SUNGLASSES 101

2014

COT, Inc. Easy-to-use Guide to the World of Sunglasses

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WHY PEOPLE WEAR SUNGLASSES

We expect a lot from our eyes. They work much harder than a lot of people realize. During a normal day our eyes use about the same amount of energy as our legs would walking fifty miles. Intense sunlight presents additional challenges. On one hand there is harmful UV light (which is invisible to us), and on the other there is glare (which causes us to squint and feel discomfort). Wearing sunglasses protects us by blocking the UV rays and reducing the intensity of the incoming light resulting in less stress for our eyes.

For many, sunglasses are also a fashion statement. A frame that is well suited for a person's face can greatly accentuate his or her features. No other accessory is as visible as sunglasses are because they are worn on the face.

Still, for some people sunglasses are part of active wear as they can offer protection against impact (example: tennis, volleyball), serve as a windshield (example: biking, skiing), and even improve precision (example: fishing, driving).

ABOUT SUNGLIGHT

Ultraviolet Light

Ultraviolet (UV) light is electromagnetic radiation with a wavelength shorter than that of visible light, but longer than X-rays, that is, in the range between 400 nm and 10 nm. UV light is a natural component of sunlight.

It can cause short-term and long-term ocular problems such as photokeratitis, snow blindness, cataracts, pterygium, and various forms of eye cancer. Medical experts advise the public on the importance of wearing sunglasses to protect the eyes from UV; for adequate protection, experts recommend sunglasses that reflect or filter out 99-100% of UVA and UVB light, with wavelengths up to 400 nm. Sunglasses which meet this requirement are often labeled as "UV400." Sunglasses are not sufficient to protect the eyes against permanent harm from looking directly at the Sun, even during a solar eclipse.

High Energy Visible light (aka Blue Light)

High-energy visible light (HEV) is high-frequency light in the violet/blue band from 400 to 500 nm in the visible spectrum.

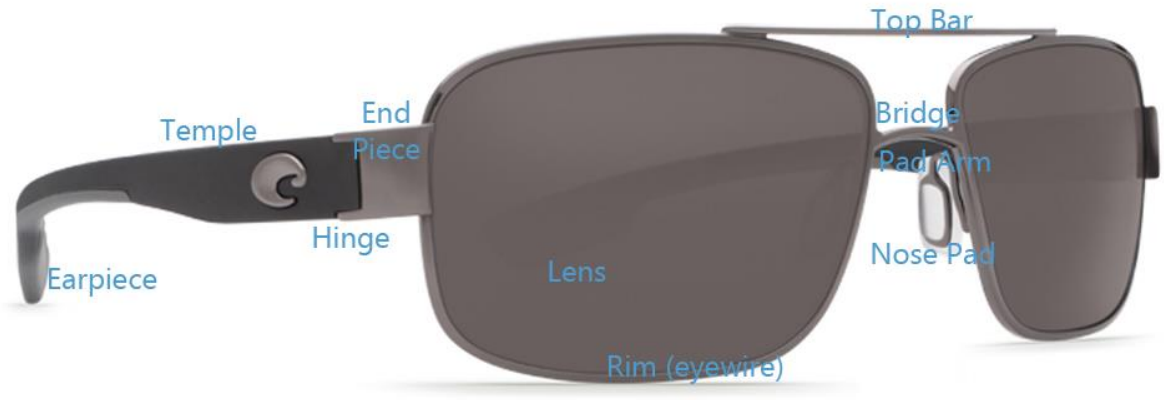
HEV has been implicated as a cause of age-related macular degeneration; before, debates had already existed as to whether "blue blocking" or amber tinted lenses may have a protective effect. Some manufacturers already design to block blue light; the recommended minimum blocking is 95% of the blue light. Sunglasses are especially important for children, as their ocular lenses are thought to transmit far more HEV light than adults (lenses "yellow" with age).

Glare and Reflected/Polarized Light

Glare is light that is too intense for the eyes to handle comfortably and efficiently. Glare can come directly from a light source - like when a person is driving toward the sun, or it may be reflected – such as light bouncing off the road. Light coming directly from a light source is generally scattered in all directions (has normal distribution) but when it becomes reflected it tends to align on a single plane or become polarized. Note that light reflected from metal surfaces does NOT get polarized. The polarized light we are mostly concerned with in the sunglass industry is the horizontal kind- that is light that hits a flat reflective surface such as the road, water, snow, etc. Think of it as horizontal light waves (going left and right) coming towards the observer on a single plane.

Directional glare can be managed through lens tint, mirrored coatings on the outside of the sunglasses lenses, and anti-reflective coatings on the inside of the lenses. Polarized light can only be managed by lenses with polarized filters. Although all sunglasses offer UV protection, not all sunglasses are polarized.

EYEWEAR PARTS



Bridge:
The area that arches up over the nose between the lenses. It is designed to support the majority of the glasses' weight.

Rims (Eye wire):
Front portion of the sunglasses where the lenses are inserted.

Lenses:
Glass or plastic material through which the wearer can see.

End Pieces:
Portion of the frame that extends outward from the lenses and connects to the temples

Hinges:
Portion of the frame that connects the rim to the temple and allows the temple to fold inward. Barrel hinges are the most common. These are designed with interlocking pieces held together with a screw. Spring hinges are another (more expensive) option. They are made with a spring that allows the temples to press more firmly around the head while also giving them a degree of outward movement.

Screw:
Tiny metal fastener found at the hinge that connects the temples to the frame front. Screws are also used on the bridge to hold the nose pads in place.

Temple:
Often called the arm, this is the piece of the frame that extends over the ear to help hold the sunglasses in place.

Earpiece:
The portion of the temple that rests on top of the ear (in metal frames often covered in plastic for comfort).

Pad Arms:
The attachment that holds the nose pad in place, while allowing room for adjustment, so the glasses may conform to the wearer's nose.

Nose Pads:
Plastic piece that helps keep the sunglasses in the proper position on the wearer's face. Designed for comfort and a snug fit, it can be attached directly to the frame or the pad arm.

Top/Sweat Bar:
Bar that runs across the top of the bridge between the two lenses, to provide extra support. The top bar is not present on all sunglasses but is commonly found on aviator styles.

NOTE: Most brand sunglasses will have sizing (in millimeters) on the inside of the temple. These usually will appear as such: 51 ◊ 19 145. What this means is that the lenses are 51mm wide each, the bridge is 19mm, and the temples are 145mm long.

BASIC FACTS ABOUT SUNGLASSES

Optically correct lenses are important because, when the eye has to look through a lens that is not optically correct, it has to continually refocus due to distortion, and this places a large amount of strain on the eye and can lead to headaches, nausea, and dizziness.

Types of Lenses

The four main types of lenses are:

- Solid Tint
- Gradient
- Photochromic
- Polarized

Solid Tint:

These lenses are fixed in the percentage of light they absorb and appear as one color. They provide excellent directional glare protection and are a good choice for those who are often in bright sunshine.

Gradient:

These lenses are darker at the top of the lens and get progressively lighter at the bottom. They are used mainly in fashion sunglasses as the gradation softens the shape of the frame which gives an appealing effect.

Photochromic:

Lenses that darken when exposed to UV light (NOT visible sunlight) are known as photochromic. Once the light source is removed, they will gradually return to their normal state. In the industry we tend to use the term photochromic to specifically refer to lenses that already have a base tint and then get about 20-30% darker (so they can be used to manage various light conditions and are great for driving), versus transitions which are prescription lenses that are 100% clear to 5% tinted and then reach full darkness in UV light (so they are designed for use indoors into outdoors but are not good for driving as they have no base tint inside the vehicle). Note that photochromic lenses must be conditioned before reaching their full capacity to change color (which takes a few uses).

Polarized:

As mentioned earlier, polarized filters are used to reduce the glare (and they do so very efficiently), in particular light reflecting from flat non-metallic surfaces such as the road, water, snow, etc. These filters resemble microscopic Venetian blinds that are oriented vertically thus breaking the horizontally polarized light wave patterns while allowing

normal light through. Polarized lenses are usually designed by sandwiching the polarized filter between two optically correct lenses.

NOTE: Lenses can be a combination of a solid OR gradient tint AND photochromic AND/OR polarized. The more they can do, the better they are, and the more they cost.

LENS MATERIALS

Sunglass lenses can be made of three different materials:

- Glass
- Polycarbonate
- CR-39

Glass:

Optical quality glass makes the clearest lenses because it is free of bubbles, seeds, or haziness, which can distort vision. Ground and polished, the surface is free of imperfections. Optical quality lenses are chemically or heat treated to make them impact resistant in order to meet FDA safety standards. While glass is heavier than plastic, it keeps its shape when heat is applied. This means that glass lenses will do better than plastic if accidentally left on a dashboard in hot afternoon sun. Glass is also up to 12 times more scratch-resistant than plastic lenses.

Polycarbonate:

Polycarbonate (often abbreviated as polycarb or poly) is a remarkably strong plastic. In fact, aircraft windshields, motorcycle windshields, and sport safety glasses are made of polycarbonate because it is so strong. Compared to CR-39 and glass, polycarbonate weighs the least and is the most impact-resistant (20 times more impact resistant and 3 times lighter than glass). Polycarbonate is a good choice for those who want really rugged sunglasses and for people who engage in outdoor activities and fast-action sports where lightweight gear and impact safety are the biggest concerns. It is also the cheapest lens material to produce so it is widely used in the industry. Its major drawback is that it is very soft and more susceptible to scratching. It is also not as clear as glass is.

CR-39:

Made of hard resin, CR-39 is considered the best optical quality plastic for lenses. It is lightweight (weighs about half as much as glass). It exceeds FDA requirements for impact-resistance because of its comparatively loose molecular structure. And also does not scratch quite as easy as polycarbonate, although is not nearly as scratch resistant as glass. To help resist scratches, polycarbonate and CR-39 lenses are often protected with anti-scratch coatings (the latter more often than the former). CR-39 is often considered the best of both worlds as it has some of the benefits of both glass and polycarbonate and few drawbacks.

LENS COLORS

Vision can be enhanced through the use of specific lens colors (tints). Under any situation the goal is to achieve optimum perception with minimal eyestrain. Lens color can affect what we see because colors vary in how they absorb light. Each lens color serves a different function for the wearer. For example, brown/amber makes details clearer; grey produces the truest colors and reduces glare. The majority of sunglasses offered in the industry will be either of the above mentioned tints and often times the same model will come with a brown/amber and grey option.

Brown/Amber:

- Warm shade and excellent general purpose color
- Improves contrast because it filters out a lot of the blue light
- Especially well-suited for driving and fast-reaction sports
- Can also be used in overcast, hazy conditions

Grey:

- Neutral shade and excellent general purpose color
- Allows true perception of colors with the least amount of color correction of any lens color because light pass through evenly
- Because it is also the darkest color, it is superb in combating directional glare during high light intensity (noon sun, open outdoors)

Other Tints:

- Green: Neutral with higher light transmission and contrast than grey. Excellent for golfing and grass.
- Rose: Warm with lower light transmission than brown. Great for snow.
- Yellow: Very high light transmission that provides excellent depth perception and contrast in low light. Most often used for dusk/night driving, shooting, or skiing.
- Misc: There are many more colors used in the sunglass industry but they serve more of an aesthetic purpose. This isn't to say they won't have their respective benefits but they will generally align with the above mentioned warm or neutral (or cool) tints.

LENS COATING

Coatings are chemical oxides applied to lenses, which augment the lenses by providing protective or enhancing benefits.

Mirrored Coatings

Thin metallic coatings placed on the outside of sunglass lenses to create a reflective look. Mirrored coatings make a lens more effective for intense sunlight and directional

glare. This makes them especially good on open water where the light intensity is much higher than on land. They are also often used as a fashion statement due the more aggressive look they give sunglasses.

Anti-reflection coatings:

These are applied on the backside of the lenses to prevent sunlight from coming in from behind and reflecting off the lenses and into the eyes. These coatings are very useful for every day purposes and are found on most high quality sunglasses.

Hydrophobic/Oleophobic coatings:

Hydrophobic coatings repel water (it beads off, the way it would from a car windshield). Oleophobic coatings repel oils. Having one of these coatings usually means being more susceptible to what the other one handles, so often times these are combined by using substances such as silicates or fluorocarbons which are both hydrophobic and Oleophobic. These are usually found in high quality sunglasses.

Scratch resistant coatings:

Scratch resistant coatings prolong the life of the sunglass lenses by shielding them from minor scratches. They are most often used on plastic lenses (CR-39 and polycarbonate), although some glass lenses are also scratch coated.

BASIC FACTS ABOUT FRAMES

FRAME MATERIALS

Nylon:

Nylon frames are lightweight and flexible. They are able to bend slightly and return to their original shape instead of breaking when pressure is applied to them. This flex gives the glasses a better grip on the wearer's face. A version of nylon, called blended nylon, has been popularized by Oakley and made standard in sportswear. Even more cutting edge is Mylon by Mikita which is used to create frames by 3-D printing.

Cellulose Acetate (Zyl):

A natural plastic derived from processing cellulose usually from cotton linters or wood pulp. Acetate frames are more rigid and heavier than nylon. The temples of these frames often have metal wire cores which give additional stability to the frame and make the temples easier to adjust. To adjust acetate it needs to be heated which makes it more pliable so it can be then molded to perfectly fit a person's face. Acetate takes color extremely well (much better than nylon) and is often produced in the form of color flakes which are then mixed to produce various color effects (including the tortoise shell pattern which has become classic and although sometimes applied to nylon, is much richer when executed in acetate). So the benefits of using acetate are the feeling of substantiality the frame has and its superior color. This has made acetate the standard in the fashion industry. NOTE: The best acetate in the world comes from Italy and is called Mazzucchelli acetate.

Injected Plastic:

Injection mold plastic frames are the cheapest on the market, because they are produced en masse off completely machine-driven assembly lines. First, a petroleum-based plastic is liquefied and then injected into a mold before colors are sprayed on. Finally, the frames are glossed to create the sheen typical of plastic materials. Although injection mold plastic frames are more flexible and bend more easily, they are also brittle and are of a very low quality.

Metal:

Metal frames are usually more durable than plastic ones. They often weigh less and are corrosion resistant. Because metal frames are more rigid, some models have spring loaded hinges to help them grip the wearer's face better. The ends of the resting hook are usually curved so that they wrap around the ear; however, some models have straight resting hooks (ex: Oakley). The end of the resting hook and the bridge over the nose can be textured or have rubber or plastic material to improve hold. However, unlike plastic frames there is a limitation to the color options. The most common metal

materials found in the industry are alloys of nickel, chromium (ex: stainless steel), and titanium. Titanium is considered the premium option as it has an attractive silver color, low density, and high strength. In fact, titanium has the highest strength-to-weight ratio of all metals. In its pure state titanium is as strong as stainless steel but 45% lighter. Metal frames are better suited for every day purposes versus sports, but this isn't to say there are no sports frame options in metal.

Carbon/Graphite Fiber:

A material composed of fibers of mostly carbon atoms. Carbon fiber is extremely lightweight, strong, and corrosion resistant. It has a checkered pattern that gives it a unique look. Carbon fiber is mostly used to make sports frames that appear metallic.

FRAME TYPES

The three most common types of eyewear frames are full-frame, half-frame, and frameless. Full-framed sunglasses completely surround the lenses. Half-framed sunglasses surround only half the lens, usually the upper portion. Frameless (rimless) sunglasses, a favorite among people who prefer slim lines and lightweight frames, have no rims around the lenses. The lenses of this type of sunglass frame are usually attached to the ear stems. Almost all sunglasses will be one of these types.

POPULAR FRAME STYLES

Aviator:

Aviator sunglasses feature oversize teardrop-shaped lenses, double bar, and a thin metal frame. The design was introduced in 1936 by Bausch & Lomb (and marketed as Ray-Ban) for issue to U.S. military aviators (hence the name). The original design featured G-15 (neutral grey) tempered glass lenses, transmitting 20% of incoming light. Bayonet earpieces or flexible cable temples that hook behind the ears were also utilized. The design attempts to cover the entire range of the human eye and prevent as much light as possible from entering the eye from any angle. Aviator glasses became fashionable in the 1960s and their popularity has continued to increase since (except for a drop in the 90s). Modern aviators come in a variety of materials (metal, plastic, and mixed), often feature mirrored lenses, sometimes wrap around, or have less of a teardrop. We tend to refer to these as modified aviators in the industry.

Wayfarer:

Wayfarers are plastic frames designed in 1952 by Bausch & Lomb (manufactured and sold as Ray-Ban since 1956). At that time the design was a revolutionary departure from the metal frames of the past. The design is upside down trapezoidal in shape and features thickened temples (to give an overall edgy masculine look). Wayfarers were very popular in the 50s and 60s but sales significantly declined in the 70s. The style was on the verge of being discontinued in the beginning of the 80s but heavy investment in TV and movie product placement brought it back in fashion (ex: Risky Business). The 90s saw another decline in popularity and in 2001 the design was updated to make it smaller, less angular, injected plastic (vs. acetate), and more wearable. This new style is known as New Wayfarer. The classic Wayfarer was brought back in fashion in the late 2000s. Both styles have seen a steady growth in sales since. Modern squared plastic frames with a Wayfarer-like design are quite common in the industry.

Clubmasters:

Brow-line glasses were a very popular style of eyeglasses which had its heyday in the 1950s and 60s. These have a plastic upper part of the frame and temples, with metal lower rims. This style fell out of fashion in the 70s due to the hippie counter-culture which viewed them as conformist. Clubmasters are a sunglass version of brow-lines introduced by Ray-Ban in the 1980s as a response to the popularity of a tinted pair of Shuron's worn by Bruce Willis on TV. At that point, Ray-Ban was already dominating the market with Aviators and Wayfarers and Clubmasters quickly became the third best-selling style of the 80s. Clubmasters continued to be popular in the 90s, and have recently seen a renewed interested due to the rise of the hipster sub-culture.

Round:

Round wire-rim sunglasses became popular in the late 60s as part of the hippie culture. They were most famously worn by John Lennon and are still to this day often called Lennon glasses. The original rounds were medium-sized, with perfectly round lenses, and a thin wire frame. They often came in colored tints and mirrors to match the psychedelic look of the 70s. These fell out of style shortly after the decline of the hippie culture but have been brought back recently in metal but also in plastic (homage to the eyeglasses that Gregory Peck wore in "To Kill a Mockingbird" in 1962)

Cat Eye:

Cat eye glasses have an upsweep at the outer edges where the arms (typically referred to as temples) join the frame front. These were popular among fashionable women in the 50s and 60s (ex: Marilyn Monroe, Audrey Hepburn). They fell out of fashion in the 70s and did not resurge until the late 2000s when designers such as Tom Ford revived it and celebrities like Rihanna popularized it. Cat eyes are now very popular among women, although usually in less aggressively upswept versions.

Oversized:

Oversized sunglasses were first popularized by Jacqueline Kennedy Onassis in the 60s (sometimes still referred to as “Jackie O’s”) and have been a strong trend in women eyewear ever since. In the 70s they were mostly square but later evolved into larger and rounder styles which were popular in the 80s. They saw a bit of a decline in the 90s before returning in the 2000s in a more rectangular version. The infinity shape was made popular by Tom Ford in the late 2000s and is considered the most modern of the oversized designs. The large round frames of the 80s have also seen a resurgence.

Wrap-around (Wrap):

Wrap around glasses are a style of glasses that curves around the face in a semi-circle in much the same fashion as snow goggles do. They can have a single lens (these are often called “shields” or “blades”) or two lenses (these are often called “sports wraps”). Because of the superior coverage these offer the most protection and peripheral vision of all sunglasses. Wrap around glasses first emerged in the 60s (ex: Yoko Ono) and were popular for a couple of years but fell out of style after that. They made a big return in the 90s and became one of the most popular styles. Wraps are quite common these days and are a staple of sportswear.

FITTING FRAMES TO FACES

The key to fitting sunglasses is to balance out the facial features of the person wearing them. In order to do that, the frame shape should contrast, or be the opposite of, the shape of the face. So if the facial features are generally soft, a sharper looking frame will work best. Conversely, if the facial features are sharp, a softer frame will be better. The frame size should be in proportion with the face size. This means that- regardless of style, smaller frames are best for smaller faces while larger frames are best for larger

faces. Please note, this does not mean that people with smaller faces cannot wear oversized glasses, it simply means that the oversized glasses should not be too wide or too deep for the small face. Here are some specific recommendations for the most common facial structures:

Round face:

Frames should make the face appear longer and thinner. In general, look for frames equal to or wider than the broadest part of the face. Minimize curves and add definition with soft, angular, rectangular styles. Higher temples create a longer profile. Glasses with brow bars also pull the eye upward, making the face appear longer. Wider frames with angular rectangular styles are a good start.

Diamond:

(Wide or high cheekbones with a narrow forehead and chin)
Oval glasses soften the contour of the face. Softly curved square frames will work as well. Make sure the styles are no wider than the top of the cheekbones. Combination frames (a plastic brow bar with a metal rim) are a good choice because they widen the forehead and minimize the temples and cheekbones.

Square:

To reduce the angles of the square-shaped face with its strong jaw line, broad foreheads, and wide cheekbones, use soft, curvy styles that will give the face some definition. Higher temples or cat eyes will lengthen the face. Classic ovals are perfect.

Oblong:

Widen and shorten the face with styles that don't extend beyond the widest part of the face. Wear round or square shapes. John Lennon/Annie Hall style frames will look great on this face. Frames with short horizontal and long vertical lines also work. Decorative or contrasting temples add width to the face.

Triangle:

This face shape has a wide jaw and a narrow forehead. Soften the lower portion of the face by accenting the eye area. Temples should be placed high. Frames can be top heavy and angled inward at the bottom. Styles such as cat eyes should angle outward at the top corners and be wide enough to balance the jaw line. You can also try metal frames with rimless bottoms.

Heart:

Minimize the upper portion of the face by choosing frames no wider than the forehead and angling outward at the bottom corners. Temples shouldn't be placed too high. Very light colors and rimless styles work well on this face.

PROPER CARE OF SUNGLASSES

Clean dust, lint, and minor smudges from your lenses with a soft microfiber cloth. This ensures the lenses will not get scratched. Do not use your shirt to clean sunglasses as fabrics such as cotton and wool can scratch the lenses. This is especially important with plastic lenses.

To remove heavier smudges, oils, and/or fingerprints, a lens cleaner is recommended, or wash the lenses with a mild non-abrasive soap. Dry them with the microfiber cloth. Do not use your fingers or fingernails to remove a spot on the lens surface.

It is always best to place your sunglasses in a case when you are not wearing them. If you leave your sunglasses on a table or any other hard surface, place them on folded temples with the lenses facing up. Avoid placing your sunglasses in your purse or pocket without protection.

Remove glasses gently from your face with two hands. This will prevent the frame from becoming bent and curved. Wearing sunglasses on the top of your head can stretch the frames.

Don't leave sunglasses with plastic frames on the dashboard of your car on a hot day. You don't want your sunglasses to "melt" and lose their form. Visor clips can be useful if keeping the glasses in the car but, again, keeping them in the case is the best option.

Wearing your sunglasses on a cord or chain around your neck is recommended if you tend to misplace your glasses, or you’re putting them on and taking them off frequently throughout the day, or if you’re doing anything active where they could easily fall off.