight is the electromagnetic radiation, which reaches the earth from the sun and is not filtered by the upper atmosphere. It also contains a high proportion of Blue Light.

Up to 80% of UV rays can pass through the clouds on an overcast day.[4]

Up to 40% of damage caused by UV rays occurs when we are not directly in the sun.[4]

LED Backlit LCD

Many modern devices use LED as a light source for backlighting LCD screens, these often emit peaks of Blue Light in the shorter wavelengths of 400-455nm. 35% of the optical radiation from LEDs is blue.[5]

Fluorescent

The cool blue light or 'daylight' fluorescent bulbs give strong white light for good color rendition, but emit strong levels of HEV Blue Light.

4 U.S. Environmental Protection Agency, Review of Ophthalmology, Skin Cancer Foundation.

5 Barrau C, Villette T, Cohen-Tannoudji D. Blue light: Scientific discovery. Essilor. 2013 February; 1-49. Blue Light Hazard: New Knowledge, New Approaches to Maintaining Ocular Health, Report of a Roundtable, 2013.

Good Blue Light

Not all blue light is bad. Certain portions of blue light on the visible spectrum are an essential part of our daily rhythm, and control our sleeping and waking patterns. This is why it is important not to "block" all blue light but rather to filter certain parts of the color spectrum to still receive the benefits of good blue light and maintain good color vision.

Exposure to artificial 'Blue Light' during naturally dark periods after dusk or before dawn can affect the body's ability to switch off and produce natural hormones associated with the Circadian Rhythm.[6]

HEV Blue Filters can reduce the impact on sleep cycles from the use of unnatural sources of HEV during normally darker hours after dusk

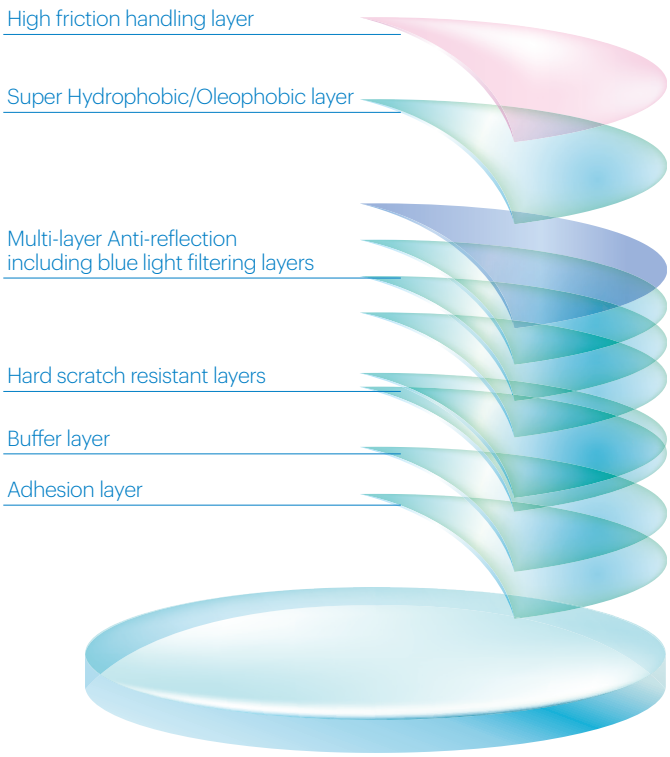
6 www.preventblindness.org

Blue Light Filtering in A Lens Coating

KODAK Lenses creates specific products, in both materials and coatings, to minimize the potential harmful effects of HEV Blue Light while maximizing vision and color clarity.

A blue light filtering lens coating can be applied to the lens, to provide a certain level of potentially Harmful Blue Light filtering as well as the benefits of an AR lens coating.

A blue light filtering lens reduces glare caused by blue light entering the eye and therefore enables the wearer to better compensate for lighting conditions and offers a greater visible contrast. This type of coating may have a blue hue reflectance color compared to the majority of anti-reflection coatings that have a green residual hue.



Blue Light Filtering AR

By changing the thickness and formation of the multi-layer anti-reflection coating stack, the amount of potentially Harmful Blue Light entering the eye is decreased.

Blue Light Filtering Lens Materials

The development of specific lens materials is another level of protection from damaging UV rays while filtering potentially Harmful Blue Light.

This type of material is virtually clear in colors.

Blue Light filtering materials include specially-formulated monomers that absorb HEV Light transmission, block UV and filter potentially Harmful Blue light.

Blue Light Filtering in Photochromics

Photochromic lenses darken with exposure to UV rays. This type of lens is especially convenient for people who spend equal time indoors and outdoors. A photochromic lens is also ideal for those that experience light sensitivity. An additional benefit of a photochromic lens is the ability to filtering Harmful Blue Light at all times.

With and without comparison of HEV Blue Light source such as a handheld tablet

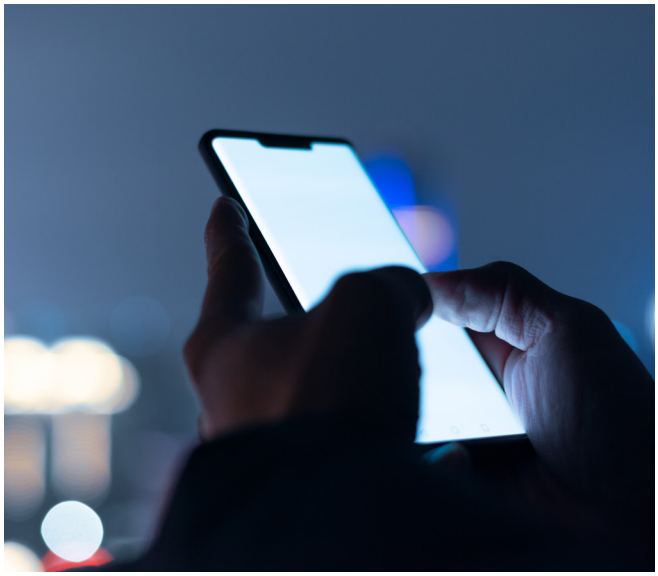
For dramatization purposes only.

A photochromic lens protects against UV rays and filter potentially Harmful Blue Light.

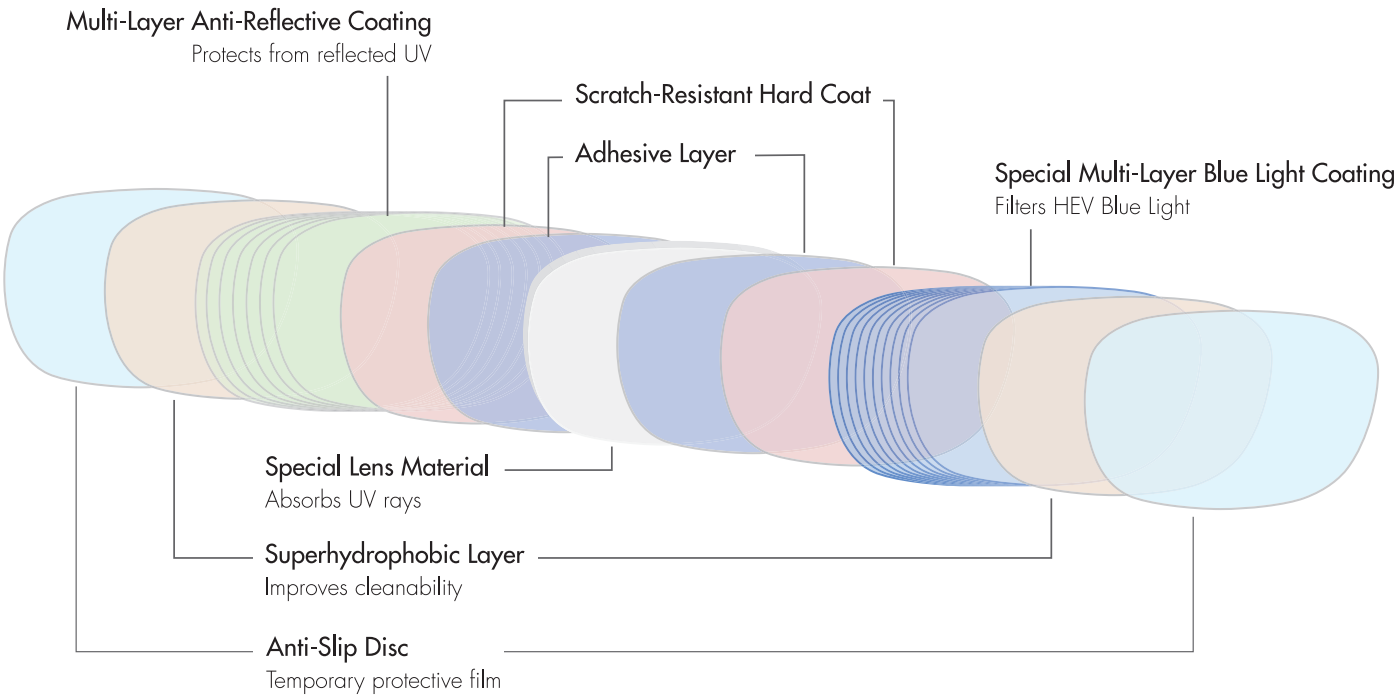
Combining Material and Coating for Blue Light Filtering

The combination of lens material and coating allows for the highest level of blue light filtering in a clear lens as well the additional benefits associated with an anti-reflective lens coating.

This lens and coating combination blocks 100% of UV light from the sun, filters out potentially harmful blue light emitted from digital screens and reduces the reflections and glare of blinding lights both day and night.



Harmful Blue Light might contribute to visual fatigue, and modern lifestyles mean it is almost impossible to avoid.



An example of a combination of lens coating and material to filter HEV Blue Light.

With the use of digital devices as well as time spent online increasing year over year, the need for protection from potentially Harmful Blue Light exposure has also increased. We do not know for certain to what extent the long-term impact will be on vision. The KODAK Lens portfolio continues to create different levels of protection to guarantee that all patients will have a solution to fit their vision needs.

Product	Photochromic	HEV Protect Source			Features
		Coating	Material	Combination	
Total Blue*				●	Offers highest level of UV protection and Harmful Blue Light filtering in a clear lens.
City				●	Increased clarity for nighttime driving
EvoBlue	●		●		Provides UV Protection and Harmful Blue Light filtering in a photochromic lens
UVBlue			●		Provides UV Protection and Harmful Blue Light filtering
BluProtect		●			Reflects Harmful Blue Light in a clear lens.

*North America Only.

KODAK Lens
See the Colors of Life