TRIVEX™

PPG INDUSTRIES

The Tri-Performance Lens Material.

User's Guide

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Introduction

Welcome to the world of possibilities made available through Trivex™ lens material — the first to offer a combination of superior optics, impact resistance and ultra-lightweight qualities in a single lens material. *Trivex* lens material gives patients the attributes they want while delivering the advanced optical performance demanded by eyecare professionals.

To help you to effectively prescribe, recommend and process lenses made from *Trivex* material, the knowledgeable professionals at PPG Industries Optical Materials Group have created this comprehensive Users Guide. The guide includes sections on the history of *Trivex* material and its technical properties. Special sections give advice on recommending lenses made from *Trivex* material and tips for dispensing. The Laboratory section features tips on surfacing and finishing, tinting and drilling lenses made from *Trivex* material for rimless eyewear.

Laboratories and eyecare professionals with in-office edging equipment can also refer to our educational CD-ROMs entitled, "The Trivex™ Material Edge, Volumes I and II" for tips and instructions on how to edge lenses made from *Trivex* material using a variety of state-of-the-art edgers as well as popular edgers manufactured and sold before *Trivex* material was introduced. These videos can be viewed from our Web site: www.ppgtrivex.com.

If you have any questions, please don't hesitate to contact your lens distributor for further assistance or visit www.ppgtrivex.com for more information.

On behalf of all of us at PPG's Optical Materials Group, I thank you for your support in making *Trivex* lens material the material of choice for your patients.

Sincerely,

Christine Camsuzou
General Manager
PPG Optical Materials
Monroeville, PA

The History of Trivex™ Lens Material

Originally developed as "visual armor" for the military, PPG Industries adapted the plastics technology in 2001 for use in the ophthalmic industry and called it *Trivex* lens material because of its unique tri-performance properties.

An entirely new category, *Trivex* material was the first to offer the combination of excellent optics, strength characteristics and ultra-lightweight qualities in a single lens material.

The growth in demand for lenses made from *Trivex* material around the world has been unprecedented. This rapid acceptance is a testimony to the material's exceptional properties. Eyecare professionals have discovered that they can rely on *Trivex* material, and patients are experiencing its valuable package of benefits.

Because the attributes of *Trivex* material make it an appealing choice for a variety of patients, manufacturing and distribution partners are continually expanding options in lens types and designs, and new partners are coming onboard. As the number of lens lines increases in each country, and as availability expands to new countries, the growth trend for *Trivex* lens material is expected to remain strong into the future.

Lenses made from *Trivex* material provide sharp vision, protection and comfort.

Timeline for *Trivex* Material

Year	The History of *Trivex* Lens Material
2001	PPG develops *Trivex* material for ophthalmics.
2002	Hoya Vision Care launches new Phoenix lenses in the US.
	Younger Optics launches Trilogy® lenses in the US.
	Trivex material awarded Optical Laboratories Association Award of Excellence in the "Best in Lens Materials" category.
2003	Hoya launches PNX lenses in Europe.
	Younger introduces Trilogy® lenses in Europe.
	Thai Optical Group offers Excelite™ TVX brand of lenses in Europe and Asia.
2004	Augen Optics introduces Trinity™ double aspheric lenses, representing the foray of *Trivex* material into the Latin America market.
	Thai Optical begins marketing Excelite™ TVX lenses in the US.
	Shamir Optical markets its Genesis™ lenses in *Trivex* material in Europe and the US.
2005	X-CEL Optical Company launches its line of Aris™ lenses made from *Trivex* material in single vision, trifocals and D28 bifocals.
	The American Optometric Association (AOA) recognizes *Trivex* material with their Seal of Acceptance for Ultraviolet Absorbers/Blockers.
2006	Signet Armorlite begins marketing KODAK Concise™ and Precise™ Lenses made with *Trivex* material.

The Technical Features of Trivex™ Lens Material

The technical features of *Trivex* optical lens material provide superior benefits to your patients. Once you understand them, you will appreciate why lenses made from *Trivex* material represent the best choice for nearly every one of your customers.

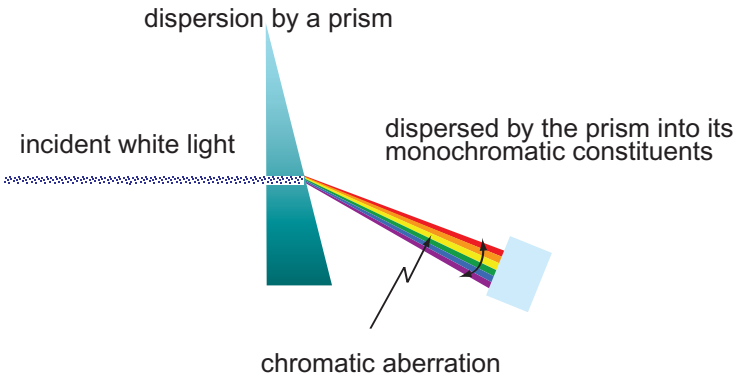
Trivex material is a urethane-based pre-polymer. In 2001, PPG developed and refined it for use as an ophthalmic lens material. Lenses made from *Trivex* material are cast in molds using a special machine and thermally cured. The tri- performance properties of the material provide for crisp and clear, strong and safe, light and thin lenses when compared to other materials currently available. *Trivex* material's unique properties make it an ideal lens material for nearly every eyeglass wearer. Here is a review of the technical features of *Trivex* material as measured under recognized industry standards for optical materials.

Trivex Lens Material Technical Properties

Optical Tests	Method	Values
Abbe (d-line)	ASTM D542	43 - 45
% Transmittance	ASTM D1003	89.19 - 91.54
Impact	ANSI Z87.1	Passes high velocity impact test
Impact	FDA drop ball	Pass
UV cut-off	Detemined using a Cary 4000 UV-Vis spectrophotometer	394 nm
UV protection	Detemined using a Cary 4000 UV-Vis spectrophotometer	Blocks 100% of UVA and UVB
Chemical Resistance	ISO 175	Pass
Density (g/cm3) @ 25°C	ASTM D792	1.105 - 1.11
Refractive Index (d-line) @ 20°C	ASTM D542	1.528 - 1.533
Refractive Index (e-line) @ 20°C	ASTM D542	1.530 - 1.536

THE CRISP AND CLEAR FEATURE

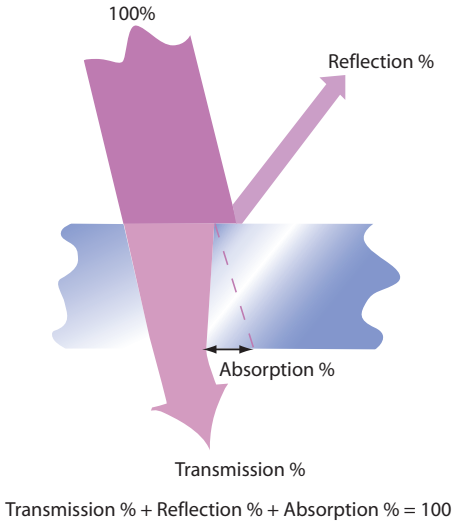
Abbe Value



Abbe value is a measure of the dispersion of light through a lens into its color elements. This dispersion is known as the chromatic aberration. Wearers of lenses with a higher level of chromatic aberration can suffer from a distortion of images viewed through the lenses. The higher the Abbe value assigned to a lens material, the lower the chromatic effect and the lower the possibility of visual distortion.

Lenses made from *Trivex* material have an Abbe value ranging from 43 to 45. Compared to polycarbonate with an Abbe value of 30 and high index materials with Abbe values of 32 to 34, the high Abbe values of *Trivex* material mean that color aberration is virtually undetectable by patients who wear lenses made from *Trivex* material, even with higher powered lens prescriptions.

Percent Transmittance



Transmission % + Reflection % + Absorption % = 100

As light travels through a lens, a certain percentage of that light is lost through absorption and reflection at each air-to-surface interface. The amount of original light available to the eyeglass wearer by the time it exits the lens will vary depending on the quality of the lens material and type and amount of anti-reflection coatings applied to the lens surface. This is an important factor that directly affects the actual brightness of an observed image. The term used to describe this percentage of light that is not lost is transmittance, and for most quality optical lenses this figure will usually be above 90 percent. *Trivex* lens material has one of the highest transmission levels of all commonly utilized lens materials at 91.4%. This means that patients will enjoy sharp, clear and crisp vision through lenses made from *Trivex* material.

THE STRONG AND SAFE FEATURE

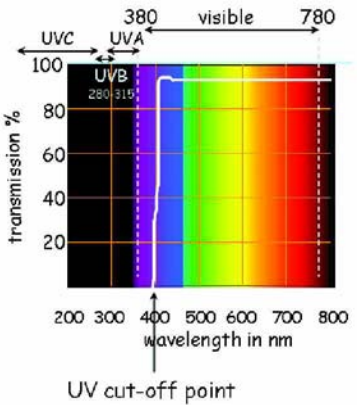
Impact Resistance

Lenses made from *Trivex* material are tough enough to pass the most rigorous optical industry standard for eyewear: the ANSI Z87.1 High Velocity Impact Test[1]. This is the test required for safety lenses that have center thicknesses as thin as 2.0mm. In this test, the lens is mounted in a holder and is able to withstand an impact from a ¼-inch steel pellet traveling at a velocity of 150 ft/sec.

In 1972 when the majority of spectacle lenses were made from glass, the US Food and Drug Administration (FDA) required that "all lenses must be impact resistant". Their regulation requires that all lenses must be capable of withstanding the impact of a 5/8 inch steel ball dropped from the height of 50 inches onto the horizontal upper surface of the lens. Lenses made from *Trivex* material can not only pass the FDA impact resistance test at the usual 2.0mm center thickness, they can pass it at a 1.0 mm center thickness and are even stronger than the FDA requirement.

Ultra-Violet Absorption

Ultra-violet (UV) radiation can have damaging short-term and long-term effects on essential parts of the eye. The wavelengths that pose these problems fall below the visible spectrum starting at 400 nanometers (nm). *Trivex* lens material filters out the harmful UV-A and UV-B wavelengths naturally thereby providing 100% UV blockage up to 394nm. This means that it is not necessary to dye lenses made from *Trivex* material to obtain this level of UV protection – the lenses inherently absorb harmful UV wavelengths.

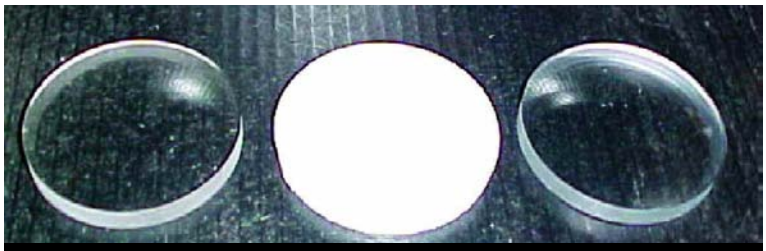


Chemically Resistant

Lenses made from *Trivex*, polycarbonate and CR-39™ materials were tested according the ISO 175[2] test method for chemical resistance. Each lens was immersed in separate containers of various chemicals commonly used in lens laboratories such as acetone (featured in this section) for 10 days. The test measures the changes in weight and diameter of the lenses after soaking as well as allows for a visual inspection for changes in clarity. The lenses made

1 American National Standards Institute, Occupational and Educational Personal Eye and Face Protection Devices, 2003

2 International Standard BS EN ISO 175:2001 BS 2782-8:Method 830A: 1999, Plastics – Methods of test for the determination of the effects of immersion in liquids chemicals



Lenses immersed in acetone for 10 days (PPG in-house test followed ISO 175.)

from *Trivex* and *CR-39* materials did not register any change in weight, diameter or clarity. The polycarbonate lenses turned solid white after being soaked in acetone as shown in the photograph.

Results from tests performed at COLTS Laboratory in the U.S. (an independent laboratory) reveal that lenses made from *Trivex* material are also resistant to household chemicals such as bleach, salt water, *WINDEX*, sun tan lotion, and nail polish remover.

THE LIGHT AND THIN FEATURE

Specific Gravity

Specific Gravity is a way in which weight of a lens material is specified. The lower the value, the less dense (and subsequently, lighter) the material is. The specific gravity of *Trivex* material is 1.11. This value makes it the lightest of all commonly utilized ophthalmic lens materials currently available. Compared to the density of *CR-39* monomer (1.32), *Trivex* material is 16% lighter; compared to polycarbonate, it is 8% lighter, and nearly 25% lighter than ultra high index (1.66 and 1.74) materials. When aspheric curvatures are used on lenses, even more thickness and weight reduction can be achieved.

Refractive Index

Trivex lens material has a 1.53 index of refraction. This mid-index value enables lenses made from *Trivex* material to be thinner, lighter and more comfortable. For example, when compared to lenses made with *CR-39* monomer (with an index of 1.50) of the same power and diameter, lenses made from *Trivex* material are up to 50% thinner and 50% lighter resulting in improved comfort for the wearer. Due to the strength of the *Trivex* material, it can also be surfaced to a 1.0mm thickness thereby reducing the weight and thinness of the lenses even further.

For more details on test results, please visit ***www.ppgtrivex.com***.

Why Prescribe Lenses Made From Trivex™ Material?

Trivex lens material is an excellent tool to aid eyecare professionals in their quest for recommending and prescribing exceptional eyewear products that provide the benefits of superior sharp vision, protection and comfort for their patients. Lenses made from *Trivex* material are Crisp and Clear, Strong and Safe, and Light and Thin.

CRISP & CLEAR ADVANTAGE MEANS "SHARP VISION" FOR YOUR PATIENTS

While cosmetics are one factor eyecare professionals and patients consider in choosing a lens, another equally, if not more important factor is optics that provide exceptional visual acuity.

Feature	Patient Benefit
High Abbe Value High Light Transmittance	→ Crisp & Clear → Sharp Vision

Abbe Value

Color aberration in lenses is one area that can impact vision and is usually seen by the patient as color blurring around objects and a reduction in the clarity of the lenses. The chromatism problem becomes potentially more troublesome as prescription powers become stronger.

The way to avoid this problem is to use a lens material that has a high Abbe value. Higher index materials, including polycarbonate have Abbe values ranging from 30 to 34. In contrast, lenses made from *Trivex* material have an Abbe value between 43 and 45 and thereby provide clear, sharp vision without distracting colored ghost images around objects that can reduce the quality of vision through the lenses.

Internally Stress-Free Lenses

Due to the manner in which lenses made from *Trivex* material are manufactured, they do not have internal stress found in nearly all polycarbonate lenses. Internal stress in a lens can promote lens breakage and create a double refraction phenomenon, known as birefringence, which can also blur vision. The only place one may notice stress

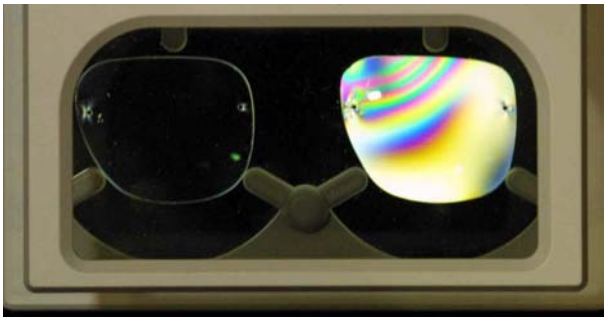


Image shows residual stress and drill mount cracks in finished lenses [Trivex material (left) vs. polycarbonate (right)] mounted on a rimless mounting as shown through polarizing film

in lenses made from *Trivex* material is around the mounting screws or eyewire screws that hold the lenses in place. This is normal to all lenses due to the pressure delivered by the mounting/eyewire hardware.

STRONG & SAFE ADVANTAGE MEANS "PROTECTION" FOR YOUR PATIENTS

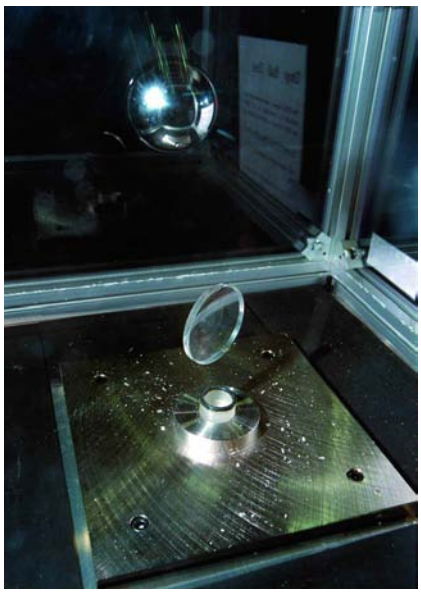
Recommending lenses made from *Trivex* material gives eyecare professionals the peace of mind that their patients' eyes are being protected at all times.

Impact Protection

Lenses made from *Trivex* material are among the most impact-resistant lenses available. Because patients in all demographics maintain some level of activity, impact resistance is an important feature for meeting the lifestyle needs of all of your patients.

Feature	Patient Benefit
Impact Resistant UV Blockage Chemical Resistant →	Strong & Safe → Protection

For those eyecare professionals who may have seen demonstrations of lenses made from *Trivex* material in the exhibit hall at trade shows or at local/state professionals meetings, the impact strength is evident. At these events, eyecare professionals can witness various heavy objects being projected onto a lens made from *Trivex* material only to find that the lens bounces back unbroken.



The Optical Laboratory Association's Duty to Warn program is based on the legal principle of "informed choice." It requires responsible eyecare professionals to tell patients about the relative impact resistance of lens materials, so that they can make informed decisions about safety. Because liability is a major issue, eyecare professionals should direct patients to high-impact resistant lens materials like *Trivex* material to fulfill performance and safety demands.

UV Protection

Another area of concern for eyecare professionals is the harmful effects of ultraviolet (UV) radiation to the eye. The cornea of the eye blocks certain UV radiations while the crystalline lens absorbs others. As the eye's lens absorbs this energy, it can develop a cataract. Wearing UV absorbing lenses helps protect the wearer from this situation. Because children's eyes have less ability to naturally block UV rays, they are excellent candidates for this type of protection, particularly since they spend a lot of time engaged in outdoor activities. It has been estimated that 80 percent of the total lifetime exposure to UV radiation occurs prior to age 18. Seniors will also benefit from UV protection because of its potential to slow age-related eye diseases such as cataracts. Active adults who spend any amount of time in outdoor activities exposed to UV from sunlight would also benefit from the protection *Trivex* material provides.

It is important to note to every patient that lenses made from *Trivex* material inherently provide 100% UV blockage of both UV-A and UV-B radiation no matter what the lens' options may be – clear, tinted or photochromic. The American Optometric Association (AOA) recognized *Trivex* material as the first category of lens material offered by multiple lens manufacturers to meet the requirements of the organization's Seal of Acceptance for Ultraviolet Absorbers/Blockers.

The *Trivex* Material Advantage for Rimless Eyewear

As a person wears a rimless mounting, the lenses and mounting parts flex. This places stress on the lenses. Because of the flex and stress, the holes of some lens materials tend to stretch out of shape (known as hole elongation) making the lenses loose over time and costly candidates for replacement. Due to the strength of the material, lenses made from *Trivex* material retain their shape.

Chemical Resistance

The chemical resistance of *Trivex* material is another of its remarkable features. The material is unaffected by moderate exposure to commonly utilized household chemicals and optical solvents like alcohol and acetone so eyecare professionals can work with lenses made from *Trivex* material with confidence. This means that while some lenses will craze, crack or show other damage due to exposure to these products, lenses made from *Trivex* material are resistant to the harm from these chemicals under normal conditions due to its superior chemical resistance.

LIGHT AND THIN ADVANTAGE MEANS "COMFORT" FOR YOUR PATIENTS

Patients of all ages and lifestyles want the most comfortable pair of glasses possible, and lenses made from *Trivex* material provide that comfort. Pediatric patients also benefit because their eyewear will sit comfortably in the appropriate place on a still-developing bridge. Presbyopes who are also first-time eyeglass wearers will have an easier adjustment when their lenses are comfortable – not only in weight but also in visual clarity. Older patients will also appreciate the light weight provided by *Trivex* material as the skin on the bridge of their nose becomes thinner and more sensitive to irritations. From an eyecare professional's perspective, lenses made from *Trivex* material are a real patient pleaser.

Light Weight

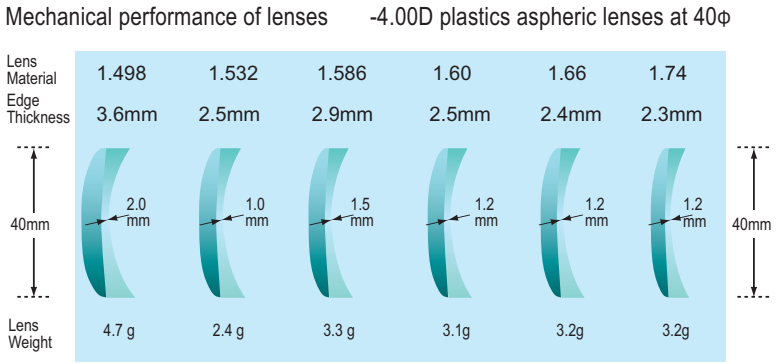
Feature	Patient Benefit
Low Density Thin Lens Centers →	Light & Thin → Comfort

Another compelling reason for prescribing/recommending lenses made from *Trivex* material is its light weight. As materials increase in index, they decrease in thickness and weight for a particular power and diameter. While it may sound like the solution for controlling weight is to simply select the highest index material, this may not always be the case. If a lightweight material is not used to begin with, the end result will be just a lighter version of a heavy material. The way to ensure that you start with a lightweight material is by comparing its density to other materials.

Trivex material is exceptionally lightweight. In fact, with a specific gravity of 1.11, it is the lightest commonly utilized material on the market. This means you can recommend lenses made from *Trivex* material confidently knowing you are providing one of the most comfortable lens options available.

Thinness

With an index of refraction of 1.53, *Trivex* material falls into the mid-index category – an excellent choice for nearly all patients. Mid-index lenses allow for slimmer, trimmer center thicknesses in plus prescriptions and reduced edge thicknesses in minus prescriptions. Approximately 80% of all prescriptions fall into the +/– 3.00D range. This is an ideal range for the 1.53 index *Trivex* material and results in lenses that are more cosmetically appealing than a 1.50 index lens. Because lenses made from *Trivex* material can be ground to minimal center thicknesses, they are light and comfortable to wear which is often a strong preference of eyecare professionals and patients.



For a more enhanced thinning affect, *Trivex* material can be teamed with aspheric and atoric lens designs. These designs flatten toward the edges on plus powered lenses and steepen toward the edges on minus lenses creating an even greater thinning effect. Aspheric designs also allow *Trivex* material to remain thin in prescriptions up to approximately +/– 6.00D. This power range covers nearly all of the prescriptive powers most eyecare professionals see in a day. For prescriptions higher than this, higher index lens materials should be considered.

Availability

When prescribing or recommending lenses, it is important to look for a lens that offers the best balance of properties available in order to provide a desirable combination of sharp vision, protection and comfort for the patient. All of these features and more can be found in lenses made from *Trivex* material.

If you want to start prescribing lenses made from *Trivex* material but fear that lens choices are limited, don't worry – *Trivex* material is available in all of the popular lens styles and types, including single vision, single vision aspherics, bifocals, trifocals, and progressives.

Lenses made from *Trivex* material are also available in Transitions® Lenses. This makes them an ideal recommendation for those patients who desire the comfort and convenience of enhanced automatic UV and glare protection in their everyday lenses. Lenses made from *Trivex* material can be easily tinted and accept hard coatings, anti-reflective, mirror and other surface treatments well, so it is an excellent platform for a good quality pair of sunglasses.

Feature	Patient Benefit
High Abbe Value High Light Transmittance	→ Crisp & Clear → Sharp Vision
Impact Resistant UV Blockage Chemical Resistant	→ Strong & Safe → Protection
Low Density Thin Lens Centers	→ Light & Thin → Comfort

Lenses made from *Trivex* material provide sharp vision, protection and comfort.

Tips for Dispensing Lenses Made from Trivex™ Material

INTERVIEW TECHNIQUES

Lenses made from *Trivex* material are an excellent choice for nearly every lens wearer. Eyecare professionals can be more successful in conveying the features and benefits if they establish the patient's needs by asking the right questions during a lifestyle interview. Tying the answers to these questions to each patient's lifestyle can help eyecare professionals relate the benefits of lenses made from *Trivex* material – clear vision, protection, and comfort – directly to the needs of the patient, making them more relevant.

Here are some tips to help you convey the value of these lenses to your patients.

Crisp and Clear for Sharp Vision

Every patient wants to see clearly day and night in any situation. Lenses made from *Trivex* material are virtually free from color aberration and have a high light transmittance providing crisp and clear vision. To bring this point home, ask your patients the following:

- "Do you use a computer at work?"
- "Do you drive on a regular basis?"
- "Would it bother you if your vision was slightly distorted along the periphery of your lenses?"
- "Would you like to hear about a new lens material that provides the clearest, sharpest vision for your prescription?"

Strong and Safe for Protection

Patients want to protect their eyes in any situation, whether engaging in outdoor leisure activities or even just working around the house. Lenses made from *Trivex* material are strong and safe, providing the maximum protection from impact, chemicals and UV rays. To bring this point home, ask your patients the following:

- "What activities do you participate in at home, at work or during leisure time that might potentially cause a trauma or chemical exposure to your lenses?"
- "Do you spend time outdoors in the sun during work or leisure activities?" and "If you protect your skin from UV rays, why not your eyes?"
- "Has anyone in your family ever been diagnosed with cataracts?"
- "Would you like to consider the benefits of a lens material that protects you from UV, impact and chemicals?"

Light and Thin for Comfort

Every patient wants to wear the most comfortable pair of glasses available. Lenses made from *Trivex* material are lightweight and can be made very thin, making them not only comfortable, but also aesthetically pleasing in any type of frame. To bring this point home, *ask your patients the following*:

- "Do your eyeglasses feel heavy, uncomfortable or slide down your nose?"
- "Would you like to obtain the thinnest and lightest plastic lenses in your new frame?

PERSONALIZING THE MESSAGE OF BENEFITS

With all of the desirable features of *Trivex* lens material, recommending lenses made from it is a pretty easy task. Even so, every patient will selectively be interested in the features that directly benefit their lifestyle. Because of this, it is best to fine-tune your discussion to the lifestyle aspects most important to the patient sitting in front of you. Here are some points to hit for various patient types.

Kids, 'Tweens & Teens

Sharp Vision

Children's eyes are still developing, so having lenses that provide sharp, clear optics is a must to ensure vision develops to its fullest potential. All school age children need the sharpest, crispest vision possible to make school work easier and playtime more enjoyable.

Protection

Because children's eyes (up to the age of eighteen) are exposed to approximately 80% of the total lifetime exposure to UV light, you will want to emphasize how important it is to have the 100% UV blockage provided by lenses made from *Trivex* material. Children are also naturally more pre-disposed to UV damage due to the amount of time they spend outdoors.

When speaking with the parents of kids, 'tweens and teens, be sure to emphasize the excellent impact capabilities of lenses made from *Trivex* material. Ask parents if they provide their child with the proper sports equipment, such as a helmet for bike riding, to help them understand that buying lenses made from *Trivex* material is like buying a protective piece of sports equipment, or applying sun lotion. Mention too that lenses made from *Trivex* material pass the most stringent optical industry standards and are recognized by the ophthalmic industry as well-suited for children.

Comfort

Another aspect of lenses made from *Trivex* material that parents will appreciate is its light weight. "Did you know that the bridge of your child's nose is still developing?" is a good open-ended question for parents with little ones. "By using these very lightweight lenses, your eyeglasses will be as comfortable as possible" is something every parent wants to hear about their child's new eyewear.

Active Adults

Sharp Vision

Busy, active adults will find the crisp and clear optics in lenses made from *Trivex* material to be just what they need at the office, on the road, or during their leisure pursuits. People who are on the go can do without minor annoyances, like color blur in their vision. The clear optics that *Trivex* material provides is an excellent benefit for progressive lens optics and other multifocal lenses, so patients don't have to fear the same non-adapt issues that are often associated with these designs.

Protection

Possible scenarios for eye injury are numerous; and asking questions about the need for impact resistance will unearth the patient's potential for encountering eye hazards. Driving, playing sports and even enjoying leisure activities in and around the home can result in accidents.

Comfort

Active people will appreciate the comfort and light weight lenses made from *Trivex* material offer, especially when they are involved in rigorous activities. Busy, active adults also appreciate convenience, which makes them good candidates for the photochromic lens options available in *Trivex* material with Transitions® Lenses. One pair can be used for all indoor and outdoor activities.

Many presbyopes are first-time eyeglass wearers. They may be apprehensive that their vision will be compromised by their new lenses. The thinner, lighter lenses that are made from *Trivex* material can help them feel comfortable and confident as they adapt. They may also have apprehension that their vision will be compromised by their new lenses. Given the broad range of frame designs from which to choose, patients also benefit from the ability to select nearly any frame, and style-conscious presbyopes do not have to sacrifice fashion for function.

Seniors

Sharp Vision

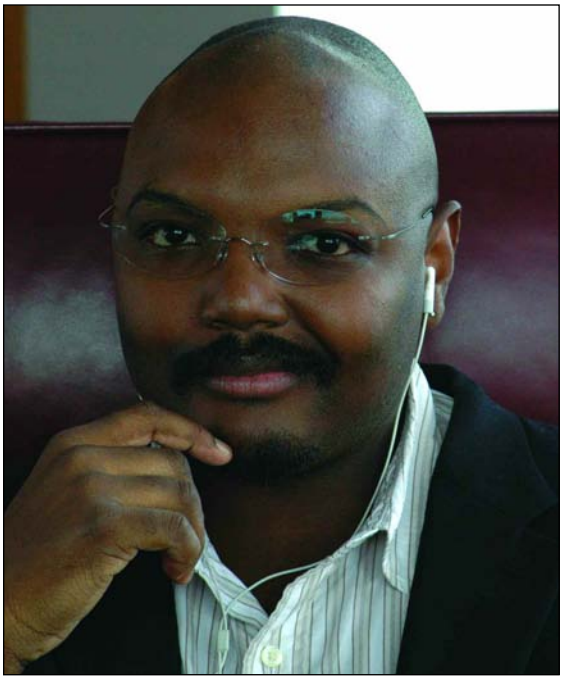
Seniors will also appreciate the excellent optics these lenses provide and variety of multifocal designs. Seniors experience a "dimming" of vision as they get older due to aging factors. That's one reason why starting with highly clear lenses made from *Trivex* material will be well appreciated by them. The crisp, clear and sharp optics of these lenses is just what the doctor ordered for seniors, too. And when it comes to multifocal options like long and short corridor progressive designs and segmented options like Flat-Tops, you'll find a full array of products to choose from with all the popular lens options seniors find useful like anti-scratch coating, anti-reflective coating and *Transitions* gray or brown.

Protection

Seniors are also excellent patients with which to discuss the 100% UV blockage of lenses made from *Trivex* material because of their increased risk for age-related eye diseases. Explaining the benefits and the overall value this protection can provide for their eye health will help them to make an educated decision.

Comfort

Seniors welcome products that provide comfort and simply need to be educated about the merits of lenses made from *Trivex* material. "Did you know that as we age, the skin on our noses become thinner and more sensitive to weight?" and "Do your glasses ever feel heavy or uncomfortable?" are two questions that can help eyecare professionals to approach seniors about lenses made from *Trivex* material.



Rimless Wearers

Sharp Vision

Rimless mountings afford an unrestricted view of the world. Lenses made from *Trivex* material optimize rimless designs with crisp, clear optics that enable wearers to enjoy sharp vision. If it's that "barely there" look you're after, the edges of lenses made from *Trivex* material polish to a beautiful sheen for a lustrous appearance.

Protection

With the popularity of rimless eyewear has come a unique set of challenges; and many eyecare professionals have encountered disappointed patients who have had their lenses crack or fracture. Not only is this situation frustrating to the patient, it is also difficult and costly to the eyecare professional. An effective way to avoid this problem is to use lenses made from *Trivex* material. Given the exceptional impact- and chemical-resistant features of the material, lenses made from *Trivex* material are extremely durable and tough enough to withstand the stress associated with rimless eyewear.

Comfort

Style-conscious patients who choose lenses made from *Trivex* material for rimless eyewear won't have to sacrifice cosmetics for comfort. The lenses are thin and lightweight, helping patients feel comfortable and confident in their fashionable eyewear.

Tips for Surfacing and Finishing Lenses Made from Trivex™ Material

Looking back at days when polycarbonate lenses were introduced, industry veterans will recall having to learn a whole new set of skills to surface them properly. In contrast, optical laboratories will be pleased to find that surfacing lenses made from *Trivex* material is as easy as surfacing other plastic lens materials; and with a little refining, most of the techniques used for other lens materials can be used for lenses made from *Trivex* material. As with any lens material, there are a few basic lab techniques one should know to improve their final results. The following recommendations are provided for both novice and experienced laboratory personnel.

SURFACING RECOMMENDATIONS

Base Curve Selection

Many of the lens manufacturers who work with *Trivex* material produce their single vision lenses with aspheric base curve designs. It's important to choose a base curve that is within the specified range for the power that is needed. Manufacturers have base curve selection guides to assist you in this step. Some of the newer surfacing software will specify which base curve to select. Going outside the recommended parameters will cause adverse power problems for the eyeglass wearer. This is true of any lens made in any material and is particularly troublesome with aspheric designs. Eyecare professionals who specifically request base curves outside of the recommended range for a specific Rx should be informed that the lenses they receive may not provide the level of aberration control and vision correction they expected from the design they ordered.

Surfacing Layout

Single vision aspheric lenses made from *Trivex* material have a specific factory-marked base curve center on the blank. This point is the apex (or steepest part) of the curve that defines the lens' asphericity. This center should coincide with the optical center after the lens has been surfaced. If it does not, the lens (depending on power) may have

undesirable and unpredictable multi-axis cylinder and may need to be remade.

Double aspheric lenses have an axis marking line on them that must be properly aligned with the Rx axis. These markings can be prevented from coming off when the surface protector tape is removed if a piece of disappearing cellophane tape is placed over the markings prior to applying the surface protector tape. These markings will be used to verify that the lens' optical center and axis are aligned with the aspherical apex during finishing layout.

In order to obtain the full optical and cosmetic benefits that lenses made from *Trivex* material have to offer, it is recommended that layout computing be completed with software that is specifically designed for these lenses. The combination of aspheric design, 1.53 index and minimum thickness variances requires this upgrade to your layout program.

Surface Taping and Blocking

As with any plastic lens material, the base curve of the lenses made from *Trivex* material should be covered with surface protecting tape prior to blocking and generating. The front of these lenses has a built-in, protective, scratch-resistant layer, but shielding the lens with surface protector tape offers enhanced scratch protection and provides a better bond for the surfacing block. There is also an increased amount of torque created when surfacing this material and the surface protector tape will help provide a good bond with the surfacing block.

Heat is always an enemy of plastic lenses so the less heat lenses made with *Trivex* material are exposed to, the better they will turn out. That is why a low temperature alloy or wax blocking method is recommended for blocking lenses made from *Trivex* material. Be sure to allow adequate cooling time after blocking so that the blocking bond is optimal and the lens is not stressed from the heat of the blocking process.

Generating

There are two basic generator types used in today's optical laboratory. Different procedures are recommended depending on the type of generator being used.

Manual Sweep Arm and Diamond Quill Generators

A combination grit diamond quill meant for both *CR-39* monomer and polycarbonate will work well with *Trivex* material. It is best to run the coolant throughout the manual generating process. Generator operators should use slightly slower sweeps and take less thickness off with each sweep than they normally do with polycarbonate. There is an increased amount of torque produced during the grinding process on lenses made from *Trivex* material, so slow things down a bit. A very slow final sweep with a minimal thickness cut and with coolant running will give the lens an excellent pre-fining surface.

A fluffy, wool-like swarf that can clog the coolant drain is produced when generating lenses made from *Trivex* material in a diamond generator. Be prepared to clean out the swarf trap after generating each lens.

Single-Point CNC Dry Milling Generators

A two or three flute cutter will work best with *Trivex* material. Cutters must be sharp in order to produce the best surface quality. If the generator has an optional cribbing setting, use it. This is because edging lenses made from *Trivex* material causes a lot of torque so if the lens diameter is minimal, there will be less torque. This helps keep lenses on axis during edging.

Using the pin bevel setting on a dry mill generator will help reduce wear on your fining and polishing pads and eliminate sharp edges.

Thickness

While lenses made from *Trivex* material have excellent impact resistance with a 1.0mm center thickness, they may warp over time if placed in frames that exert significant pressure around the lens' circumference. Because of this, some labs add 0.2mm to 0.3mm of thickness to the lenses. The extra thickness does not alter the final appearance of the glasses noticeably (for example, a 1.0mm edge vs. a 1.3 mm edge) and can help avoid the potential warping problem.

Fining

Photo courtesy of HOYA Vision Care

Some laboratories may choose to use a two-step fining process to surface lenses made from *Trivex* material. When doing so, use compensated lap tools. These tools have been cut with a slightly steeper curvature to allow for pad stacking. If a second fining pad is stacked on top of the first fining pad, it adds diameter to the lap tool curvature which can cause a noticeable power error in these lenses depending on the lens' power. Compensated laps correct this problem. Single-use foam lap tools must also be cut to compensate as well.

Fining pads made specifically for lenses made from *Trivex* material usually have grit ratings of about 300 for the first fining and 1150 for the second fining depending on the pad manufacturer. Some labs find that the pads they use for polycarbonate lenses work well too since there is little difference in the grit sizes of 280 for the first fining and 1000 for the second fining.

Be sure that cylinder machines are adjusted to their fully-recommended sweep and stroke settings (on most cylinder machines this will be about 28mm tall for the stroke by 62mm wide for the sweep). If they are not, there may be areas on the lenses that do not fine completely.

Use a slightly lower pin head pressure than the usual 20 psi (about 18 psi), a timer setting of 1.5 – 2.0 minutes and the slow speed setting on your cylinder machines for lenses made from *Trivex* material. These lenses fine out very easily compared to polycarbonate and do not require much excess pressure or time to bring them to an excellent finish. Do not over work these lenses; it simply is not necessary.

Polishing

Some laboratories have found that polishing pads and polishes designed specifically for *Trivex* material work very well. Other laboratories have found that they can use pads and polishes recommended for polycarbonate with good results too. Lenses made from *Trivex* material tend to be very forgiving to the surfacing process as long as the process is not rushed.

Backside Scratch-Resistant Hard Coating

Even though lenses made from *Trivex* material are considerably more scratch resistant than uncoated polycarbonate lenses, a backside scratch-resistant hard coating. A good quality UV cured tintable coating will improve scratch resistance as well as enhance the tintability of these lenses.

Anti-Reflective and Mirror Coating

In general, AR and mirror coating techniques that provide good results for other plastic lens materials work well for lenses made from *Trivex* material also. As with other lens materials, a good scratch-resistant hard coating is an essential part of the AR and/or mirror coating's success. Coatings adhere well to lenses made from *Trivex* material. Therefore, washing lenses with soap and water is preferable to etching prior to coating. Some coatings can have a detrimental effect on impact resistance.

Lens Inspection

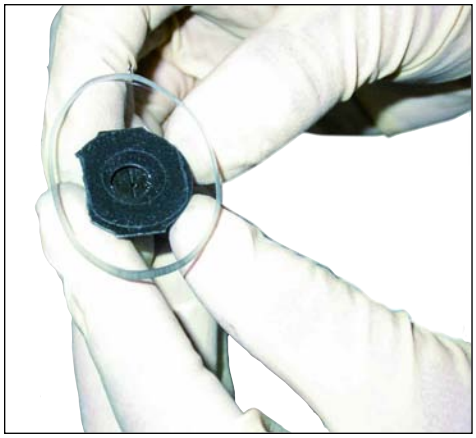
As mentioned earlier, the center markings on single vision aspheric lenses made from *Trivex* material must align with the optical center after surfacing. Measure the lens thickness using a lens caliper and visually inspect the lens for any flaws before moving on. Lenses that consistently come out with waves or warpage suggest that there was too much heat or pressure applied during surfacing. Check the chiller and coolant waters in the generator and cylinder machines to ensure they are keeping the lenses cool at all times. Double check the pin head pressure on your cylinder machines to be sure they set properly (around 18 psi).

FINISHING RECOMMENDATIONS

Finish Blocking

A high quality pad should be used to block lenses made from *Trivex* material. Pads that stretch too easily may cause axis problems. Also remember, the smaller the diameter and the thinner the lens blank edge is, the less torque there will be in the edger, helping to keep things on axis. Be sure to use the correctly curved block for the lens' base curve. Lenses made from *Trivex* material have a little flex in them so using the wrong shaped block may damage the lens when it is chucked in the edger. Flexible plastic blocks work well to reduce this problem but avoid using older over-used plastic blocks that could cause axis problems. Chucking pressure should not exceed 20 psi or be less than 18 psi or the metric equivalent of 80kg.

Edging – For Dry, Blade Style Edgers



A dry, cutter blade edger provides excellent edging results with lenses made from *Trivex* material. Good sharp cutter blades will not only cut the lenses easily and with very little additional torque, they will also produce a semi-glossy edge that some technicians feel needs no additional edge polishing. For semi-rimless chord mounted jobs, it is advisable to use the semi-rimless blades that automatically groove the lenses, if possible. This saves time and an additional step in the groover. It is also not necessary to clean out the melted swarf that accumulates in a manual groover with *Trivex* material.

An airborne particulate and a distinctive smell can be created when edging lenses made from *Trivex* material. To help reduce the particulate and scent, use a dry-cut cycle that has a vacuum to collect the dry swarf if possible. It may be advisable for lab techs to wear a dust mask during the edging and surfacing process.

Edging – For Wet-Sump Diamond Wheel Edgers

Having a wet edger with the correct diamond wheels is one of the most important factors in getting lenses made from *Trivex* material to finish on axis and with a high quality bevel. The recommended diamond wheels have diagonal slots or a series of holes in either of both the roughing wheel and the beveling/finish wheel. The purpose of these slots/holes is to allow for cooler roughing and beveling cycles. The diamond grit on these wheels is very much like the grit on conventional polycarbonate stones and they work well on all types of plastic lenses.

If the edger has a "*Trivex*" setting it should be used. Most older edgers will not; in which case the, polycarbonate setting will work best. Lenses made from *Trivex* material should be rough cut and rough-finish cut dry (without the coolant water running on the wheels). Coolant water should be running on the final finish edging cycle to bring the bevel to a smooth finish. If the machine has an edge polishing wheel, use the coolant water on this cycle, too.

There will be a noticeable amount of melted swarf coming off the lenses during the rough cycle which can form into hard chunks. These fragments may clog the swarf drain in the edger if the machine does not automatically wash them away. They can also get wedged between the diamond wheels and the grinding chamber walls, causing a loud bang when they dislodge and propel back into the grinding chamber. Because of this, it's important to be very cautious and wear safety glasses while edging lenses made from *Trivex* material.

Sizing and Bevel Placement

Lenses made from *Trivex* material maintain their size and shape well over time and do not need to be edged large to compensate for shrinkage like some materials. Cut these lenses right on size.

Trivex material hand edges slowly on conventional grit ceramic-pin-beveling hand stones. Use a dual grit hand edger stone with a coarser grit on one side and a finer grit on the other side in order to hand edge it effectively.

Manual Edge Polishing

The automatic edge polishing function (on edgers that have it) give lenses made from *Trivex* material a shiny luster and is a convenient way to edge polish these lenses. For

labs that use manual edge polishing equipment, use a fresh, new felt polishing pad or muslin buffing wheel in conjunction with a high-quality dry polish stick designed for polycarbonate. This dry polish has a lubricating wax in it that will help keep the lenses from getting pits in them from too much heat. Always protect the lens surfaces with surface protecting tape before polishing. Use as little of the polish stick as possible and use very little pressure when polishing. Avoid polishing the apex of the lens bevel, if the lenses were cut exactly to size, or they may turn out too small. Manually bringing lens edges to a high gloss takes a little time so be patient and do not overheat the lenses or they will blister.

Manual Grooving

Manually groove lenses made from *Trivex* material dry (without using water). After grooving, clean the excess swarf out of the groove with an optical screwdriver, or similar device, the same way as with polycarbonate. This removal will be a little easier with *Trivex* material than it is with polycarbonate because the swarf comes off in long strands.

Computerized and Manual Drilling

Lenses made from *Trivex* material are ideal for rimless eyewear. For drilling tips, see the section entitled, "Drilling."

Tinting

Tinting lenses made from *Trivex* material is as easy tinting any other plastic lenses. Consult the "Tinting" section of this manual for tips on getting the best results when dyeing these lenses.

Mounting and Inserting

If properly edged and sized, lenses made from *Trivex* material will have a high-quality edge enabling easy glazing. These lenses should not be glazed too tightly or they may warp, causing distortion and stress aberration.

Be cautious when glazing lenses made from *Trivex* material into plastic frames using a heating pan containing glass beads or salt. Excessive heat can blister the lenses, so a hot air frame warmer is recommended for this task.

Use standard mounting and insertion techniques to glaze lenses made from *Trivex* material into metal and semi-rimless frames.

Tips for Tinting Lenses Made From Trivex™ Material

Anyone that knows how to tint lenses can tint lenses made from *Trivex* material – it's really that simple. The basic equipment, dyes and techniques that apply to other lens materials, apply to *Trivex* material also. Even so, there are a number of techniques that can be employed to obtain a higher quality tint product and reduce spoilage. Here are a few tinting tips to maximize the tinting of lenses made from *Trivex* material.

Check for Hard Coating

Lenses that have been surfaced may or may not have a back surface hard coating applied. While *Trivex* material accepts lens dye readily, on occasion lenses may exhibit uneven coloring, due to uneven dye absorption. The way to avoid this is to hard coat the back surface of the lens with a tintable coating. This will also help produce more consistent color results.

It is not recommended that a dip hard coating be added after the lens has been tinted, as it can cause the lens dye to leach into the hard coating mixture, reducing the lens' color density and contaminating the hard coating material.

Preparing the Lens for Tinting

As with any lens material, the surfaces of lenses made from *Trivex* material must be clean before tinting. Since *Trivex* material has superior resistance to chemicals, most laboratories and eyecare professional offices use acetone or alcohol to clean the surfaces of lenses made from *Trivex* material to remove oils and debris. Wearing gloves will help keep the lens surfaces clean, prevent the transfer of oil from your hands, make it easier to grip the lens during the tinting process and, of course, keep your fingers tint-free.

Some labs have found that using acetone or alcohol to clean lenses before tinting in general can adversely affect the dye they use. If this occurs with lenses made from *Trivex* material, use a warm, mild detergent bath, ensuring that all debris and greasy residue have been removed from the lenses before placing them in the dye.

The last preparation step is to use a commercially available lens prep solution made specifically for preparing

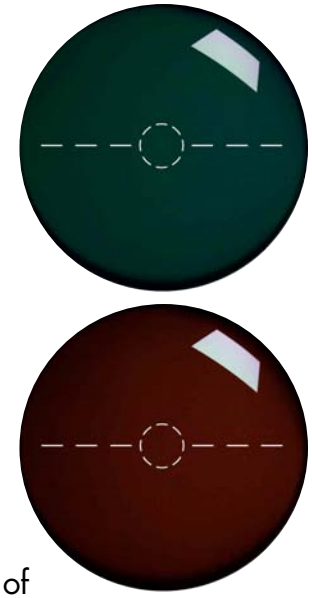


Photo courtesy of HOYA Vision Care

lenses for dyeing. These solutions help to eliminate color blotching and promote even color absorption. They are inexpensive, easy to use and provide improved coloring results.

Dye Tank Temperature

Not all lenses made from *Trivex* material tint the same. This is because of variations in the composition of the individual manufacturer's lens material and hard coating. Some lens manufacturers suggest using a tinting temperature of 175° F, while others suggest using normal tinting temperatures (between 200° F to 205° F). Because of these variations, check with the lens manufacturer to determine the recommended temperature for tinting their lenses made from *Trivex* material.

As with any other lens material, keeping the dye temperature consistent, and at the recommended temperature, is important. A reliable and accurate thermometer, that is designed especially for dye vats and tanks, should be used unless the dyeing equipment itself provides the exact temperature inside of each dye tank.

Color Correcting

Many optical offices use a single set of color samples when selling patients a lens tint. Since all lens materials tend to differ slightly with the same dye, the color results you obtain with lenses made from *Trivex* material may vary from the sample color. This is easily fixed by color correcting the lenses using the appropriate color(s). Check with the dye manufacturer for recommendations for doing this. To avoid this problem altogether, make a set of colored lens samples using lenses made from *Trivex* material and use them when showing lens tint colors.

Length of Time

While lenses made from *Trivex* material and their hard coatings readily accept lens dye, they should be tinted in short periods of time and checked often. This technique is not specific to *Trivex* material; it is a good procedure for avoiding color shift problems and making the lenses too dark for any lens material. Try two-minute intervals. Bring the lens out of the dye and rinse it in warm water in between inspection and re-insertion into the dye vat.

Constant Stirring

Lens dye is made of large particles that tend to settle out of the dye mixture if left alone too long. This means that a heavier concentration of dye will settle at the bottom of the tank if the dye is not stirred often enough. Uneven dye density creates uneven results on the lenses. The way to avoid this problem is to stir lens dyes often. Some manufacturers have created dyeing equipment with stirring features that automate this process. The need to stir lens dye is not unique to *Trivex* lens material, so the automated stirring feature can be useful for all lenses.

Know Your Brand

Each manufacturer uses slightly different techniques and surface coat formulas in making lenses made from *Trivex* material. This means they can tint differently, e.g., rate of absorption, different hues, etc. While it is not common to use lenses from two different manufacturers in brand-new orders, if only one lens is being replaced, it is important to know the manufacturer of the lens that is not being replaced so that the new lens can be matched to it. One way to do this is to ask the laboratory to provide the lens package with each order, and then staple it to the patient's work order and/or record. For electronic records, the lens brand can be added to the appropriate field. Lenses from the same manufacturer should always be used in both eyes of a pair of glasses. Doing this will prevent tedious color touch-ups and the need to darken/lighten one lens to match the other, due to differences in dye absorption characteristics.

Adding UV

Trivex material inherently absorbs ultra-violet light up to 394nm. This means that UV absorbing dyes are not needed to obtain this high level of UV blockage. Using dyes that provide slightly higher levels of UV wavelength absorption may be used, but they will likely add a color cast to the lens, such as yellow.

Drilling Lenses Made from Trivex™ Material

Trivex lens material is an excellent platform for rimless eyewear. The material is less sensitive to heat during drilling than other lens materials so holes are drilled cleanly with no distortion, melting or fracturing. Lenses made from *Trivex* material do not chip, flake or develop "spider cracks" around the rim of the holes like lenses made from polycarbonate and other lens materials. Due to the durability of *Trivex* material, the lens holes also retain their size and shape over time with normal wear.

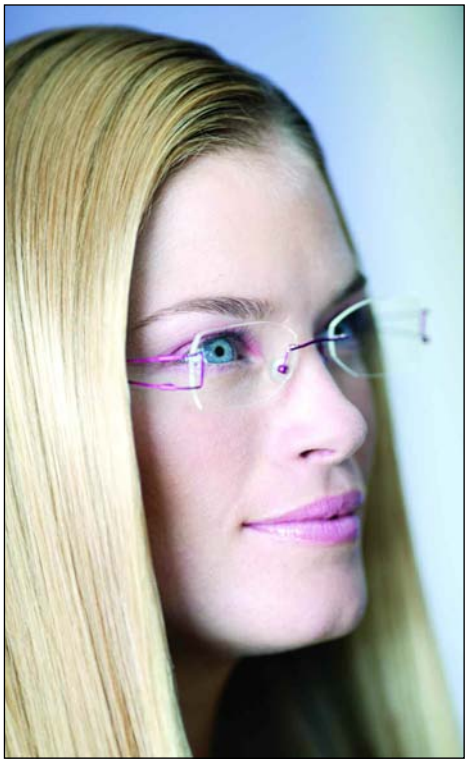


Photo courtesy of HOYA Vision Care

Trivex material is also chemical resistant, making it compatible with adhesives often used in the assembly of rimless eyewear. Lenses made from *Trivex* material edge as easily as other plastic lenses and polish to a high luster.

From an eyecare professional's perspective, all of these features – in combination with the high level of clarity, protection and ultra-light weight of *Trivex* material – complements the "barely there" style of rimless without the hassles often associated with this type of eyewear.

The following drilling tips will help you obtain the maximum benefit from using lenses made from *Trivex* material offer for rimless eyewear.

Keep It Sharp

Whether you are using computerized, mechanized or manual drilling equipment, the first rule of good drilling technique is to use a sharp drill bit. Even though *Trivex* material is less sensitive to heat, dull bits or burrs generate excessive heat around the holes which can burn, melt or distort any lens material. Use a good quality carbide bit if possible although stainless steel works fine as long as it is sharp.

Keep it Cool

Keep drilling temperatures cool by using a low RPM setting on your drill. Remember, you don't need to drill fast when the goal is accuracy and the perfect hole. Another means of keeping drilling cool is to use small pulses (down, up, down, up) of pressure during drilling with non-computerized drills, approximately 0.5mm at a time. When down to the last 0.25mm, it is a good practice to turn the lens over and drill the last 0.25mm from the opposite side. This helps prevent chipping the hole on the backside. It is also a good idea to remove the lens dust and drilling particles in between the pulsing by simply blowing it off the lens.

Protect It

Protect lens surfaces by placing lens protector tape or surface protector dots (small versions of surface protector tape) onto the lens surfaces prior to drilling. The point of the drill is caught by the tape just long enough to begin drilling the lens instead of slipping sideways on the slick lens surface. This helps prevent the drill bit from "skipping" because the slick lens surface is covered with the soft vinyl adhesive tape. It also helps when the lenses are clamped into place.

Double Check

Double check the measurements before you drill, especially on equipment that is not automated. If the mounting came with an adhesive drilling guide, place it on the lens. These stickers are generally well designed and increase the chance that lens holes will be placed where the mounting designer intended. Once you have determined the exact location of the holes with the guide, double check it against the mounting. Be sure to use a permanent marker with an ultra fine point to get a precise location.

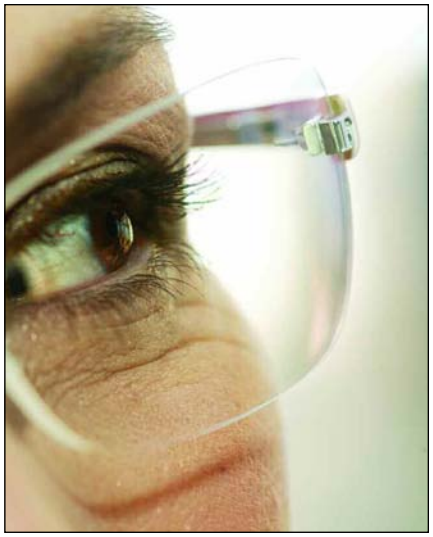


Photo courtesy of HOYA Vision Care

Photo courtesy of HOYA Vision Care

Drill Perpendicular

Drilling holes perpendicular to the lens' base curve is the proper technique for most rimless eyewear. Some drills come with a tilting stage or a tilting drill head. Practice using it. If the drill doesn't have this feature, the angle can be changed manually. Try adding a couple of 3M LEAP pads onto the drilling stage in order to raise the lens on one side and get it perpendicular to the drill bit. Using double-sided tape and attaching a rubber faucet washer to the drill's stage directly below the drill bit may also work. Both of these options lift the lens' edge up off of the stage for a reasonably good drilling angle. The steeper the lens' base curve, the higher the lens edge will need to be.

Finish the Rim

Even though lenses made from *Trivex* material drill without flakes or chips around the holes, the lenses will have a more finished look if you bevel the front and back rims of the holes with a chamfering tool. It only takes a few seconds but it adds a nice clean look to the lenses.

Comfortable, Bright & Magnified

Make sure you have a comfortable, well lit, shadow-free area for the drilling station, and don't forget to use safety glasses. Consider adding a little extra plus to the lenses of the safety glasses for a slight magnification that will help with fine-tuning the detail work.

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