



KODAK Progressive Lens Technologies
Technical Report



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 Progressive Lens range.



The beginning...

KODAK Lenses have been available since 1993 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Cast progressive technology has been superseded by utilizing technologies where a complex surface can be directly machined onto a semi-finished lens blank.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.



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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 the potential degradation of the lens mold over time is reduced.

Simplifying the lens 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.



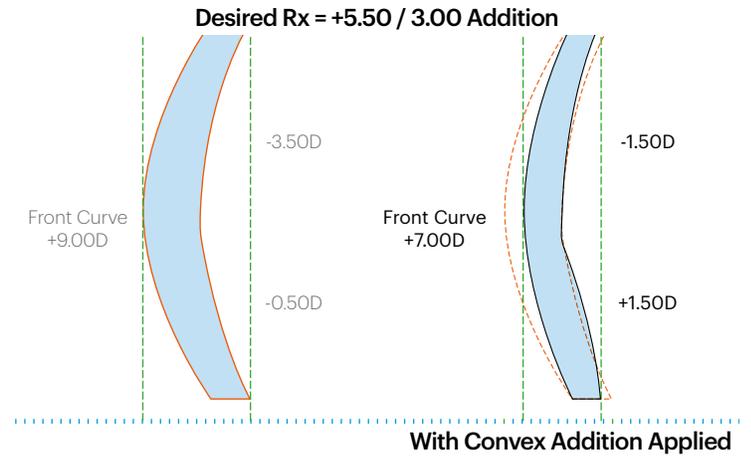
Advantages of Digital Lenses

- 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

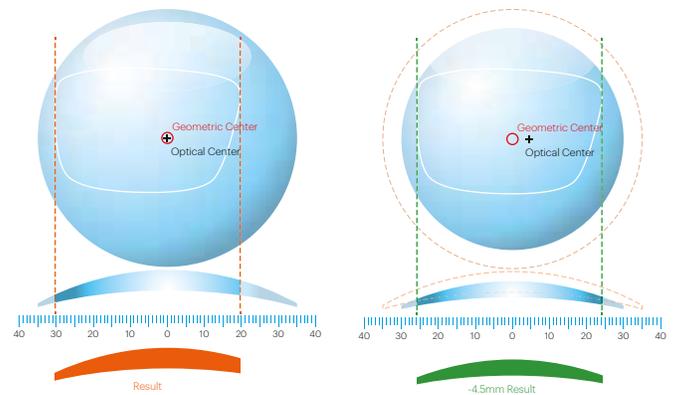
Freeform machinery and computer software are able to control and design complex 3D surfaces, meaning for some prescriptions, the power can be created using a flatter base. The ability to produce a convex curve while cutting on a concave surface allows a flatter base curve and will produce a more aesthetically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



Variable Decentration

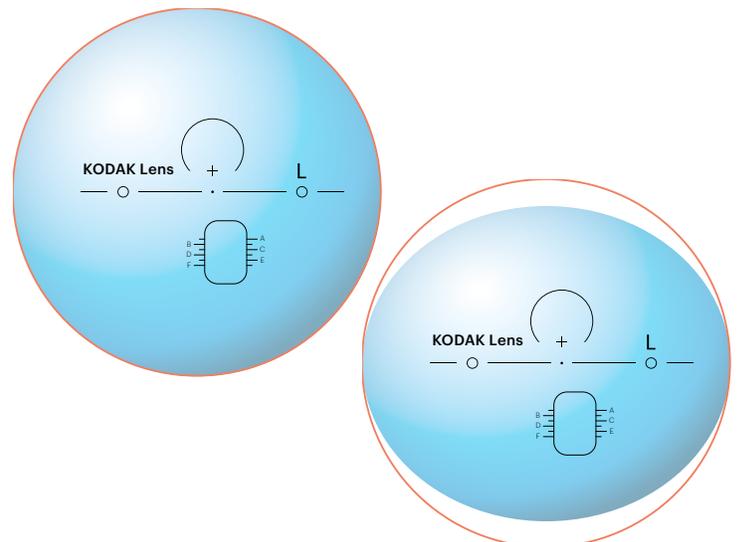
Freeform allows the computer software to recalculate and move the optical center of the lens design away from the geometric center of the blank.

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.



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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.

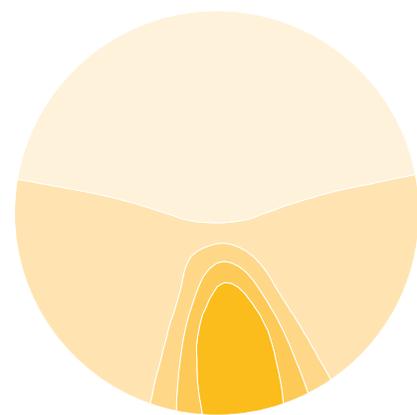


Vision First Design offers:

- 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

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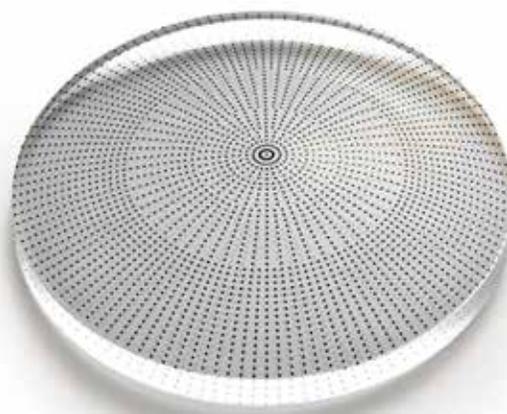
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i-Sync™

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.

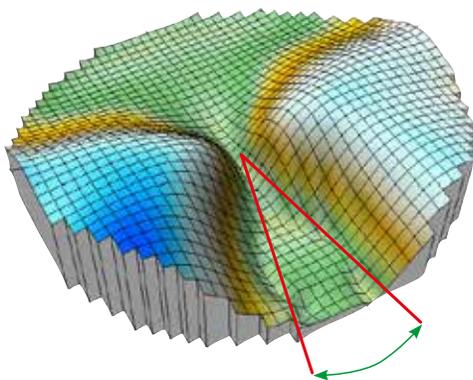
	Surface Analysis	What the patient will actually see	What the patient will see after the i-Sync™ applied
+5.00			
-5.00			

Dynamic Reading Optimization®

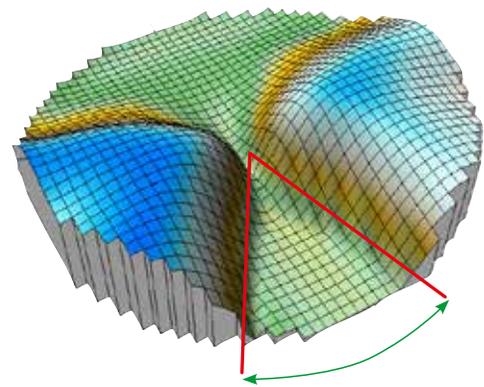
Introduced to meet the lifestyle of the modern presbyope who regularly views multiple devices at different distances, at the same time, Dynamic Reading Optimization (DRO) improves the overall optical performance of the lens while significantly reducing oblique astigmatic errors in the reading area.

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.



Standard Digital Design
Oblique Astigmatism Plot



Useable reading area increased with application of DRO
Oblique Astigmatism Plot

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 DRO 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 DRO 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.)

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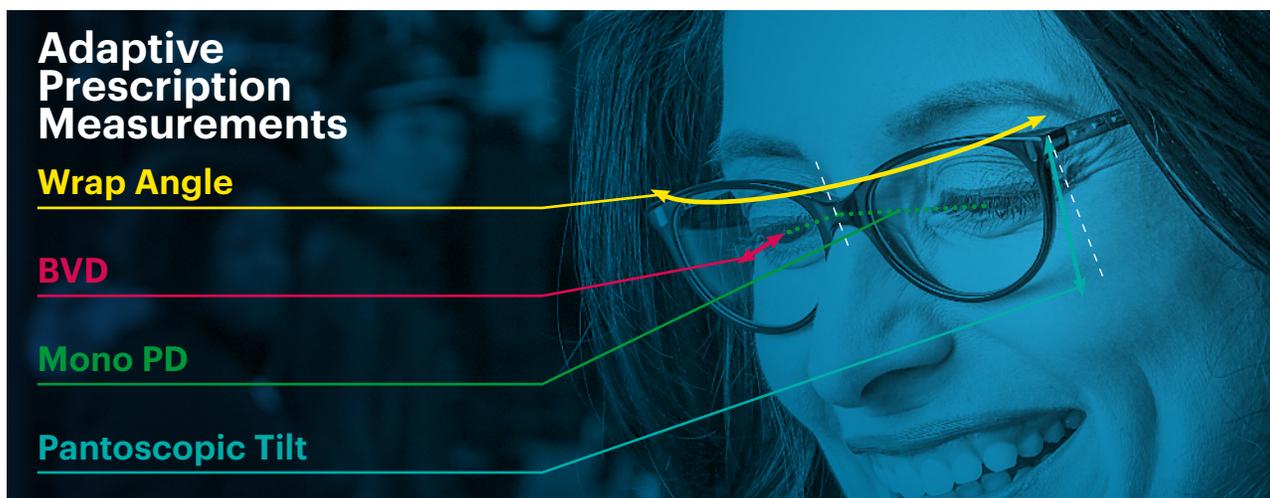
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Adaptive Prescription (HD Customization)

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.

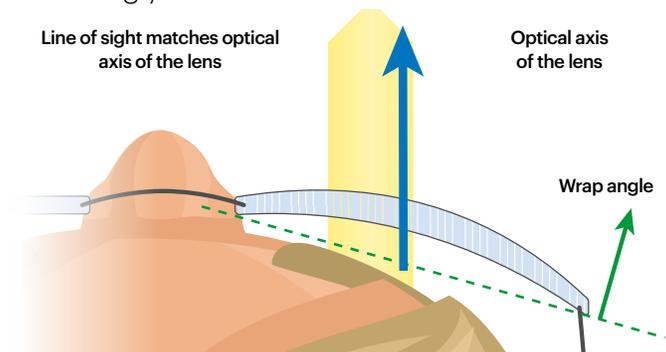
Adaptive Prescription is the ability to adjust a progressive lens design based on Point-of-Wear measurements to more highly adapt the lens to the individual patient's viewing needs.

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

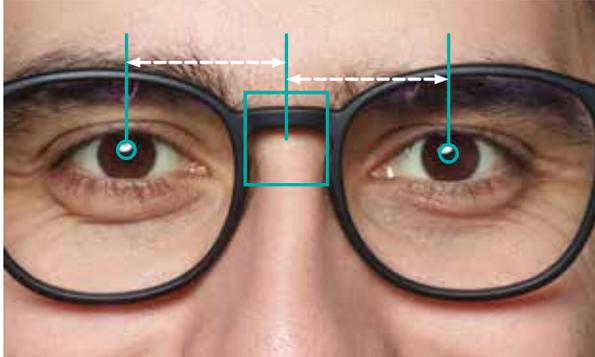
This refers to how much the frame is bowed. For a frame with a large bow, such as a wrapped frame, the wearer will notice a significant reduction in viewing through the correct prescribed power and that the optical centers will need to be readjusted accordingly.



Back Vertex Distance

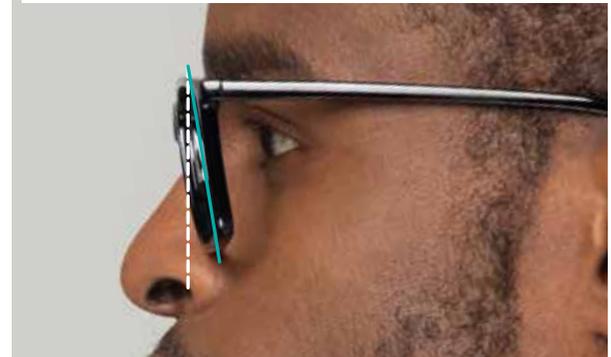
Slight modifications will be needed based on how close or far the wearer's eyes are to the back lens surface. A proper vertex distance allows the wearer the full benefit of width of the lens corridor.





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.

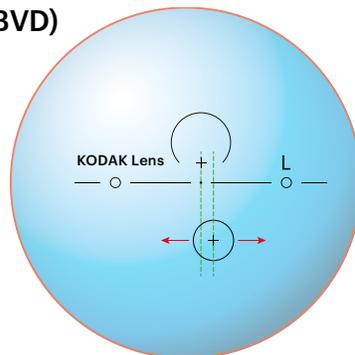
The variable inset allows the optimum reading area for the patient to match their convergence requirements based on the following parameters:

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

KODAK Progressive Lens Portfolio

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
	Back	Dual	Cast					
Unique DRO HD	●			6: 13 to 18	●	●	●	●
Unique DRO	●			6: 13 to 18	●	●	●	
Unique HD	●			6: 13 to 18	●	●		●
Unique	●			6: 13 to 18	●	●		
Precise Plus/Short	●	●		13, 17	●			
Precise PB/ Short	●			13, 17	●			
Precise/Short			●	13, 17	●			
Easy	●			14, 18				

RESOURCES:

www.KodakLens.us / www.SignetArmorlite.com / www.SALitOnline.com

contact: 800-830-3995

email: KodakLensHotline@signetarmorlite.com



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