Reading Material for

Dispensing Opticianry
(Paper-A)

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PREFACE

A two years post matric teaching program of Dispensing Opticianry Technician for the students of Allied Health Sciences. The purpose of this reading material is to provide basic education to the paramedics about Dispensing spectacles. This reading material attempts to cover almost all the basic theoretical knowledge required by students about Dispensing, optics, spectacles manufacturing so that they can perform their work better in Optical Laboratories.

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<u>Section I</u>

<u>Unit 1:</u>

<u>The Eyes</u>

Eye is the organ of vision which contains two types of visual receptors, the rod cells and cone cells. The two eyes are locatedin the deep cavities of the skull called orbits which are situatedon the frontal side of the cranium. Two eyeballs rest on the pad of fat.

Learning Objective:

The Opticians have a very significant role in managing opticianry problems so they should have the knowledge of various structures of eye, particularly to ensure appropriate referrals.

After completing this unit, the students will be able to demonstrate and describe the basic structure and form of the eye ball and its adnexa.

STRUCTURE OF THE EYEBALL

Each eyeball is nearly spherical, fluid filled ball and is approximately 2.5 cm in diameter. It consists of the coats of the eyeball and the refractory media of the eyeball.

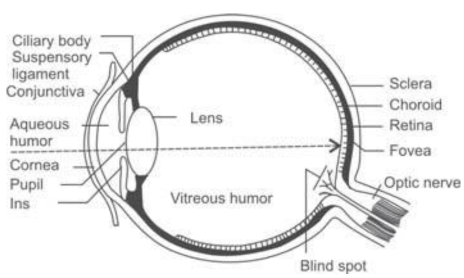

Fig. 12.1: *Structure of human eye*

Coats of the Eyeball

The eyeball is covered by outer, middle and inner coats.

Outer Coat

The outer most tough fibrous layer of the eyeball is called the fibrous coat. It has two parts:

1 Cornea and
2. Sclera.

Cornea: The anterior one-sixth of the eyeball is the cornea of the eye. It forms the transparent bulging part of the eyeball. The dioptrical value of the cornea is approximately + 42.00 D and the refractive index is 1.337. It has many layers. It allows the light to enter the interior of the eyeball. That is why it is some times termed as "Window of the eye."

Sclera: The posterior five-sixth opaque white part is known as sclera. It gives shape to the eye and prevents light rays topass through it.

Middle Coat

This is the vascular coat of the eyes and has two parts:

1. Choroid and
2. Ciliary body.

Choroid: The vascular layer which forms the inner lining of theopaque portion of the sclera is called choroid. It is heavily charged with the black pigments called pigmentum nigrum. Hence, this layer looks black. This is also a protective coveringof the eyeball and does not allow any external reflection.

Ciliary body: At the anterior end of the choroid there is a circularzone which is known as ciliary body. It holds the crystalline lens with the help of suspensory ligaments. There is a colored disk situated in between the cornea and the lens which is calledthe iris. At the periphery it is continuous with the ciliary bodyand at the center there is a circular aperture called the pupil. The ciliary body muscles contract and relax and thereby altering the lens thickness.

Inner Nervous Coat

Retina is the innermost light sensitive nervous layer and is present at the posterior side of the eyeball between the choroidand vitreous humor. This layer contains many neurons and

light sensitive cells called photoreceptors. According to the shapes, the photoreceptors are called rod cells and cone cells. Rod cells are cylindrical and are mostly found on periphery part of the retina. The cone cells are pyramidal in shape and are found at the central portion of the retina, opposite to the pupil and the lens. At about the center of the retina, there is a round depressed portion, yellow in color which is extremely sensitive to the light and is called the Yellow Spot or Macula Lutea. This area contains highly developed cone cells only. Just below the yellow spot a disk like area is located which does not contain any rods and cones. This is known as optic disk or blind spot. This is the place at which optic nerves leavethe eyeball and blood vessels enter into the eyes.

Rods and cones contain photosensitive pigments calledrhodopsin and iodopsin respectively. When the light falls on retina, these pigments are bleached and the light energy is converted into visual impulse. Rod cells are responsible for dim light vision and cones for bright light vision, color vision and for detail perception.

Refractive Media of the Eyeball

There are four refractive media of the eye, which help toconverge the light rays and focus them on the retina—cornea, aqueous humor, lens and vitreous humor.

Aqueous Humor

It is a watery fluid that fills up the chambers in front of the lens and supplies nutrition to lens and cornea. The refractive index of this is 1.337.

Lens

The eye is provided with transparent, elastic circular lens, enclosed in a capsule and suspended through the suspensory ligaments and is located approximately 2 mm behind the cornea. It is biconvex but its rear surface is more convex than the front. The refractive index of the lens is 1.42 and is approximately + 18.00 D of power.

Vitreous Humor

It is a protein matrix that forms a gelatinous but clear fluid and is present in the compartment behind the lens. It maintainsthe eyeball pressure.

MECHANISM OF VISION

The working of the eye can be compared to that of a camera. Light is essential to see an object as for taking a photographby a camera. Light rays reflected from an object enters the eye through cornea, pupil, aqueous humor, lens, vitreous humor and finally falls on retina.

The size of the pupil is regulated by the contraction of muscles present in the iris. This contraction of muscles takes place reflexly. Size of pupil regulates the intensity of light thatenters the eye. The light rays refracted by different refractory media like cornea, lens, aqueous humor and vitreous humoris finally converged on the retina. It forms an inverted and reduced size image. The muscles of the ciliary body adjust thecurvature of the lens, thus light rays are clearly focused on the retina. The rods and cones exposed to the light in the region of the image are stimulated by photochemical reactions.They convert these stimulation into visual impulse. It is conducted through the optic nerve into the visual center of the cerebrum. The result is vision.

Passage of light through eye:

Light rays from an object
Cornea
Aqueous Humor
Pupil
Lens

Vitreous Humor
Retina
Optic Nerve
Brain

SOME DEFECTS OF VISION

A healthy eye focusses the parallel light rays exactly on the retina. This is called emmetropia. However, some common abnormalities may occur due to which the light rays are not focussed exactly on retina. This situation is known as ammetropia.

Myopia

In this case, the person cannot see the distant object in any case but somehow manage to see the near object at a certain distance. So they are called short-sighted. The light rays are focussed in front of the retina. The defect can be corrected by using a concave lens.

Hypermetropia

In this case, the person can manage to see the distant object by applying accommodation but he fails to see the near objectat all. So they are called long-sighted. The parallel rays comingfrom infinity comes to a focus behind the retina when accommodation is at rest. The defect can be corrected by usinga convex lens.

Astigmatism

It is a common structural defect in the cornea or the lens. There may be a difference in the curvature of the two principalmeridians of the cornea or the lens. The result being that the rays refracting by these surfaces do not focus at one point. For this reason the vision is not sharp. The defect can be corrected by using cylindrical lenses.

Presbyopia

Presbyopia is an age related visual defect. Usually above the age of 40 years the person can see the distant object but he cannot see the near objects. This is due to loss of elasticity of the lens and weakness of the ciliary muscles to accommodate. Thedefect can be corrected either by using near power spectacle or by bifocal lenses.

Cataract

It is a condition in which the crystalline lens inside the eye turn opaque and the vision is cut down to even total blindness. It can be corrected by surgically removing the lens and by using a very high power convex lens compensating for the removed lens. In new technique, a small artificial lens madeof plastics (IOL) is implanted behind the iris.

ACCOMMODATION

A normal eye can see an object at infinity without giving any strain to the eyes. This implies that a normal eye can focus theobject of infinity on the retina in a state of relaxation. But when the object is brought nearer to the eyes, it is found that the image has a tendency to focus behind the retina. But the ciliary body muscles automatically get contracted and pulls the choroid coat in front. Thus, the ligaments which are connected to the ciliary body become loose and the surfaces, specially the anterior surface become more curve and the effective focal length is thus reduced so that the images isnow focussed on the retina. This process of the eye is known as accommodation of the eyes. In precise words the process of focusing the objects at different distances is called the accommodation. It is a reflex process and is mainly done by changing the curvature of the elastic lens. The amplitude of accommodation is very strong in case of children but reduces with the increase in age.

Sample Questions:

1. **Draw and label cross section of the eye?**

Ans: STRUCTURE OF THE EYEBALL

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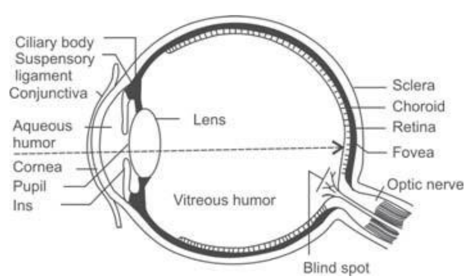

Structure of human eye

2. **Discuss common conditions related to ocular structures?**
   1. **Myopia**

In this case, the person cannot see the distant object in any case but somehow manage to see the near object at a certain distance. So they are called short-sighted. The light rays are focussed in front of the retina. The defect can be corrected by using a concave lens.

2. **Hypermetropia**

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3. **Define and explain accommodation?**

ACCOMMODATION

A normal eye can see an object at infinity without giving any strain to the eyes. This implies that a normal eye can focus the object of infinity on the retina in a state of relaxation. But when the object is brought nearer to the eyes, it is found that the image has a tendency to focus behind the retina. But the ciliary body muscles automatically get contracted and pulls the choroid coat in front. Thus, the ligaments which are connected to the ciliary body become loose and the surfaces, specially the anterior surface become more curve and the effective focal length is thus reduced so that the images is now focussed on the retina. This process of the eye is known as accommodation of the eyes. In precise words the processof focusing the objects at different distances is called the accommodation. It is a reflex process and is mainly done by changing the curvature of the elastic lens. The amplitude of accommodation is very strong in case of children but reduces with the increase in age.

Unit 2:

Action of Eye

Properties of Light and Visual Function

Light may be defined as energy to which the human eye is sensitive. Scientists do not yet fully understand the true nature of light in the physical sense, but the behaviour and properties of light have been extensively studied and are well known.

Learning Objective:

The Opticians have a very significant role in managing opticianry problems so they should have the knowledge of functions and actions of various structures of eye, particularly to ensure appropriate referrals.

After completion of this unit, students will be able to demonstrate the actions of eye ball, functions of eye, basics of vision and form of the eye ball and its adnexa.

This chapter aims to describe those aspects of optics which are relevant to the practicing opticians. In this chapter a simple account is given of the nature and properties of light.

Electromagnetic Spectrum:

Optical Radiation

Optical radiation lies between X-rays and microwaves in the electromagnetic spectrum and is subdivided into seven wavebands. Each of these seven wavebands group together wavelengths which elicit similar biological reactions. These seven domains are ultraviolet C (UV-C), 200–

The electromagnetic spectrum.

280 nm; ultraviolet B (UV-B), 280–315 nm; ultraviolet A (UV-A), 315–400 nm; visible radiation, 400– 780 nm; infrared A (IRA), 780–1400 nm; infrared B (IRB), 1400–3000 nm; and infrared C (IRC), 3000– 10000 nm. As with all electromagnetic radiation, the shorter the wavelength, the greater the energy of the individual quanta, or photons, of optical radiation.

The cornea and sclera of the eye absorb essentially all the incident optical radiation at very short wavelengths in the ultraviolet (UV-B and UV-C) and long wavelengths in the infrared (IR-B and IR-C). The incident UV-A is strongly absorbed by the crystalline lens while wavelengths in the range 400– 1400 nm (visible light and near infrared), pass through the ocular media to fall on the retina.

The visible wavelengths stimulate the retinal photoreceptors giving the sensation of light while the near infrared may give rise to thermal effects. Because the refractive surfaces of the eye focus the incident infrared radiation on the retina, it can cause retinal damage, e.g. eclipse burns.

Colour Vision

The visible wavelengths of the electromagnetic spectrum are between 400 nm and 780 nm. The colour of any object is determined by the wavelengths emitted or reflected from the surface. White light is a mixture of wavelengths of the visible spectrum. Colour is perceived by three populations of cone photoreceptors in the retina which are sensitive to light of short (blue), middle (green), or long (red) wavelength.

A congenital colour vision defect occurs if a cone pigment is absent or if there is a shift in its spectral sensitivity. Hence, deuteranopia, protanopia and tritanopia indicate absence of green, red and blue cone function, and deuteranomaly, protanomaly and tritanomaly indicate a shift in the corresponding cone sensitivity. The X-chromosome carries genes encoding for red and green pigment whereas chromosome 7 carries the blue pigment gene. Of men 8% and of women 0.5% have a defect of the red/green system; the commonest is deuteranomaly which occurs in 5% of men and 0.3% of women. Tritan defects are rare.

Congenital colour defects characteristically affect particular parts of the colour spectrum. Acquired colour defects occur throughout the spectrum but may be more pronounced in some regions. For example, acquired optic nerve disease tends to cause red–green defects. An exception occurs in glaucoma and in autosomal dominant optic neuropathy which initially cause a predominantly blue–yellow deficit; it has recently been found that visual field loss in glaucoma is detected earlier if perimetry is performed using a blue light stimulus on a yellow background. Acquired retinal disease tends to cause blue–yellow defects (except in cone dystrophy and Stargardt's disease, which cause a predominantly red–green defect).

Clinical Testing of Colour Vision

Ishihara pseudoisochromatic test plates specifically test for congenital red–green defects, the most common abnormality of colour vision. The test plates consist of random spots of varying isochromatic density. Numbers or wavy lines (for illiterates) are represented by spots of different colours. A patient who is colour blind will see only a random pattern of spots or incorrect numbers. The figures can only be distinguished from their background by their colour and not by a difference in contrast.

The Lanthony New Colour Test tests hue discrimination and can be used by children.

Ultraviolet Light

The retinal photoreceptors are also sensitive to wavelengths between 400 nm and 350 nm in the near ultraviolet (UV-A). These wavelengths are normally absorbed by the lens of the eye. In aphakic eyes or pseudophakic eyes with intraocular implants without UV filter, such UV radiation gives rise to the sensation of blue or violet colours. Newly aphakic patients frequently remark that 'everything looks bluer than before the operation'.

Of greater concern is the recent evidence that wavebands between 350 nm in the UV and 441 nm in the visible spectrum are potentially the most dangerous for causing retinal damage under normal environmental conditions. It is therefore desirable that intraocular lenses filter out these wavelengths and protect the retina. Intraocular implant lenses are therefore being produced which incorporate a UV- A absorbing substance.

The bright illumination employed in modern ophthalmic instruments may also cause retinal damage under some circumstances. Prolonged exposure to high intensity indirect ophthalmoscope illumination, intraocular light pipe illumination and operating microscope light is potentially damaging to the retina, which may in many instances

already be unhealthy. Some instruments have yellow filters built into them to reduce exposure to the most damaging wavelengths.

Fluorescence

Fluorescence is the property of a molecule to spontaneously emit light of a longer wavelength when stimulated by light of a shorter wavelength. For example, the orange dye fluorescein sodium when excited by blue light (465–490 nm) emits yellow–green light (520–530 nm).

Wave Theory of Light

The path of light through an optical medium, e.g. glass, is always straight if no obstacle or interface between optical media is encountered. Diagrammatically light is represented as a straight arrowed line or ray. (By tradition optical diagrams show rays travelling from left to right on the page.) However, some experimental observations of the behaviour of light are not fully explained by the simple concept of light as rays, and it is now understood that light really travels as waves although its path is often represented as a 'ray'.

Wave motion consists of a disturbance, or energy, passing through a medium. The medium itself does not move, but its constituent particles vibrate at right angles to the direc-tion of travel of the wave. (Imagine a ribbon tied to a rope along which a wave is 'thrown'. The crest of the wave moves along the length of the rope, but the ribbon moves up and down at one point on the rope.)

Interference

When two waves of light travel along the same path, the effect produced depends upon whether or not the waves are in phase with one another. If they are in phase, the resultant wave will be a summation of the two, and this is called constructive interference. If the two waves of equal amplitude are out of phase by half a cycle, they will cancel each other out: destructive interference. The final effect in each case is as if the waves were superimposed and added (in the algebraic sense) to each other. Phase differences of less than half a cycle thus result in a wave of intermediate amplitude and phase.

Interference of two waves.

Destructive interference occurs within the stroma of the cornea. The collagen bundles of the stroma are so spaced that any light deviated by them is eliminated by destructive interference.

Interference phenomena are also utilised in optical instruments. One example is low reflection coatings which are applied to lens surfaces. The coating consists of a thin layer of transparent material of appropriate thickness. Light reflected from the superficial surface of the layer and light reflected from the deep surface of the layer eliminate each other by destructive interference.

Diffraction

When a wave front encounters a narrow opening or the edge of an obstruction, the wave motion spreads out on the far side of the obstruction. It is as if the edge of the obstruction acts as a new centre from which secondary wave fronts are produced which are out of phase with the primary waves. This phenomenon is called diffraction.

When light passes through a circular aperture, a circular diffraction pattern is produced. This consists of a bright central disc surrounded by alternate dark and light rings. The central bright zone is known as the Airy disc.

Diffraction effects are most marked with small apertures, and occur in all optical systems including lenses, optical instruments and the eye. In the case of lenses and instruments, the diffraction effect at the apertures used is negligible compared with the other errors or aberrations of the system (see Chapter 8). In the case of the eye, diffraction is the main source of image imperfection when the pupil is small.

However, the advantage of a large pupil in reducing diffraction is outweighed by the increased effect of the aberrations of the refractive elements of the eye (Chapter 8).

The principle of diffraction is used in the design of some multifocal intraocular lenses.

Limit of Resolution; Resolving Power

The terms limit of resolution and resolving power refer to the smallest angle of separation (w) between two points which allows the formation of two discernible images by an optical system. The limit of resolution is reached when two Airy discs are separated so that the centre of one falls on the first dark ring of the other.

Angle of resolution (w).

Tests of Visual Acuity – Resolving Power of the Eye

It is important in clinical practice to be able to measure the resolving power of the eye. There are many tests of visual acuity. The more commonly used and important ones are discussed here. In young children, tests appropriate to the age and development of the child must be selected. As soon as the child is old enough, tests to which the response is behavioural should be replaced by those requiring matching.

Babies are best examined when alert and not hungry. Fixation with either eye should be central, steady and maintained (CSM). The best target is a face (especially that of the mother), a toy, or a television cartoon. A strong preference for one eye, indicated by an aversive response to occlusion of that eye, squint, nystagmus, roving gaze, and eye poking, all suggest poor visual acuity.

Visually directed reaching develops between two and five months of age. When the vision is poor, the movements are exploratory in nature. Much can be deduced from watching babies playing. The ability of a child aged 15 months or older to pick up a tiny coloured 'hundreds and thousands' sweet suggests near visual acuity equivalent to 6/24 or better and the absence of a serious visual defect. However, good near visual acuity may develop in the presence of high myopia.

The Catford drum comprises a white cylinder marked with black dots of increasing size corresponding to visual acuities ranging from 6/6 to 2/60 when viewed from 60 cm. The drum is masked by a screen except for a rectangular aperture which exposes a single spot. This spot is made to oscillate horizontally and stimulates corresponding eye movement if seen by the child. This test overestimates the acuity both because the target is moving and because the test is conducted at a short working distance.

The STYCAR (Screening Test for Young Children And Retards) rolling balls are ten white polystyrene spheres ranging in size from 3.5 mm to 6 cm in diameter. They are rolled across a well illuminated contrasting floor 3 m from the child. Pursuit eye movements indicate that they are seen. The Worth's ivory ball test is similar.

Other methods for assessing visual acuity in preverbal children depend upon preferential looking and the measurement of visually evoked potentials. Preferential looking can be used to assess the visual acuity of infants based upon their turning their head or eyes towards a patterned rather than a uniform target. A black and white square wave grating (alternating black and white stripes) is presented simultaneously with a plain grey target of equal size and average luminance. Children with better vision are able to see a finer grating and turn towards it.

Visual evoked potentials are the electrical responses generated in the occipital cortex by visual stimulation of the eye. The stimulus used is either a black and white square wave grating or a chequerboard pattern in which the pattern reverses at a set frequency.

An optotype is a symbol, the identification of which corresponds to a certain level of visual acuity. All tests employ black letters or pictures on an opaque or retroilluminated white background in order to maximise contrast. The requirements of each optotype test correspond to the literary ability of the subject.

Testing of young children requires them to match the optotype letter or symbol on a card shown by the examiner who is 6 m or 3 m away by pointing to one of a group of matching letters on a key card.

Children aged 18–24 months may be able to perform a picture optotype test. The Kay's pictures test uses pictures of objects such as a cat, train or house; the Cardiff cards also use pictures. The STYCAR letter tests use the letters first recognised by children (H ,O, T, V and X) to test children up to the age of approximately 3 years. The Sheridan–Gardiner test uses seven letters, adding U and A.

Optotype testing of the literate involves the naming of letters. The Snellen visual acuity test is the most commonly used. The test is based on the theory that the smallest object which can be resolved by the eye subtends the same visual angle at the nodal point of the eye as a cone photoreceptor, i.e. one minute of arc (see Fig. 1.11). The test employs a chart with rows of letters of diminishing size. Each row is accorded a number indicating the distance in metres at Snellen test type letter.

which a person with normal visual acuity should correctly identify the letters. The bars and spaces of each letter subtend an angle of one minute of a degree. The test chart is normally read from 6 m (20 feet). Thus, a subject who identifies the letters on the '12' line from 6 m has 6/12 vision (20/40) – the numerator indicates the viewing distance. 'Normal' visual acuity is 6/6 (20/20) although young adults often achieve 6/4 acuity. Children are sometimes able to perform the test before 5 years of age, and may be able to match the letters to a key card before 4 years of age.

LogMAR (Logarithm of the Minimal Angle of Resolution) visual acuity charts (e.g. the Bailey–Lovie test) are more precise than the Snellen test because they have a regular progression in the size and spacing of the letters from one line to the next and the same number of letters on every line (Fig. 1.12). Comparable results are therefore possible at any test distance.

Near Visual Acuity Testing

The near visual acuity is usually tested at a distance of 25–33 cm. Near acuity charts usually comprise unrelated words or passages of text.

The British N system is based on the use of the typesetters' point system to specify the size of the metal block on which letters were traditionally cast. Each point is equal to 1/72 inch and blocks are sized in multiples of this, e.g. the blocks bearing N5 letters measure 5/72 inches in height. Times Roman is used as the standard font because the size of printed text depends on the font chosen. Jaeger text types are a less satisfactory alternative because they do not follow a logical progression in size.

Potential Visual Acuity Testing

These tests may be used to assess the potential visual acuity of eyes in which it is not possible to see the macula e.g.

because of a cataract. Good potential visual acuity indicates that cataract surgery is likely to be of benefit. The simplest clinical test is the pinhole test.

The blue field entoptic phenomenon is the ability to see moving white dots when blue light diffusely illuminates the retina. They are thought to represent light transmitted by white blood cells in the perifoveal capillaries. When this phenomenon is present, macular function is grossly intact.

Interferometers project laser light from two sources on to the retina. Interference occurs where the two sources meet and this is seen as a sine wave grating if the macula is functioning.

The potential acuity meter projects a letter chart on to the retina through a small aperture.

Contrast Sensitivity

Tests of visual acuity do not adequately reflect the ability of the eye to see low-contrast objects such as faces. In many conditions, e.g. cataract, glaucoma and optic neuritis, the visual acuity may be almost normal whilst the contrast sensitivity is considerably reduced.

Contrast sensitivity is measured using a sine wave grating. This is a pattern in which there is a gradual transition between alternating light and dark bands, i.e. the edges of the bands appeared blurred.

Narrower bands are described as having a higher spatial frequency. A contrast sensitivity curve is constructed by plotting a range of different spatial frequencies against the lowest degree of contrast at which the eye can still detect the grating. Low or very high spatial frequencies must have higher levels of contrast in order to be seen.

In clinical practice, the contrast sensitivity is measured using either a television monitor or a chart. The Pelli–Robson contrast test chart displays letters that have decreasing levels of contrast to their background. The VISITECH chart has 40 circles with different sine wave gratings and levels of contrast. The subject must indicate the orientation of the circles.

Glare Testing

Scattered light which reduces visual function is called glare. Glare may be the predominant symptom of corneal oedema or scarring, cataracts or opacification of the posterior lens capsule. The effect of a glare source depends on its position and intensity and on the light scattering properties of the ocular media.

Glare testing refers to the measurement of visual function (e.g. visual acuity, contrast sensitivity, colour vision) in the presence of a source of glare.

Polarisation of Light

The orientation of the plane of the wave motion of rays comprising a beam of light is random unless the light is polarised. Figure 1.14a shows a beam cut across and viewed end-on: the light is travelling perpendicular to the page. In contrast, Fig. 1.14b shows the cross section of a beam of light in which the individual wave motions are lying parallel to each other. Such a beam is said to be polarized. (Elkington)

Cross section of beam of light to show plane of wave motion.

Polarized light is produced from ordinary light by an encounter with a polarizing substance or agent. Polarizing substances, e.g. calcite crystals, only transmit light rays which are vibrating in one particular plane. Thus, only a proportion of incident light is transmitted onward and the emerging light is polarised. A polarising medium reduces radiant intensity but does not affect spectral composition.

Light is polarised on reflection from a plane surface, such as water, if the angle of incidence is equal to the polarising angle for the substance. The polarising angle is dependent on the refractive index of the substance comprising the reflecting surface. At other angles of incidence the reflected light is partly polarised, i.e. a mixture of polarised and non-polarised light. Furthermore, the plane of polarisation of the reflected light from such a surface is parallel with the surface. As most reflecting surfaces encountered in daily life are horizontal, it is possible to prepare polarised sunglasses to exclude selectively the reflected horizontal polarised light. Such glasses are of great use in reducing glare from the sea or wet roads.

Birefringence

Some substances have a molecular structure which transmits light waves lying parallel to its structure but which selectively slows and therefore redirects light waves vibrating in a plane perpendicular to its structure. Crystals of quartz have this property, which is known as birefringence.

Because they split incident unpolarised light into two polarised beams travelling in different directions, they have two refractive indices.

Dichroism

The molecular structure of dichroic substances completely blocks transmission of light waves not aligned with its structure by absorption. Thus, only one beam of polarised light emerges, much weakened in intensity compared with the incident non-polarised light. Tourmaline and polaroid (the latter made from fine iodine and quinine sulphate crystals embedded in plastic) are dichroic substances, polaroid being commonly used in sunglasses.

Other examples of the use of polarised light in ophthalmology are the assessment of binocular vision in which polarising glasses may be used to dissociate the eyes, e.g. in the Titmus test in pleoptics to produce Haidinger's brushes; and in the manufacture of optical lenses to examine them for stress.

Stereoscopic Vision

Stereopsis is the ability to fuse slightly dissimilar images, which stimulate disparate retinal elements within Panum's fusional areas in the two eyes, with the perception of depth. It is graded according to the least horizontal disparity of retinal image that evokes depth perception, and is measured in seconds of arc.

The normal stereoacuity is approximately 60 seconds of arc or better (slightly different values are quoted by different workers). An individual with very good stereoscopic vision may have a stereoacuity of better than 15 seconds of arc, which is the smallest disparity offered in the Frisby stereotest (range 600–15 seconds of arc). The maximum stereoacuity is achieved when the images fall on the macular area of the retina, where the resolving power of the eye is at its best. Good stereoacuity is therefore a product of central single binocular vision. A stereoacuity of better than 250 seconds of arc is said to exclude significant amblyopia, while a stereoacuity of worse than 250 seconds of arc may be an indicator of amblyopia.

Clinical Tests of Stereoacuity

There are quite a variety of tests of stereoacuity available, but those most commonly used in the UK are the Titmus test, the TNO test, the Frisby test and the Lang stereotest.

The Titmus test, which includes the Wirt fly test, is in the form of vectographs. A vectrograph consists of two superimposed views presented in such a way that the light entering each eye is plane polarised, the light from one view being at right angles to that from the other. The composite picture must be viewed through a polarising visor or spectacles.

The Wirt fly is the largest target in the test, which also includes graded sets of animals and circles, one of which is disparate and appears to stand forward. The test must be viewed at 40 cm, and covers a range of stereoacuity from approximately 3000 to 40 seconds of arc.

The Frisby test consists of three clear plastic plates of different thicknesses. On each plate there are four squares filled with small random shapes. One square on each plate contains a 'hidden' circle, which is printed on the back surface of the plate. The random shapes give no visual clue to the edge of the 'hidden' circle, and the test is purely three-dimensional and does not require polarising or coloured glasses to be worn. At a 40 cm viewing distance the plates show a disparity of 340, 170 and 55 seconds of arc, and by adjusting the viewing distance the test can be used to give a disparity range from 600 to 15 seconds of arc.

The TNO test comprises computer-generated random dot anaglyphs. An anaglyph is a stereogram in which two disparate views are printed in red and green respectively on a white ground. Red–green spectacles are worn to view the anaglyph. The eye looking through the red filter sees only the green picture, as black, and the eye looking through the green filter sees the red picture, again as black, and the two views may be fused to give a stereoscopic effect. In the TNO test the disparities range from 480 to 15 seconds of arc.

The Lang stereotest targets are made up of fine vertical lines which are seen alternately by each eye when focused through built-in cylindrical lens elements. The displacement of the random dot images creates disparity ranging from 1200 to 550 seconds of arc. The test card must be held parallel to the plane of the patient's face to avoid giving uniocular clues. The test is viewed at a normal reading distance.

Quantitative Measurement of Light (Radiometry, Photometry)

This topic can be confusing because of the different nomenclatures that are used. Radiometry quantifies radiant energy in all parts of the electromagnetic spectrum as an absolute value, whereas photometry quantifies part of the spectrum in terms of the visual response it produces, i.e. the spectral sensitivity of the eye. Photometric measurements are therefore more commonly employed in visual science.

Radiometry measures light in terms of how much is emitted from a source (radiant flux), its intensity (radiant intensity) and the amount falling on a surface (irradiance) or reflected from it (radiance).

The total flow of light emitted in all directions from a source is termed either the radiant flux, if measured in watts, or luminous flux, if measured in lumens (Fig. 1.15).

The intensity of light emitted from a source is a measurement of the flow of light per unit solid angle of space extending away from it. It is called either the radiant intensity if measured in watts per steradian or luminous intensity if measured in candelas (lumens per steradian). A steradian is the unit of solid angle (resembling a cone) and defined as the angle at the centre of a sphere which subtends an area on the surface of the sphere measuring the square of the radius (r). Since the surface area of a sphere is 4Dr2, it follows that a point source whose luminous intensity is one candela emits a total of 4D lumens.

The original unit of luminous intensity was the candle, based on the emission from a wax candle of standard composition. Attempts to produce a more uniform and precise source of light by which others could be measured led to the current standard unit, the candela, whereby the luminous intensity per square centimetre of a black body radiator at the freezing point of platinum is defined as 60 candelas because the black body radiator is 60 times brighter than the standard candle.

Automated Perimetry

Perimetry measures the light sensitivity of points on the retina by the ability of the patient to detect light stimuli of varying intensity presented at corresponding points in the visual field. Currently, most perimeters have a standard background luminance of 31.5 apostilbs (asb). The eye to be tested should be positioned at the centre of the hemisphere, and the near spectacle correction should be worn whilst the patient maintains steady fixation. Spots of light are projected on to the inner surface of the hemisphere.

Light stimuli may vary in intensity between 0.8 and 10 000 asb. This range can be expressed as a logarithmic scale and the log units are termed decibels (dB; 1 log unit equals 10 dB). The range 0.8–10 000 asb used in perimetry corresponds to 51 dB.

Sample Questions:

1. **What is stereo acuity? How it can be measured clinically?**

There are quite a variety of tests of stereoacuity available, but those most commonly used in the UK are the Titmus test, the TNO test, the Frisby test and the Lang stereotest.

The Titmus test, which includes the Wirt fly test, is in the form of vectographs. A vectrograph consists of two superimposed views presented in such a way that the light entering each eye is plane polarised, the light from one view being at right angles to that from the other. The composite picture must be viewed through a polarising visor or spectacles.

The Wirt fly is the largest target in the test, which also includes graded sets of animals and circles, one of which is disparate and appears to stand forward. The test must be viewed at 40 cm, and covers a range of stereoacuity from approximately 3000 to 40 seconds of arc.

The Frisby test consists of three clear plastic plates of different thicknesses. On each plate there are four squares filled with small random shapes. One square on each plate contains a 'hidden' circle, which is printed on the back surface of the plate. The random shapes give no visual clue to the edge of the 'hidden' circle, and the test is purely three-dimensional and does not require polarising or coloured glasses to be worn. At a 40 cm viewing distance the plates show a disparity of 340, 170 and 55 seconds of arc, and by adjusting the viewing distance the test can be used to give a disparity range from 600 to 15 seconds of arc.

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2. **Discuss actions of the eye and describe few Visual Functions?**

Potential Visual Acuity Testing

These tests may be used to assess the potential visual acuity of eyes in which it is not possible to see the macula e.g.
because of a cataract. Good potential visual acuity indicates that cataract surgery is likely to be of benefit. The simplest clinical test is the pinhole test.

The blue field entoptic phenomenon is the ability to see moving white dots when blue light diffusely illuminates the retina. They are thought to represent light transmitted by white blood cells in the perifoveal capillaries. When this phenomenon is present, macular function is grossly intact.

Interferometers project laser light from two sources on to the retina. Interference occurs where the two sources meet and this is seen as a sine wave grating if the macula is functioning.

The potential acuity meter projects a letter chart on to the retina through a small aperture.

Contrast Sensitivity

Tests of visual acuity do not adequately reflect the ability of the eye to see low-contrast objects such as faces. In many conditions, e.g. cataract, glaucoma and optic neuritis, the visual acuity may be almost normal whilst the contrast sensitivity is considerably reduced.

Contrast sensitivity is measured using a sine wave grating. This is a pattern in which there is a gradual transition between alternating light and dark bands, i.e. the edges of the bands appeared blurred.
Narrower bands are described as having a higher spatial frequency. A contrast sensitivity curve is constructed by plotting a range of different spatial frequencies against the lowest degree of contrast at which the eye can still detect the grating. Low or very high spatial frequencies must have higher levels of contrast in order to be seen.

In clinical practice, the contrast sensitivity is measured using either a television monitor or a chart. The Pelli–Robson contrast test chart displays letters that have decreasing levels of contrast to their background. The VISITECH chart has 40 circles with different sine wave gratings and levels of contrast. The subject must indicate the orientation of the circles.

Glare Testing

Scattered light which reduces visual function is called glare. Glare may be the predominant symptom of corneal oedema or scarring, cataracts or opacification of the posterior lens capsule. The effect of a glare source depends on its position and intensity and on the light scattering properties of the ocular media.

Glare testing refers to the measurement of visual function (e.g. visual acuity, contrast sensitivity, colour vision) in the presence of a source of glare.

3. What is Polarization of light? Explain its significance?

Polarisation of Light

The orientation of the plane of the wave motion of rays comprising a beam of light is random unless the light is polarised. Figure 1.14a shows a beam cut across and viewed end-on: the light is travelling perpendicular to the page. In contrast, Fig. 1.14b shows the cross section of a beam of light in which the individual wave motions are lying parallel to each other. Such a beam is said to be polarized.

Unit 3:

Frame Types and Parts

The purpose of this chapter is to acquaint the reader with the basic terminology used in eyewear. This knowledge is essential to avoid misunderstanding the terms used later in the text to describe in detail the actual dispensing procedures.

Learning Objective:

1. At the end of this unit, students will be able to learn types, parts and material of the frame.
2. The purpose of this is to acquaint the students with the basic terminology used in eyewear. This knowledge is essential to avoid misunderstanding the terms used later in detail in the actual dispensing procedures.

BASIC PARTS

The frame is that portion of the spectacles that holds the lenses containing the ophthalmic prescription in their proper position in front of the eyes.

A frame generally consists of the *front*, which in one form or another contains the lenses, and the *temples*, which attach to the front and hook over the ears to help hold the spectacles in place. Frames occasionally do not have temples and are instead held in place by pressure on the sides of the nose (pince-nez), by attachment to another frame (clip-ons), or by being held in the hand (lorgnettes).

Frame Fronts

That area of the frame front between the lenses that rests on the nose is the *bridge*. The rim going around the lenses is known as the *eyewire* or *rim*. The outer areas of the frame front, to the extreme left and right where the temples attach, are known as the *endpieces*. A few plastic frames may still have a metal *shield* on the front of the endpiece to which rivets are attached to hold the hinge in place (Figure 1-1).

The *hinges* hold the temples to the front, and consist of an odd number of interfitting *barrels*, the total number being three, five, or seven. Hinges may vary in construc- tion, but for simplicity are usually classified by the total number of barrels they have when assembled, such as a three-barrel hinge.

Some frames have *nose pads*, which are plastic pieces that rest on the nose to support the frame. These may be directly attached to the frame or to connecting metal pieces known as *guard arms* or *pad arms*.

Temples

The portion of the temple that is nearest its attachment to the front is known as the *butt portion* or *butt end*. The place on the temple where it first bends down to go over the ear is called the *bend*. The portion of the temple

between the butt end and the bend is called the *shank* or *shaft*, and that portion beyond the bend and behind the ear is referred to as the *earpiece*, *bent-down portion*, or *curl* (Figure 1-2).

CONSTRUCTION

Frames

Frames without an eyewire going completely around the lens are called *mountings*. Lenses are “inserted” into frames, but “mounted” into mountings. Frames them- selves can be classified in a simplified manner by one of the following categories of frames or mountings.

Plastic

Plastic frames are made of some type of plastic material. Plastic frames were occasionally referred to as *shell* frames, dating back to the time when eyeglass frames were made of tortoise shell. This term has fallen into disuse. Another general term that many still use for certain plastic frames is *zyl*, since at one time zylonite (cellulose nitrate) was a commonly used material. Zylonite is highly flammable and no longer used for spectacle frames. The name “zyl” continues to be used, but usually refers to the most commonly used plastic material- cellulose acetate. Now, with the emergence of many new materials, either the exact name of the plastic material is used or the frame is simply referred to as *plastic* (Figure 1-3).

Metal

Metal frames are those made of all metal parts, except for the nose pads and the posterior temple sections, which are plastic covered. The eyewire runs completely around the lens (Figure 1-4).

Nylon cord frames

Nylon cord frames, sometimes called *string mounted frames* or *nylon supras* hold the lenses in place by means of a nylon cord that fits around the edge of the lens. This gives the glasses the appearance of being rimless. Usually the top of the lens is fitted into the upper rim of the frames. The rest of the lens has a small groove cut into an otherwise flat edge (Figure 1-5).

Combination

Combination frames are commonly frames having a metal *chassis* and plastic top rims and temples (Figure 1-6). The chassis includes the eyewire and center or bridge section. Although this is the most common construction, techni- cally any frame with a combination of metal and plastic could be included in this category, as in the case of a

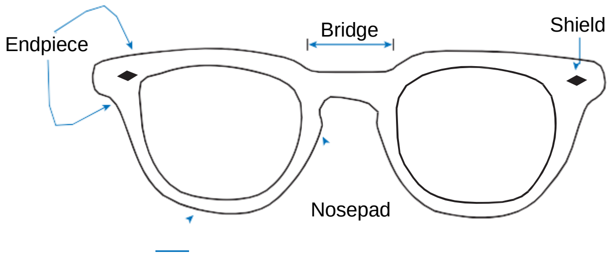


Figure 1-1. The frame front.

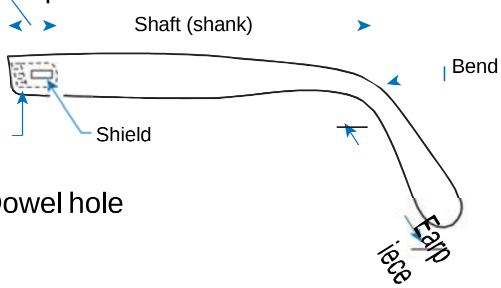


Figure 1-2. Parts of a temple.

frame with plastic eye-wires and metal bridge and temples.

Half-eye

Half-eyes are frames made especially for those who need a reading correction but no correction for distance. They are constructed to sit lower on the nose than normal, and are only half as high as normal glasses. This allows the wearer to look over the top of the glasses. They may be of plastic, metal, or even nylon cord construction (Figure 1-7). Less common are half-eyes for distant vision, which allow the wearer to look under the lenses for reading.

Rimless, Semirimless, and Numont

Rimless mountings hold the lenses in place by some method other than eyewires or nylon cords. Often screws are used, but cement, clamps, and plastic posts have been used. Most rimless mountings have two areas of attach- ment per lens, one nasally and one temporally (Figure 1-8). Rimless mountings are sometimes referred to as *3-piece mountings*.

Semirimless mountings are similar to the rimless except for a metal reinforcing *arm*, which follows the upper posterior surface of the lens and joins the *centerpiece* of the frame to the endpiece. The centerpiece of a mount- ing consists of bridge, pad arms, and pads (Figure 1-9). *Numont mountings* hold the lenses in place only at their nasal edge. They are seldom seen today. The lenses are attached at the bridge area and the temples are attached to a metal arm that extends along the posterior

Figure 1-3. An example of a plastic frame.

Figure 1-4. One version of a metal frame.

Figure 1-5. A nylon cord frame or “string mount” holds the lens in place with a cord that fits around the edge of the grooved lens.

Figure 1-6. Examples of combination frames.

Figure 1-7. Half-eye frames in use. Half-eyes are made especially for those who need a reading correction but no correction for distance vision.

Figure 1-8. An example of a rimless mounting. The central area of the frame is not connected to the endpieces. The only connecting points are the lenses themselves.

Figure 1-9. A semirimless mounting has a bar behind the top of the lens connecting the endpieces to the bridge area.

Figure 1-10. A Numont mounting has only one nasal point of attachment per lens.

Currently most dispensers refer to any of these three variations of a rimless mounting as “rimless.” They do not differentiate between the three.

Other Mountings

Balgrip mountings secure the lens in place with clips attached to a bar of tensile steel that fits into a nasal and a temporal notch on each side of the lens. The lens can be easily removed by pulling the clips back from the lens. For this reason, this type of mounting can be used with more than one pair of lenses for the same frame. Sun-lenses, special purpose lenses, or tinted lenses could then be used interchangeably with the patient’s regular lenses (Figure 1-11). Notches are now more often used in combination with drilled holes in rimless mountings to lend stability to the mounting.

Bridge Area

The bridge area of a frame can be constructed of either plastic or metal. Because of the variety of nose shapes,

A

B

Figure 1-11. A balgrip mounting. In this form of rimless mounting, the slotted lenses **(A)** are held in place with clips **(B)**.

there is also quite an assortment of bridge constructions in both materials.

Plastic Bridges

The bridge area of a plastic frame is preformed and sits directly on the bridge of the nose. It is important, then, in picking out a plastic frame that the frame fit the nose well, since adjustments to this part of the frame are extremely difficult. Bridge adjustments for certain plas- tics, such as nylon, carbon fiber and polyamide, are not possible.

The *saddle bridge* is shaped like a saddle in a smooth curve and follows the bridge of the nose (Figure 1-12). This spreads the weight of the frame evenly over the sides and crest of the nose.

Figure 1-12. The saddle bridge closely follows the contour of the nose, evenly spreading the weight of the frame.

Figure 1-13. The modified saddle bridge has fixed nose pads attached at the back to increase the weight-bearing area of the frame.

In the *modifi ed saddle*, the bridge area looks much the same as the saddle bridge does when viewed from the front. The difference is that there are nose pads that are part of the back of the bridge. These pads help to carry some of the weight of the frame (Figure 1-13).

The *keyhole* bridge is shaped like an old-fashioned keyhole. At the top, the bridge flares out slightly. The bridge rests on the sides of the nose, but not on the crest (Figure 1-14).

Metal Bridges

The bridge commonly used in metal frames is the *pad bridge* (see Figure 1-8). In the pad bridge, nose pads are attached to the frame by metal pad arms. In this case, the pads alone support the weight of the glasses.

When a metal frame is equipped with a clear plastic

Figure 1-14. Besides having an identifying shape, the keyhole bridge supports the

frame weight upon pads.

Figure 1-15. Metal saddle bridges were originally designed to rest directly on the crest of the nose. They may still be used as originally designed shown in the frame pictured. Often a metal saddle bridge is just for decorative purposes and is used in conjunction with nosepads.

Metal and rimless frames were, and sometimes still are, constructed with a *metal saddle bridge*D (Figure 1-15) and enjoyed widespread use for a period of history. It may yet appear exactly as before or decoratively in con- junction with nose pads.

With rimless mountings, the *crest* of the bridge does not include the pads or straps, but is the center most area.

Endpiece Construction

Endpiece construction, like the bridge area construction, can be of either plastic or metal.

Plastic Endpieces Construction

There are three general types of endpiece construction in plastic frames (Figure 1-16). The most commsaddle-type bridge, the bridge type is referred to comfort bridge.

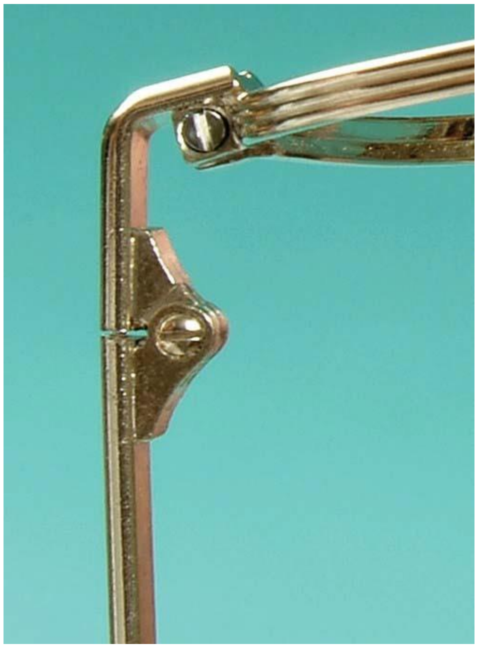


Figure 1-17. This traditional metal endpiece has a turn-back design.

"Classic" Rimless Fronts

The centerpiece of a rimless front consists of the bridge, pad arms, and pads. These parts are the same as for metal also have straps to hold the lenses, as well as hinges for temples.

Coloration

Plastic frames may be partially classified by coloration. A *solid* frame is all one color. A *vertically gradient* frame is darker all the way across the top, including the bridge, and is lighter across the bottom. A *horizontally gradient* frame is darker at the temporal portions and lightens toward the central area. *Clear bridge* frames somewhat resemble the horizontal gradient, but are dark at the top, except for the bridge area. The bridge, along with the lower half of the frame, is clear plastic. The multitude of color combinations available now makes categoriza- tion beyond this difficult.

FRAME MATERIALS

Plastic Frame Materials

The first classification of a frame is by the material used in its construction: either plastic or metal. Several types of both are used to make frames.

The first plastics used for spectacle frames were made from *bakelite* and *galalith*.[1] These did not perform well in cold weather because of their brittleness. Later *cellulose nitrate (zylonite)* was widely used. Cellulose nitrate accepts a good polish, but is flammable if brought to a suffi- ciently high temperature. Because of the danger posed, cellulose nitrate has been banned by the FDA and is no longer used for spectacle frames. However, because these zylonite frames were the only plastic frames commonly used for a period of time, plastic frames were known as

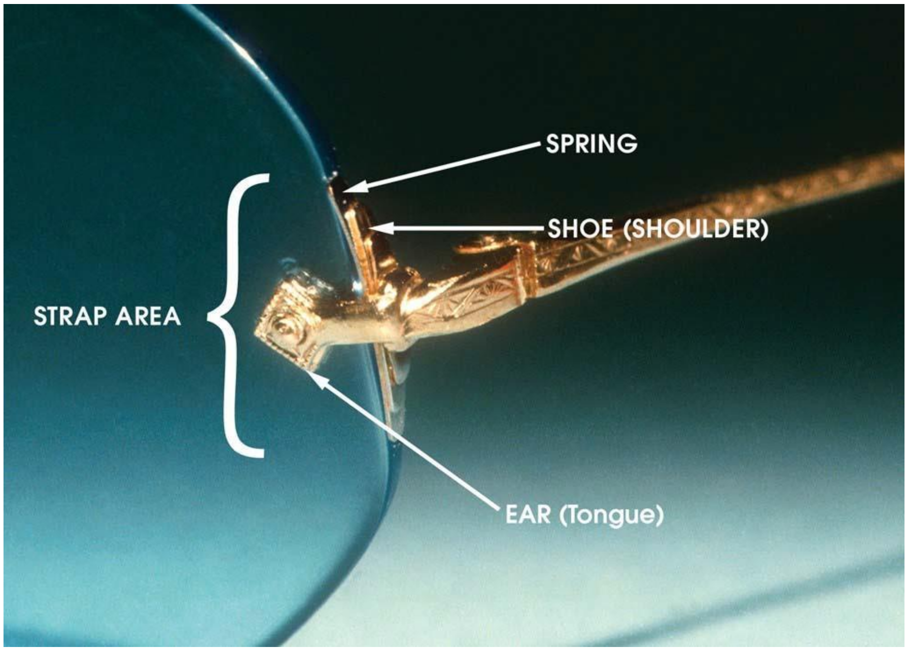


Figure 1-18. The strap area in a classic-style rimless mounting has the same construction at both center and endpiece locations. Contemporary rimless mountings do not necessarily have this classic-style construction.

Cellulose Acetate

A material used extensively for spectacle frames is *cellu- lose acetate*. The basic cellulose material may be extracted from cotton or wood pulp and then further processed.[1] When derived from cotton, the material used is the fiber that adheres to the cottonseed after ginning and is too short to be used for making textiles. These fibers are called cotton linters.[2] This cotton or wood material is treated with a mixture of anhydride and acetic acid using sulfuric acid as a catalyst. Plasticizers and aging stabiliz- ers are then added to this material.[2] Nevertheless, cel- lulose acetate does become brittle with age.

Some allergies are attributed to wearing cellulose acetate frames, though this is rare. More often skin problems are not so much allergic reactions to the mate- rial itself, but to those things which can be absorbed by the material. Higher quality cellulose acetate frames are coated in order to seal the surface. When left uncoated, cellulose acetate may absorb materials which might be allergen producing. A good frame coating will contain a UV inhibitor.* This inhibitor in the coating keeps frame color from fading.

*A “UV inhibitor” blocks out the sun’s ultraviolet rays.

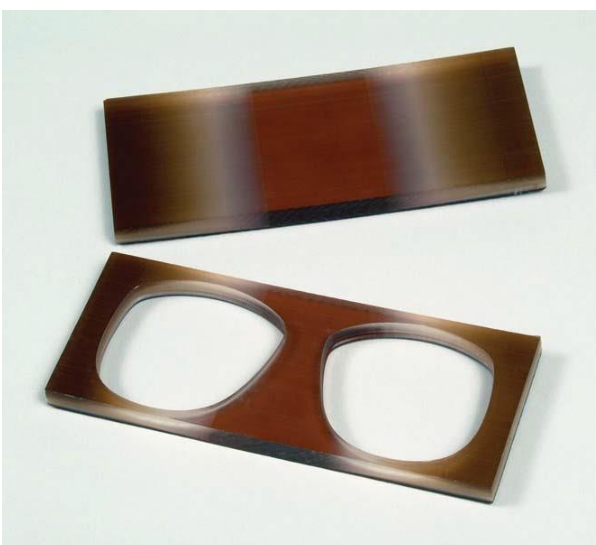
Cellulose acetate can be formed into sheets of plastic from which frame parts can be cut, or it can be made into acetate granules that are used for injection molding. For spectacle frames, cellulose acetate is generally made into sheets and milled (Figure 1-21).

Propionate

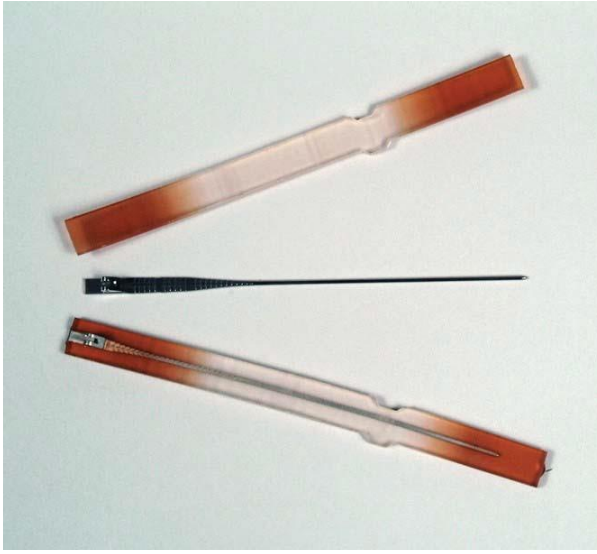
Cellulose aceto-propionate, more commonly referred to as *propionate*, has many of the same characteristics as cellulose acetate and works better for injection molding. Propionate has less color stability than cellulose acetate and, unless it is covered with a high quality frame- coating material containing UV absorbers, will fade within a relatively short period of time. Propionate frames are made beginning with granules of the material that are heated until liquid, then injection molded to the desired frame shape. Granules may initially be colorless, allowing the frame parts to be dyed to the desired color after they have been molded. Propionate has a slight weight advantage over acetate, in that it is about three quarters of the weight.

Optyl

Epoxy resin is used for spectacle frames and is known under the trade name of Optyl. A liquid resin and a hardener are mixed together and drawn into the frame molds using a vacuum process. The material is *thermo- elastic*. This means that it will bend when heated and will return to its original shape when reheated. (Cellulose acetate is *thermoplastic*. This means that it will bend when



A



B

Figure 1-19. Frame fronts and temples can be milled from slabs of cellulose acetate. They are finished in steps until being polished, and usually coated to protect the frame material from sunlight and to decrease the possibility of allergic reac- tions in sensitive wearers. **A,** The frame front is being milled from a slab of plastic. **B,** One method for making temples. First the cellulose acetate is formed (*top*). Then the metal hinge and core (*middle*) is injected into the plastic (*bottom*). From this point, the temple is milled to the desired form and shaped.heated but does not return to its original shape when reheated because it does not have a "plastic memory.") Optyl is approximately 30% lighter than cellulose acetate.[2] Because of its stability, Optyl is appropriate for those who might be allergic to other types of frame materials. (For more information on working with Optyl material, see Chapter 7, Insertion into an Optyl Frame.)

Nylon and Nylon-Based Materials

Nylon. Nylon is a material of high flexibility. When used alone in spectacle frames, nylon will lose that flex- ibility unless periodically soaked in water overnight. Otherwise, over time, it will become brittle. "Pure" nylon was previously used extensively for sports eyewear. It has also been used for over-the-counter sunglasses.[3] It is now being combined with other material for added strength and stability, remaining a part of the array of frame materials in use. (See Chapter 7, Insertion into a Nylon Frame.)

Polyamide/Copolyamide. Polyamide is a nylon- based material that is quite strong. Because it can be made thinner and is only 72% of the weight of cellulose acetate, polyamide has a real weight advantage. Polyam-ide frames can be made opaque or translucent. Frames made from polyamide are resistant to chemicals and sol- vents, and are also hypoallergenic.[3] (For more on poly- amide frames, see Chapter 7, Insertion into a Polyamide Frame.)

Grilamid. Grilamid is a nylon-based material used in sports and performance type of eyewear. Unlike plain nylon frame material, grilamid has a large variety of color possibilities. Some manufacturers have fused Gril- amid with titanium to create a strong, comfortable varia- tion of this frame material.

Carbon Fiber

Carbon fi ber material is used to create a thin, strong frame. This material is made from strands of carbon fibers combined with nylon. It is not adjustable and is consequently used mainly for frame fronts. The temples are generally made from another material. In other words, if a carbon fiber frame does not fit well in frame selection, do not plan on making it fit well later on. The principle advantage is the light weight that can be achieved. Carbon fiber is 60% the weight of cellulose acetate. Not only is the material light weight, but because of its strength, it can also be made thinner. Since carbon is black, frame colors will be opaque and are limited.

Some problems may be encountered with breakage in cold weather. Because of the thermal problems, it is imperative that the material not be directly worked with right after it has been outside. (For more information on working with carbon fiber material, see Chapter 7, Inser- tion into a Carbon Fiber Frame.)

Polycarbonate

Polycarbonate is a material usually associated with lenses, but can be molded into frames. Frames made from poly- carbonate are primarily for sport or safety purposes. When made for nonprescription purposes, the lenses and frame are molded as one unit.

Frames (and lenses) made from polycarbonate are very impact resistant. Unfortunately, polycarbonate frames do not work well for conventional eyeglasses because of their resistance to adjustment. They are better suited for

Figure 1-20. Polycarbonate sports frames can be ordered from the manufacturer with plano lenses already in place. They can also be ordered without lenses for prescription use.

Figure 1-21. Safety frames with plano lenses can be molded as one unit. In the sample shown, both the frames and lenses are molded together from polycarbonate material.

the type of sports glasses that are held in place with elastic straps (Figure 1-20) or for shield types of glasses that may be used either alone or worn over conventional glasses (Figure 1-21).

Kevlar

Kevlar is a material that is also mixed with nylon. It, too, is a strong, lightweight ophthalmic frame material. Kevlar will remain stable over a large temperature range, but is difficult to adjust. Although it becomes pliable with heat, it will not shrink or stretch.

Rubber

Some sports eyewear and sunglass frames may be made from a combination of nylon and rubber. As would be expected, these frames are flexible and will return to their original shape, but are not adjustable.[4]

Combinations of Plastic Materials

There are numerous possible combinations of plastic materials. These include materials sometimes called *memory plastics*. Memory plastics are tough and flexible. They can be bent or twisted and still return to their original shape.

Not all composite plastic materials are memory plas- tics. Other composite plastics combine various materials to produce frames and frame parts for specific needs and purposes.

Metal Frame Materials

In the past, gold-containing alloys were the more pre- dominant metals used for spectacle frames. (See Chapter 2, Gold Classifications for Metal Frames with Substantial Gold Content.) Today few frames contain any gold.

Great progress has been made in metal frames because of the electrolytic treatment techniques, which allow for corrosion resistance and finished beauty. Any nostalgia over the disappearance of gold alloy frames from the marketplace should be dispelled by the beauty and ser- viceability of the product that has taken its place.

It is also common for frames to be made with more than one material. The temples may be from one mate- rial for flexibility, the frame front from another, and the connecting pieces something different still.

Nickel-Based Materials

Nickel is a material that is often used for eyeglass frames. It is strong and malleable. The main disadvantage is the number of people who may have an allergic reaction to nickel. It is reported that 10% of the population may be allergic to nickel.[5] Fortunately high-quality ophthalmic frames are coated with a protective material that both prevents corrosion and keeps the metal from coming in direct contact with the skin while the coating remains on the frame.

Pure Nickel. Nickel resists corrosion. Because of malleability, pure nickel frames are easily adjusted. Nickel's characteristic of accepting color well makes these frames versatile.

Nickel Silvers. Nickel silvers contain more than 50% copper, 25% nickel, and the rest zinc. But "nickel silver" contains no silver. Copper gives the material its pliabil- ity, zinc adds strength, and nickel gives the alloy a whitish appearance. When the nickel content of nickel silver exceeds 12%, the copper color no longer shows through.[1] Another name for nickel silver is *German silver*.

Monel Metal. Monel is whitish in color, is pliable for good adjustment, resists corrosion, and accepts a high polish. It is made from nickel, copper, iron, and traces of other elements. The largest component of the material (63% to 70%) is nickel. The second largest component is copper. Iron constitutes only 2.5%, and there are traces of silicium, carbon, and sulfur.[1] Monel is used quite often as a frame material.

Aluminum

Aluminum is both strong and extremely lightweight. It can be finished in a wide variety of colors and does not corrode. Aluminum does not solder or weld well, so must be made such that its parts are assembled with screws or rivets.[6] It holds the adjustment well, but has no flexibility. If it bends, it stays that way.

Stainless Steel

In the nineteenth century, some frames were made from regular (nonstainless) steel material. Stainless steel was developed in the early 20th century. It is made mainly from iron and chrome and is highly resistant to corro- sion. Stainless steel is strong. When made very thin, it has an element of springiness and flexibility that makes it well suited for temples. Yet that very springiness means that "adjustments are difficult and often do not hold.[7]" Stainless steel is one of the more nonallergenic materials.

Titanium

Titanium is a versatile and abundant material that has become increasingly common for use in ophthalmic frames. The *advantages* include the following:

- Titanium is extremely light in weight. When compared with conventional metal frame materials,allergies related to frame wear. This makes titanium a very attractive frame material for those with skin allergies.
- When used in combination with other metals, titanium allows frames to be made so that they are very flexible. It should be noted that some frames use titanium in combination with nickel to increase flexibility. Without an appropriate coating on the frame, this would increase the likelihood of an allergic response for some.

The *disadvantages* of titanium are fewer. These include the following:

- Titanium is hard to solder or weld.
- Because the manufacturing process is more demanding, titanium is more expensive than conventional materials.

Titanium Marking Guidelines and Classifications. The Vision Council of America (VCA) has established voluntary marking guidelines for frames containing tita- nium. The reason for these guidelines was “to end some of the confusion that arises when frames are labeled ‘titanium’ but are actually only part titanium—or do not contain titanium at all.[9]” Because these are voluntary guidelines, this means that there may still be some con- fusion in marking. However, if frames are marked according to VCA standards, then the buyer should know what that particular frame contains. To be certi- fied, the titanium content of the frame must be tested by an independent accredited laboratory. Here are the guidelines:[10]

- *Certifi ed 100% Titanium*—All major components of the frame are at least 90% titanium by weight and, to assure there will be no problems with wearer allergy, the frame must not contain any nickel (Figure 1-24, *A*).
- *Certifi ed Beta Titanium*—All major components of the frame are at least 70% titanium by weight, and there must be no nickel content (Figure 1-24, *B*).
- titanium is 48% lighter.[8]
- Titanium is very strong, which allows titanium frames to be designed exceedingly thin. Thinness also contributes to still more weight reduction.
- Titanium is very corrosion resistant. This makes titanium an excellent choice for people in hot climates or those working in conditions where they would be perspiring a great deal.
- Titanium is hypoallergenic. It should be noted that

Certified 100%

TItaniu m

A

Certified beta

TItaniu m

Vision Councilof America

B

titanium is often used in combination with other metals. If the wearer is allergic to another of the metals in the alloy, then, unless the frame is appropriately coated, allergic reactions could still occur. But when titanium is not mixed with other metals, it is the metal of choice for those with skin

Figure 1-22. The Vision Council of America marking guide- lines for titanium uses a symbol that would normally appear on the demonstration lens of the display frame. **A,** Certified 100% Titanium means 90% titanium and there is no nickel contained in the frame. **B,** Certified Beta Titanium means 70% minimum titanium with no nickel content.

Not included in the Vision Council of American classification is what has been called *combination titanium*—a name applied to frames with titanium for the major parts of the frame and trim pieces made from other metals.[8] The name *nickel titanium* or *shape memory alloy (SMA)* is applied to a titanium alloy made with 40% to 50% titanium and the rest nickel.[11] Sometimes simply called *memory metal*,[12] this material is extremely flexible and returns to its original shape after being twisted or flexed. (It should be noted that there will be other types of metal frame materials that will also function like a “memory metal.”)

Bronze

Bronze is a metal alloy traditionally made from copper and tin. It is suited for spectacle frames because it is corrosion resistant, lightweight, and takes color well.

Magnesium

Magnesium is even lighter in weight than titanium. Frames made from magnesium are extremely lightweight and exceptionally durable. The exterior of the frame is normally sealed because of the corrosiveness of raw magnesium. Magnesium is also used as part of an alloy in combination with other metals.

Other Materials and Alloys

There are other materials that are also suitable for frames, including cobalt, palladium, ruthenium, and beryllium.

As would be expected, there are many different possible combinations of the previously listed metals that may be combined to optimize certain characteristics. Some have trade names applied especially for a particular combination used by a given frame manufacturer. One, for example, called FX9 is a combination of copper, manganese, tin, and aluminum engineered to yield a hypoallergenic, lightweight, and malleable material.[13] Another, referred to as Genium, combines 12% carbon, 17.5% to 20% manganese, 1% silicone, 17.5% to 20% chrome, and 58.9% to 63.9% steel. These materials are combined to create a hypoallergenic frame that is thin, strong, lightweight, flexible, and durable.[14] As frame designs change, metal alloy combinations will vary to meet these new design demands.

ALLERGIC REACTIONS TO FRAME MATERIALS

As previously noted, most frame manufacturers will use a coating on their plastic frames to protect the frames and also to reduce any possibility of allergic reactions. However, sometimes this is not enough.

To reduce the possibility of a reaction for people who have a history of skin reactions to wearing frames, use frame materials that are known to be hypoallergenic.

Sample Questions

1. What are the key differences between plastic and metal frames?
2. Explain the purpose of nose pads and the different types available.
3. How do saddle bridges differ from keyhole bridges?
4. What are the benefits of using hypoallergenic frame materials?
5. Briefly describe the properties of cellulose acetate and propionate.
6. What are the advantages and disadvantages of nylon-based frame materials like polyamide and Grilamid?
7. How is carbon fiber used in eyewear, and what are its limitations?
8. Discuss the use of titanium in spectacle frames and the different classifications based on its content.
9. What are some emerging trends in frame materials and design?
10. How can frame selection be personalized to complement different facial features and styles?
11. Discuss the different types of frame materials used in eyewear, highlighting their pros and cons in terms of durability, weight, adjustability, cost, and potential for allergic reactions. What factors should be considered when choosing a frame material based on individual needs and preferences?

12. Explain the various parts of a spectacle frame and their functions. How do different bridge and temple designs impact the fit and comfort of the glasses?

13. Describe the evolution of rimless eyeglasses, exploring the different mounting techniques and materials used throughout history. Discuss the advantages and disadvantages of rimless frames compared to traditional full-rim styles.

Unit 4:

Frame Measurement and Markings

Learning Objectives:
At the successful completion of this unit, students will be able to learn:

1. Familiarity with frame measurements and how they are marked is essential to proper ordering of prescription glasses.
2. Knowledge of measurement procedures assures receipt of the proper size when ordering a replacement for a broken part.
3. The purpose of this is to give students a complete understanding of frame dimensional properties. The confidence and capability achieved as a result of this is the base on which to develop skills.

THE OLDER DATUM SYSTEM

The previously used datum system for measuring lenses was established as a system of reference points for frames and lenses so that placement of lens optical centers and bifocal segment heights would be consistent.

With the lens placed as it should sit in the frame, horizontal lines were drawn at the highest and lowest edges of the lens (Figure 2-1). A line drawn halfway between the two horizontal lines and parallel to them was known as the *datum line*. The width of the lens along this line was called the *datum length* or eye size. The point along the datum line halfway between the edges of the lens is the *datum center*. The depth of the lens, measured as the vertical depth through the datum center, was the *mid-datum depth*. The datum system preceded the currently used boxing system.

THE BOXING SYSTEM

The boxing system improved on the foundation pro- vided by the datum system. The datum system used two horizontal lines—one against the top and the other against the bottom of the lens. The boxing system kept these two horizontal lines and added two vertical lines. These vertical lines are placed against right and left edges of the lens. All four lines form a box around the lens (Figure 2-2).

Horizontal Midline

There is a horizontal line halfway between the top and bottom of the lens. In the datum system, this was called the datum line. This name continues to be used. However, in the boxing system, this line is more commonly referred to as the *horizontal midline* or *the 180- degree line*.

Geometric Center

The center of the lens is the point on the horizontal midline halfway between the two lens-bordering vertical lines. It is known as the *geometric center* or *boxing center* of the edged lens. This term does not imply anything about the optical positioning of the lens.

Size

The size of the lens then is the length and depth of the box containing the lens. The horizontal length is now commonly referred to as the *eye size* when referring to the frame and the *lens size* when referring to the lenses. Both are measured in millimeters.

When most practitioners speak of lens size or eye size, they are referring primarily to the horizontal measure of the lens, denoted by the letter “A” in Figure 2-2. Some frames list an eye size value that is different from and unrelated to the frame A dimension. Such procedures attempt to relate this eye size number to a “fitting value.” This is not a recommended practice and leads to confusion, but is so commonplace that frame reference materials will usually list both an A dimension and an eye size, even if they are the same value.

The letter “B” denotes the vertical measure of the box enclosing the lens. Both “A” and “B” are in a sense independent of lens shape. The letter “C” refers to the width of the lens itself along the horizontal midline.[1] (This can vary considerably from the A dimension.) The C dimension of a lens is seldom used. In the older datum system, this was the eye size of the frame. Some people still mistakenly measure the eye size this way.

The C dimension of a lens should not be confused with the “C-size” of a lens. *C-size* is the circumference of the edged lens and is sometimes used to increase accuracy when duplicating an old lens size when edging.

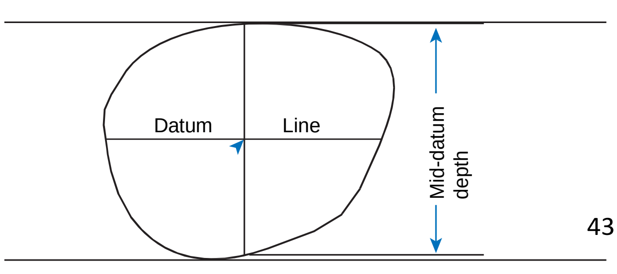
Measurement

In determining the horizontal boxing dimensions of a *frame*, the measurement begins at the inside of the groove on the left side of the imaginary enclosing box and extends horizontally across the lens opening to thefarthest part of the groove on the right side of the box (Figure 2-3). Do not filt the box.

In measuring a *lens*, the measurement begins at the apex, or point, of the bevel on the left side of the box enclosing the lens and extends to the apex of the bevel on the right side of the box. Remember, the A dimension is the width of the enclosing box. It is not the width of the lens at the middle of the shape.

Effective Diameter

The effective diameter of a lens is found by doubling the distance from the geometric center of the lens to the apex of the lens bevel farthest from it (see Figure 2-2).



Datum center

Figure 2-1. In the datum system, the mid datum depth may not always be equal to the distance between the horizontal tangents. The datum eye size is the width of the lens at the level of the datum line. The datum system eye size and the boxing system eye size are not the same. Some measure the eye size according to the datum system, thinking they are using the boxing system. The two eye size measures are not the same.

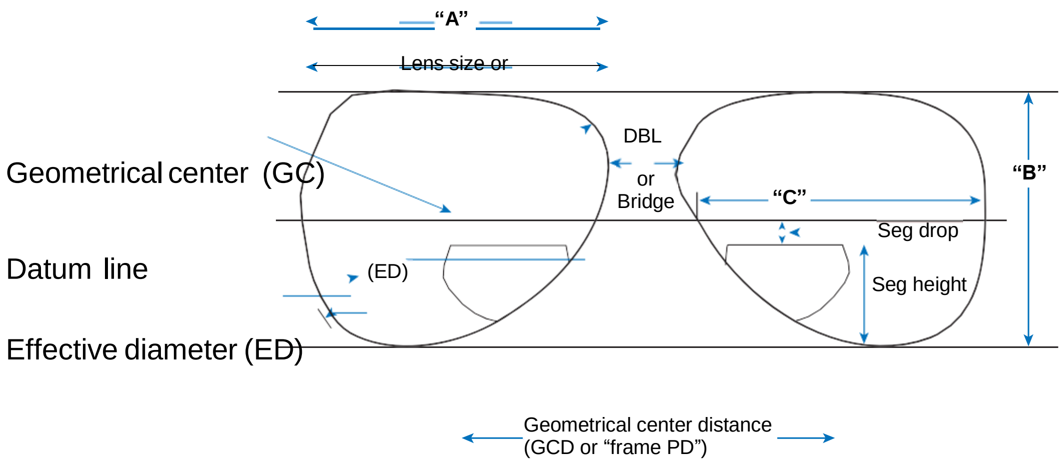


Figure 2-2. In the boxing system, the A dimension is the horizontal boxing width. If the frame is properly marked, the eye size will be equal to the A dimension of the frame. The B dimension is the vertical boxing length. The C dimension is the width of the lens along the horizontal midline. This dimension is seldom used today. The C dimension should not be confused with the "C-size" of a lens. The C-size of a lens is the distance around the lens (i.e., its circumference). The dispenser uses the C-size to ensure that a lens ordered by itself (without the frame) will be exactly sized for that frame. This measurement helps determine the smallest lens blank from which the lens can be cut.

Frame Difference

The difference between the horizontal and the vertical measurements is known as the *frame difference* and is measured in millimeters. The larger the difference, the more rectangular the enclosing box appears (Figure 2-4). Frame difference is sometimes referred to as *lens difference*.

Distance Between Lenses (DBL) or Bridge Size The boxing system also makes it possible to define the distance between lenses (DBL). The DBL is the distance between the two boxes when both lenses are boxed off
in the frame. This is usually synonymous with bridge size, although it is important to note that manufacturers not adhering to the boxing system may mark a bridge size that does not correspond to the distance between lenses.
Bridge size or DBL is measured on the frame as the distance from the inside nasal

eyewire grooves across the bridge area at the narrowest point (Figure 2-5). This distance is measured in millimeters. Naturally, two frames having the same DBL will not necessarily fit the same person in the same manner because of variations in lens shapes.

Geometric Center Distance (GCD)

The distance between the two geometric centers of the lenses is known as the geometric center distance (GCD).

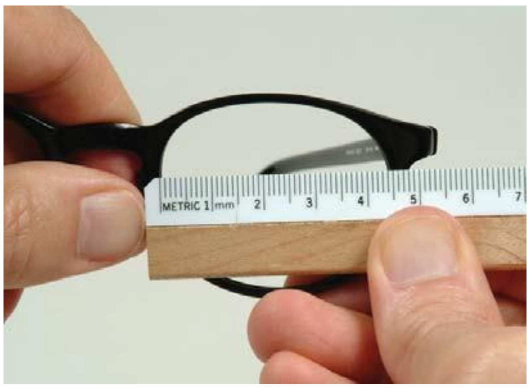
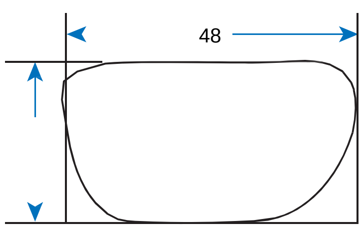


Figure 2-3. To measure the horizontal dimension of a frame, the measurement begins at the inside of the groove on one side and extends across the lens opening to the farthest part of the groove on the other. We cannot see the inside of the groove when looking from the front. This means we can estimate where it will be and hold the ruler so that the zero point is at the position of the left-hand side of the groove. Then we need to read the ruler at the position where the groove will be on the right. If the opening itself is measured, then about ½ mm per side needs to be added to the measure to allow for the depth of the groove. This may vary somewhat, depending upon the depth of the groove.



Frame difference of 20

Frame difference of 10

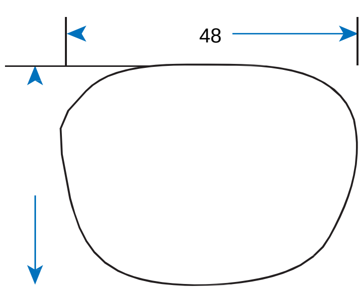
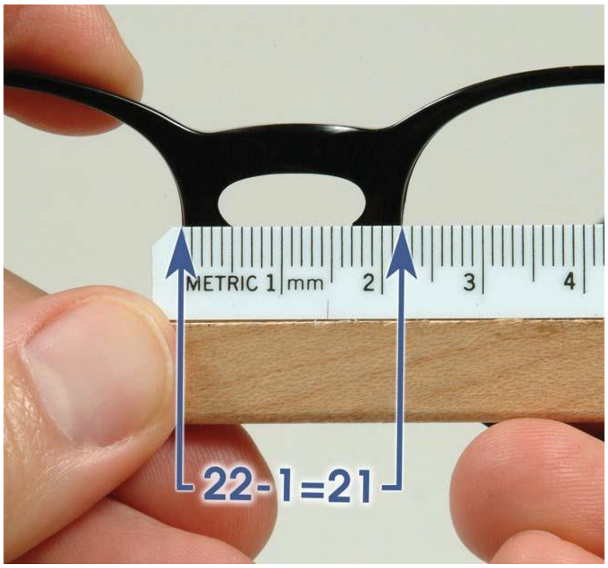
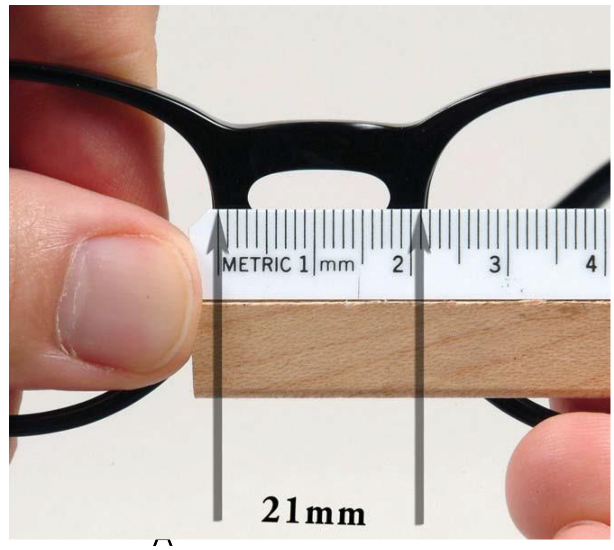


Figure 2-4. The difference between the horizontal and verti- cal measurements of a frame is known as the frame difference.

It can be measured more easily as the distance from the far left side of one lens opening to the far left side of the other (i.e., from the left side of one “box” to the left side of the other “box.”) Or the geometric center distance can be calculated by simply adding the eye size to the DBL. The result is the same.





A

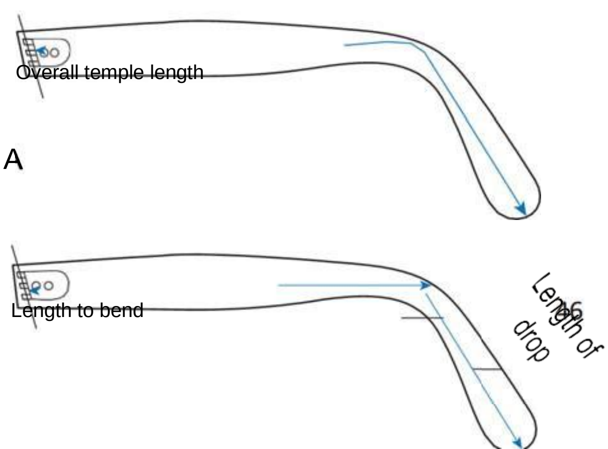
B

Figure 2-5. A, The DBL or bridge size is measured on the frame as the distance from the inside nasal eyewire grooves across the bridge area at its narrowest point. When measuring the bridge size, we cannot see the inside of the groove and must estimate its location. **B,** If the measurement is made from lens opening to lens opening, then approximately ½ mm per groove must be *subtracted* from the measure depending upon the depth of the groove.

The GCD is also known by three other names:

1. *Distance between centers* (DBC)
2. *Frame center distance*
3. *Frame PD*

The term frame PD is commonly used in dispensing, but has no relationship to the wearer’s interpupillary distance or distance between pupil centers.*



B

C

Figure 2-6. A-C, Various methods used in specifying temple lengths.

Seg Height

When specifying bifocal or trifocal segment height, the reference points are given in millimeters as either (l) the distance below or above the horizontal midline (called *seg drop* or *seg raise*), or (2) the distance from the lower line of the boxing system rectangle enclosing the lens shape (called *seg height*). In the actual measuring process, the level of the lower line of the box corresponds to the lowest point in the eyewire groove. *This level may be different from the depth of the point on the lens edge found directly below the pupil* as can be seen by looking carefully at Figure 2-2.

TEMPLE LENGTH

Most temples are currently marked with the total, or overall, temple length. Temple lengths are expressed in millimeters. Temple length may be measured in one of the following ways.

Overall Temple Length

The overall temple length is the distance from the center of the center barrel screw hole to the posterior end of the temple, measured along the center of the temple (Figure 2-6, *A*). Many times the center of the barrel *The term "Frame PD" may have originated when frame size was determined by selecting the correctly fitting bridge size, then choosing an eye size so that the wearer's pupils would be at the geometric centers of the frame's lens openings.screw hole will match the position of the butt end of the temple. But this is not always the case. Also, when measuring the overall temple length, it is necessary to measure around the bend and not in a straight line, unless of course the temple is straight. The easiest way to do this is shown in Figure 2-7, *A* through *D*.

Comfort cable temples are measured in terms of overall length. The actual measurement is done by grasping the tip and extending the temple along the ruler (Figure 2-8).

Length to Bend (LTB)

An older method of measuring temple length is in terms of the length to bend (LTB). This is measured from the center of the barrel to the middle of the bend (Figure 2-6, *B*). The distance from the middle of the temple bend to the end of the temple is known as the *length of drop* (see Figure 2-6, *B*).

Front to Bend (FTB)

If the endpieces wrap around in a swept-back manner, there is a distance between the plane of the frame front and the actual beginning of the temple. In this case, the temple length could be specified as frame to bend (FTB) (Figure 2-6, *C*), which would be slightly longer than LTB. This measurement method is seldom used.

FRAME MARKINGS

Most frames are marked according to size with three measurements: eye size, DBL, and temple length. Metal frames that are manufactured from “rolled gold” are also marked as to the amount of gold found in the frame. Rolled gold frames were used regularly a good while ago. Any new rolled gold frames are very expensive.

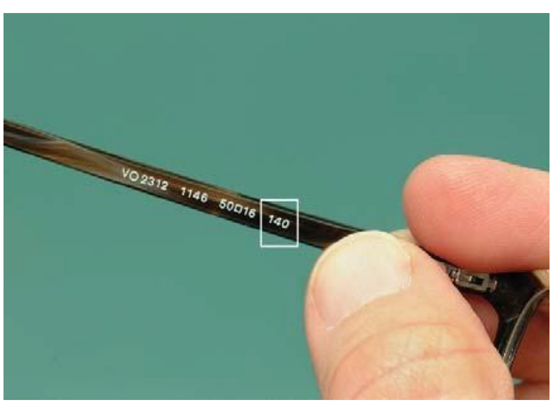
Eye Size and DBL

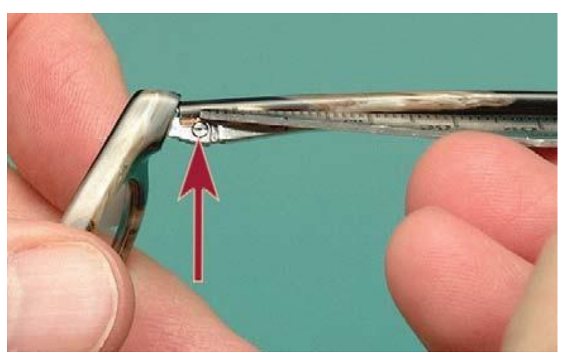
When a frame marking such as 50☐20 is seen, it means that the eye size is 50 mm and the distance between lenses is 20 mm. The box between the numbers means that the eye size is measured according to the boxing method; it also serves to separate the two numbers and prevent confusion. The eye size and DBL are sometimes simply marked 50-20 or 50/20.

Location of Markings

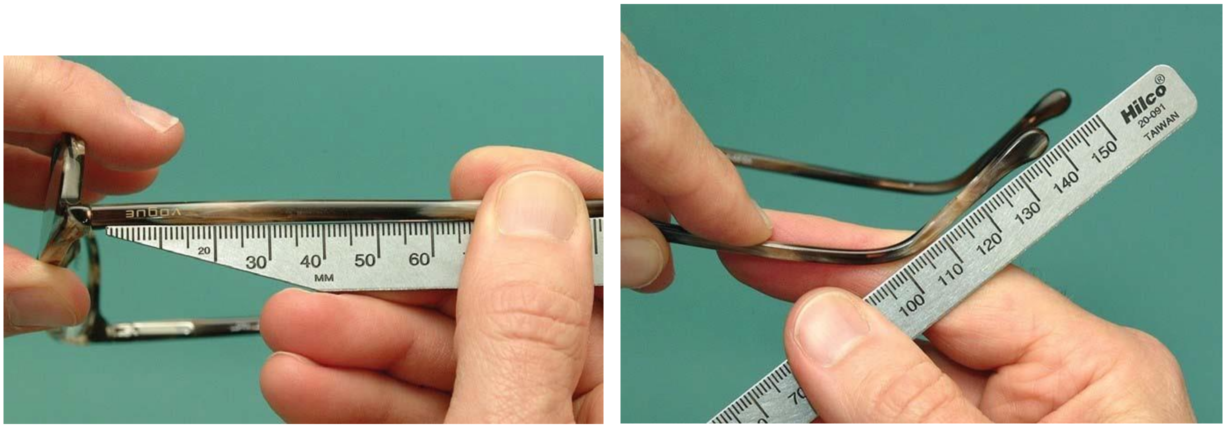
On a *plastic frame* the marking may be found in any of several places. It may be printed on the inside of the nosepad, or it may be found on the upper outer section of the eyewire. Some frames had the size printed on the back side of the endpiece, and the temple must be folded closed to find it. Sometimes the eye size is printed on one endpiece and the DBL on the other. As it should be, temple length is printed on the inner side of the temples. Some manufacturers put all three measurements on the temple. This is done because most frames are sold as a complete unit rather than a frame front with a matching set of temples. Unfortunately this leads to confusion when temples are exchanged.

On *metal frames* and frames with metal chassis, the eye size and DBL are usually on the inside of the bridge, although occasionally they are printed on the underside of a top reinforcing bar, or again, on the temples.





A B



C D

Figure 2-7. Measuring overall temple length. **A**, Here is a temple marked with a temple length of 140. We will be measuring this temple and comparing our results with what is marked. **B,** Begin the measurement by placing the zero on the ruler at the center of the hinge barrel, as seen in this measuring view. **C,** Looking at the temple from the side it is evident that the zero point is not at the butt end of the temple. Often times the position of the center of the barrel and the butt end of the temple are at the same location. It is obvious from the photo that in this case they are not and the beginning point for measuring does not start at the end of the temple. **D,** Turn the ruler around the temple bend and note where the end of the temple falls on the ruler scale. This is the overall temple length.

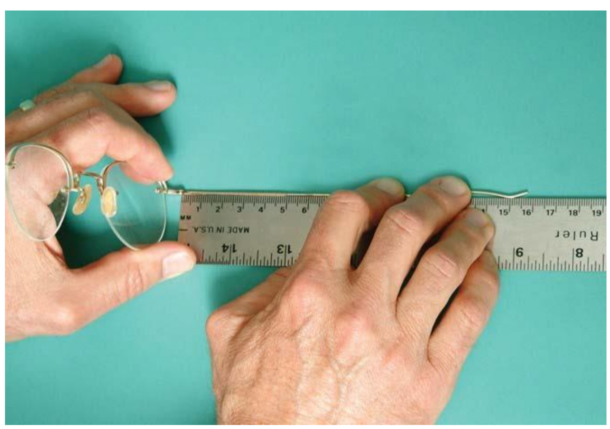


Figure 2-8. The overall temple length for a cable temple is obtained by stretching the cable temple along the ruler.

Frame Manufacturer Name, Color, and Countryof Origin

Frames should also be marked as to country of origin, manufacturer, and frame name. Many frame manufacturers use a number rather than a name. This can be confusing if the frame color is also specified by number and both numbers are stamped on the frame. Consulting a frame reference catalog or database will help.

Safety Frame Markings

Frames that are suitable for use as safety glasses must have "Z87" or "Z87-2" and the name or logo of the manufacturer stamped on the frame front and on both temples. This is as specified by the American National Standards Institute (ANSI) in their standard called *American National Standard Practice for Occupational and Educational Eye and Face Protection* . The standard is numbered as Z87.1. If a pair of glasses has safety lenses, but is not in a frame marked "Z87" or "Z87-2," the glasses are not safety glasses. (For more on safety eyewear, see Chapter 23.)

Gold Classifications for Metal Frames WithSubstantial Gold Content

Metal frames may not have any gold or any significant amount of gold in the frame. This does not imply any- thing about the quality of the frame. (See Chapter 1 for more on frame materials.) When a frame has a substantial gold content, numbers other than those indicating the size of the frame are printed on the frame to indicate the nature of the gold content. Gold or part-gold articles can be classified as fine gold, solid gold, gold filled, or having gold plating or gold flashing.

The color of a frame with gold content has nothing to do with its quality. The color depends on what type

Name	**Meaning**
Fine gold	100% pure gold
Solid gold	Gold plus base metal evenly mixed throughout
Gold filled	Base metal inside a "solid gold" coating
Gold plating	A base metal thinly plated with gold
Gold flashing	A base metal with gold thinly and quickly applied in a manner similar to that of gold plating

of metal is used in combination with gold to make the gold alloy.

The karat system is used to determine the amount of gold present. The number marked on the article is the amount of gold by weight in comparison to a total of 24 units: an article marked 12k is an alloy made up of one- half gold and one-half another metal.

Fine Gold

Fine gold is the name used for an article that has no metal in it other than gold. The gold found in it is chemically pure. Although this is the purest form, it is not always the most practical, as is the case in spectacle frames. Frames of fine gold would be too malleable and would bend and dent too easily to be practical. Using the karat system, fine gold is 24 karats fine, which means that by weight, 24 parts out of 24 are gold.

Solid Gold

Solid gold articles are actually an alloy of gold and another metal, a mixture of gold and a base metal. Thus the term is misleading, as it does not mean all gold. The solid gold article is made entirely of the gold alloy. It maintains its luster regardless of how far down it is worn through use.

The symbol q is used to denote a 10k solid gold bridge; the symbol ☐ to denote a 12k solid gold bridge.

Gold Filled

Gold-fi lled articles are made of a metal other than gold and then covered with a gold alloy. The term does not indicate that the article is "filled with gold," but rather the opposite: an outer wrapper of gold alloy is "filled" with a baser metal. To be classified as gold filled, a minimum of one twentieth of the article's total weight must be gold.

Articles in this classification are marked with a frac- tion, a karat rating, and the abbreviation for gold filled. The fraction shows what part of the total weight of the article is represented by the gold alloy covering. The karat rating shows, as always, the amount of gold by weight in the gold alloy in comparison to a total of 24 units. The GF classifies the article as gold filled. For example:

- 1/10—10% of the total weight of the article is alloy.
- 12k—12 parts out of 24 parts of the covering alloy by weight are gold.
- GF—The article is classified as gold filled.

Thus the article would bear the marking of 1/10 12k GF.

A gold-filled article retains its luster until the gold covering eventually wears through.

If a frame is made from parts having different per- cents of gold, the frame must be marked according to the part containing the least amount of gold. If, for example, the temples are 1/8 12k GF and the front is 1/10 12k GF, the frame must be marked 1/10 12k GF.

Gold Plating

Gold plate articles are made of some other metal, the surface of which is plated with gold, usually by an electrolytic process. Articles classified as gold plate have no minimum requirement as to the total amount of gold used. Gold plate articles maintain luster only until the thin plating is worn through and the base metal is exposed.

Gold Flashing

Gold flashing is a method of gold application that is done in almost the same way that gold plating is done, only faster. Gold flashing is applied using a cyanide-based bath instead of an acid-based bath.[2] It produces an extremely thin layer of gold. If it were not for the protective coating, which works very well, the gold would not be very durable. A large percentage of spectacle frames have gold flashing and because of the coating are very serviceable.

Sample Question:

1. **Describe the ways to measure temple Length?**

Most temples are currently marked with the total, or overall, temple length. Temple lengths are expressed in millimeters. Temple length may be measured in one of the following ways.

Overall Temple Length

The overall temple length is the distance from the center of the center barrel screw hole to the posterior end of the temple, measured along the center of the temple (Figure 2-6, *A*). Many times the center of the barrel *The term “Frame PD” may have originated when frame size was determined by selecting the correctly fitting bridge size, then choosing an eye size so that the wearer’s pupils would be at the geometric centers of the frame’s lens openings.screw hole will match the position of the butt end of the temple. But this is not always the case. Also, when measuring the overall temple length, it is necessary to measure around the bend and not in a straight line, unless of course the temple is straight. The easiest way to do this is shown in Figure 2-7, *A* through *D*.

Comfort cable temples are measured in terms of overall length. The actual measurement is done by grasping the tip and extending the temple along the ruler (Figure 2-8).

Length to Bend (LTB)

An older method of measuring temple length is in terms of the length to bend (LTB). This is measured from the center of the barrel to the middle of the bend (Figure 2-6, *B*). The distance from the middle of the temple bend to the end of the temple is known as the *length of drop* (see Figure 2-6, *B*).

Front to Bend (FTB)

If the endpieces wrap around in a swept-back manner, there is a distance between the plane of the frame front and the actual beginning of the temple. In this case, the temple length could be specified as frame to bend (FTB) (Figure 2-6, *C*), which would be slightly longer than LTB. This measurement method is seldom used.

2. **What is segment Height? Draw and Explain?**

Seg Height

When specifying bifocal or trifocal segment height, the reference points are given in millimeters as either (l) the distance below or above the horizontal midline (called *seg drop* or *seg raise*), or (2) the distance from the lower line of the boxing system rectangle enclosing the lens shape (called *seg height*). In the actual measuring process, the level of the lower line of the box corresponds to the lowest point in the eyewire groove. *This level may be different from the depth of the point on the lens edge found directly below the pupil* as can be seen by looking carefully at Figure 2-2.

Unit 5:

Measuring the Interpupillary Distance

Learning Objective:

At the successful completion of this unit, students will be able to learn:

Methodology for measuring the interpupillary distance (PD). Failure to accurately determine the interpupillary distance results in a misplacement of the optical center of the lenses. This induces unwanted prismatic effects, requiring the wearer to turn his eyes inward, or even outward, to keep from experiencing double vision. Over time, this effort causes visual discomfort and can result in a decreased ability of the eyes to work together in binocular vision.

DEFINITION

The *anatomic PD* is the distance from the center of one pupil to the center of the other pupil, measured in mil- limeters. Before ordering prescription glasses or even before doing a visual examination, the distance between the pupils must be determined. It can be measured in a variety of ways.

DISTANCE PD

Binocular PD

The most common method used to measure the PD also requires the least amount of equipment. The technique uses a simple millimeter ruler, commonly referred to as a *PD rule*.

Technique

When the PD is to be measured, the dispenser should be positioned at a distance of 40 cm (16 inches) directly in front of the subject, with his or her eyes at the same vertical level as those of the subject. The PD rule is positioned across the subject's nose with the measuring edge tilted back so that it rests on the most recessed part of the nose. The dispenser holds the PD rule between thumb and forefinger and steadies the hand by placing
the remaining three fingers against the subject's head.

The dispenser closes the right eye and sights with the left (Figure 3-1). The subject is instructed to look at the dispenser's open eye while the dispenser lines up the zero mark of the rule with the center of the subject's pupil.

When the zero mark is lined up correctly, the dispenser closes the left eye and opens the right. The subject is instructed to look at the dispenser's open eye. The PD for the distance prescription is read off as that mark falling in the center of the subject's left pupil (Figure 3-2).

The dispenser now closes the right eye and opens the left. The subject is again instructed to look at the dispenser's open eye. This step is primarily a recheck to make sure the zero mark is still properly aligned. (This technique is summarized in Box 3-1.)

When difficulty is experienced in determining the exact center of the pupil, the edge of the pupil may be used as a measuring point if both pupils are the same size. Measurement is read from the left side of one pupil to the left side of the other. Measuring from the inside edge of one pupil to the inside edge of the other would give an artificially low reading; from the outside edge of one pupil to the outside edge of the other, an artificially high reading.

When a person has dark irises or unequally sized pupils, it may be difficult to use either the center or the edge of the pupil. In this case, the dispenser may use the limbus edge—the sharp demarcation between white sclera and dark iris (Figure 3-3). (Because the pupil is displaced 0.3 mm nasal ward from the center of the limbal ring,[1] a limbal measure will be approximately
1.5 mm greater than the measure found using pupil centers.) The same rule must be applied when using the limbus edge as when using the pupil edge: the same sides of the limbus (both left or both right) must be used, or an extremely large error is induced.

Common Diffi culties and Their Solutions

Dispenser Cannot Close One Eye. Occasionally the person doing the measuring is unable to close one eye independent of the other. This can be remedied by occluding (covering) the eye with the free hand. The practice of holding the lid down with one finger gives an unprofessional appearance, especially when wearing glasses. Occluding the eye with the hand held flat appears to be a natural part of the test and does not reveal a person's inability to close only one eye.

Dispenser Visually Impaired in One Eye. If the dispenser is blind in one eye, or has visual acuity too poor to allow the ruler to be read accurately, then the technique is modified. The dispenser places the good eye directly in front of the subject's right eye and at the normal distance. The zero mark is lined up as usual. The dispenser then moves sideways until the good eye is positioned in front of the subject's left eye and the measurement is read. Unfortunately this method can easily lead to parallax errors. The most desirable solution for someone with this difficulty is to use another type of instrument that only requires the use of one eye.

Subject Is Strabismic. The strabismic subject, whose eyes are in a tropic position (i.e., with one eye pointing in a different direction from the other) presents a special problem, since the PD rule method of measurement may then give an artificially high or low reading. To deter- mine a true reading, simply cover the subject's eye not

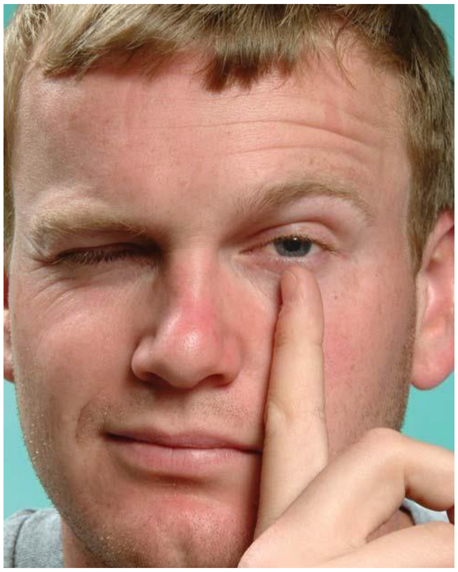


Figure 3-1. Position of the dispenser for beginning the PD measurement using just a PD ruler.being observed. This ensures that the subject is fixating with the eye under observation and ensures that it is notturned unless eccentric fixation is present. Even if eccen- tric fixation is present, the PD measurement is still correct, since the subject never uses this eye in any otherposition relative to the dominant eye.

In some instances where one eye turns out constantly, the prescribing doctor may determine that the wearer is better served if the lenses are centered in front of the pupils, even for the eye that is turned. This will require that a separate measure be taken for each eye. One measurement will then be considerably larger than the other. **Subject Is an Uncooperative Child.** If the subject is young or uncooperative, making normal PD measurements impossible, the dispenser may have to take a canthus-to-canthus measurement. (The canthus is the corner of the eye where the upper and lower lids meet.) This is done by measuring from the outer canthus of one eye to the inner canthus of the other eye. Unfortunately,this measurement is not entirely exact, since the inner canthi of the eyes encroach farther across the sclera with younger children.

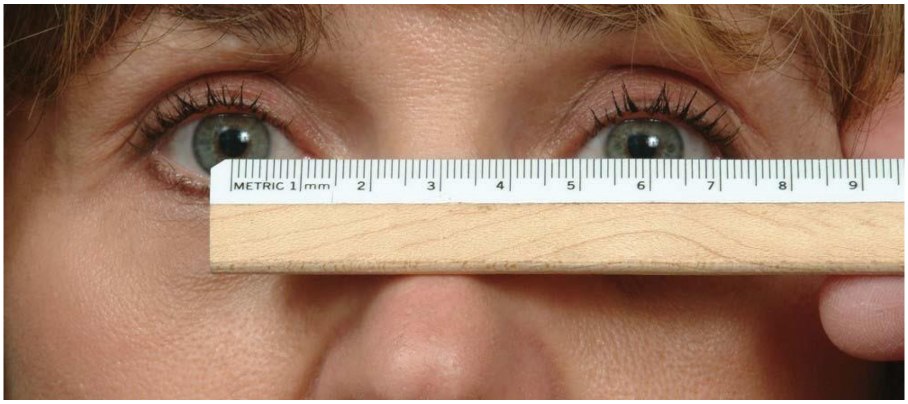


Figure 3-2. The dispenser uses his or her left eye to establish the zero point of the PD rule in the center of the pupil of the subject's right eye as shown here. The subject is looking at the dispenser's left eye. Next the subject looks at the dispenser's right eye. The dispenser uses his or her right to read the pupillary distance at the center of the subject's left eye. (This is not what is seen in this photo.)

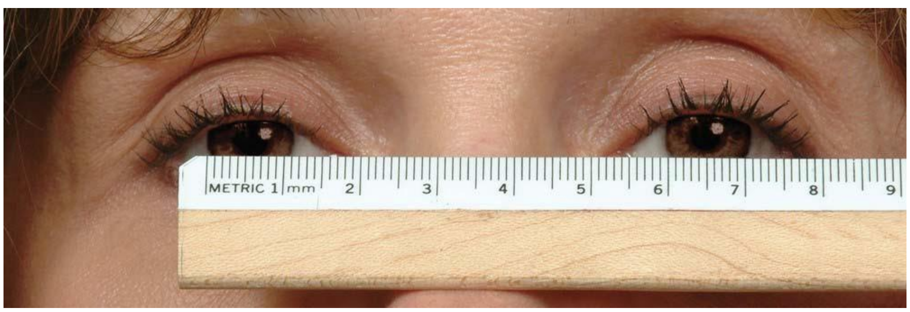


Figure 3-3. When the subject has dark irises, the outside edge of the limbus may be used as the zero reference point and the inside limbal edge of the other eye as the measuring point.

Common Causes of Errors

There are several common causes of errors inherent in using a PD rule.[2]

1. There will be an error in measurement if the measurer's PD differs significantly from the subject's because the lines of sight are not parallel. For example, if the measurer's PD is 16 mm larger than the subject's, the reading will be 1 mm too high because of this parallactic error.
2. The above error will be increased if the PD rule is not tilted on the subject's nose so that the scale is in the most recessed area. The most recessed area corresponds to the approximate position where the spectacles will be worn.
3. Just as error will be increased when the measurer's PD is significantly different from the subject's, the parallactic error will also be increased even more if the dispenser is too close to the subject. Too close is closer than the normal 40 cm (16 inch) distance.

4. A significant error will be induced if the subject is strabismic (one eye turns in or out) or if the subject does not fixate binocularly* during the PD measurement.
5. An error can result if the subject's head moves.
6. An error can result if the person measuring moves his or her head.
7. An error will result if the person measuring does not close or occlude one eye at a time to ensure sighting from directly in front of the subject's eye under observation.
8. The subject may not look directly at the measurer's pupil during the test, as he or she should, which will result in an error.

*What does "not fixating binocularly" mean? It means that one eye may have a tendency to turn in or out when the subject is not concentrating. In simple terms, they will only be using one eye to see instead of both eyes. When this does happen, one eye usually turns outward somewhat and the measurement is then too large.

Monocular PD

Since faces are not always symmetrical, it is often necessary to specify the PD for each eye independently. The main goal in taking the PD is to eventually place the optical centers of the lenses directly in front of the subject's eyes to prevent any undesired prismatic effect.

If one eye is set closer to a person's nose than is the other and the optical centers of the lenses are placed symmetrically in the frames, the wearer's lines of sight will not pass through the optical centers of the lenses. The error is not too serious if the lenses are of the same power and are not strong. If, however, one lens is very different from the other, the centers must be placed accurately to prevent unwanted binocular prismatic effects (Figure 3-4). Monocular PDs are also important when using aspheric lenses or high index lenses, including polycarbonate lenses. High index lenses have more chromatic aberration than crown glass or regular (CR- 39) plastic lenses. The negative effect of chromatic aberration on vision is increased if the eye is not looking through the optical center of the lens.

Procedure for Measuring Monocular PDs Using a Ruler

The monocular PD is best taken using a pupillometer. When a pupillometer is not available, monocular PDs are taken by measuring from the center of the nose to the center of the pupils. The procedure consists of the following three steps:

1. Measure the binocular PD as described earlier in the chapter. Use the center of the pupil as the reference point.
2. Before moving the ruler, note the scale reading on the ruler at the center of the nose. This is the right monocular PD.
3. Subtract this reading from the binocular reading to obtain the left monocular PD.

For example, the binocular PD is 66. The scale reading at the center of the nose is 32. The monocular PD for the right eye is then 32. To calculate the monocular PD

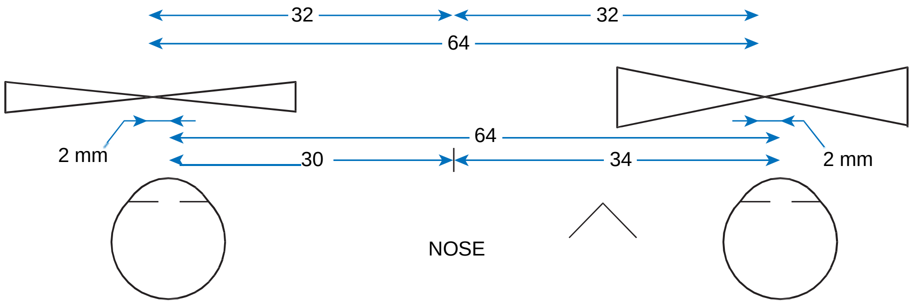


Figure 3-4. Here the PD has been measured binocularly as shown on the top measurements. However, the wearer has very different monocular PDs. Even though the distance PD is 64, the monocular PDs are not 32 and 32. Instead they are 30 and 34. When the lenses are made as if the wearer had 32/32 monocular PDs, in this case there will be unintended Base Out prism caused by the misplaced lenses.

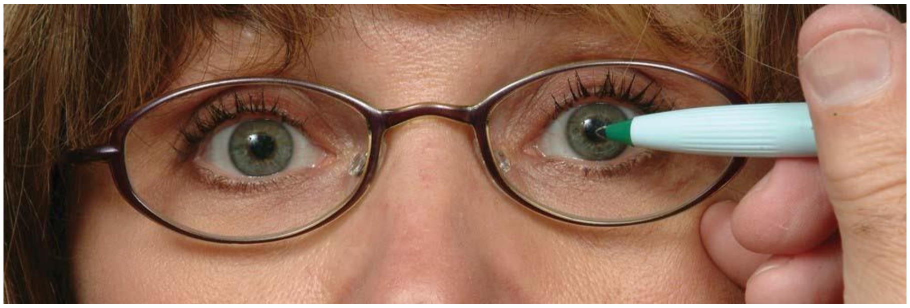


Figure 3-5. To measure monocular PDs using a marking pen and a frame with lenses in the frame, the same procedure is followed as would be used with a ruler. It is essential that the wearer be looking at the dispenser's eye that is directly in front of the eye being measured. In other words, to mark the location of the wearer's right pupil center, the wearer looks at the dispenser's open, left eye. (The dispenser's right eye is closed.) To mark the location of the wearer's left pupil center, the wearer looks at the dispenser's open right eye. (The dispenser's left eye is closed.) for the left eye, subtract 32 from 66, to get a reading of34. The procedure is the same as in taking a binocular PD measurement, except that the two readings are independent of one another and, for purposes of measuring, the center of the pupil is always used. (There are other methods that are considerably more dependable than this method in their ability to yield consistently accurate results.)

Procedure for Measuring Monocular PDs Using the Frame

One error inherent in using a ruler alone appears when a person has an asymmetrical nose. An asymmetrical nose often occurs when a nose has been broken. In this case, the frame positions itself somewhat to the left or right. For the lenses to be accurately placed, this factor must be taken into account. It is possible to use an over- head transparency marking pen and the glazed* lenses

*Glazed lenses are also called “coquilles,” “dummy lenses,” or “demo lenses.”

in the sample frame. If the sample frame does not have glazed lenses, clear tape may be placed over the lens opening of the empty frame.

The procedure for measuring monocular PDs begins by adjusting the frame. The frame should occupy the exact position it will have with the lenses in place. The dispenser should be at the same level as the wearer and approximately 40 cm away. The dispenser closes the right eye. The wearer is instructed to look at the dispenser’s open left eye. Since there is no ruler used, the dispenser uses an overhead transparency marking pen and marks a cross on the right glazed lens. If there is no lens in the frame, the clear tape placed over the lens opening is marked instead, directly over the center of the wearer’s right pupil (Figure 3-5).

Next the dispenser closes the left eye and opens the right eye. The subject is instructed to look at the dispenser’s open eye. The dispenser then marks a cross on the lens or tape directly over the left pupil center.

Because of the movement involved in marking pupil centers and the ease with which unintentional head movement can occur, it is important that these markings be carefully rechecked.

When the dispenser is confident that pupil centers are accurately marked, the frames are removed and the distances from the center of the bridge to the center of each cross are measured.

Figure 3-6. The digital version of Essilor’s pupillometer dis- plays monocular PDs for the right and left eyes, as well as the binocular PD. It can be set to measure distance or near PDs.

PD Measuring Instruments

The interpupillary distance is most easily measured by using an instrument especially designed for this purpose. Readings taken using this instrument are not nearly as subject to parallax errors as those taken using a PD rule. Such a device also solves the problems caused when the person doing the measuring is monocular or is amblyopic in one eye.

Most instruments have an occlusion system, which allows for individual monocular measurements, with each eye fixating alternately in cases of strabismus.

A well-designed PD measuring instrument should rest against the bridge of the subject's nose exactly as a frame would. This most accurately approximates the way the glasses will position themselves. It should also posi- tion the measuring plane at the approximate spectacle plane.

The subject will see a ring of white or colored light around a dark, central dot within the instrument. The dispenser will see the subject's eye and a scale appearing on it, from which a direct measure is read. Alternately, in some instruments, a split image of the pupil may be seen.

BOX 3-2

Steps in Measuring Monocular PDs Usingthe Sample Frame

1. The selected frame is adjusted in exactly the samemanner as it will be when worn.
2. Dispenser positions at 40 cm from the wearer and atthe same level.
3. Dispenser opens left eye, closes right eye, and instructs wearer to look at dispenser's open (left)eye.
4. Dispenser marks location of wearer's right pupilcenter on glazed lens.
5. Dispenser opens right eye, closes left eye, and instructs wearer to look at dispenser's open (right)eye.
6. Dispenser marks location of wearer's left pupilcenter on glazed lens.
7. Dispenser rechecks the locations of the marked crosses by repeating steps 3 and 5 and notes thepositions of the marked crosses.
8. If one or both crosses are wrong, the frames are removed and the cross(es) erased using a damp cloth.
9. When crosses are accurate, monocular PDs are measured from frame center to cross

Instruments Using Corneal Refl exes

Although some instruments use a method of taking the PD where the reference point is the geometric center of the pupil itself, the popular alternate corneal-reflex method is used in instruments such as the Essilor pupillometer (Figure 3-6) or the Topcon PD-5, PD Meter. The instruments are supported by means of pads positioned so as to cause the instrument to rest on the nose where the average frame would rest. This is superior to a forehead support system used alone.

The dispenser asks the subject to hold his or her end of the pupillometer so that the pads rest on the nose (Figure 3-7). The forehead support should be against the forehead. The dispenser uses one eye to look into the instrument. (A real advantage for dispensers with good vision in only one eye.)

An internal light produces an image by reflection on each cornea, and the hairline within the device is moved until coincident with this corneal reflection (Figure 3-8). The measurement is assumed to correspond with the subject's line of sight, but is an objective measurement of the position of the corneal reflection rather than the position of the line of sight. In addition to a distance PD, near PD may be measured for near points from 30 or 35 cm to infinity.

The line of sight is defined as a line passing from the center of the pupil to the object of regard. This is the line that desirably passes through the optical center of

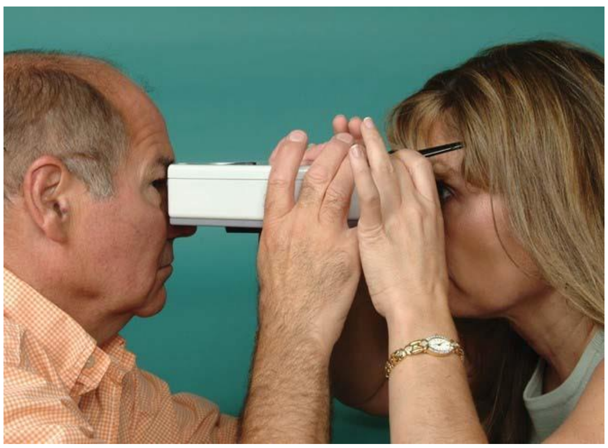


Figure 3-7. To use a pupillometer, the subject (on the right) holds the pupillometer so that the pads rest on the nose in the manner of normal eyeglasses. The dispenser views the sub- ject's eyes through the instrument.

Figure 3-8. The corneal reflection as seen through Essilor's pupillometer. The hair line is adjusted to the center of the corneal reflex. (Courtesy of Essilor, Inc.)

the lenses and is the basis upon which the measurement of interpupillary distance rests.

Corneal reflections are observed along a line which intersects perpendicularly the center of curvature of the anterior surface of the cornea. (Technically this line is referred to as the pupillary axis.) This line intersects the line of sight at the entrance pupil of the eye. It varies in its orientation by an angle,* which for the average eye is approximately 1.6 degrees.[1] This places the corneal reflection somewhat toward the nose. Thus a PD deter- mined on the basis of corneal reflections will vary slightly from that determined by the centers of the pupils.

It is possible to use a corneal-reflection-style instrument to measure a PD based on pupil center distances. To do this, the hairline within the device is moved to the center of the pupil rather than the center of the corneal reflection. The corneal reflection method is definitely the method of choice when measuring a PD for someone with pupils dilated from a recent eye examination.

*This angle is angle lambda, but is often commonly designated as angle kappa.

Using Corneal Refl ections to Measure the PD without a Pupillometer

It is possible to use corneal reflections to measure inter- pupillary distance with even a PD ruler, or by using the frame with glazed lenses. Procedures need only be slightly modified. The dispenser should be positioned at the near working distance. The dispenser holds a pen light directly below his or her eye and shines it into the eye of the subject. The subject looks either at the pen light or the dispenser's eye. The reflection of the pen light on the cornea is used as the reference point instead of the geometric center of the pupil. The sequence of measurements is followed exactly as outlined in Boxes 3-1 and 3-2, except that the dispenser must position the pen light directly below his or her "open eye" through- out the sequence.

Photographic Instruments for Measuring PD

There are instruments available for taking a wearer's interpupillary distance that make use of a photograph of the wearer's eyes with the frame in place. The frames are adjusted as they are to be worn. The wearer fixates a light in the instrument, and the photo is taken. PD and segment height measurements are determined using the picture. Up to this point, no photography-based PD measuring system has successfully penetrated the U.S. ophthalmic market.

NEAR PD

The near PD is required for single vision reading glasses or for multifocals.

For *single vision reading glasses*, the lenses are set so that their optical centers will be in the lines of sight of the eyes when the eyes are converged for reading.

For *multifocals*, the distance portion is ground to correspond to the distance PD, while the bifocal or trifocal portion is decentered inward to be properly situated for near vision. The near PD can be either measured or calculated.

Measuring Near PD With a PD Rule

To measure the near PD with the PD rule, the dispenser is positioned at the subject's working distance; that is, at the distance for which the reading portion is prescribed.

Closing his or her poorer eye, the dispenser aligns his or her better eye directly

before the subject's nose and instructs the subject to look into that open eye.
The PD rule is lined up with the zero point corresponding to the center of the subject's right pupil. It should also be held in the same place that the subject's new frames will rest because this will also affect the reading.

The dispenser then notes the mark corresponding to the center of the subject's left pupil. This is the near PD (Figure 3-9). The subject is not required to shift gaze, and the dispenser is not required to change eyes during the procedure. (See Box 3-3 for a summary of this technique.)

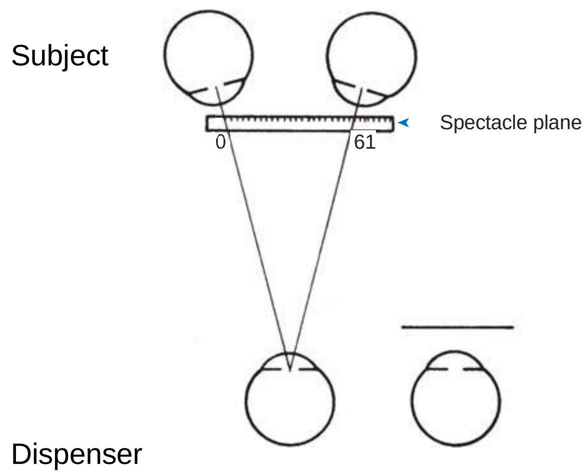


Figure 3-9. Using a PD rule, near PD may be taken with the dispenser positioned as shown. The distance between dispenser and subject is equal to the subject's working distance.

It should be added that it is also possible to use the edge of the pupil or the limbus for reference points in taking the near PD, as long as only the right or only the left edges are used, and not both outer or both inner edges.
In practice, many who use a PD rule to measure the binocular distance PD, measure the near PD at the same time. This is done as follows:
(The first three steps are how binocular distance PD measures begin.)

1. Dispenser is positioned at 40 cm.
2. The dispenser closes his or her right eye and the subject, using both eyes, fixates on dispenser's left eye.
3. Dispenser lines up zero point of ruler on center of subject's right pupil. (This next step allows for the near PD measurement.)

The dispenser looks over at the subject's left eye and reads the scale on the ruler at the location of the left pupil center. This is a measure of the near PD for the distance from the subject to the dispenser.
The dispenser now continues the steps for finding the binocular distance PD as listed in Box 3-1.

Taking Near PD Using a Pupillometer

Usually a PD measuring instrument will allow both distance and near PD to be measured. This is done through the use of a movable internal lens that changes the image distance and convergence for the subject. The near readings are carried out in the same manner as the distance readings.

USING THE NEAR PD FOR BIFOCAL INSET

For the near "reading" area of a pair of glasses to be used most comfortably, it must be positioned accurately in the lens. Horizontal placement of the near segment viewing area is determined by the near PD.

The horizontal position of bifocal segments is specified as the distance from the farpoint PD that the segments are set in toward the bridge. The total inset is the difference between the distance PD and the near PD.

Because of the possibility of unequal monocular PDs, segment inset is usually specified individually for each eye. Ordinarily segment inset is the difference between the distance PD and the near PD, divided by 2:

$$\text{Segment Inset} = \frac{(\text{distance PD}) - (\text{near PD})}{2}$$

For example, if the distance PD is 68 and the near PD is 64, then the segment (seg) inset for each eye is 2 mm.

Where inequality of the monocular PDs exists, this rule may result in errors, since both eyes may not be required to converge equal angular amounts for near fixation. The actual amount of error is usually so slight, however, that it is usually ignored. The exceptions would be cases of very marked differences in monocular PD or very strong lenses.

If there is a large difference in monocular PDs, inset- ting the bifocal segments accordingly may result in a rather unusual-looking pair of glasses (Figure 3-10). This effect can be made less noticeable by using a bifocal with a wider segment.

Calculating the Near PD

There are several other factors to be considered when calculating the near interpupillary distance, most notably those that cause differences in segment inset.

Calculation

The most logical way to calculate the interpupillary distance is to draw a triangle with the center of rotation ofthe eyes being two points of the triangle and the near point of fixation being the third. A similar triangle is then constructed by drawing a line corresponding to the spectacle plane.

By similar triangles, the monocular near PD can be calculated from the monocular distance PD (Figure 3-11).

When using a prewritten prescription, the working distance will normally never exceed the reciprocal of the power of the near addition. For example, a D2.00

diopter near addition will indicate a working distance no further than 50 cm.

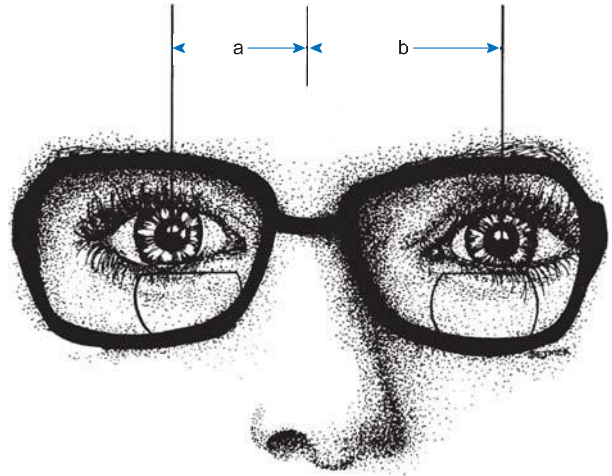


Figure 3-10. If there is a large difference in monocular PDs, insetting the bifocal segments from these points may result in a rather unusual-looking pair of glasses. Using a wider segment size or changing to a progressive addition lens is a better choice.

$\frac{1}{D2.00}$ D 0.50 meters D 50 cms

Unless the professional situation or physical build of the wearer indicates otherwise, the customary near working distance can be assumed to be 40 cm. If, however, the power of the near addition (add power) is greater than D2.50 diopters, then the working distance

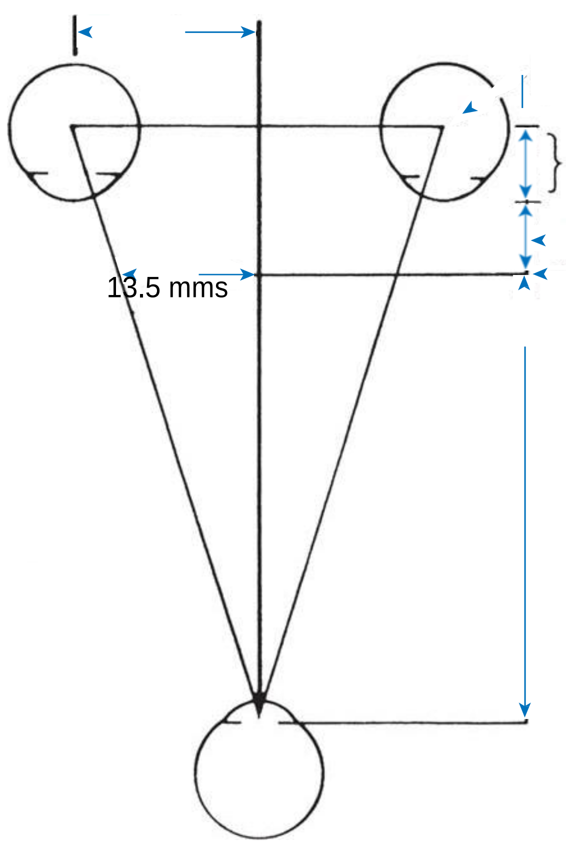


Figure 3-11. *a* D monocular distance PD; *b* D calculated monocular near PD. The distance from the front surface of the cornea to the center of rotation of the eye is normally considered to be 13.5 mm. (The diagram is, for clarity, not drawn to scale.)

The Infl uence of Distance Lens Power on Segment Inset

The power of the distance prescription has an effect on bifocal inset. When a person looks at a near object, the eyes turn inward and are no longer looking through the optical centers of the lenses. Negative power, or minus lenses, keep the eyes from converging as much as they normally would because of the Base In prismatic effect at this point on the lens. Positive power, or plus lenses, cause the eyes to converge slightly more than they normally would because of their Base Out prismatic effect.

For positive lenses then both the measured or the Gerstman-calculated near PD would need to be reduced (i.e., the segment inset of the bifocal increased). For minus lenses, the near PD would need to be increased (i.e., the inset of the segment reduced).

The position of the near reading area becomes more important when the reading area is small. This means that for progressive addition lenses, the position of the intermediate and near readings areas is very important. Progressive addition lens designers are now taking dis- tance power into consideration when determining how much inset the near viewing area should have.

Segment Inset Formula. There have been several factors listed as having an effect on segment inset. These were:

- The distance the lenses are from the eyes
- The distance PD
- The near working distance
- The power of the distance lens

Taking all these factors into consideration, Eller-brock[4] derived the following formula for segment inset.

i D———————————P 1 D D D 1 D 1D

s ✯ ☇ f

where P is one half the distance PD, D is the distance of the lens from the working nearpoint, *s* is the distance from the lens to the center of rotation of the eye, and *f* is the focal length of the lens in the 180-degree meridian. All measurements are expressed in millimeters.

Summary of Factors

Fortunately the variations in segment inset caused by all these factors are not

radically different from that found using the measured near PD. This assumes, of course, that the near PD is measured at the appropriate working distance.
Table 3-2 summarizes the effect of distance lens power on segment inset for the normal working distance (40 cm or 16 in).[5]

Recommendations For Finding The Near PD After all of these possibilities, what is the most appropri- ate way to determine segment inset? Here are some rec- ommendations for different situations. The idea is to provide the best accuracy without making it too difficult. Keep in mind that just using a PD ruler may not be the most reliable method.

Recommendations for Finding the Correct Segment Inset

- When the working distance is normal (40 cm)
  1. Measure the near PD with a pupillometer or a PD ruler.
  2. If the distance lens powers are high, use Table 3-2.
- When the working distance is less than 40 cm
  1. Again, measure the near PD with a pupillometer or PD ruler. Be certain to set the correct working distance in the pupillometer before measuring. When measuring with a PD ruler, the dispenser must be at the shorter working distance.
  2. If the working distance is less than that allowed for in the pupillometer, use Gerstman's three- quarter rule (assuming adult PDs between 62 and 68 mm), or use Table 3-1.
- When the distance lens powers are especially high
  1. If the working distance is normal (40 cm), use Table 3-2.
  2. If the working distance is closer than 40 cm, use Ellerbrock's formula. (Ellerbrock's formula could actually be used in any of the above circumstances, but it is unhandy to work with.

<u>Sample Questions:</u>

1. For a reading distance of 40 cm, and an add power of D1.00D, what is the inset per lens?

Solution

To find the answer, we first need to know the dioptric demand. The dioptric demand is the inverse of the working distance, *not* the inverse of the D1.00 add power. Therefore since the working distance is 40 cm or 0.40 m, the dioptric demand is

$$\frac{1}{0.40} \text{ D } 2.50 \text{ D}$$

Having found the dioptric demand, we can find the insetper lens by multiplying by three-quarters, as the rule name implies. Therefore the inset per lens is

$$2.50 \text{ D } \frac{3}{4} \text{ D } 1.9 \text{ mm}$$

2. What would the segment inset be for a person with a 70 mm distance PD who is wearing a prescription of D6.50D? Assume they are wearing a D2.50 add, but are working at anear working distance of 20 cm. The spectacle lenses are 25 mm from the center of rotation of the eye to the back of the lens.

Solution

We are using Ellerbrock's formula. In Ellerbrock's formula *P*
is half the distance PD, so

$$P \text{ D } \frac{70}{2} \text{ D } 35 \text{ mm.}$$

The value of D is the distance from the lens to the nearworking point in millimeters. This distance is given as 20 cm, which is the same as 200 mm.
The focal length of the lens is the reciprocal of the powerof the lens. This is

$$\frac{1}{6.50} \text{ D } 0.1538 \text{ Meters}$$
$$\text{D } 153.5 \text{ mm}$$

Since the lens is a sphere, the power in the 180-degreemeridian is the same as the power in any other meridian.
The distance from the lens to the center of rotation of theeye is given as 25 mm, so s D 25 mm.
Inserting all of this into Ellerbrock's formula results in

$$i \text{ D } \frac{P}{s \ f} \ 1 \text{ D D } \text{D } 1 \text{ D } 1 \text{ D}$$

$$\text{D } \frac{35}{25 \ 153.5} \ 1 \text{ D } 200 \bullet \text{ D } 1 \text{ D } 1 \text{ D}$$

$$\text{D } 4.5 \text{ mm}$$

So the inset per lens for this wearing situation is 4.5 mmper eye.

Examples for Finding the Near PD

Here are some examples. Both the power of the prescription and the distance PD are known. Use the most appropriate method to find the segment inset and then the near PD.

3. A spectacle lens wearer has the following prescription

R: D1.00 D sphereL: D1.00 D sphereadd: D2.00

TABLE 3-2

Insets to Make Reading Fields Coincide at 16 Inches

Power of distance	**Distance from Nose to Center of Pupil**									
lens 180th	**in27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**
D15	2.5	2.5	2.5	2.5	3	3	3	3	3	3
D14	2.5	2.5	2.5	2.5	2.5	3	3	3	3	3
D12	2	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3
D10	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5	3
D9	2	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5
D8	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5
D7	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5
D6	2	2	2	2	2	2	2.5	2.5	2.5	2.5
D5	2	2	2	2	2	2	2	2.5	2.5	2.5
D4	2	2	2	2	2	2	2	2	2.5	2.5
D3	1.5	2	2	2	2	2	2	2	2	2.5
D2	1.5	1.5	2	2	2	2	2	2	2	2
D1	1.5	1.5	1.5	2	2	2	2	2	2	2
0	1.5	1.5	1.5	2	2	2	2	2	2	2
D1	1.5	1.5	1.5	1.5	2	2	2	2	2	2
D2	1.5	1.5	1.5	1.5	2	2	2	2	2	2
D3	1.5	1.5	1.5	1.5	1.5	2	2	2	2	2
D4	1.5	1.5	1.5	1.5	1.5	1.5	2	2	2	2
D5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2	2
D6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2	2
D7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2
D8	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2
D9	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
D10	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
D12	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
D14	1	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
D16	1	1	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5
D18	1	1	1	1	1.5	1.5	1.5	1.5	1.5	1.5
D20										

The distance PD is measured as 64 mm. For a 40 cm working distance, what is the expected near PD?

Solution

Since the working distance is 40 cm, simply measure the near PD with a pupillometer (or PD ruler). If a pupillometer is not available, use Table 3-2. In the table, we find the inset for a 32 mm monocular distance PD with a D1.00 D power to be 2 mm. Therefore the binocular near PD would be 4 mm less than the distance PD. Since 64 D 4 D 60 mm, then the near PD equals 60 mm.

4. Suppose an individual has a distance PD of 64 mm, a dis- tance prescription of D1.00 D sphere for both eyes, and a bifocal add of D2.00. (These are the same lens powers as given in the previous example.) What would the near PD be if the near working distance was 25 cm instead of 40 cm?

Solution

Since the working distance is less than 40 cm, we would find the near PD either by a direct measurement using a pupillometer (or PD ruler) or by using the three-quarter rule. To find the near PD by measurement, the best option would be to use a pupillometer. Unfortunately, most pupillometers only measure up to 33 cm. However, it is possible to use a PD ruler. If a ruler is used, the dispenser's face must be at the subject's near working distance.

If the near PD is to be calculated, it is possible to do these calculations with Gerstman's three-quarter rule. To use the three-quarter rule, begin by the finding the dioptric demand. Dioptric demand is the reciprocal of the working distance in meters. In this example, the working distance is 25 centi- meters or 0.25 meters. Therefore

$$\text{Dioptric demand} = \frac{1}{0.25 \text{ meters}} = 4D$$

Next, to find the inset per eye, the dioptric demand is multiplied by 3/4.

$$\frac{3}{4} \times 4 = 3 \text{ mm per eye}$$

Thus the near PD will be

Distance PD D (segment inset × 2) Or
64 D 6 or 58 mm.

This means that a prescription for a person with a bifocal add and a 25 cm working distance should have the distance optical centers set for a far PD of 64 mm and the segments set for a near PD of 58 mm.

Using Table 3-1 would have yielded an inset of 3.3 mm per eye and a near PD of 57.4

mm. Remember that the three- quarter rule is a close approximation and because the table does not list every PD and working distance, it may also be a close approximation.

5. A prescription reads as follows:

R: D1.50 D 1.00 × 180
L: D1.50 D 1.00 × 180
add D3.50

The distance PD is found to be 61 mm. What should the nearPD be?

Solution

A near addition with a power greater than D2.50 D should be a red flag to the dispenser. An add greater than D2.50 Dmeans that the working distance will be less than 40 cm.The near PD is best found by direct measurement with a pupillometer or PD ruler. The three-quarter rule is not as accurate because the PD is smaller than the normal 62 to 68 mm range. The next best thing is to use Table 3-1.

To measure directly with pupillometer or PD ruler, the working distance must be known. When an add power is greater than D2.50 D, unless another distance is specified the working distance is found by taking the reciprocal of the add power.

Working Distance $D\frac{1}{3.5}$ D 0.29 M or 29 cms

Now the near PD may be measured for this 29 cm working distance with the pupillometer or at this 29 mm workingdistance with a PD ruler.

Table 3-1 is not ideal, because neither the distance PD nor the “working distance” can be found directly and mustbe interpolated, choosing a number in between those given in the table. If the number halfway between is chosen, thismakes the closest seg inset to be 2.75 mm per lens. This makes the near PD

Near PD D 61 D D2 D 2.75D
D 61 D 5.5
D 55.5 mm

Unit 6:

Frame Selection

Learning Objectives:

Frame selection entails considerably more than just helping a person try on frames. Students will be able to learn;

1. At the very least, a working knowledge of basic facial shapes and right size of frame according to need is necessary. The person aiding in selection must have the ability to know what the frame will look like with appropriate lenses, and how it will perform in fulfilling the wearer's needs.
2. The knowledge necessary to acquire basic competency in frame selection

USING THE WEARER'S OLD FRAME

Sometimes a person wants to use their old frames instead of selecting something new. This may or may not be appropriate.

There are a number of valid reasons for wanting to use the old frame and not purchase a new one. These include cost, comfort of the old frames, and sometimes the inability of the wearer to look in the mirror with any other frame and still have what they see look right to them. Even though any of these could be considered valid, there are other factors that could outweigh keeping the old frame. If none of these others are overriding factors and the frames are in good condition, then there is no reason not to use the old frames. However, even if there are valid reasons not to use the old frames, if the wearer has been fully informed of the pitfalls and still persists, their desires should be respected.

Factors to Consider Before Using the Wearer'sOld Frames*

There are certain precautions that must be considered before using the old frame for the new prescription. These are the most common:

- Putting new lenses in an old frame may involve putting additional stress on the frame. Older frames may not withstand that stress very well, particularly older plastic frames that have become brittle with age. Sometimes frames will withstand the stresses ofthe new lenses, but be weakened, only to break shortly thereafter.

*Many of the factors listed in this section are from the following brochure: Cook P: Should I use my old frames, Item No. BRO011, 1999, Diversified Ophthalmics.

- It is hard to predict how long an old frame will last. Will it last the life of the new lens prescription? If the frame breaks, it is not a simple task to find another frame into which those new lenses will fit.
- If the old frame needs repairing in the future, will there be parts available? A used frame may already be discontinued. If it has been and there are no parts

available, any savings could be lost when both frames and lenses need to be repurchased.

- Usually people keep their old glasses as a backup spare pair in case they lose or break their new pair. Using the old frames eliminates the emergency backup.
- Sometimes old lenses can be tinted and the older pair be transformed into prescription sunglasses. This is particularly true if the only change in a multifocal prescription is in the near vision portion. A person could get a second pair of prescription eyeglasses for the cost of tinting the old lenses.
- If the existing frames have not been discontinued and the wearer decides to get exactly the same frame, there is an advantage to having interchangeability of parts should the new frame break.
- Does the lab need the old frames to make the new lenses correctly? If so, can the wearer do without their current glasses while the frames are at the laboratory?
- Are the old frames out of style or nearly out of style? If they are nearly out of style, what will these older frames look like by the time the wearer is ready for

the next prescription change?

In summary, there are a number of reasons why a person may not be well-served in keeping their old frames. These reasons have to be logically and carefully explained; otherwise the wearer will conclude that the dispenser is only interested in their own financial gain.

COSMETIC CONSIDERATIONS

From an esthetic point of view, glasses are of no small importance to the person wearing them. Each individual expects and should receive help, not only with sizing, but also with the cosmetic aspects of a frame.

The habitual wearer often needs just as much help in frame selection as the non-wearer because individuals are used to seeing themselves in the frame style they are presently wearing. Any new frame will represent a change and will look strange. The wearer who is forced to change frames because the style has been discontinued will be especially dependent on the advice of the person fitting the frames.

Despite continuous changes in frame styles, there are still certain basics that can be used to arrive at an aesthetically pleasing and comfortable frame. The wearer ultimately has the final choice of what will be worn, but should not be allowed free rein in selecting a frame.

Frame selection is often a process of trial and error, can be time consuming and is frequently frustrating. An experienced fitter aware of the basics of frame selection can save considerable time and earn the wearer’s gratitude by being able to readily select several frames that are obviously suitable.

Proper assistance in frame selection is especially important for the type of person who may be inclined to accept the first frame presented. Unless such a frame consists of a good bridge fit, proper eye size, and an acceptable shape, the fitter may inherit the almost impossible task of attempting to adapt a frame to a face for which it was not designed.

At the same time, what is cosmetically correct for a given face must be related to whatever styles are in vogue. At a time when narrow frames are in fashion, a person whose face requires a deep frame will not wear one quite as deep as when larger, deeper frames are in style. The person with a narrow interpupillary distance can wear a wide frame more acceptably when everyone is wearing large frames than when everyone is wearing smaller frames. Just as changes in styles of clothing—longer or shorter hemlines, wider or narrower neckties—become customary by repetitious display, so do variations in spectacle designs. Thus when basics in frame selection are noted, it is understood that they are applied within the framework of current eyewear trends.

Frame Shape and Face Shape

Since frames are exceedingly obvious on the face, their shape tends to emphasize or deemphasize characteristics of the face. A good frame selection can be simplified by considering first which facial lines are complimentary to the person. Those lines should be emphasized through repetition, usually by the upper and lower eye wires. On the other hand, uncomplimentary lines should not be repeated by the frame line.

Because a hairstyle can also alter the apparent shape of the face, frames are generally chosen to compliment the face as it appears with the hairstyle being worn at the time of frame selection. A radical change in hairstyle may also radically change the effect that the frame has on the face. Few faces meet the artistic ideal in bone structure and conformity. A well-selected frame can increase the attractiveness of a face by emphasizing those planes and lines more closely approaching the "ideal" and by drawing attention away from those most contradicting it. Conversely, a frame that tends to overemphasize or repeat the less desirable aspects of a face can make that face more unattractive.

In most instances, the lines of the frame selected should create the effect of balancing facial planes that are not components of idealized proportions. The idea is the same as using vertical stripes to enhance the appearance of a short or an obese person.

Facial Types

Knowledge of basic facial shapes is not essential for appropriate frame selection, but it is a valuable aid in making a quicker and more accurate decision about a specific frame. The average fitter can tell how appropriate a frame looks after it has been placed on the face. The accomplished fitter who has an understanding of facial shapes will know how a frame will look before placing it on the face.

The awareness of the considerable influence that spectacle frames can have on the basic facial shape, either positively or negatively, is essential to competent selection of the ultimate frame for each specific face.

Generally, there are seven basic facial shapes:

1. *Oval*—considered to be the ideal type

2. *Oblong*—thinner and longer than usual, with the sides of the head being more parallel to one another than in the oval type
3. *Round*—more circular than the oval
4. *Square*—again, the sides of the face are more parallel than in the oval, with the face being wider and shorter than usual
5. *Triangular*—the lower part of the face is wider than the upper part
6. *Inverted triangular*—the upper part of the face, the temple area, is wider than the lower jaw area
7. *Diamond*—the central section of the face is wider, with the upper and lower extremities of the face narrowing down considerably (Table 4-1)

To simplify the face shapes to help choose frame width and depth, the seven shapes can be condensed to the following five shapes.[1] The oval face is considered *normal* and can wear almost any frame, so only the general rules apply. The oblong face is simply referred to as *long*. Both the round and the square face fall into the category of the *wide* face. The *erect* or base-down triangular face is a category that does not lend itself to condensation. For fitting purposes, the diamond face is included in the *inverted* or base-up triangular classification, since these shapes are all fit in basically the same manner. Using this simplified system, a face may deviate from the normal in four essential ways: it may be either too long, too wide, or too triangular, with the base of the triangle up or down.

This “rule” is subject to modification with style changes, but the widest bony part of the face is always used as the reference point.

The bone structure is used instead of the actual width because excess body and face weight may cause the wearer’s features to appear to be set in toward the center of the face; a frame based on the width of the actual face rather than structure would cause the person to appear cross-eyed.

As a general rule, the longer the face, the greater the vertical *depth* (distance from the upper to the lower rim)

Wide Face

Affecting the Length of the Face

For purposes of frame selection, we are concerned with the vertical and horizontal *dimensions* of the frame, the roundness or squareness of the frame *shape*, and the *coloration* of the frame front.

For simplification, discussion of the shape of frame suitability can be broken down into two categories. The first concerns the width and depth of the frame (dimen- sions) and whether the emphasis should be in the upper portion of the frame, as with a gradient frame, or across the entire frame, as with a frame that is solid in color (emphasis/coloration). These considerations all relate to the length and breadth of the face. The second category deals with the angularity or roundness of the frame line (shape) as related to the angularity or roundness of the face and the eyebrow line.

The proper *width* of the frame* can be gauged as approximately equal to the widest part of the skull’s

*The width of the frame is taken as the outer width of the frame itself, and not simply the outer edges of the lenses.would fall into this category. A solid frame seems to curtail the length of the face in the area extending from the dark lower rim to the chin.

On a frame with a dark upper rim section and a lowerrimless or nylon cord section, the reference point for face length is from the dark part of the frame at eyebrow level (the part that immediately catches our eye) to the bottom of the chin. Thus these frames have a face- lengthening effect, making them more compatible to thewide face.

The *outer areas* of the frame may also be used to advantage in giving the illusion of shortening or length- ening the face. The eyes are actually set very close to the vertical center of the head, although they are usually assumed to be at the top because the visual reference is from the hairline to the eyes and from the eyes to the bottom of the chin.

Spectacle *temples* interject an artificial dividing line. The lower the line, the shorter the face appears; the higher the line, the longer it appears. Thus for long faces, frame fronts with lower endpieces shorten the face. For wide faces, temples with high endpieces add length to the face.

When the face is viewed from the side, it is divided by the location of the spectacle temple, which interposes an artificial dividing line.

If the temple attaches high on the frame front, there is more facial area below this line, and the face appears lengthened (Figure 4-1, *A*). If the temple is attached lower on the frame, there is less distance from this line to the bottom of the chin, and the face appears shorter. If the face is too long, lower endpieces will help give the appearance of less length; if the face is wide and short, higher endpieces are desirable.

An extreme case of the wide face would be one with smallish features that appear to be bunched centrally in the middle of a large face. Actually, as the person gains weight, head size increases but features remain stationary, giving the face a “bunched-up” look. The width of the frame should be gauged by the bone structure of the face and not by the actual widest part of the head. Otherwise the person’s face will be overpowered by the frame or the eyes will appear abnormally close together. The same rules that apply to fitting the wide face also apply to the pudgy face, but must be adhered to more strictly. The less obvious the frame, the better. In a plastic frame, a medium to lightweight plastic would be appropriate, but a better alternative is the thin metal, nylon cord, or even rimless frame. Attention also must be given to the vertical dimension of the frame.

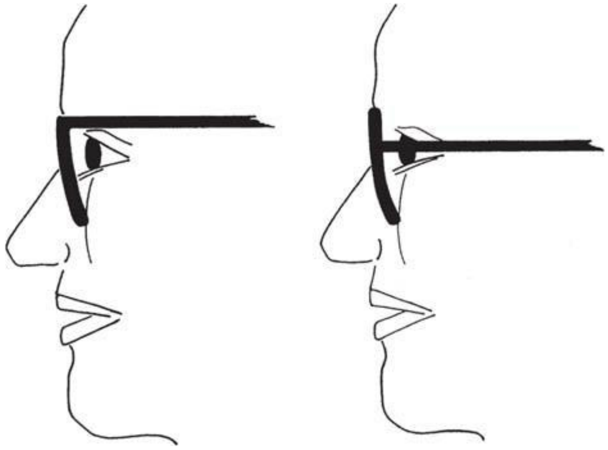


Figure 4-1. A, If the temple attaches high on the frame front, there is more facial area below this line, and the face appears lengthened. **B,** If the temple attaches lower, there is less distance from this line, and the face appears shorter.

Affecting Facial Balance

With faces somewhat wider in one area than in another, frames can be used to balance out a wider area and to shift the facial emphasis.

The widest part of the *base-down triangular face* is the lower area. Simply wearing glasses often enhances the appearance of the face because the frames lend balance. The frames themselves should be approximately the same width as the lower facial area. The actual width will vary somewhat, depending on current frame styles.

An oval or upswept shape is preferable, as opposed to one of rectangular design. This is particularly true of the lower rim, which, if it is a straight line paralleling the jawline, tends to emphasize the width of the base of

the triangle. Frames for men in these cases may appear satisfactory with somewhat squared-off shapes because the lower line is not continuous and angular lines in a man's face are not considered uncomplimentary. For women, a frame with rounded lines will give a softer, more feminine look and squared-off lines a more assertive look.

The frame should be a dark color for emphasis to further balance the overall facial shape: solid if the face is long, vertically gradient or with emphasis on the upper part of the frame if the face is short.

The *base-up triangular face* is somewhat more difficult to fit. It is not possible to use the mere location of the frames to counterbalance the wider part of the face. Obviously a prominent frame on this type of face draws attention to the wider facial area.

To avoid undue emphasis, the frame should be as unobtrusive as possible. The frame should be the minimal width that still stays within current fashion lines. Keep in mind that the farther out the frames extend from the side of the head, the more pointed the chin will look.

The frame should be of light or medium weight and of a lighter color when possible. Metal or rimless like varieties lend themselves well to this type of face. A heavy lower line sometimes helps to counterbalance. A rounded lens shape will soften the triangularity of the face, but a squared-off frame will emphasize it. This type of face on a woman usually has a certain delicateness to it; thus the frame should also have delicate characteristics.

Frame Lines

Repeating a facial line through the line of the frame emphasizes the facial line. This can be used to advantage provided the line being repeated is complementary or used to achieve a desired effect. Inadvertently repeating an uncomplimentary line can, by the same principle, have an undesirable effect.

The lines of the frame are determined by the curve or squareness of the upper and lower rims—in other words, by the basic shape of the lens. At this point, the depth and width of the desired frame should be fairly well known, depending on the length, width, or triangularity of the face.

As a general rule, when using the frame shape for cosmetic emphasis, the upper areas of the frame are determined by the eyebrow line, while the lower frame areas are determined by the lines of the cheek and jaw. The lower eyewire area near the nose should follow the nasal contour of the face, as discussed previously.

The *upper frame area*, or upper rim, should have the same basic shape as the eyebrow itself. Too much deviation from this line creates a disharmonious look to the face, roughly similar to the confused effect of wearing stripes with plaids.

Ideally the upper rim should follow the lower edge of the eyebrow, leaving it visible. At its highest possible position, the upper rim bisects the eyebrow. This is not always possible or desirable. Some even prefer an above-the-eyebrow position.[2] In any case, the most important thing to be kept in mind when dispensing conventional eyewear is to follow the basic line of the eyebrow with the upper line of the frame.

Balding males may benefit from a frame with a straight browbar.[3] The theory underlying this is that the brow bar takes away some of the forehead area, detracting from the appearance of a large forehead.

As far as the *lower frame area* is concerned, apart from a squared or rounded effect, which is determined by the squared or rounded aspects of the face, the most important thing a lower rim can do is add a lift to a face that has begun to sag with age. Using an upsweep on either upper or lower rim of a frame tends to counteract the downward lines of the face. In general, a frame with a downward line, which emphasizes the undesirable characteristic, should be avoided.

Frame lines can somewhat alter the mood expression of the face, causing the wearer to have a happier, sadder, more stern, or even a somewhat surprised look, depending on the interaction of the frame lines with the back- ground facial configuration.

Another important effect that may be accomplished through the use of lower rims is to help conceal the bags that many people have under their eyes. Helpful camouflage is attained by choosing a frame with fairly thick lower rims of a dark color, properly positioned to cover the lowest part of the bags.

Frame Color

Up to this point, frame color has been noted essentially in regard to how certain effects can be emphasized through the use of a darker color or deemphasized through the use of a lighter color. Although the actual color chosen may be left to the wearers, the dispenser has a responsibility to guide them toward the final choice.

Hair color, skin color, feature size, and eye color can all give valuable clues to the suitability of eyewear color. With all the possible shades and degrees of translucence in available frames, plus innovative uses of color combi- nations, firm rules to guide color selection are difficult.

Clothing and Accessories. The common sense rules that apply to clothing and accessories also apply to the proper choice of eyewear. Certainly the favorite or dominate color that the individual regularly wears ought not be overlooked. Choosing a frame color should not be done based on skin, eye, and hair color at the exclusion of habitual dress. Eyeglasses are considered to be accessories and, as Dowaliby states, "It is traditional... that the best dressed are identified by accessories repeating tones in the ensemble.[4]"

Considering that most people do not wear the same colors continually, it should be understood that one

single frame cannot be expected to coordinate with every possible mode of dress—both in color and in effect. Those who choose one pair of glasses to serve in every work or recreational situation, with every style and color of clothing, should be aware of the limitations this imposes.

Hair. Frames in pale tints of blue or rose benefit gray hair. People with thicker, darker hair are able to wear heavier, darker, bolder frames than individuals with lighter, finer hair. A lighter-colored, more delicately styled frame is recommended for the person with light, fine hair. A bold dark frame on a person with light, fine hair draws attention to itself much more emphatically than it would on someone with thicker, darker hair.

When a metal frame is to be dispensed, those with blond, light brown, or red hair can wear gold well; those with gray hair can wear silver well. Those with black or extremely dark hair can wear either color well. Individuals with salt-and-pepper hair, or hair that is just starting to gray will find that choosing a silver frame will make the "salt" component of their salt-and-pepper hair more noticeable. It should be kept in mind that not everyone may consider choosing a frame color that will emphasize beginning grayness to be a detrimental choice. Much depends upon the image the individual wishes to project. Therefore the role of the dispenser becomes that of an aide in helping a person find a frame that produces the desired effect, while avoiding any unintentional changes the wearer may consider unpleasant.

Facial Features. As far as facial feature size is concerned, the smaller and more delicate the features, the lighter the frame color can be; the heavier the features, the darker the frame color allowable.

Narrow and Wide-Set Eyes. A person whose eyes are set close together in comparison to the total width of the face will want to choose eyewear that does not draw attention to the center of the frame. Low-set, thick, dark-bridged frames will make such an individual look as though the eyes are so close together there is hardly room for the frame to sit on the nose. Instead, this person should choose a frame with a clear bridge (little central emphasis) but with distinctive upper temporal areas. In this way the observer's attention is drawn outward and away from the close-set eyes.[5]

An individual with extremely wide-set eyes needs the exact opposite. The best choice is the frame with a low- set, dark, thick bridge. The space between the eyes is "filled in" and the eyes do not appear as widely spaced. **Frame Color by Season.** In spite of suggestions given on frame color up to this point, it is very difficult to determine rules that work consistently. It is true that some people can wear certain colors better than others.

The difficulty lies in finding which colors are best suited for each individual. In an attempt to facilitate finding the colors that are most complimentary for a given individual, one approach divides individuals into one of four basic groups.

Each group is identified by one of the four seasons. "For just as nature has divided herself into four distinct seasons, Autumn, Spring, Winter, and Summer, each with its unique and harmonious colors, your genes have given you a type of coloring that is most complimented by one of the seasonal palettes.

To determine which "season" a person is, skin tone, hair color, and sometimes eye color are evaluated. Finding the correct "season" is reportedly best done by trial and error using colored fabric draping to discover those that are most complimentary to a person's skin and hair color. All individuals, regardless of season "...can wear almost any color; it is the shade and intensity that count. If someone already knows which "shades and intensities" of color he or she looks best in, frame color selection may be simplified. If not, trying on one frame after another while looking for the best effect is certainly simpler than first trying to determine season, *then* selecting frame color.

In summary, although it may be possible to find a few starting points for frame color selection, the process does not lend itself to simple answers. Most probably, in the end, personal tastes in color combined with trial and error will prevail.

Lens Tint

There are many purposes for a tint in prescription eyewear—so many, in fact, that a complete chapter in this book is devoted to the subject. Yet sometimes the only reason a person wants tinted lenses is to make the glasses look better. When this is the case, the color of the tint is usually coordinated with the frame.

Frame Thickness

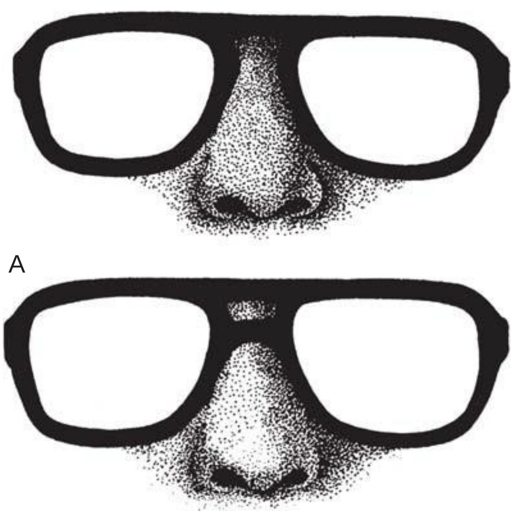
Many of the effects caused by the lightness or darkness of a frame go hand in hand with frame color. As with frame color, the smaller and more delicate the features, the lighter (thinner) the frame should be. The larger and broader the features, the heavier (thicker) the frame should be.

One exception is a man with large, broad facial features who is smaller in stature than would be expected for the ruggedness of the face. To help neutralize the effect of a head out of proportion to the body, a frame weight lighter than normal might be used.[7] The size must not be too small for the face, however, because a frame that is too small for the face is still too small, whatever the size of the body. A bold frame look can be created by using a dark color in spite of the reduction in frame thickness.

Children and women with childlike features are especially complimented by a thin frame. Using a frame too thick for these features will easily overpower the face and create a puny appearance rather than add a complimentary facet to the face.

Occasionally the fitter will encounter a person whose features are not strong enough for a heavy frame but who wants the heavy frame look. The answer is to use a frame of medium thickness in a very dark color. The dark color makes the frame appear heavier. Similarly, a frame with clear lower rims makes the weight appear less than it really is.

When in doubt as to which frame weight to choose, always select the lighter weight.



A

B

Figure 4-2. To “lengthen” the nose, a frame is chosen that exposes as much of the nose as possible. The frame in **A** is correct; the frame in **B** is incorrect.

Frame Weight	Indicated for
Heavy	Large, broad features
Medium	Normal features, large features, and small

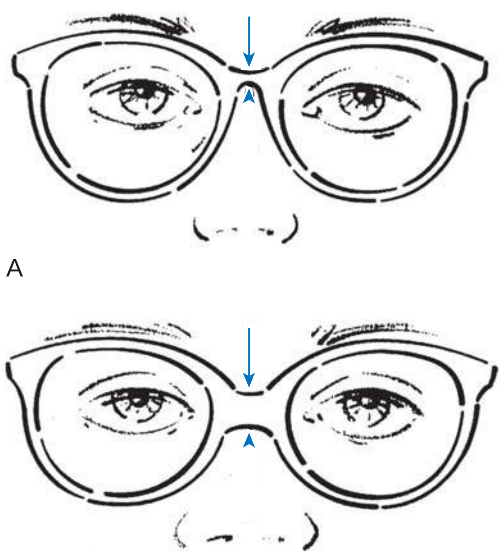
stature
Light Small, delicate features, women with childlike features,
children

Bridge Design

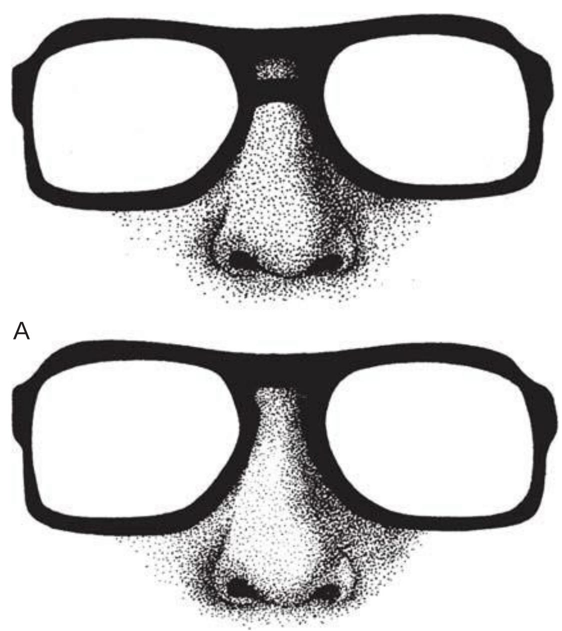
Frame selection can cause the nose to appear longer or shorter than it really is, depending on the frame bridge chosen. Apparent nose length depends on the extent of nose visible beneath the frame bridge, just as apparent face length depends on the area of face observed below the frame.

To “lengthen” the nose, choose a frame that exposes as much of the nose as possible (Figure 4-2). An open- bridged frame allows most of the nose to be seen because it rests on the sides and not on the crest of the bridge.

Dark frame colors draw attention to the surrounding facial area and tend to emphasize whatever characteris- tics are created by the fit of the frame. In the case of the



A



A

B

B

Figure 4-3. The lower the bridge, the greater the impression of shortening the nose. The bridge in **A** is correct; the bridge in **B** is incorrect.

B

Figure 4-4. A, If the base of the nose is narrow, choose a frame with a high, thin bridge style. **B,** If the base of the nose is wide, choose a frame with a low-set, vertically wide bridge. (Reprinted with permission from Wylie S: Eyewear Beauty Guide: Don't Choose Your Eyewear Blindfolded! Oldsmar, Fla, 1986, Varilux Press.)

keyhole bridge, using a dark frame color will increase the illusion of nose length. If for reasons of physical fit the keyhole bridge must be used on a person with a long nose, the lengthening effect will not be as emphasized if the bridge is clear or light-colored or if a frame with darker endpieces is used.

The saddle bridge is designed to cut across the crest of the nose. The lower the bridge, the greater the effect of shortening the nose (Figure 4-3). A darker color will give a sharper demarcation and make the nose look shorter still, while a lighter color has a tendency to reverse the effect.

Up to this point, the discussion has been on how frame bridge design affects the apparent length of the nose. Yet with some individuals the length of the nose may not be of primary importance, but rather the width of the base of the nose may matter most. (The base of the nose refers to the lowest point of attachment at the sides of the nostrils.) If the base of the nose is narrow, the bridge of choice is one that is relatively high and thin. Whereas if the base of the nose is wide, the best bridge design will be one that is low-set and vertically wide (Figure 4-4).

FITTING CONSIDERATION

Many difficulties associated with adjusting a pair of spectacles appropriately rest with errors in the initial fitting or selection of the frame. Once the lens size and shape have been selected, the essence of the well-fitted

frame rests in the choice of the proper bridge and the proper temple style and length. The spread of weight or force over the largest surface is the objective for both pads of the bridge and the behind-the-ear portion of the temple.

The Bridge

When the bridge is fixed, as in most plastic frames, the choice of the appropriate bridge is determined by how well the weight of the frame is borne on the nose. If the bridge is not properly selected, attempts to adjust the frame and the bridge to secure wearer comfort are exceedingly difficult and essentially hopeless.

The appropriate bridge is determined by its width, the position of its pads, the frontal angle of the bridge at the pads, the flare or splay angle of the pads, and the vertical angle of the pads. The bridge selected should not allow the eyewires to ride on the cheeks.

The Signifi cant Nasal Angles for Fitting

If the nose is observed from the front, it will be noted that the two sides form a *frontal angle* with each other, which if projected, would have its apex somewhere on the forehead and its base across the nostrils and tip of the nose. The angle with which each side deviates from the vertical is called the frontal angle (Figure 4-5).

The *splay angle* is seen as the nose widens from front to back. It can be best visualized as if viewed from above and is at the level where the nosepads of the frame will rest (Figure 4-6).

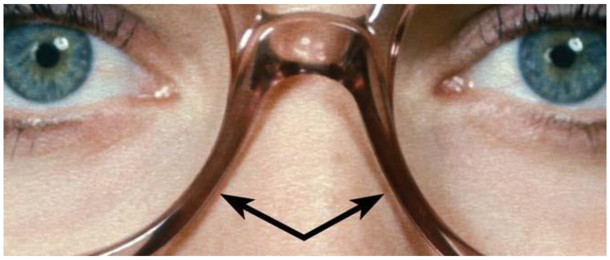


Figure 4-7. With the frame pictured here, the frame frontal angle is too vertical for the angle of the nose. As a result, the frame has a tendency to rest on the bottom rims.

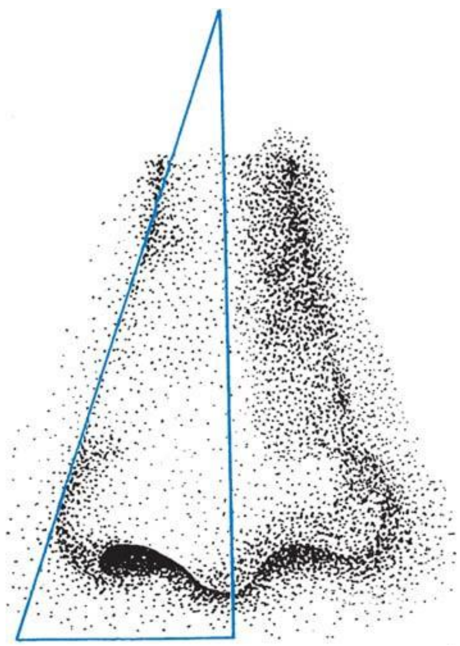


Figure 4-5. The angle with which each side of the nose deviates from the vertical is called the frontal angle.

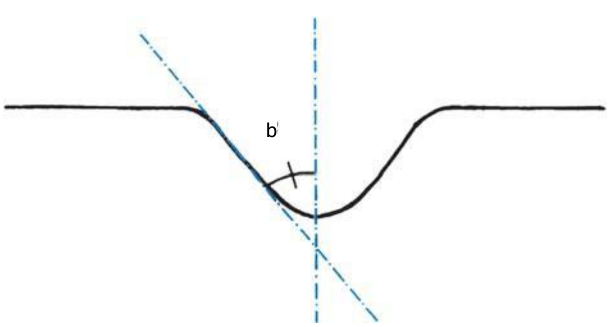


Figure 4-6. The splay angle (b) of the nose is the angle formed by the side of the nose as viewed from the top. The drawing shows a cross section of the nose at the level where the nose- pads will rest.

Both of these angles are of prime importance to the proper fit of the frame. These frontal and splay angles may vary greatly among individuals.

The Frontal Angle. If a frame has a frontal angle which does not parallel the sides of the frontal triangle of the nose, either the inner bottom rims of the frame front or the top of the bridge crest will rest on the nose rather than the pads which should support the frame (Figures 4-7 and 4-8). Matching the angle becomes particularly important if the bridge is fixed and unadjustable.

It should be remembered that the pads will lie on the side of the nose only if the width of the bridge (or DBL) is proper, even after the angle has been matched. If the bridge is too wide, even if the angle is correct the frame will still either rest on the bridge crest or will rest low on the nose with the lenses too low. The lines of sight will then be close to the upper rim, or the lower rim may touch the cheeks. A keyhole bridge that is too large may fit like a saddle bridge.

If the bridge is too narrow, the upper rim may be above the eyebrows, the lines of sight may pass through the lenses near the lower rim or in the bifocal, and the lower rims may carry the weight on the side of the nose rather than on the pads. To check *bridge size*, lift the frame very slightly from the nose and move it to the left or right. There should be about 1 mm of clearance between the nose and free side of the bridge.

With noses that exhibit very broad frontal angles, rather flat crests, and wide splay angles, it is recommended that a bridge design at least somewhat lower than others be used. This type of frame is depicted in Figure 4-4, *B*. Despite the wide area of the crest, a rather narrow bridge is recommended so that the actual pads can be bent back enough to place their flat surfaces on the sides of the nose.

If the bridge is adjustable, it is possible to align the pads to the matching angle by bending the pad arms. If it is not adjustable, the frontal angle of the pads (corresponding to the frontal angle of the nose) can be altered within limits by changing the shape of the lenses.

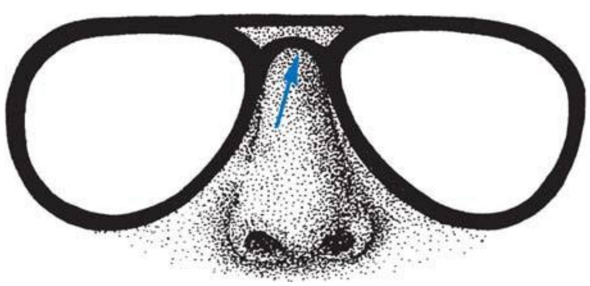


Figure 4-8. With the frame pictured here, the bridge area is too flared for the nose.

Since the nose and frame frontal angles do not correspond, the top of the bridge crest is the only part supporting the weight of the frame.

Figure 4-9. If the frame is such that its bridge area does not flare enough when the wearer's nose exhibits a wide splay angle, the back of the bridge area will cut into the side of the nose. The drawing is a top view in cross section and has been exaggerated for clarity.

An alternative for plastic frames consists of heating the empty frame eyewire and *reshaping the eyewire* to conform to the wearer's facial requirements. A pattern may then be made from this modified shape, or the shape may be traced with a frame tracer. Both lenses are cut to the new configuration.

The Splay Angle. The nose becomes wider as it approaches the inner corners of the eyes, therefore the pads must not only have an appropriate frontal angle, but must also exhibit an appropriate splay angle so that the weight of the spectacles is distributed over the entire *flat* surface of the pad.

If the angle of the pads is such that the backs of the pads are about the same distance apart as are the fronts, but the nose exhibits a wide splay angle, the backs of the pads will cut into the sides of the nose. With a heavy frame this will produce painful and obvious grooves in that area of the nose (Figure 4-10).

If the angle of the pads is such that the backs are farther apart than are the fronts and the amount exceeds the splay angle of the nose, the fronts of the pads or eyewires will cut into the sides of the nose (Figure 4-11).

The Crest Angle

Observing the face from the side reveals the crest angle of the nose: the angle from base to top compared with a vertical plane roughly parallel to the brows and cheeks (Figure 4-12).

This angle is not of great concern in bridge selection unless a saddle or contoured bridge is used. Then the angle of the inside of the contour should parallel the

*If lenses are edged "in-house" an extra pattern for the selected frame can be reshaped. When the altered pattern is used, left-right lens shape symmetry is assured.

crest angle so the bridge contacts the nose with its full expanse.

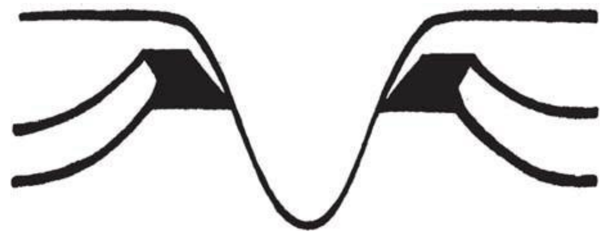


Figure 4-10. If the frame is such that the flare of the nose area exceeds the splay angle of the nose, the fronts of the bridge area may cut into the sides of the nose. The drawing is a top view in cross section and has been exaggerated for clarity.

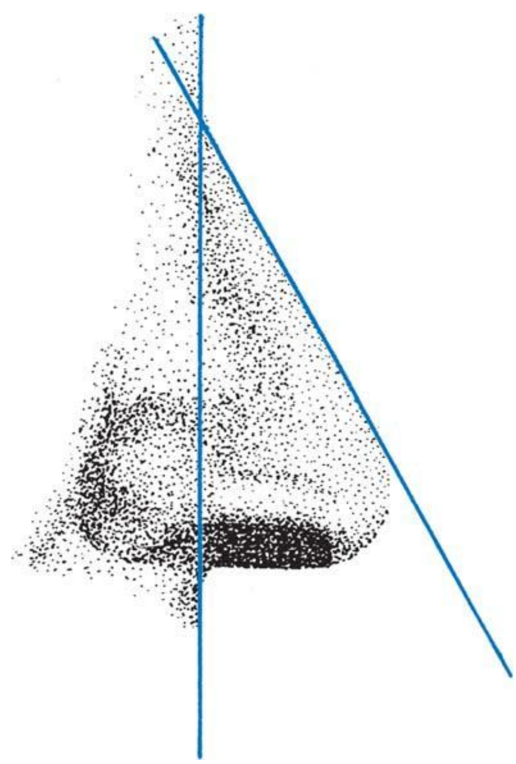
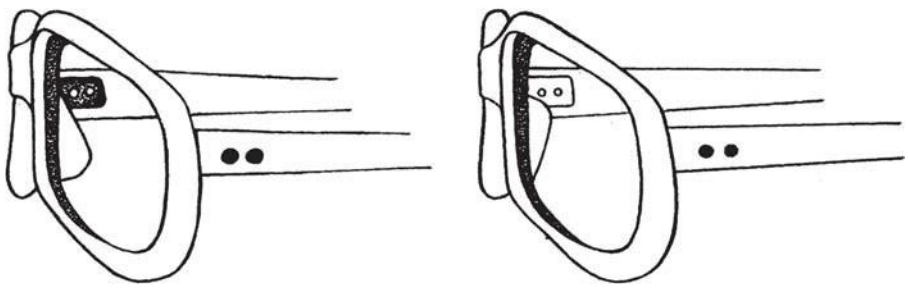


Figure 4-11. The crest angle is that angle of the nose from the base to the top compared with a vertical plane roughly parallel to the brows and cheeks.



A B

Figure 4-12. A, Notice how there is more support at the bottom of this nosepad, making it more suitable for children. **B,** Compare the nosepad in **(A)** with an adult-style nosepad.

Adjustable Pads

The position of the pads on the nose is of utmost impor- tance. The essential objective is that the *full flat* surfaces of the pads rest on the sides of the nose. Since the pad arms that carry the pads are malleable, the pads can be adjusted individually for each side of the nose. In select- ing a frame with adjustable pads, the principal criteria therefore are:

1. The DBL should be such that the pads can be easily set to rest on the sides of the nose without either stretching the pad arms a great deal laterally or compressing them together.
2. When heavy frames or lenses are being selected, the following factors influence pad comfort.
   a. The inclination of the frontal angle of the nose on which the pad surface will rest. The closer to vertical the pad is, the greater will be the pressure on the nose to hold the frame in place.[10]
   b. If the surface of the pad is almost vertical, it is best to use lightweight lenses. Pads made from silicone material do not tend to slip as much as regular plastic pads.
3. The questions of proper vertical angle, splay angle, and full contact of the broad side of the pad are usually handled by bending the pad arms. (Refer to Chapters 8 and 9 for detailed descriptions.)

In selecting a frame with an adjustable bridge, however, care must also be given to the type of pad arm and its attachment to the eyewire. Certain frames carry the pads via practically straight, very short, vertically attached pad arms. Such arms allow only very limited adjustment of the pads. Any attempt to raise and lower pads with these pad arms is almost impossible. Selection of frames with this type of pad arm requires that the DBL and the lens position be correct almost from the beginning and that adjustment of the pads be minimal. (For more on adjustable pads, see Chapter 9.)

4. The center of gravity of a heavy frame is closer to the front. If the pads are set closer to the frame front, the frame moves closer to the face. This places the center of gravity farther back, resulting in the frame staying in place more easily. Thus it is desirable to set the pads as close to the front as facial

construction, lash length, and so forth, will allow.

Larger pads, which distribute the weight over a larger area on the nose, can also be used as the mass of the spectacles is increased.

Children's Bridges

It has been found that in children between the ages of 3 and 18 years there is only a slight change in the crest angle of the nose (the slope from the crest to the tip of the nose).[11] The main change is in the splay angle (the slope from the crest of the nose to the cheek) and in the depth of the nasal bridge.

What this means in terms of fitting children is that there needs to be (1) more support at the bottom of the nose pad area, and (2) a larger pad splay angle (more flare to the pad). A larger pad or contact surface area helps the frame sit better (Figure 4-13).

Temples

The distribution of forces necessary to hold a frame in place on the face generally shifts from the nose to the ears as the head is bent forward. Thus the activity of the wearer and the intended use of the spectacles should be considered to determine the temple style ordered. Because temple style is greatly dependent on wearer preference, these considerations should be pointed out. Spectacles with flat, straight-back, or library temples are suitable when their removal and replacement without altering adjustment is desired. This situation would arise when the spectacles are to be worn only occasionally or mainly for reading or desk work.

A skull temple is applicable if the wearer's activity requires the normal amount of movement or constant wear. If the head is to be lowered markedly or the individual is physically active, riding bows or comfort cable temples are preferable.

All temples help hold the lenses in place primarily by the area of contact with the side of the head and not by

TABLE 4-3
Fitting Temple Styles

Temple Style	Indicated for	Contraindicated for
Comfort cable or riding bow	Active people Jobs requiring unusual head positions Young children Especially heavy frames and/or lenses	Off and on wear
Straight back	Off and on wear	Heavy lenses Persons with parallel-sided noses Persons with flat noses Frames with weak fronts

Skull	Normal, everyday wear	Jobs requiring unusual head positions

pressure at the tip of the temple or against the upper crease in the ear. The choice of proper length is there- fore important in frame selection. The temple should be long enough so that the bend of the temple takes place just barely past the top of the ear (see Figure 9-12). The exact fit of the bent-down portion or earpiece against the head can be achieved during adjustment of the frame.

Table 4-3 summarizes the temple styles suitable when considering both the activity of the wearer and the intended use of the spectacles.

Selecting Frames for the Progressive AdditionLens Wearer

A progressive addition lens wearer needs a frame with:

1. A minimal vertex distance.
2. An adequate pantoscopic tilt.
3. Sufficient vertical depth in the nasal portion of the frame shape.

A *minimal vertex distance** is required because of the relatively narrow viewing areas afforded by the progres- sive optics of the lens for intermediate and near distances (see Chapter 20). The closer the progressive viewing zone is brought to the eye, the wider the intermediate and near viewing areas will be. Using a frame with an *adequate pantoscopic tilt* will also help bring the lower (reading) half of the lens closer to the eyes. When the eyes are turned downward for near viewing, the reading width will be increased.

The shape of the frame is important with progressive addition lenses. If the lens has too much of the lower nasal area cut away, as with the classic aviator shape, the reading area is reduced (Figure 4-14, *A*). Also, when the lens is narrow vertically, much of the near viewing area will be lost. This loss may be prevented if a progressive lens specifically designed for frames with narrow vertical dimensions is chosen (Figure 14-14, *B*). However, frames with an extremely narrow vertical dimension will not

*Vertex distance is the distance from the back surface of the lens to the front surface of the eye.

work well for progressive addition lenses. A good frame shape for a progressive lens has a *suffi cient vertical depth and not much nasal cut*. The best design for a progressive addition lens is one that has extra vertical depth in the inferior, nasal portion of the shape. Unfortunately, style and function do not always agree.

Selecting Frames for the High Minus Wearer Although lenses are usually chosen for optical appropriateness, the cosmetic effects of certain types of lenses also should be considered. These are usually lenses at extreme powers of minus or plus, which notably minify or magnify the eyes and face behind them. Several cosmetic factors must be taken into account when fitting the high minus correction wearer (Box 4-1).

Size

Size considerations include avoiding frames with lenses that are very large, since the lens edge gets thicker farther away from the center. Frames with rounded corners should be used when possible for this same reason.

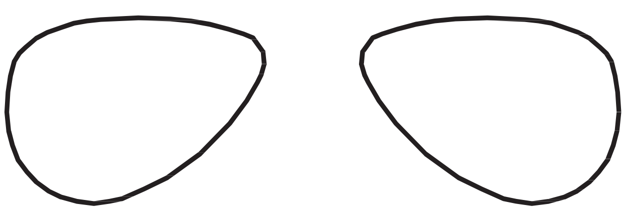
A frame wider than the wearer's face at the temple area should also be avoided, since high minus lenses make the side of the wearer's head look narrower through the lenses.

Excessive *decentration* should be avoided or the outer lens edge will be much thicker than the inner edge. An alternative is to use a wider bridge and smaller eye size. The nose pads can be brought closer together, if necessary, rather than decentering too much. For example, a 48☐20 can be used instead of a 50☐18. (For 012.00 D lenses, this will also reduce the weight of the lenses by a considerable amount.)

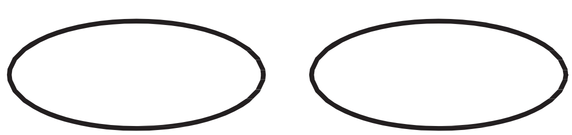
Lens Material

Lens edges are thicker with low-index CR-39 plastic. Using a lens of a higher index material will reduce the edge thickness. High index plastic lenses are chosen over high index glass because of the weight factor. High index plastic lenses are an excellent choice for high minus lenses.

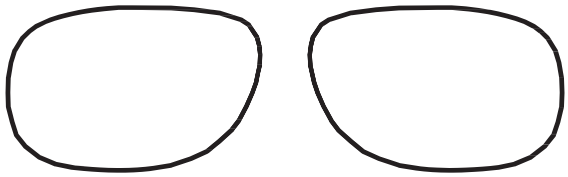
Polycarbonate lenses offer both a weight and edge thickness advantage. Polycarbonate lenses can be made with a thinner center thickness because of their high impact resistance. This translates into a thinner edge. Even if a polycarbonate lens has the same center thickness as a regular plastic CR-39 lens, the edge of the polycarbonate lens will still be thinner than the CR-39. This is because the polycarbonate lens has a higher index of refraction (1.586) than the CR-39 lens



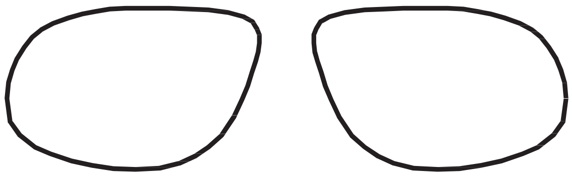
A



B



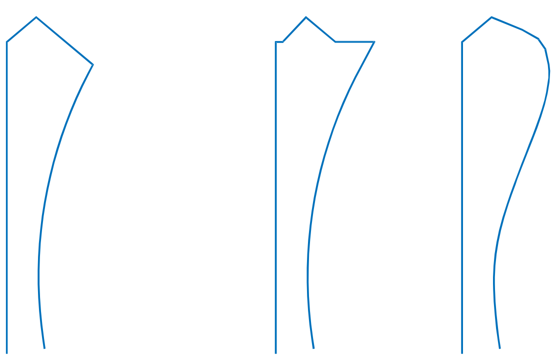
C



D

Figure 4-14. The best shapes for progressive addition lens wear have sufficient vertical depth and are not restricted in the inferior nasal lens area. **A,** This frame choice is not a good choice for progressive lenses. The area nasally where the progressive lens near zone is located is cut away by the aviator- style shape of the frame. **B,** This frame shape will work for a progressive if the progressive lens style chosen is designed for frames with a narrow vertical dimension. A frame with a narrow vertical dimension should not be used with standard- style progressive lenses. **C,** The best frame style for progressive lenses is one that has enough vertical depth to allow full use of both intermediate and near viewing areas of the progressive lens. **D,** Though not always cosmetically appropriate, a frame with a generous inferior-nasal lens area is optically ideal for a progressive addition lens.

High minus lenses minify objects. When high minus lenses are worn in a frame that is too large, the observer sees the wearer's face minified through the lenses. This makes the head look narrow in the area behind the lenses compared with the rest of the face.



A B C

Figure 4-15. A, A regular 40-degree bevel is inappropriate for a high minus lens. Fortunately, it is almost never used. **B,** A flat bevel reduces some of the internal reflections and concentric rings that would otherwise be seen with a regular 40-

degree bevel. However, the edge will still appear thick. **C,** A rolled and polished bevel reduces edge thickness.

Refl ections, Base Curve, and Lens Bevel

Refl ections, *curve,* and *bevel* are additional considerations. The larger the bevel, the more reflection rings will be noticeable because these rings are a reflection of the lens edge. Using a now-standard hidden bevel as shown in Figure 4-15, *B* (rather than the older 40-degree bevel as shown in Figure 4-15, *A*) reduces the problem.

The edge of a high minus lens can be made less noticeable by *rolling the edge*. This is especially true for metal or thin plastic frames. Rolling the edge changes it from flat to rounded, as shown in Figure 4-15, *C*, giving a nice appearance to the lens when polished and often reducing measured edge thickness by as much as 2 mm. *Polishing the edges* will make the lens look better to an observer, but unless an antireflection (AR) coating is used, such polishing will introduce internal reflections, which are disturbing to many wearers. Thus the combi- nation of *roll and polish* looks very good. Some recommend using a roll and polish with caution because of the possibility of wearer dissatisfaction because of the distortion caused by the rolled area in the periphery of the lens. An edge does not have to be rolled to be polished. A conventionally beveled lens edge can also be polished. With better manufacturing techniques, polish edges are much easier to produce and are coming to be expected on lenses with visible bevels.

Unless antireflection coated, a *front curve* reduced below 02.00 D will result in a high reflection of light from the front. Unfortunately, high minus lenses made with ordinary spherical curves require a fairly flat front curve to give good optics. It is possible to use an aspheric design to allow for a different front curve and to slightly thin the edge of the lens by steepening the lens in the periphery. An aspheric high minus lens may have a better cosmetic appearance than a conventional, spherically based lens of the same power.

Even though a light tint will reduce internal lens reflections, an antireflection (AR) coating does a much better job. Even lenses with flat front curves will lose their mirrorlike reflective appearances with an AR coating. Antireflection coatings also eliminate the con- centric rings, which are frequently seen with high minus lens prescriptions.

For wearers with excessively high minus lenses, a minus lenticular design is an option.

Miscellaneous Factors

An interesting consideration is that high minus lenses tend to cause eye *makeup* to show up less, whereas high plus lenses cause any type of makeup to be more noticeable.

Selecting Frames for the High Plus Wearer

Size and Thickness

Size and *thickness* are considerations with high plus lenses (Box 4-2). Large lenses should be avoided because of excessive weight and the increase in center thickness. High plus lenses magnify the wearer's eyes. When lens size increases, so does center thickness, causing an even greater magnification problem.

Because of differences in frame shapes, eye size is not the only influence on lens thickness. The effective diameter of a lens is increased whenever a lens deviates from a round or oval shape. The more the lens deviates from round or oval, the larger and thicker the lens will be. A good rule of thumb for very high plus lenses, such as the older cataract lenses, is to avoid frames with an effective diameter more than 2 mm larger than the eye size.

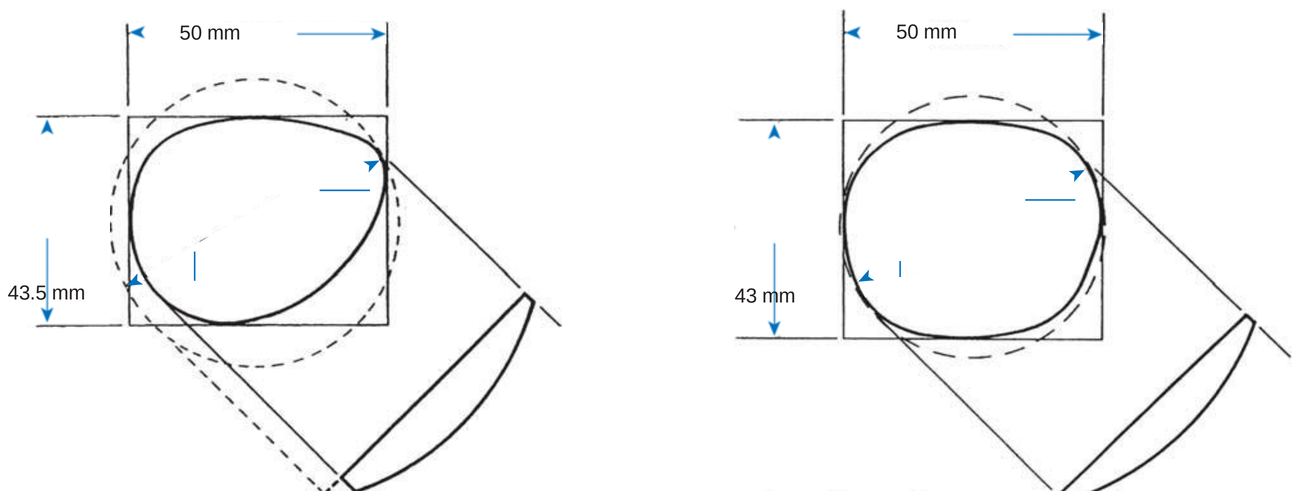


Figure 4-16. The larger the effective diameter of a plus lens for a given eye size, the thicker the edge appearance will be in certain meridians. Because a larger lens blank size is required, the center thickness will also be greater.

Figure 4-17. When the effective diameter is close to the frame eye size, the edge thickness will be more uniform and held to a minimum. Small effective diameters also make possible a lens of minimal center thickness.

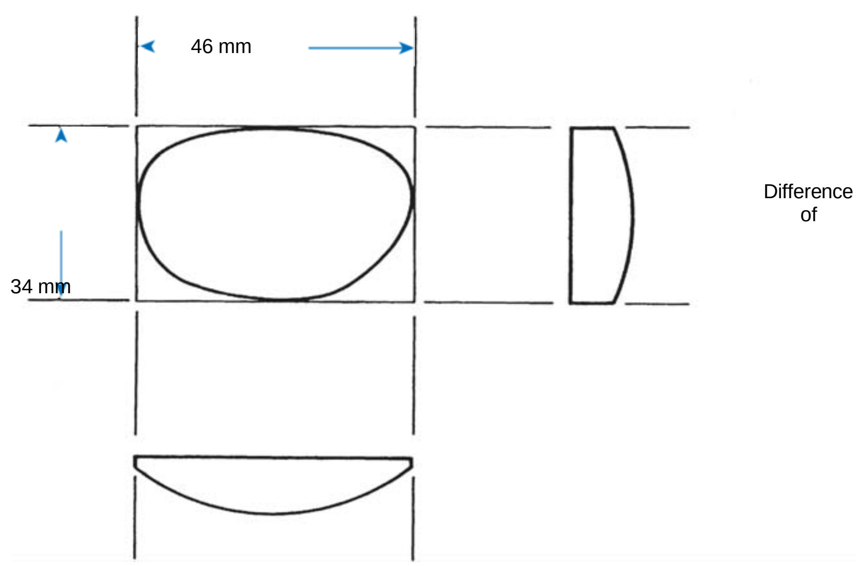


Figure 4-18. In the case of the high plus lens, the larger the frame difference, the thicker the lens will appear on the top and bottom. The case is reversed with the high minus lens, however, since the thicker edges will then be in the horizontal meridian.

E.D. = 58 mm E.D. = 51 mm

Frame Difference

The "frame difference" is an additional factor when selecting a proper frame shape for the high plus wearer

Frames with narrow lens openings (where the difference between horizontal and vertical measurements is large) cause a high plus lens to be thick on the top and bottom edges (Figure 4-19). This causes the strong plus lens to look even stronger. For the high plus lens wearer, frame differences greater than 9 mm should be avoided.

Cataract Lenses and UV Protection

Cataract lenses are very high plus lenses that were used after cataract surgery before the advent of intraocular lens implants. They are now uncommon. Cataract lenses usually range in power from 09.00 D to 022.00 D, depending upon the wearer's lens prescription before surgery. The prescription was this high because it had to replace the power of the crystalline lens of the eye that was removed during surgery. Fortunately the crystalline lens is now replaced with a small lens implanted into the eye. People who have had cataract surgery and have not received an intraocular lens implant are aphakic (which means "without lens"). They are referred to as *aphakes.* Aphakes must either wear contact lenses or high plus cataract spectacle lenses. Fortunately intraocular lens implants are now the standard for cataract surgery and such situations are rare.

Aphakes are often more light-sensitive than other individuals as a result of crystalline lens removal. To prevent damage to the retina of an aphakic individual caused by *ultraviolet (UV) light,* protection is essential. Only lenses with UV inhibiting properties should be used for aphakes.

A

B

Figure 4-20. The lens in **A** is positioned with a large vertex distance, whereas in **B** the vertex distance is minimal. The same lens was used in both photographs, which were taken under circumstances that were as identical as possible. The only difference between the two photo- graphs is the distance from lens to eye. In both cases the eye is magnified, as can readily be seen by comparing the eye behind the lens with the eye without the lens. However, the eye behind the lens in **B** shows less magnification than the eye behind the lens in **A**.

Frame Characteristics

There are certain frame characteristics that are absolutely necessary for properly fitting high plus lenses. With medium power plus lenses, these characteristics can be considered as suggested guidelines, but with high plus or cataract lenses they are mandatory prerequisites.

Frames should be chosen for their ability to hold their *alignment*. Flimsy construction allows the lenses to slide down the nose. This is not only irritating to the wearer, but also has some rather serious optical side effects. These include:

1. The blurring of distance vision as a result of an increased effective lens power.
2. A smaller field of view.
3. An increase in the magnification of objects viewed by the wearer.
4. An increase in the apparent size of the wearer's eyes to an observer (Figure 4-20); as the vertex distance decreases for plus lenses, the wearer's eyes look less magnified when viewed by an observer.

A frame should be chosen that allows the distance optical center of the lenses to be positioned properly before the eyes. See Figures 4-21 and 4-22 for further explanations.

Because field of view is increased and magnification decreased as plus lenses are moved closer to the eyes, the frame selected should hold the lenses as close as possible to the eyes. The wearer's eyelashes should just clear the back surfaces of the lenses.

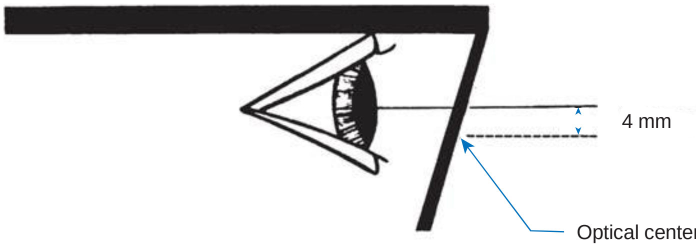


Figure 4-21. To avoid adversely affecting the optical performance of the lens, for every millimeter that the optical center is below the wearer's line of sight, there must be 2 degrees of pantoscopic tilt. For example, as pictured here, the optical center falls 4 mm below the lenses, requiring 8 degrees of pantoscopic tilt in relationship to the plane of the face.

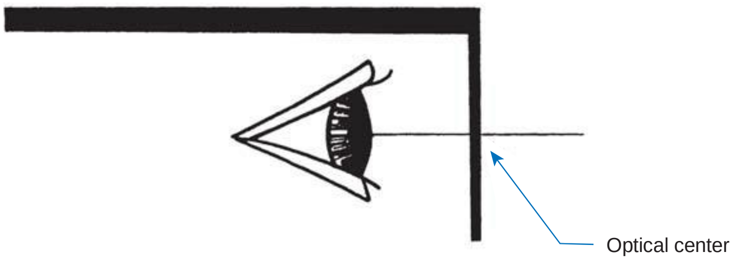


Figure 4-22. When the pupil corresponds to the optical center of the lens, there should be no pantoscopic tilt. Any lens tilt added will change the sphere power of the lens and cause an unwanted cylinder component to be manifested. For low power lenses, the power effect is negligible, but with a higher power lens it can be quite evident. (For further explanation see Chapters 5 and 18.)

Adjustable nosepads become more of a necessity as the power of the lenses increases. They offer the advantage of versatility in allowing modification of the vertical position of the frame. This allows the major reference point height, bifocal height, or progressive lens fitting cross height to be exactly adjusted.

Adjustable nosepads also allow the lenses to be positioned at varying distances from the eyes. This allows more precision in the refractive power of the correction. Unless a high-powered lens is fitted at the refracting distance used during the eye examination, an error in power will result. Unless a compensation for the vertex distance change is made, significant error results. For example, if a 015.00 D lens is intended for a 12 mm vertex distance between the cornea and rear lens surface, but is fitted at 17 mm, the lens will be almost 01.25 D too strong. It is obvious then that with high-powered lenses, power compensation for variations in vertex distance is a necessity for bridge designs not using adjustable pads.

Serious consideration should be given to using *comfort cable temples* when the anatomic features of the nose do not lend themselves to keeping the glasses in place or if the prescribed glasses tend to be somewhat heavy. Cable temples help keep the glasses from slipping down the nose and thus help avoid the difficulties listed above.

Selecting Frames for Children

When selecting frames for children, safety should be the first concern. Children are always doing things that are unexpectedly hazardous, and children's eyeglasses can be expected to endure much abuse. The main concern is not so much that the frames and lenses hold up to such abuse, but rather that the child is not put at risk because of a poorly chosen frame.

Remember, a frame that is small and sold for children may not necessarily be the best design for children. Because style is important to children, too, children's frames often mimic adult styles.

Children's frames should be sturdy. Look for solidly built frames, be they plastic or metal. The lens grooves should be deep so that the lenses are more securely seated in the frame.

It is advisable to avoid nylon cord frames because the thin cord does not hold the lenses in place securely enough for rough-and-tumble play.

When available, high quality spring temples are a good option. When hit from the side, the spring takes much of the shock, instead of transferring all of it to the side of the nose. In addition, spring temples will save trips back to the dispensary to have the frames realigned.

Although not directly related to the subject of frame selection, it is important to note that polycarbonate

BOX 4-2

Frame Selection for Children

Use	Avoid
Sturdy frames	Lightly constructed copies of adult frames
Deeply grooved frame fronts	Frames with shallow grooves
Quality spring temples	
Bridges that give support in the area of the lower portion of the nosepad	
High impact lenses such	Any lenses that are not highly impact resistant, especially glass lenses

lenses or Trivex lenses are the lenses of choice for children. The increased safety far outweighs any considerations given to the tendency for a polycarbonate lens to scratch. In short, children need high-impact-resistant lenses and dispensers have a responsibility to make sure that parents know why.

Both polycarbonate and Trivex lenses have the added benefit of giving children ultraviolet (UV) protection at no additional cost. The crystalline lens of a child's eye will let more light through than will the lens of an adult. UV light can begin to take its toll early in life, and with the increased radiation because of the earth's decreased ozone layer, it is never too early to begin protection.

If a child leaves the dispensary with lenses other than high impact lenses, the record should contain a dated statement noting that the parents were informed of the advisability of using such lenses and refused that option. A form to that effect signed by a parent is a further pre- caution against liability, but is not a legal requirement. (For more on the issue of liability, see Chapter 23.)

With an increased emphasis on sports for children, specialty sports glasses should not be overlooked. Children who participate in sports such as baseball may be at greater risk than adults who play the same sport. Not all children can react quickly enough to avoid a ball in the eye. Carelessness by other children when throwing balls or swinging bats also adds to the risks. A conscientious dispenser will be aware of options in sports eyewear for children and make them available. (For more on sports eyewear, see Chapter 23.)

See Box 4-3 for a summary of factors in selecting frames for children.

Selecting Frames for Older Wearers

When selecting frames for older wearers, perhaps the most important factor to consider is weight. With age, the skin looses its elasticity. This causes nosepads to depress the skin and underlying tissue, leaving marks that do not rebound easily. When the eyeglasses are heavy, red marks on the nose and ears can easily develop into sores that are slow to heal. Therefore choosing a frame that is lightweight and combining that selection with a lightweight lens material will do much to prevent problems.

The bridge of the frame must fit correctly. If the bridge fitting principles that were explained earlier in the chapter are exactingly applied, the frame will be comfortable. Remember, with older wearers there is less room for error. The bridge must seat itself over the largest area possible to evenly spread the weight of the glasses. For this reason, when selecting a frame with adjustable pads, it is helpful to use a frame with larger pads when available.

Unless the wearer has no distance prescription, the shape of the frame must leave enough room for the type of multifocal design selected. (See the section in this chapter on selecting frames for progressive addition lens wearers.)

It should not be assumed that the older wearer will be unconcerned with style, or will only be interested in the same type of frame as they have been wearing. Older individuals appreciate being accorded the same frame styling options given everyone else.

Selecting Frames for Safety Eyewear

Safety frames are no longer limited to drab colors and “S7” safety frame shapes, but are available in a large variety of styles. In many cases they are not easily distinguished from regular “dress” eyewear. Although function is paramount, rules for selecting a well-fitting, nice-looking frame do not change dramatically when selecting safety eyewear.

Remember that a safety frame is not just a sturdy frame with thick lenses. A safety frame must comply with specific standards and be identified with the mark “Z87” or “Z87-2” on both the temples and frame front. Metal frames should be avoided when electrical hazards are present, and side shields are necessary when eye injuries from the side are possible.

Devices That Help in the FrameSelection Process

One problem in selecting frames occurs when uncorrected visual acuity is so poor that the frames cannot be seen without glasses. There are several possible solutions.

1. *Bring a friend*

People who have been in the awkward situation of not being able to see the new frame on themselvesoften bring a friend along to help them chose something suitable. Bringing a friend, however, does not really deal with the root problem.

2. *Use a trial lens*

If there is a trial lens set available, choose the spherical equivalent for the preferred eye. The spherical equivalent of a lens is one half of the cylinder power added to the sphere power. (Incidentally, if the wearer requires a near addition, it may be helpful to add about one half of the prescribed near addition power to the spherical equivalent.) With the frame on, the wearer holds the lens in front of the preferred eye and looks in
the mirror. Although sometimes helpful, thissolution does not win high praise.

3. *Use a Visiochoix*

One system that addresses the problem of not being able to see the frame on the wearer consists of usinga set of lenses mounted in a clear plastic panel. Eachplastic panel has a handle and can be held in front of the eyes. The person selecting their frames can see the frames he or she is wearing behind the lenses because the entire mounting is made of clear plastic. The lens pair closest to the prescription is chosen from the Visiochoix set,* and the wearer is able to use both eyes. This solution is usually much preferred over the single trial lens method.

4. *Use a video system.*

Just using a standard video camera will make it easier for someone to see themselves clearly with a new frame. An individual can put on a number of frames, one after the other. Each time a frame istried on, the wearer can turn his or her head first one way, then the other, so that the frames in place can be seen from the side as well. Once a series of frames have been tried, the tape is rewound and theperson can view the tape while wearing his or her own prescription. However, there is a better video system for aiding in this process that offers much more than just a video camera. This makes use of a computerized image-capturing system.

Computerized Image-Capturing Systems

Imaging systems that are made especially for the dispensary will offer several advantages over a standard video camera and VCR. A computerized imaging system can display an image faster and easier. Here are some of the other features available at the time of this writing. Not all features are available on all systems.

- Shows images of the same frame from differentangles of view (Figure 4-23).

- Permits side-by-side comparisons of different frames on the same screen (Figure 4-24).
- May allow certain measurements to be calculated by the system, such as PD and multifocal segment

* Available from Bernell Corp., South Bend, IN.

Figure 4-23. Computerized image-capturing systems can show images of the same frame from different angles of view.

Figure 4-24. Here the image system permits side-by-side comparisons of different frames on the same screen.

heights after the frame shape has been outlined (Figure 4-25).

- May show the thickness of certain lens prescriptions from a side view of the lens, (Figure 4-26). An accompanying on-screen table comparing two lens materials for thicknesses and weight may be present.
- It may also be possible to take the image of the wearer with the prospective frames being worn and show what the lenses would look like:
  1. If AR coated.

2. If tinted to a certain solid or gradient transmission.
3. If made from a photochromic material.

- Included in some systems are simulations of how different scenes might appear to the wearer with and without an AR coating on the lenses.

In addition to the spectacle lens applications, some systems show an individual what they would look like if they were wearing tinted contact lenses of different colors.

A few systems allow web access by the wearer. This would include:

- Web access to previously recorded images of what certain frames look like while being worn. A password is required.

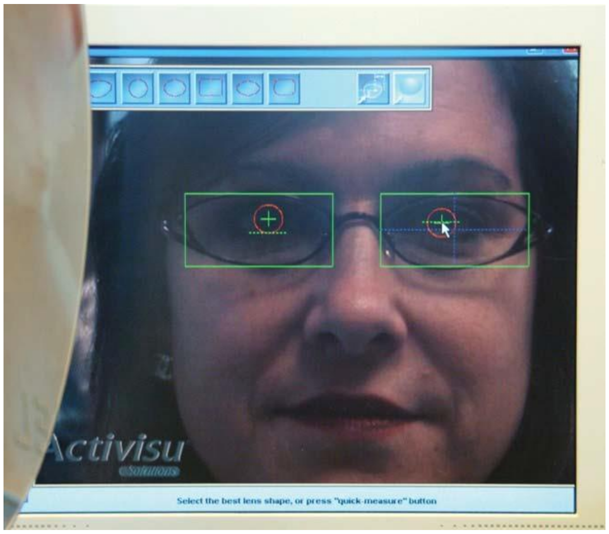


Figure 4-25. Some computer-based systems allow certain measurements to be calculated by the system after the frame shape has been outlined, such as PD and multifocal segment heights.

- Web access to a virtual frame try-on service from a home computer. This requires the wearer to have

a previously recorded image of their face placed in a database at the optical dispensary. Then any frame in a data bank of possibilities can be superimposed to scale on the image of the wearer's face. This means a person could check later on to see if there were any new frame styles available that they might like.

Closing the Frame Selection Process

Selecting a frame is a decision-making process. And making decisions is difficult. A good dispenser can help in making that process easier. Here are a few suggestions.

1. Do not prejudge a person's financial situation by only showing less expensive frames. Let each person make his or her own decision on how much to spend.
2. Do not voluntarily categorize a person's face as being a certain shape for

them. They may not agree with you. Be diplomatic.

3. Do not insist on a certain frame if the wearer does not like it, even though it may look best and be optically sound.
4. Do not allow the wearer to select a frame or lens style that you know would be unsafe or optically unsound.
5. Do not have a large number of frames spread out at any one time. People forget what they have looked

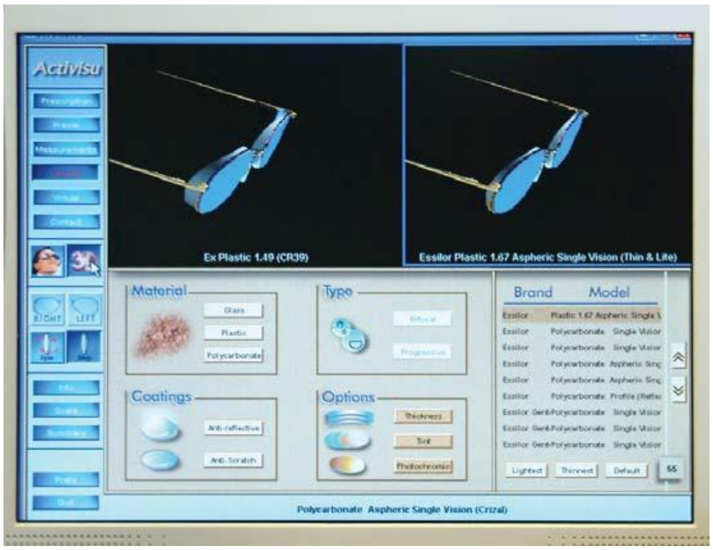


Figure 4-26. This image-capturing system shows the expected thickness of a lens prescrip- tion as seen from a side view of the lens. An accompanying on-screen table comparing two lens materials for thicknesses and weight may also be possible.at and rejected. Too many frames out at once may cause a person to become confused or overwhelmed. If a frame choice is unsatisfactory, return the frame to the display or put it out of sight. Try and keep the number of frame styles being considered at three or less at any given time.

6. Do not ask “if;” ask “which.” Presenting procrastination as a possible alternative is a disservice to those who find the decision-making process difficult. Helping to narrow the choice to two possibilities simplifies matters.
7. Do not overlook the possibility of more than one pair. In many cases one pair is not enough. Some people want or need more than one pair because:
   a. They like both and can afford both.
   b. They need a back-up pair and know it.
   c. Their visual needs vary in different work situations.
8. Be sure to point out the positive aspects of the frames that are being considered. People want to know they are buying an appropriate, quality product. The typical wearer of eyeglasses usually knows very little about frames and lenses. Telling the wearer why these frames and lenses are good will help them to feel confident in their decision.

A WORD ON FRAME MANAGEMENT

To prevent this from happening, keep a log of which frames are selling and replace those frames immediately. If a frame requires a long time to sell, do not replace that frame when you sell it unless it is in the dispensary to serve a certain type of clientele. It is advisable to consult with your frame representatives as they know what frames are selling in your area.

Sample Questions:

1: SOME FIND FRAMES EASILY; OTHERS CANNOT EVEN GET STARTED

Unlike the previous situation where it is difficult to find the right frame, in this situation frame selection is frustrating with some people, but not everybody. It is not just wearer indecision. The staff has trouble helping certain individuals find something that looks right for them, too.

Solution

When a frame representative comes into the office, there are one or two of the staff that looks over the new available frames trying to decide what to buy. In the process, the staff tries on the frames to see what looks good. As a result, overtime the dispensary is filled with frames that look great on the staff, who may have one facial type or one particular taste in style. People with other fitting characteristics are unable to find frames that are appropriate for them.

To keep the inventory balanced, the buyer needs to think about what is necessary for different facial types and different tastes in frames, such as conservative versus trendy.

Good frame selection is based on the availability of variety of quality frames in the dispensary. No matter how many frames are on the frame boards, if those frames are all the same style, the frame selection process will not lead to a successful outcome. The person responsible for buying frames needs to be aware of the various types of individuals who will be selecting frames and choose frames to buy with that in mind. Left alone, frame inventory will most certainly obey the Second Law of Thermodynamics and go from order to disorder. Below are a few examples of what can happen with frame inventory in the dispensary. The solutions given are not limited just to the example stated, but are generally applicable to the dispensary.

2: TOO MANY “DOGS”

People seem to be having an increasing hard time finding frames they like. The staff has trouble helping them. It seems that most of the frames are just not very appealing. What went wrong?

Solution

The person buying frames buys a logical selection of frames. Some frames sell immediately. Unfortunately, they are notreordered. The ones that were not popular do not sell and stay on the board. Another frame representative arrives and the same scenario is repeated. Before long the dispensary has an overwhelming number of frames that nobody really wants.

3: BACK-STOCK DRAWERS AND CABINETSARE FULL

Every dispensary has some place where extra frames are stored. There should be a limited number of frames in backstock. In this case, however, every drawer is full. What happened?

Solution

There is more than one reason why this situation could occur. The proper contents of these storage areas arebackups for frames that are moving very quickly. If all of the stored frames are discontinued or frames that just will notmove, then Example 4-1 above has been "solved" by removing the "dogs" from the board and ordering new frames. Hereis an example of what can be happening if backups are notin this category.

Frame companies often have promotions. With a certain sized order, the company may give away a "premium." Thiscould include such things as trips, watches, or computer- related prizes. If the buyer finds these things desirable, it does not take long to end up with too much stock. Do not buy frames just because they come with rewards.

4: EVERYTHING IS DISCONTINUED

You have picked out just the right frame, but the color is wrong. You try to order the needed color, but the frame has been discontinued. Unfortunately, this is becoming a regu-larly occurring problem. What is wrong?

Solution

Some discontinued stock is unavoidable. But when the issuejust keeps growing, there is a problem somewhere. Here are some typical causes and/or solutions. Most of themare just generally good practices for responsible frame management.

1. You may be buying frames from too many places. Having too many companies will make it difficult to track what is really happening with frame sales. Use a limited number of frame companies and know your representatives well. If you are not a large account for anybody, then your individual frame representatives do not have much of an interest in seeing that your framesare up-to-date. If you know your frame representatives and they know you, it should be in their best interest towork with you for the long-term benefit of your dispensary.
2. If you receive a notice that a frame is to be discontinued, act now. You have a limited time to returnit for credit. Do not miss that time. If you miss the cut- off, how

to get rid of the frame is your problem.

3. Be careful of “deals” where you can get a large number of frames for a very low price. Those frames may be scheduled to be discontinued or already be discontinued.
4. Before you bring a new frame company “on board,” ask about their return policy. Tell the representative of that company that you expect them to keep you informed of frames that are to be discontinued.
5. Allocate a frame representative from a certain company a certain given number of spaces on your frame board. Let them know that it is their responsibility to work with you to keep those frames current and moving. It will be in their best interest to determine which frames sell best in your practice and which do not. They will not want any discontinued frames taking up space in their area.
6. Although it is good practice to immediately re-order frames that are selling quickly, it is not good practice to automatically re-order everything. If a frame is not selling, do not re-order when it does sell. If you notice that a frame is not moving, do not wait to exchange it.
7. If the problem exists already, try to recover without just moving mountains of discontinued frames into a “spare parts” box. Figure out ways to move stock that has not sold, is not returnable, and may still have value. Here are some ideas: Mark it down. Put plano sunglass lenses in the frame and sell them at an attractive price. If there are some frames that still will not move, donate them to a charitable organization for a tax write-off.

Unit 7:

Reference Point Placements Multifocal Height, and Blank Size Determination

Learning Objective:

No matter how accurate the visual examination has been, if the lenses, either single vision or multifocal, are improperly positioned before the eyes, the finished product is of inferior quality. At the end of this chapter, students will be able;

1. To present the many “fine points” in lens positioning.
2. To master these fine points in addition to the general fitting rules to achieve consistency in excellence. Failure to put these points into practice can result in genuine visual hardship to wearers.

POSITION OF THE FRAME

If the frame is not properly positioned on the face for the initial measurements, both the frame and the lenses may not be in the correct positions when the frame is dispensed and properly adjusted.

With metal frames, the best policy is to adjust the nose pads to a correct angle and position before any measuring is done. This ensures a more correct bifocal height and bridge size evaluation.

With plastic frames, it is fairly simple to evaluate the bridge size. If the bridge of the sample frame is too small, the frame will sit too high; if it is too large, it will sit too low.

OPTICAL CENTERING FOR SINGLE VISION LENSES

Horizontal Placement of the Lensesin the Frame

Normally when spectacles are made, the lenses are positioned so that the *optical center (OC)* of the lens will line up with the pupil of the eye. Therefore the optical center becomes the major point of reference for the lens. When light goes through the optical center of the lens, it does not bend, but travels straight through. If the light did not travel straight through, but was bent, there would be a prismatic effect at that point. At the optical center of a lens there is no prismatic effect. Prism in spectacles is undesirable unless prescribed.

Prismatic Effect

To avoid undesired prismatic effects, the optical centers (OCs) of the lenses are placed the same distance apart as the wearer’s lines of sight. The measurement techniques for finding the interpupillary distance (PD) are covered in Previous chapter.

In some cases, a lens prescription calls for a certain amount of prism. The optical center of the lens has no prism, so it will not be placed in front of the wearer’s pupil. Instead a point on the lens where the amount of prism equals that called for in the prescription is chosen. This new point on the lens is now the point of major importance. This major reference point where the prismatic effect equals the prescribed amount of prism is called just that—the Major Reference Point (MRP). Succinctly stated*, the point on the lens where the prism is equal to that called for by the prescription is called the major reference point* (MRP).

Note that when there is no prism called for in the prescription, the OC and the MRP are at exactly the same point on the lens. But when there is prism in the prescription, the eye no longer looks through the OC. In other words, with prescribed prism the OC and MRP are in two different locations. The MRP is in front of the line of sight of the eye, whereas the OC is somewhere else.

If the wearer's eyes are at different distances from the nose, and if the two lenses are different in power, then the MRPs of the lenses must be placed according to the monocular PD rather than the binocular PD, to avoid inducing unwanted prism (see Figure 3-4).

Prentice's Rule

The amount of prism induced by improper lens placement depends on the power of the lens and the distance the OC is displaced. It is calculated according to *Prentice's rule*, which states:

D D cF

where D is prism diopters of displacement, F is the dioptric power of the lens, and c is the distance from the OC in centimeters.

For example, if the lens power is D2.00 D and the OC varies from the wearer's interpupillary reference point (usually the center of the pupil) by 6 mm, the induced prism will be:

62

D D 0.6 D 2.00 D l.2

The base direction for plus lenses is toward the center of the lens, and the base direction for minus lenses is toward the margin of the lens.

"Face Form"

There is also a relationship between the placement of the OCs in the frame and the extent to which the curve in the frame front varies from the classical four-point touch position (see Chapter 8 for an explanation of four-point touch). This curve in the frame front is often referred to as "face form," because the frame front more closely conforms to the curve of the face.

This curve serves both the cosmetic purpose of improving the frame appearance and the optical purpose of aligning both surfaces of the lenses with the wearer's line of sight.

Allen[1] has shown the correct and incorrect face form relating to the wearer's PD (Figure 5-1). If the wearer's PD equals the "frame PD" (eye size plus bridge size), then no face form is required; the frame front should be straight (Figure 5-2).

If the wearer's PD is less than the eye size plus the bridge size of the frame, then the frame front should be given face form by bending it at the bridge, allowing both cosmetic and optical alignment (Figure 5-3). A perfectly straight alignment of the frame front will tilt the OCs with reference to the line of sight and cause unwanted sphere and cylinder powers (Figure 5-4).

If the wearer's PD is greater than the frame eye size plus the bridge size, then theoretically the bridge should be bent to curve the frame opposite to the normal curve of the face. Although this permits proper optical alignment, it is cosmetically unsatisfactory, and thereby impractical (Table 5-1). Such a frame adjustment should not be done.

Vertical Displacement

Unless otherwise specified, an optical laboratory will make a single vision lens so that the MRP is centered vertically—halfway between the top and bottom of the frame. Low-powered lenses made from traditional mate- rials seldom need an MRP height specified. Optical problems caused by a vertical MRP placement that might need to be above or below the vertical frame center are so minimal with low-powered lenses that few wearers are ever bothered. However, this is not the case when lens powers increase, when different lens materials are used, or when aspheric lens designs are employed. In these instances, vertical MRP placement becomes important.

Optically Correct OC Placement

Consider a lens placed before an eye with the OC of the lens directly in the eye's line of sight (Figure 5-5). As light passes through the OC of the lens, it enters and leaves the lens at right angles to both front and back surfaces. The optic axis of the lens and the line of sight of the eye fall in the same place.

Note, however, that a lens with its OC directly in front of the eye should not be tilted. Figure 5-6 shows this incorrectly tilted lens. Tilting the lens when the OC is directly in front of the eye will both induce an unwanted cylinder component and alter the sphere value of the lens. (An optical explanation of this is found in Chapter 18.)

With most frames, the eye is slightly higher than the center of the lens. This is shown in Figure 5-7. The alignment shown in Figure 5-7 is not an optically correct alignment, since the optic axis of the lens does not pass through the center of rotation of the eye. Even though the lens is not tilted, light passing through the center of rotation of the eye also passes through the lens at an angle to both lens surfaces.

Fortunately, lenses are usually worn with the lower lens edge tilted toward the face. This *pantoscopic tilt* is the amount the frame front is tilted with reference to the plane of the face. To avoid the lens aberrations that would otherwise be caused by lens tilt, light following the line of sight through the center rotation of the eye must still pass through the lens OC at right angles. This can be accomplished by lowering the OC of the lens 1 mm for every 2 degrees of pantoscopic lens tilt and is shown in Figure 5-8. (Table 5-2 summarizes the relationship between pantoscopic tilt and OC placement.)

Amount of Face Form Required 5.1

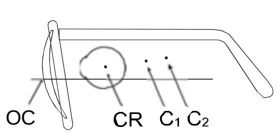
If	Then
1. PD D Eye size D bridge size	No face form
2. PD D Eye size D bridge size	Positive face form
3. PDD Eye size D bridge size	Negative face form (this is impractical and should not be carried out)

Amount of Pantoscopic Tilt Required 5.2

If	Then
1. Eyes at OC	No pantoscopic tilt
2. Eyes above OC	Pantoscopic tilt required
3. Eyes below OC	Retroscopic tilt required (this, however, is impractical and should not be carried out)

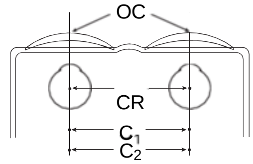
*For each millimeter the eyes are centered above or below the optical centers of the lenses, two degrees of lens tilt are required.

In Figure 5-1, Allen[1] shows several examples of correct and incorrect pantoscopic tilt with respect to vertical



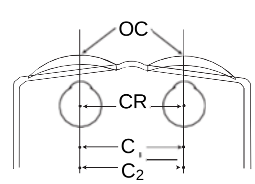
Correct pantoscopic angle

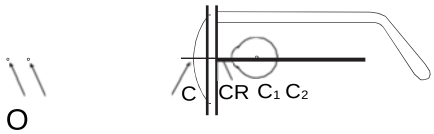
A



Correct face form for when wearer's PD equals "frame PD"

F

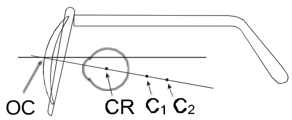




O

Correct pantoscopic angle

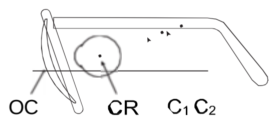
B



Optically correct retroscopic angle, but cosmetically incorrect

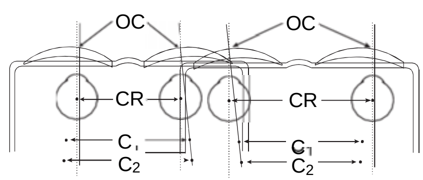
DO NOT USE

C



Incorrect face form for when wearer’s PD is less than “frame PD”

G



Correct face form for when wearer’s PD is less than “frame PD”

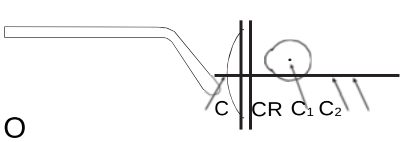
H

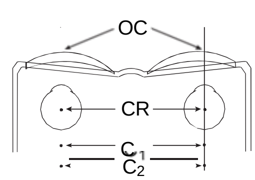
Incorrect pantoscopic angle; either the frame is too high or the pantoscopic angle is too great

D

Incorrect face form for when wearer’s PD is greater than “frame PD”

I





O

Incorrect pantoscopic angle; either the frame is too low

Figure 5-1. Here are a series of illustrations demonstrating both correct and incorrect use of pantoscopic angle and face form, depending upon the placement of the lens optical center. The symbols C_1 and C_2 show the location of the centers of curvature for the first and second lens surfaces. They also indicate the position of the optic axis of the lens. The location of the center of rotation of the eye is denoted by CR and the optical center of the lens by OC.

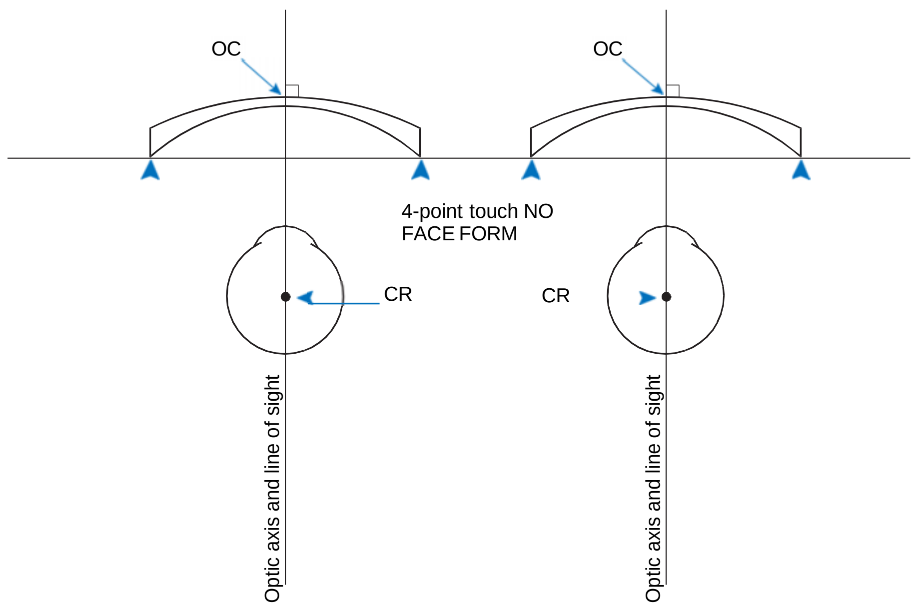
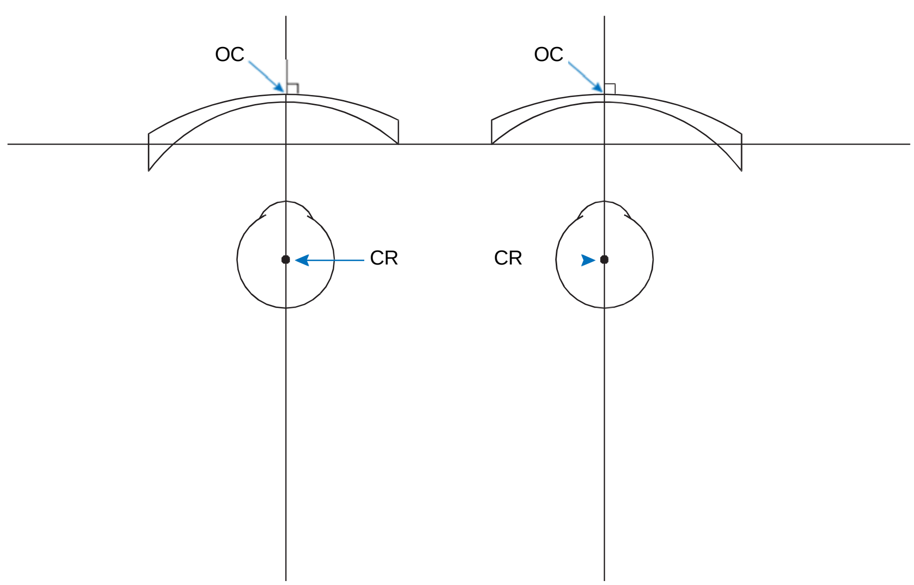


Figure 5-2. When the optical centers of the lenses are at the horizontal center of the frame's lens openings, the geometric center distance ("Frame PD") equals the wearer's interpupillary distance. The lenses should have no face form (a "4-point touch"). When this is the case, light entering along the line of sight strikes at right angles to the front and back surfaces of the lens. This prevents inducing unwanted sphere and cylinder power changes caused by tilting of the optical center.



Optic axis and line of sight

Optic axis and line of sight

Figure 5-3. To prevent optical error caused by lens tilt, when the wearer’s interpupillary distance is less than the frame’s geometric center distance (“Frame PD”) face form is required. This is because more of the lens blank has been removed nasally than temporally during edging. The object of adding face form to a spectacle lens prescription is to keep the lens surfaces at the optical center perpendicular to the line of sight.

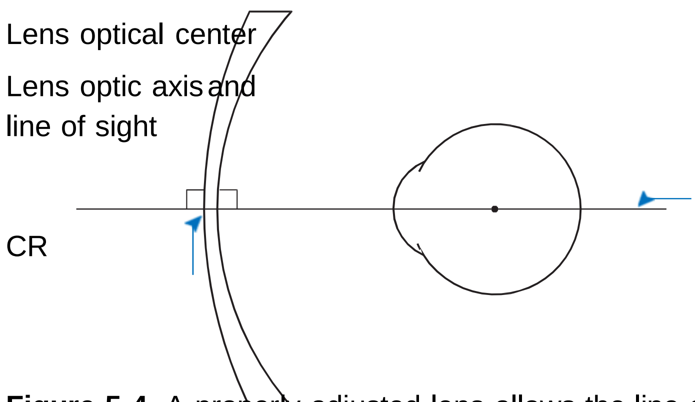
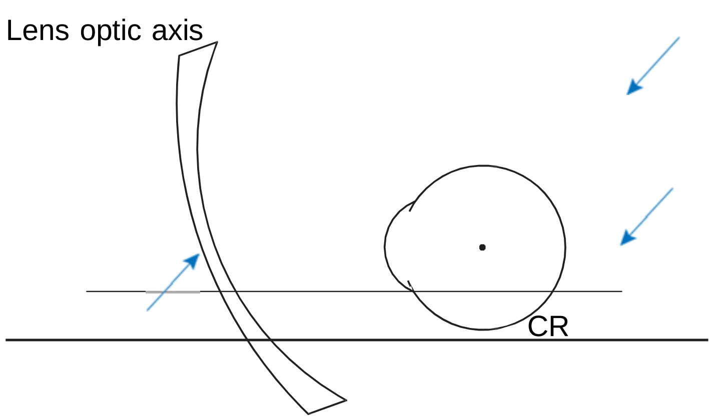


Figure 5-4. A properly adjusted lens allows the line of sight to pass through the optical center of the lens at right angles to the front and back surfaces. If the eye is midway between the top and bottom of the lens, and the optical center is directly in front of the eye, the proper adjustment contains no face form.

CORRECT



Lens optical center

Line of sight

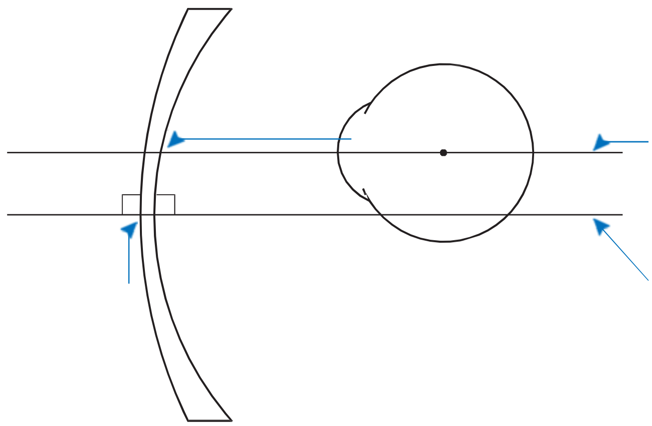
Figure 5-5. When the optical center is measured for center-pupil height, if the glasses have any pantoscopic tilt, the optic axis of the lens will not pass through the center of rotation of the eye.

INCORRECT

Not at right angles

Line of sight

CR



Lens optical center

Lens optic axis

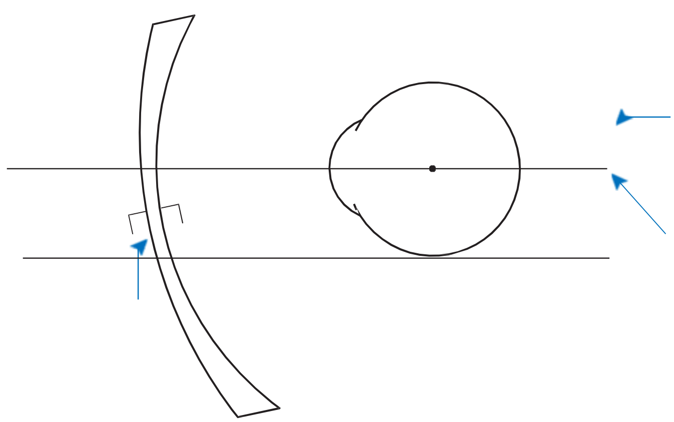
INCORRECT

Figure 5-6. When the eye is above the horizontal midline of the lens, without pantoscopic tilt the optic axis of the lens will not pass through the center of rotation of the eye. This means that the wearer will experience lens aberrations corresponding to the effect of altering lens sphere and cylinder values.

Lens optic axis

CR

Line of sight



Lens optical center

CORRECT

Figure 5-7. A correctly fit pair of glasses will drop the optical center 1 mm for every 2 degrees of pantoscopic tilt. This is also a good fitting situation because the average viewing area is not centered on a point on the lens directly in front of the eye. “The average patient moves his eye through a field of view, which is centered in a slight downward position, since we seldom have occasion to look as far above the horizontal as we do below. Even for viewing tasks other than through the bifocal segment, we look down at the sidewalk, down at store counters, even somewhat downward to drive a car to look at the road directly in front of us.[5]”

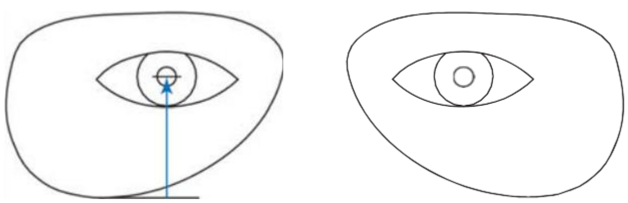


Figure 5-8. To measure pupil center height, mark the location of the pupil on the glazed lens with a short horizontal line or a cross. Pupil center height is the horizontal distance from the lowest level of the inside bevel of the lower eyewire, up to the pupil center. alignment, and correct and incorrect face form with respect to horizontal alignment.

As a general rule, eyeglasses need to be adjusted so that the lower rims of the frame are closer to the face. This widens the viewing area for the wearer and is more cosmetically appealing. The correct fitting procedure is to first adjust the empty frame for pantoscopic tilt. This angle of tilt in degrees is noted. Next the pupil center height is measured. Afterwards 1 mm is subtracted from the height of the OC for every 2 degrees of pantoscopic tilt. This gives the MRP height.

Summarizing How to Determine MRP Height

MRP height is determined by first measuring pupil center height. Pupil center height is measured with the dispenser’s eyes positioned at the same level as the sub- ject’s eyes. The subject looks at the bridge of the dispenser’s nose. Using a water-based overhead projector pen, the dispenser draws a horizontal line on the glazed lenses through the pupil center for both right and left eyes (Figure 5-9). If there are no glazed lenses in the frame, transparent tape may be used. (The use of trans- parent tape is described in the section on measuring bifocal heights found later in this chapter.) Next compensate for pantoscopic tilt using the 2-for-1 rule of thumb.

Simultaneously Compensating for Pantoscopic Angle While Determining MRP Height

There is a simple method that makes it possible to compensate for pantoscopic tilt while determining MRP height. The dispenser is positioned at the same level as the subject. With the frame fully adjusted for height, pantoscopic tilt, and straightness, the subject is instructed to look at the bridge of the dispenser's nose. Next the dispenser places a finger under the subject's chin and tilts the subject's head back until the frame front is perpen- dicular to the floor (Figure 5-10). With the subject's head in this position, a horizontal line is drawn on the glazed lens at the level of the pupil center. The distance from the lowest portion of the inside bevel of the lower eyewire to the horizontal mark on the lens is the MRP height. This height has already been corrected for pan- toscopic tilt and does not require any compensation.(This is summarized in Box 5-1.)

MRP Placement for Polycarbonate and Other High Index Materials

It is especially important to measure PDs monocularly and to consider the vertical position of the MRP when using polycarbonate and high index materials. Many of these materials have more chromatic aberration* than crown glass and regular (CR-39) plastic.

Fitting eyewear correctly will help keep many types of aberrations under control (for more on lens aberrations, see Chapter 18). If other aberrations are minimized by good fitting techniques, a small amount oflowest point on the inside bevel of the lower frame eyewireup to the pupil center is measured and found to be 28 mm. If the pantoscopic tilt is 10 degrees, then the height must be lowered by 1 mm for every two degrees of pantoscopictilt; which in this case is 10/2 or 5 mm. The new MRP height

*Chromatic aberration causes objects with high contrast border areas to have rainbowlike color fringes. Chromatic aberration may be visible with high-powered prescriptions made from lens materials with low Abbé values.

Optical centers

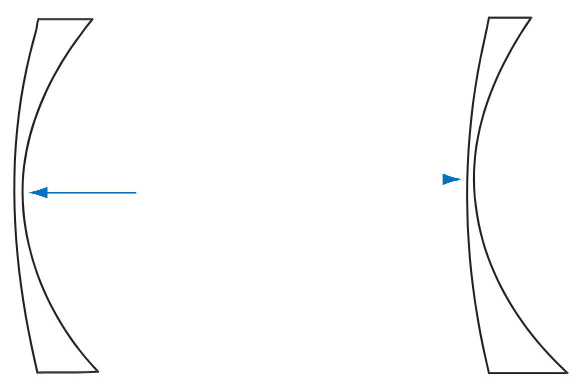


Figure 5-11. Moving the optical center of a high minus lens too far upward will cause the lower edge of the lens to be too thick. chromatic aberration is less likely

to push overall aber- ration problems into the troublesome area. It should also be noted that the farther from the OC the eye looks, the more evident chromatic aberration may become.

MRP Placement for Aspherics

An aspheric lens typically has a central zone of constant lens surface power, with the power gradually changing toward the periphery of the lens. This means that the central zone must be well positioned both horizontally and vertically. Monocular PD and measured MRP heights are important.

Other Ways of Positioning MRP Height

Some dispensers measure pupil height and do not lower the MRP from this position to compensate for panto- scopic tilt. Although this may help prevent chromatic aberration with distance viewing for polycarbonate and high index lenses, it can cause aberrations because of lens tilt and also result in a thicker lens. Raising the OC of a minus lens makes the top thinner and the bottom thicker (Figure 5-11). Raising the OC of a plus lens makes the top thicker and sometimes increases center thickness (Figure 5-12). Therefore before ordering a high-powered lens with a high OC, it is advisable to consider the resulting edge thickness.

If the dispenser fails to specify an MRP height, the laboratory will center the lens vertically in the frame. For most low-powered crown glass and CR-39 plastic lenses, no problems will be encountered. For polycar- bonates, aspherics and high index lenses, the MRP height should be measured.

Notes:

1. It is not advisable to move an MRP height below the horizontal midline (datum line) of the glasses unless the lenses are intended exclusively for near work.
2. When the pantoscopic angle is especially large, it may be advisable to (a) reconsider the frame selected

Optical centers

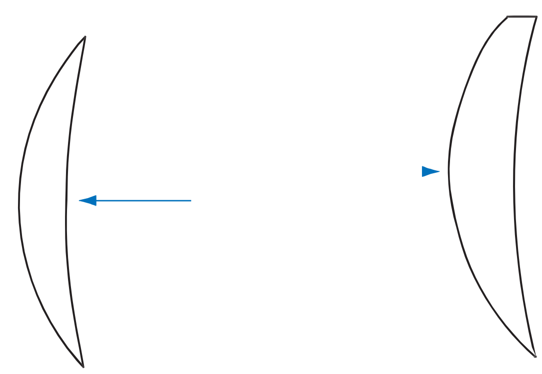


Figure 5-12. These two high plus lenses have the same refrac- tive power. The lens on the left has the optical center half way between the top and the bottom. The lens on the right has the optical center too high for a lens of this power. As a result, the upper edge is excessively thick. and choose one that will place the eyes higher in the frame, (b) reduce the pantoscopic tilt, or (c) just not lower the MRP

by the full 2-for-1 amount.

Vertex Distance

Vertex distance is the distance from the back surface of the spectacle lens to the apex of the cornea. A 14-mm distance is considered average, although the best fit for spectacles is usually obtained by fitting the frame as close to the eyes as possible without having the lashes rub the lenses.

The depth of the base curve affects the final vertex distance, since each increase of 1 diopter in the depth of the base curve increases the depth of the vertex distance by approximately 0.6 mm. The exact amount of vertex distance increase will depend on the size of the lens. Vertex distance is important when fitting someone with long lashes. Be sure to observe the person from the side with the sample frame. Have the person blink to note the lash clearance. Vertex distance becomes more of a concern in higher powered prescriptions because achange in vertex distance induces a change in both the spherical and cylindrical power of the lenses.

Measuring Vertex Distance With the Distometer

The instrument used to measure vertex distance is the *distometer* (Figure 5-13). The following technique is used to measure vertex distance: With the spectacles in place, the subject is instructed to close the eyes. The flat side of the “scissors” end of the distometer is placed against the closed lid. When the end of the distometer is pressed, the other side of the “scissors” moves out to touch the back surface of the spectacle lens. When the two parts of the distometer touch the lid and lens simultaneously, vertex distance is read from the instrument. The instrument takes average lid thickness into consideration so the reading does not have to be compensated (Figure 5-14).

MEASURING FOR MULTIFOCAL HEIGHTS

The methods used for segmented multifocals and those used for progressive addition lenses are very similar. The eye reference points are not the same. Progressive lenses

Figure 5-13. A distometer measures the distance from the back surface of the lens to the front surface of the eye.

Figure 5-14. The distometer is positioned so that the stationary part of the instrument is against the closed lid. When the probe touches the back surface of the spectacle lenses, the vertex distance may be read from the scale.

Measuring for Bifocals

The actual techniques for measuring bifocal height are not any more difficult than measuring the PD. There are, however, a few more considerations that must be taken into account to prevent certain difficulties.

Measurement for segment height should be done using only the actual frame that will be worn, or one of exactly the same size and type. Any variations in size must be precisely compensated for, as previously explained at the beginning of the chapter. The frame must be carefully positioned to sit at the same height at which it will be worn.

Lower Limbus Method

The dispenser positions himself on the same level as the subject and directly in front of him. The subject is instructed to fixate a point straight ahead at eye level—most often, the bridge of the dispenser's nose.

When using the PD rule to measure bifocal height, hold it vertically with the scale extending downward and align the zero point with the lower limbus (Figure 5-15). The bifocal height is indicated by the figure on the scale of the ruler that corresponds to the level of the lowest part of the groove inside the lower eyewire (Box 5-2).

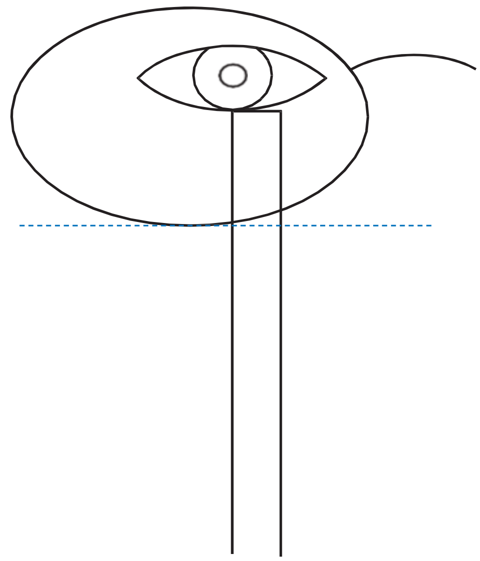


Figure 5-15. Measuring for bifocal height. When using the inside edge of the lower eyewire as reference, an additional amount must be allowed for the depth for the lens bevel in the groove. Although this may vary somewhat, an additional 0.5 mm added to the measure is normally suitable. Alternately, it may be easier to estimate the depth of the groove and measure directly to this estimated location.

The lowest portion of the eyewire must be used, even if it is not precisely under the limbus. Certain frames have a lower eyewire that slants, a problem best illus- trated by the aviator frame shape. The distance from the top of the seg to the eyewire immediately below it is notably different from the distance to the lowest part of the eyewire (Figure 5-16).

Lower Lid Margin Method

The lower lid margin is often used as a reference point for measuring bifocal height instead of the lower limbus. The difference is frequently academic because the two are usually in approximately the same position.

BOX 5-2

Steps in Measuring Bifocal Height Using Lower Lid or Limbal Method

1. Fitter positions himself or herself on the same level as the subject.
2. Subject fixates the bridge of the fitter's nose.
3. Holding frame in correct wearing position, the fitter places the PD rule vertically in front of subject's right eye. The zero point is at lower limbus and the ruler scale is positioned downward.
4. For a rimmed frame, the fitter reads the scale at the level of the lowest point where the inside of the groove would be. For a rimless frame, the reference is the level of the lowest point on the demo lens.
5. Repeat for left eye.

Note: If the lenses are being marked for reference instead of using a ruler in front of the face, the glazed lenses are marked at the level of the limbus with a marking pen. When both lenses have been marked, the fitter removes the frames from the subject and mea- sures from the mark down to these reference points.

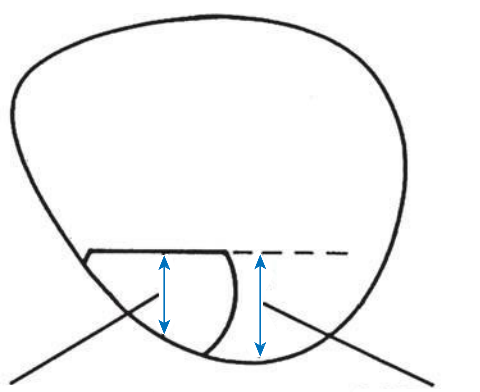


Figure 5-16. The lowest portion of the lens as positioned in the frame must be used in measuring seg height. This is true even if the height at the center of the seg has a different mea- surement. (*Note:* The segment height is *not* measured using the outside of the frame. The edge of the lens is the reference used.)

The lower lid margin position can vary considerably more than the lower limbus position, however, making the latter a more consistent reference point.

Subjective Determination

Subjective determination is the most accurate means of determining the seg height and of assuring the wearer that the bifocal will be positioned properly. The proper bifocal position for each person, of course, is determined with the occupational and personal characteristics of the individual in mind.

Marking on the Glazed Lens. When the sample frame has glazed lenses, the level of the bifocal can be marked on each lens with a marking pen instead of mea- suring with the PD ruler. With the dispenser and wearer on the same level and the wearer looking straight ahead, a short horizontal mark is drawn at the proposed level of the bifocal segment line (Figure 5-17). This can be checked before ordering by lengthening the line to sim- ulate the width of the bifocal (Figure 5-18). This way the wearer can be given the opportunity to evaluate the suit- ability of the proposed height. Ask the wearer to stand and evaluate the position of the line.

Figure 5-17. Using a marking pen, the proposed level of the bifocal can be drawn on the glazed lens in the new frame. If the wearer will be using old frames, the mark is made on the old lenses.

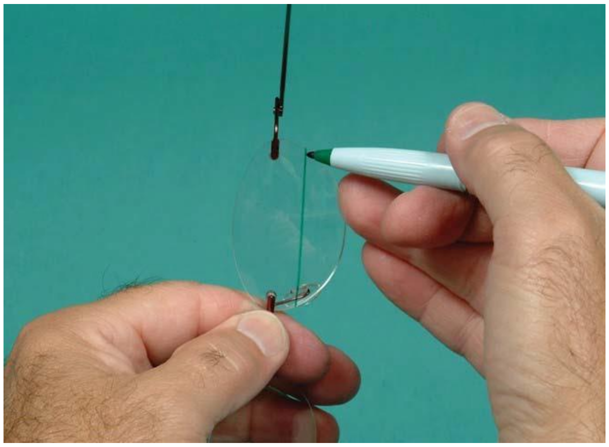


Figure 5-18. Drawing a complete line at the proposed bifocal height will allow the wearer a realistic evaluation of where the segment will be located after the finished lenses are in the frame.

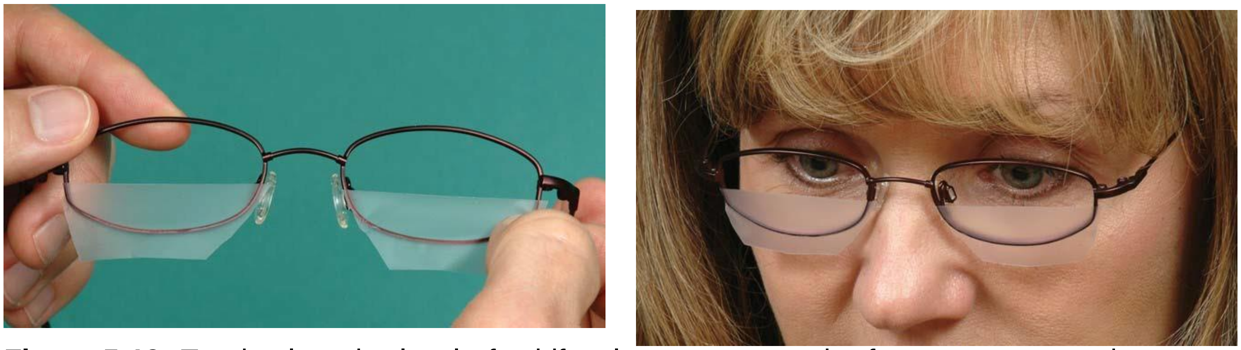


Figure 5-19. To simulate the level of a bifocal segment, a strip of transparent tape is placed across the lower half of each eyewire.

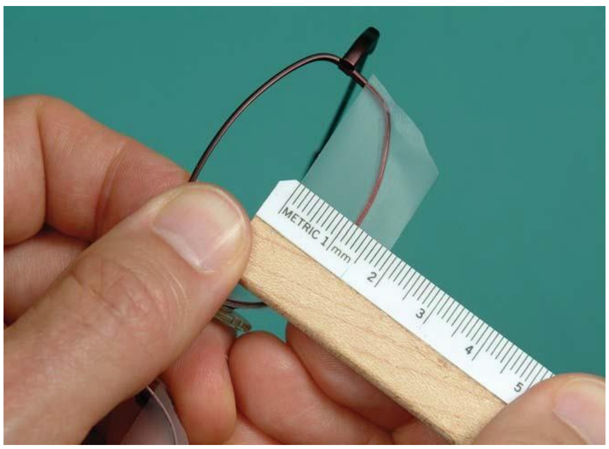


Figure 5-20. The simulated bifocal height is measured from the lowest part of the inside of the lower eyewire.

Give the wearer something to hold in the reading position. Encourage the wearer to simulate normal working conditions and evaluate whether the line is too high, too low, or just right. If the line is too high or too low, redraw the line and have the wearer reevaluate the new height. When the level is judged as satisfactory, measure the distance from the lowest level of the inside bevel of the lower eyewire up to the drawn bifocal line for each lens.

Using Transparent Tape. The method using trans- parent tape is slightly more time consuming, but is useful for checking when there are no lenses in the frame. This method also works for checking unequal seg heights. A strip of tape is placed across the lower portion of the empty frame at exactly the level of the proposed segment (Figure 5-19). The proper height is checked in the same way as a regular bifocal (Figure 5-20), and the tape is readjusted if necessary. When the wearer looks into the distance, the taped area should not interfere with vision. When looking up close, the nearpoint material should be seen as if located within the area covered by the tape (Figure 5-21).

Figure 5-21. Subjectively checking seg height: The wearer should be readily able to locate reading or near point material within the transparent tape area. The same is true when using a frame with glazed lenses that have been marked for height with a lens marking pen.

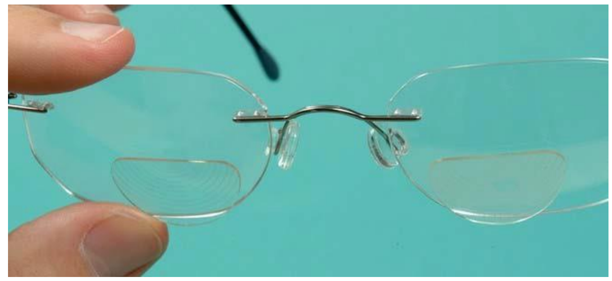


Figure 5-22. Fresnel press-on segments are removable and reusable. They offer a greater degree of reality when asking the wearer to subjectively judge the most appropriate segment height.

Using Fresnel Press-On Segments

By using Fresnel optics, it is possible to produce a uni- formly thin, flexible, stick-on lens or prism. Such lenses are normally used to provide high amounts of prism in visual training or to apply prism in certain sections of a lens. However, Fresnel lenses are also available as tem- porary flat-top bifocal segments. By obtaining a series of Fresnel press-on segments in increasing powers, it is possible to stick the lenses on the wearer's old single vision lenses, or on the glazed lenses in the new frame (Figure 5-22). Having the wearer's prescribed near power in the removable segment will add a dimension of reality that will enable the wearer to judge more accurately the most useful bifocal height for a given work situation.

Measuring For Trifocals

The techniques for measuring trifocals are identical to those for measuring bifocals, except the reference is the top of the trifocal intermediate segment rather than the top of the lower near segment. The trifocal height is the top line (Figure 5-23).

Bifocals enable the wearer to see at two distances clearly: (1) off in the distance through the upper portion of the lens, and (2) at reading distance for the smaller

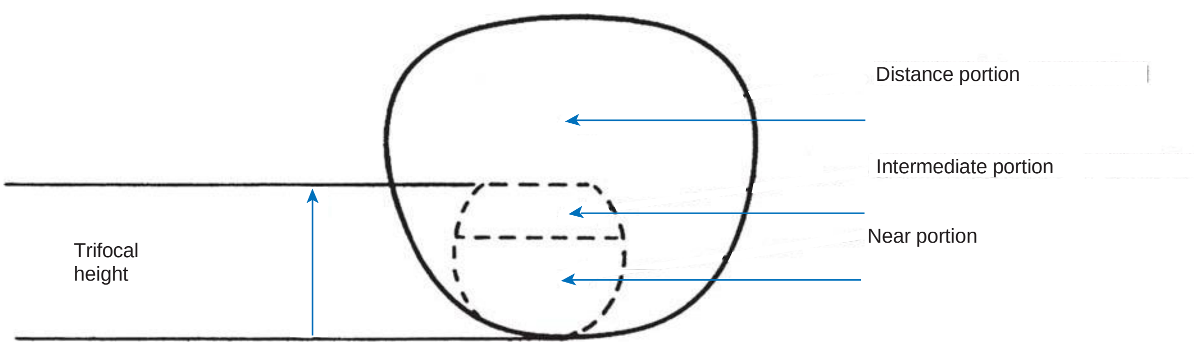


Figure 5-23. No specification for lower seg line is necessary when ordering trifocal lenses. The style of trifocal ordered dictates this position. The top of the intermediate

portion is the position measured.

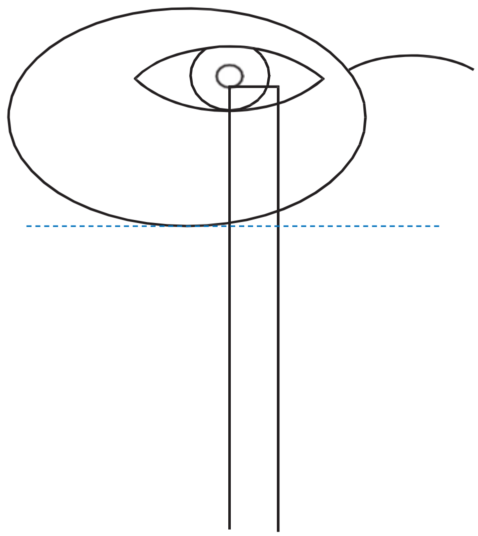


Figure 5-24. Measuring for trifocal height starts as shown. Subtract a full millimeter so that the intermediate seg does not get in the way for distance viewing. If the frame has a groove for the bevel, that must also be considered.

segment area in the lower portion of the lens. When it becomes necessary to see clearly at an intermediate distance (usually an extended arm's length), trifocals are used. Trifocals differ from bifocals only through the addition of an intermediate portion immediately above the near portion, giving the wearer three distances of clear vision instead of two.

Lower Edge of Pupil Method

The lower edge of the pupil method is similar to the lower limbus and lower lid margin methods used for bifocals. For trifocals, however, the lower pupil margin is aligned with the zero mark of the vertically held PD rule. The reading is that point where the scale intersects the level of the inside groove of the lower eyewire (Figure 5-24). Then 1 mm is subtracted to compensate for pupil clearance during fixation of the eye in distance viewing.

Thus if the seg height for a trifocal measures 18 mm from the edge of the pupil, the net seg height ordered would be 17 mm.

Subjective Determination

The subjective technique is again similar to that used for bifocals, with the addition of a test for the third section of the lenses. When an overhead transparency pen and glazed lens are used, the two trifocal lines may be drawn on the lens. The area in between is "colored in" with the pen. Objects viewed through this colored intermediate area will appear tinted.

If the total seg height is lowered, the near portion area will be reduced, and vice versa. For example, assume that a trifocal with a 7-mm intermediate portion is to be fitted 17 mm high in the eyewire. This leaves 10 mm for the near portion of the seg (17 total D 7 intermediate D 10 near). If the top of this intermediate seg is too high, lowering it reduces the reading portion. If the reading portion is increased, the top of the trifocal is raised.

The feasibility of using a trifocal in a given frame can thereby be easily ascertained. If the trifocal seg is deliberately set very low, the resulting small near (reading) portion will probably permit too little reading area; but on the other hand, increasing the reading area may place the trifocal intermediate portion high enough to inter- fere with distance vision. When no suitable trifocal position in the selected frame is possible, a frame with a greater vertical depth is indicated.

Comparison With Old Lenses

When a person who is currently wearing bifocals is refit- ted with new bifocals, the segment position may be maintained or changed. If a person is dissatisfied, the complaint will indicate the necessary change in position. If the bifocals were "always in the way," the seg height was too high. If the seg height was too low, the wearer will complain of stiffness of neck caused by constant head-tilting.
Any change that is made, however, should be done via the same techniques described for new multifocal wearer to ensure correct positioning. This is also true for a bifocal wearer changing to trifocals. If the trifocal is merely added to the bifocal height, the tops may intrude into the pupillary area.

Seg Height Factors

If a person is satisfied with the seg height currently worn, but is changing any aspect of the frame, the specifications necessary to achieve the previous seg height may A be different. Only with exactly the same frame shape and size will the seg height measurements be identical to the previous order.
One factor that influences the position of the seg is the bridge. The shape and size of the bridge determine the height at which the frame sits on the nose. For example, two frames might both have a vertical dimension of 38, but the bridge on one frame might hold theeyewire higher on the face than a differently shaped bridge on the other frame.

14 mm
The influence of lens size on segment height is evidentn the vertical depth if one frame is a 38 eye size and the other 42. Even if the bridges hold both frames in relatively the same position, as the horizontal size increases, so does the vertical size.
Lens shape influences segment. The seg height might be 15 mm for a narrow frame and 20 mm for a deep frame, yet both frames could place the segment line right at the lower limbus.
When measuring to match the segment height of a new bifocal lens with that of an old bifocal lens, have the person wear his or her old glasses. Note the location of the

segment line on the face or in relation to the lower lid. Measure from the lower lid to the seg line: plus if above the lower lid, minus if below it (Figure 5-25, *A*). Place the new frames on the face. Measure the distance from the lower eyewire to the lower lid, then add or subtract the distance from the lower lid to the old seg line (Figure 5-25, *B*).

Other Methods

When a frame lacks glazed lenses, plastic segment- measuring devices are handy and accurate alternatives to the PD-rule method of measuring bifocal height. Such a device may be held in place in one of several ways. One type uses expandable wire springs. Another uses the same principle, but is held in place by three vertical plastic strips: two strips are positioned behind and one strip in front of the upper eyewire. A third design uses double sided tape to hold the device to the frame. In all instances, the scale can be read directly because the clear plastic segment portion is marked in millimeters. Because such devices sit inside the frame bevel, there is no need to compensate for bevel depth. An additional advantage is the fact that they enable comparison of the segment heights of both eyes simultaneously (Figure 5-26). Because frames come with demonstration lenses to

B

Figure 5-25. Duplicating the old seg height positions for use in the new frame or for a second pair of glasses is done by first measuring from the lower lid, down (or up) to the seg line. The measure will be plus if the old seg line is above the lower lid and minus if it is below it. In the figure, this measurement is D2 mm. Next, with the new frame in place, the distance from the lower lens edge up to the lower lid is measured. In the figure, this measurement is 14 mm. The distance in **(A)** is then added to the distance in **(B)** to determine the seg height for the new or second pair of glasses so that both old and new segment heights match. For the example, this is D2 mm
D 14 mm D 12 mm.

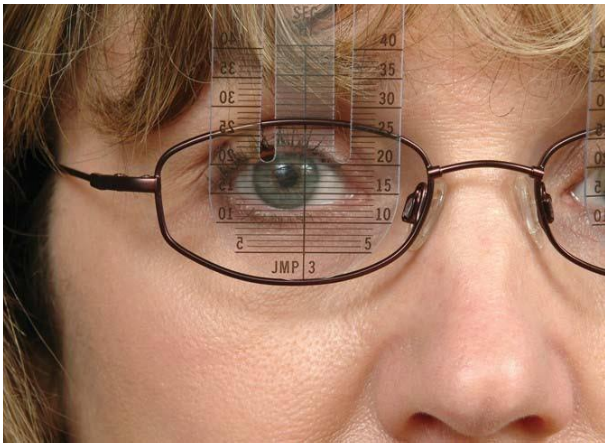


Figure 5-26. Measuring for seg height using a segment mea- suring device allows for easy comparison of seg heights between left and right eyes.

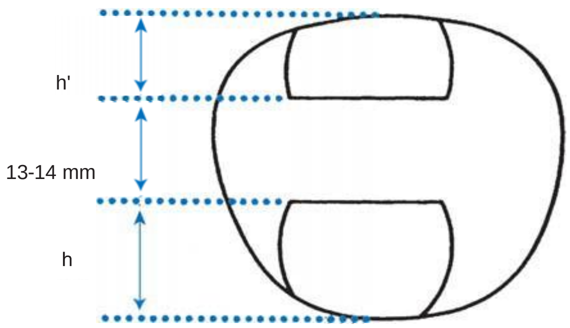


Figure 5-27. The double seg lens. Most double seg lenses have a 13 to 14 mm distance between segs. Measure hD is therefore dependent upon seg height h and the vertical dimension of the frame chosen.

increase frame stability, these devices are used much less that previously.

Measuring For Double Segs

A double seg lens has near segments in both the lower portion and the upper portion of the lens (Figure 5-27). This upper seg allows the wearer to do near work more comfortably when the working area is above eye level. Double segs are available in several seg shapes.

Measuring for a double seg is done in practically the same manner as for the normal bifocal. The only initial consideration is the lower seg height. This can be measured by any of the methods described previously.

When a double seg lens is ordered, the lower edge of the top segment will automatically be 13 to 14 mm above the lower seg line position. With the frame in place, note the position in the frame where the upper seg will begin. If there will not be a large enough field of view in the upper seg, either a different frame with more area above eye level must be chosen or the lower seg must be placed deeper in the frame to bring down the upper seg. A rea- sonable minimum area for the upper seg is considered to be 9 mm.[2] The opposite problem can result if the subject has previously worn the bifocal seg lower than normal. The upper seg will be so low that it will partially obscure distance vision. The lower seg then has to be raised until the upper seg is high enough that it is no longer disturbing the wearer.

When the wearer is unsure of the applicability of double segments to his or her situation, it may be helpful to use a set of Fresnel segments* to demonstrate the application. To do so, subtract 0.50 D from the power of the new bifocal add and select Fresnel segments of this power. Position the Fresnel segments upside down and 14 mm above the wearer's old bifocals.

*Fresnel segments were described under the "Subjective Determination" section earlier in this chapter.

Unequal Seg Heights

Both eyes should be measured independently for bifocal or trifocal heights (Figure 5-28). If one eye is higher than the other and the segments are placed at equal heights, the wearer will have a blur area considerably larger than normal; one eye sees the segment line first as the person looks down, then as that eye begins to clear, the other eye sees the line and begins to clear later.

Before prescribing unequal segment heights, be sure to check (using the actual frame to be worn) to be certain that the frame sits straight on the face. A crooked frame obviously will result in unequal segment heights.

When unequal segment heights are used, they should be called to the wearer's attention. Otherwise they will be discovered as an "error."

Transparent Tape or Drawn Line Methods Used Subjectively

To subjectively check the relationship of the two segment heights to one another, have the person look at a given near object and slowly tilt his or her head back until the "line," or top of the tape, first hits the object. Next, alternately occlude the wearer's eyes to determine whether the "line" is at the same point for each eye. If not, move the tape until there is an equalization. Then measure the height of the tape or drawn line from the lower eyewire for each lens (Box 5-3).

Transparent Tape or Drawn Line Methods Used Objectively

To check the segment height relationship objectively using the transparent tape or drawn line methods, have the wearer look at the bridge of the dispenser's nose, as the dispenser tilts the wearer's head back slowly and notes which "segment" reaches the lower pupil edge first. The tape level is readjusted until both "lines" reach the pupils at the same time (Box 5-4).

Segment Height and Vertical Prism

A prism causes the light to deviate from its path to a new direction. A ray of light will be bent toward the base of

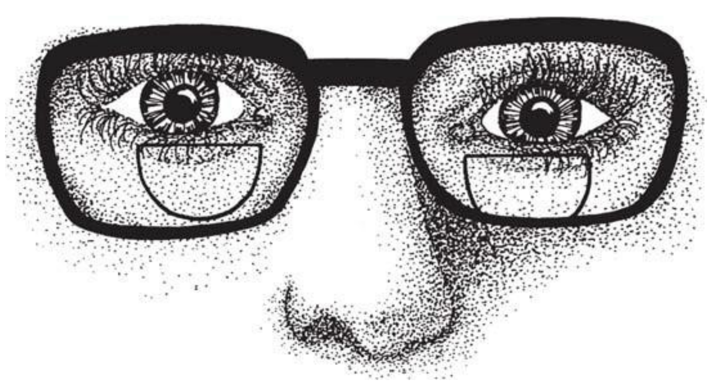


Figure 5-28. A difference in prescribed seg heights is sometimes required so the

person's eyes will meet the bifocal line simultaneously on downward gaze.

BOX 5-3

Steps in Subjectively Checking Equality of Seg Heights

1. On empty sample frame use tape at seg level; on glazed lens, draw a bifocal line with a marking pen; on wearer's old glasses, use the existing bifocal line.
2. Wearer is positioned in normal reading position.
3. Wearer fixates a given reading line through the distance portion of the lens.
4. Wearer tilts head back until he experiences a blur of the fixated line.
5. Fitter alternately occludes wearer's eyes to see if same reading line blurs for both eyes.
6. If not, glasses are (tape or line is) adjusted.
7. Repeat until equal.

BOX 5-4

Steps in Objectively Checking Seg Height Equality

1. Fitter positions himself at wearer's eye level.
2. Wearer fixates bridge of fitter's nose.
3. Fitter places finger under wearer's chin and slowly tilts wearer's head back.
4. Fitter observes seg lines to see which line reaches the pupil first.
5. Glasses (or tape or drawn line level) adjusted.
6. Repeat until even.

the prism, causing the image of the object viewed to be displaced in the direction of the apex. This also causes the eye to turn in the direction of the perceived object. A prism may be necessary in a prescription if there is a slight paralysis of one or more extraocular eye muscles. Without the help of the prism, the person may experience diplopia, or double vision. Even if a person does not have double vision, a prism may be prescribed for ocular comfort. If a tendency for the eyes to turn is present, the person is said to have a phoria condition (i.e., a tendency of the eyes to turn, but with no actual turning manifested) and must exert constant effort to keep both eyes pointing straight ahead. This can lead to fatigue and headaches. A prism can be used to relieve this discomfort. If one eye tends to turn down or up, a vertical prism with the base of the prism up or down is prescribed. If the eyes turn in or out, a horizontal prism with the base of the prism out or in may be prescribed.

When a vertical prism is prescribed, one eye is allowed to turn up slightly more than the other (Figure 5-29). Given equal seg heights, when a person with vertical prism in the prescription is wearing bifocals or trifocals and looks down toward an object in the near field of view, there is a point where one eye crosses the bifocal line before the other. This inequality is not detected in measuring for seg heights if the condition prescribed for is only a phoria.

The inequality of turn can be calculated, however, using the definition of a prism diopter: 1 cm displacement of the image of an object at a distance of 1 m. Assuming 30 mm distance from the back surface of the spectacle lens to the center of rotation of the eye, the difference in the vertical position of the two eyes at the spectacle plane can be calculated. This is the difference in seg height from that which was measured.

According to Figure 5-30, for one prism diopter it can be seen from similar triangles that:

$$\frac{10}{1030} \text{ D } \frac{x}{30}$$

and so

× D 0.29 mm

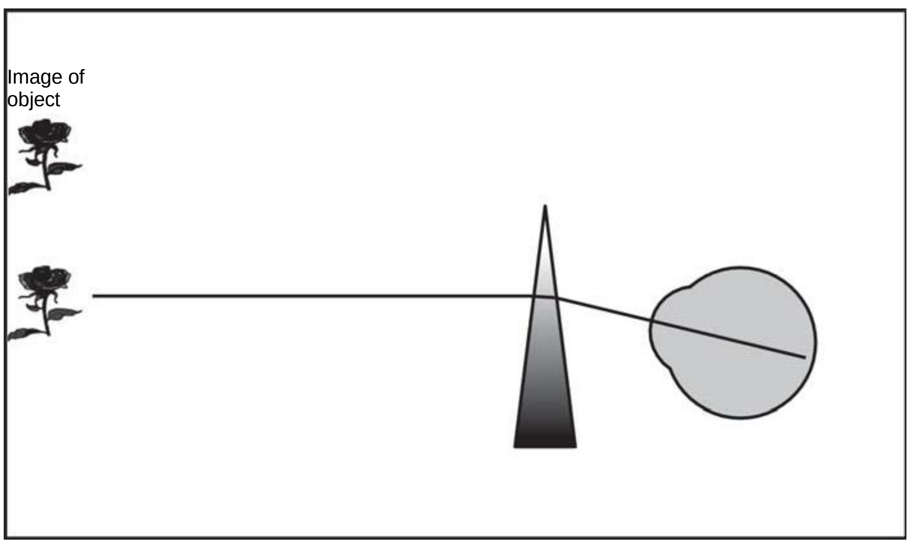


Figure 5-29. A vertical prism causes the eye to turn. This requires an alteration of seg height.

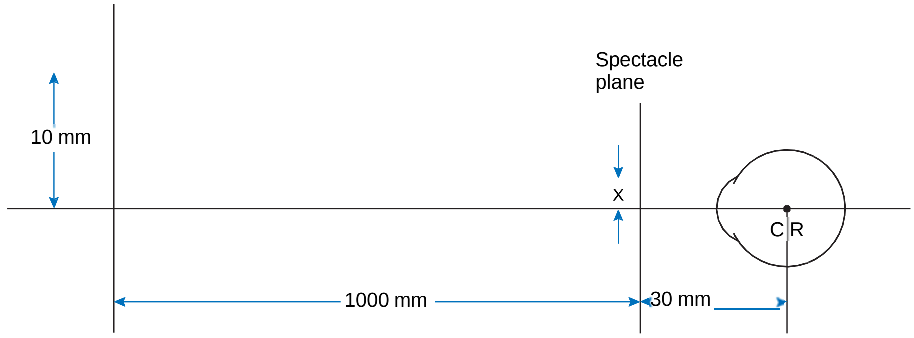


Figure 5-30. Diagram showing required difference in seg heights (*X*) when one prism diopter of vertical prism is prescribed.

Prism Diopters	Total Segment Height Difference (mm)
1	0.3
2	0.6
3	0.9
4	1.2
5	1.5
6	1.8

*When vertical prism is present in a pair of glasses, segment height must be compensated. Each of the prism amounts listed on the left requires a compensated segment height difference as shown on the right.

or approximately 0.3 mm difference for every diopter of vertical prism prescribed. Therefore, a good rule of thumb for prescribing differences in seg heights is to allow 0.3 mm for every prism diopter.

The seg top is always displaced from its original location in the direction of the apex or point of the prism. (The seg line should be moved in the direction the prism apex points.) If a prescription included three diopters of prism base up before the right eye, then the right seg height should be *lowered* approximately 1 mm from its measured position.

Variations of Seg Height

It is not reasonable to expect every person to be best served with a bifocal segment height that comes to the level of the lower limbus. But because some starting point must be used for seg height determination, the lower lid or limbal margin technique was described. It should be understood that these rules should be used as a basis, or starting point, for professional seg measure- ment. Other variations influence final seg height placement.

Posture

Perhaps the most obvious influence on segment height is posture. The person who “walks tall” or erect and carries the head back may find that the normally placed segment is constantly interfering with distance vision. This person would benefit from a segment placed at a level lower than usual because tilting the head back moves the segment higher and into the line of sight.

The person with the opposite tendency (i.e., that of carrying himself or herself in a somewhat stooped-over manner) could wear the segment slightly higher than usual.

These extremes in posture should be noted when apparent, although they are not the norm.

Height

A tall person sometimes needs segments set slightly lower than normal because the eyes must turn downward to a greater degree to sight the floor. The bifocal line would be more likely to interfere if placed at the normal level. Shorter persons, however, should not be given higher than normal segs.

Occupational Need

The person who works at a desk all day may need a higher (and wider) segment than the person who works outdoors and who seldom is required to do any close work.

Round Segs

Different types of segs need to be set at different heights because of variance in the distance to the OC of the bifocal segment and in the shape of the seg top. Specifi- cally, round bifocals need to be positioned about 1 mm higher than flat-top bifocals because their upper area is less useful, being limited in extent, and because their OCs fall much farther from the top. The round bifocal is positioned only l mm higher because it would be dif- ficult to raise it significantly more without interfering with distance vision.

For example, a round, 22 mm-wide seg has its OC 11 mm from the top. Its widest usable area is also located at that 11-mm-from-the-top distance. If a seg were fitted 14 mm high, the center of the seg and the widest usable area would be 3 mm above the frame’s lower rim. If a flat-top seg were used at the same height in the frame as the round seg (i.e., 14 mm high), the OCs would be 9 mm above the lower rim of the frame, as would the widest part of the bifocal.

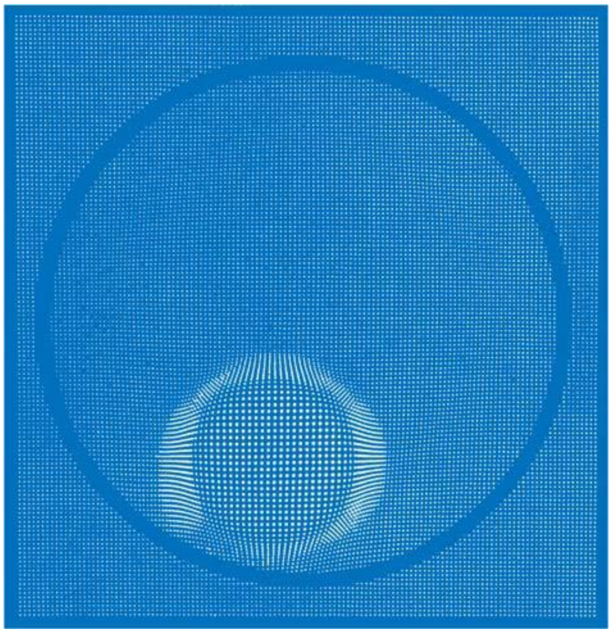


Figure 5-31. A blended bifocal works well for those who desire an invisible near addition, but either do not want or cannot afford a progressive addition lens. (Courtesy of Essilor of America, St. Petersburg, Fla.)

Blended or "Invisible" Bifocals

The so-called *blended bifocal* follows the optical charac- teristics of the usual round-seg bifocal, except that the demarcation line between the distant portion and the bifocal is obliterated by a polishing process of the lens or lens mold that substitutes a narrow nonoptical transi- tion area for the line of demarcation.

A blended bifocal is not a progressive addition lens. The only resemblance is that in both lens designs the near segment is not obvious. Optically a blended bifocal performs the same as a standard bifocal because only two actual zones of focus exist: one for distance and one for near. Consequently, no aberration or unwanted cylinder is noticeable peripherally.

Distortion is produced around the bifocal segment by the blended area, which varies in width from less than 3 mm to just under 5 mm, depending on the power of the add and the base curve (Figure 5-31). This area serves as the boundary of the bifocal, and permits the lens to be fitted according to the same provisions that affect an ordinary visible bifocal. Both the height of the segment and near PD need to be specified.

Because most blended bifocals are of the round seg type, and because the blend is wider than the usual demarcation line, the bifocal may require either slightly higher placement of the top of the segment or greater depression of the gaze for reading. The manufacturer recommends fitting this bifocal 1 mm higher than is usual for other types of bifocals. The frame used should provide sufficient space in its lower area to contain the bifocal.

The blended area is proportionately less visible in low powers than in higher ones. The tendency for the lens segment to be slightly visible increases with an increase of power in distance or near portions.

High Powered Lenses

Looking away from the center of a high plus lens will cause decreased visual acuity because of lens aberrations. This is especially noticeable in regular, nonaspheric lenses and very strong plus lenses such as are used for aphakic corrections.
For example, a regular nonaspheric D12.00 D lens with a D3.00 D back surface curve will show a power of

D11.40 D sphere in combination with a D0.94 D cylinder at a point 25 degrees from the OC. Therefore, it may be seen that the farther from the central area of the lens a person looks, the greater will be the departure from the desired power. Since the power is increasingly affected as a person looks farther from the OC, it is desirable that the reading area of the lens be as close to the distance OC as possible. For these reasons, a straight-top bifocal is more likely to meet this requirement than a round one, and the higher the bifocal is placed in the lens (closer to distance OC), the better the optical requirements can be met.

Children

Bifocals are seldom prescribed for children because of an inability to focus near point material. More often their need for a bifocal stems from a binocular visual problem. Children will normally see clearly through both distance or near portions when viewing near objects. Unless the seg height is properly placed, the child may unconsciously use the distance portion above the seg line for reading or near point work instead of the bifocal portion. To assure that the near addition is being used, the bifocal should be measured and placed so that the seg line *bisects* the pupil. For measuring purposes, the fitter should be on the same level as the child. This ensures that no par- allax error occurs. Children adapt quickly and are not bothered by the high seg placement.
The type of bifocal seg commonly used is a wide flat- top style. A wide near area helps to guarantee that the whole near field will be covered by the add, ensuring its prescribed use. (Some practitioners prefer using a progressive add lens for children who need a near addition because the seg is invisible.) If a progressive addition lens is used for children, the fitting cross is placed 4 mm higher than normal (i.e., 4 mm above the pupil center).

Summary

As can be seen, a considerable number of factors can influence the bifocal height.

Not all of these have been noted here, but those covered in this section can be summarized as follows.

1. Head back—seg lower; head down—seg higher.
2. Tall persons: seg lower
3. Adapt the height to the occupational need. Office professions (close work)—seg higher; outdoor occupations (distance vision)—seg lower.
4. Set round segs 1 mm higher.
5. Set seg tops in high plus lenses as high as is practical.

Influence of Vertex Distance on Apparent Seg Height

The apparent height of the segment is dependent on the distance that the lens is from the eye, or the vertex distance.

If a wearer complains that the new bifocals are too high and always in the way, yet from the front the segs look to be exactly the same height in relation to the eyes as the old pair, the lenses are very likely sitting farther from the face than the old ones were. To illustrate, imagine standing 3 feet away from a window and looking over the window sill at the ground. Approaching the window, more of the ground can be seen, even though the actual height of the sill has not changed. The same is true of the dividing line of bifocals. If the bifocals are farther from the face, they inter- fere with vision just as if they were placed higher.

The solution is to decrease the vertex distance by changing the adjustment of the pad arms on metal or combination frames (see the section on nose pad adjustments or to increase the pantoscopic angle of the frame, tilting the lower edge of the frame toward the face (Figure 5-32). The pantoscopic angle can be increased on almost any type of frame and provides a workable solution because the bifocal section is apparently lowered when it is moved closer to the face.

Because of the relationship between apparent seg height and vertex distance, one seg will appear higher to the wearer than the other if one lens is closer to the face than the other. This possibility should always be investigated if the wearer complains of unequal seg heights (Box 5-5).

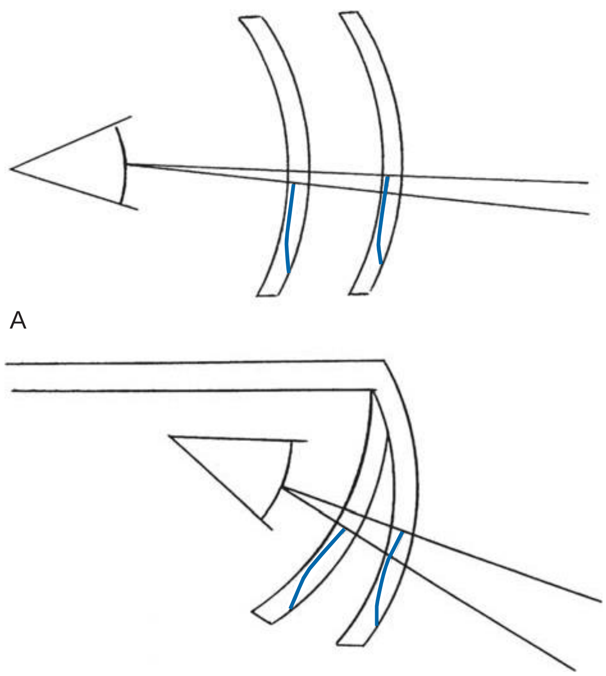
Prism-Compensated Segs

When a person has anisometropia (a large difference in power between the left and right eyes), unequal prism is induced when looking through any area of the lenses except the center.

An individual who does not require bifocals is able to avoid the prism by turning the head and keeping the lines of sight of both eyes close to the optical centers of the spectacles. When reading, the chin is dropped to keep the OCs lined up with the material. The amount the eyes turn inward from these points is usually small enough to elicit only a low amount of prism. The prism base is horizontal and is easily compensated.

If the wearer attempts to read by lowering the eyes rather than the lenses, the eyes will move away from the OCs and additionally induce definite amounts of vertical prism. This may be clinically significant. Some individuals with anisometropia, however, learn to com- pensate for this.

When an anisometrope is forced to use bifocals or trifocals, the prismatic consequences of the prescription can no longer be avoided because the reading segments must be placed away from the OCs of the distance cor- rection. To predict if this will be a problem, ask the wearer to read through the old (nonbifocal) glasses. If the wearer drops the head to read, he or she is looking through the OCs and may need help in the form of slab- off prism to counteract the unequal prismatic effects. If, however, he or she drops the eyes to read and looks through the bottom of the lenses, the wearer isaccustomed to reading through this portion of the glasses and will probably not need any prismatic compensation in the seg.



B**Figure 5-32. A**, Decreasing the vertex distance of a lens from the wearer's point of

BOX

Seg Adjustments Listed in Order to Be Tried

Segs Seem Hgh	**Segs Seem Low**
1. Increase pantoscopic tilt.	1. Narrow pads.
2. Decrease vertex distance. by adjusting pad arms.	2. Bend pads down
3. Spread pads.	3. Increase vertex
4. Move pads up by pantoscopicadjusting pad arms.	4. Reduce tilt.
5. Stretch bridge (plastic (plasticframe).	5. Shrink bridge frame).

view will cause a reduction in the appar- ent height of the seg. **B**, Increasing the pantoscopic angle of a frame also reduces the apparent seg height for the wearer.

COMPENSATING FOR AN INCORRECTLY SIZED SAMPLE FRAME

At the very beginning of the chapter, the importance of a properly positioned frame was emphasized. Before measuring for lens placement, the frame must be positioned on the face where it will be worn, otherwise the measurements will be wrong. So with metal frames, the nosepads are positioned for proper height. And as stated earlier, with plastic frames, if the bridge of the sample frame is too small, the frame will sit too high; if it is too large, it will sit too low. But what should be done if the sample frame is not the same size as the frame that will be worn? Unless allowances for frame size differences are made, the lens measurements will be wrong.

If the eye size is too large or too small, the depth of a given frame style will vary uniformly from one size to the next, according to the “boxing” concept of lens size. If the eye size is incorrect, the segment height ordered will need to be changed to allow for the difference in lens depth. Since the usual difference in vertical dimension from one given eye size to the next is 2 mm, the change required in either the optical center (OC) or seg position from the bottom of the eyewire is 1 mm.

Obviously the chance of error is much greater when using a sample with a correct eye size but an incorrect bridge size because compensation for eye size is relatively simple.

When the Eye Size Is Incorrect

Suppose a person needs, for example, a 52☐20, but the closest available sample is 50☐20. The bifocal is measured using the 50☐20, and the height is determined to be 15 mm. If the lenses are ground for the larger frame, a 15-mm bifocal height will place the seg line too low. The question is how much higher must it now be placed?

To determine the answer, consider that a given frame may use the same pattern for all eye sizes. When the eye size is increased by 2 mm across the A dimension, there is effectively 1 mm of lens material being added to the outside edge in every direction (Figure 5-33). This means that the distance from the geometric center to the lower bevel will be increased by 1 mm. At the same time, the distance from the *desired* seg top position to the lower eyewire also increases 1 mm. Therefore, if a 50☐20 frame requires that the seg line be 15 mm high, a 52☐20 will mandate a 16 mm high seg to maintain the location of the upper line at the desired level. By the same reasoning, a sample frame having an eye size 2 mm too large will measure 1 mm higher than actually required.

Rule of thumb: For an improper eye size, the seg height is corrected by one half the difference between sample frame eye size and desired frame eye size.

As with any rule of thumb, exceptions do occur. They are:

1. If the bridge of the frame is constructed proportionally higher (or lower) in the

frame as the eye size changes, the variations will not be constant. (To check this, for an individual frame style, the distance from the bridge crest to a line running tangent to the upper rims is measured. The difference in these measured values between eye sizes should be half the difference between the two eye sizes, as in the rule of thumb.)

2. Because of the wearer's nose-cheek formation, if it appears that a larger eye size will cause the inner, lower eyewire sections of the larger frame size to rest on a different anatomic part of the face, a larger eye size may rest higher on the face than might be expected. Appropriate care should therefore be taken.

If the Correct Bridge Size Is Unavailable

Now consider the case where the correct eye size is avail- able, but the bridge is one size too small. It is still not possible to measure directly using the frame as it sits "normally" when placed directly on the face. When the bridge size is too small, the whole frame will sit too high on the face. Any uncompensated direct measure will result in a seg that is much too low. The right bridge size will allow the frame to be at its correct lower position. Unfortunately, there is no conversion factor possible using a sample frame with the wrong bridge size. Instead the fitter must move the frame down the nose until properly positioned, then hold it in place while measur- ing for seg height. (This presumes that the fitter is able to accurately estimate where the correct size will place the frame.)

The Alternatives

Of the two situations presented, the more predictably accurate involves an incorrect eye size combined with a correct bridge size. If the fitter has a choice betweenusing either (1) an incorrect eye size and correct bridge size, or (2) a correct eye size and incorrect bridge size, then the first instance should be chosen.

INSTRUCTING THE NEW BIFOCAL WEARER

New multifocal lenses represent a completely foreign experience for the first-time wearer. Some of the resultant problems may be prevented by direct advice ahead of time.

Because of the magnification produced by plus lenses, the wearer can expect objects seen through bifocals to appear magnified, creating the impression that these objects are closer because they appear larger. Curbs look higher than they really are, and staircases become real hazards when observed through the bifocal add. Distance judgment returns to normal after a period of ada tation despite the magnification, and the height of stairs, curbs, and so forth, are properly judged.

The new bifocal wearer will experience differences from well-established habits, and the necessary adjustments to compensate for the differences should be explained to him or her. For example, before wearing bifocals:

1. The floor could be seen by keeping the head erect and dropping the eyes into the lower portion of the lenses.
2. A book could be read by holding the eyes at the center of the lenses and dropping the chin and head. To correctly use bifocals:
1. The floor is seen by holding the eyes at the center of the lenses and dropping the chin and head.
2. A book must be read by holding the head erect and dropping the eyes into the lower portion of the lenses. These differences may be contradictory to the wearer's well-established habits. A period of adaptation is required, and the wearer can more easily master the new responses required if he or she understands them ahead of time.

DETERMINING LENS BLANK SIZE

A *lens blank* is a lens before it has been edged to fit into the frame. It may be either finished or semifinished. A *fi nished* lens blank has the correct powers called for in the prescription and needs only to be edged. A *semifi nished* lens blank has only one side of the lens finished, usually the front side; the back side needs to be ground and polished to the correct power.

The dispenser is concerned with lens blank size for several reasons. For single vision lenses, the question is

MBS for Single-Vision Lenses

The PD *measurement* in essence determines the position of the OCs of the lenses and helps decide the total size of the finished lens blank required for the designated frame. It will be recalled from Chapter 2 that the effective diameter (ED) of the spectacle lens is found by taking the distance from the geometric center of the lens to the edge point of the lens farthest from the geometric center and doubling it (see Figure 2-2). If a person's eyes are not at the geometric centers of the frame, the centers of the lenses must be displaced or decentered so they are vertcally aligned with the centers of the wearer's pupils.

For example, if the OC of the lens falls at the geometric or boxing center of the frame's lens shape, then a lens blank with a diameter equal to the frame shape's ED is large enough to fill the frame's lens opening. But if the lens must be decentered, then as a general rule 2 mm must be added to the ED of the lens blank for every 1 mm the lens is decentered.*

Determining MBS for Finished, Single-Vision Lenses Using a Drawing

It is possible to use the newly selected frame in combination with a scale drawing to determine the minimum, finished single-vision lens size necessary. This drawing is shown to scale in Figure 5-34. Follow the directions given with the figure legend.

Determining MBS for Multifocal Lenses Using a Drawing

For multifocal lenses, the location of the segment in the frame determines whether or not the semifinished lens blank will be large enough. If the bifocal or trifocal segment is too high, there may be an air space between the bottom of the edged lens and the frame's lower eyewire. It is always an embarrassment to the dispenser when the surfacing lab calls to say that the lens will not cut out for the chosen frame. This can sometimes mean that the wearer must be asked to return to select a new frame. Therefore it is best to try and avoid problems in questionable cases by verifying lens blank size ahead of time. This may be done using actual-size drawings or charts. An example of a chart is shown as Figure 5-35.

All charts basically mimic the semifinished lens. The frame is placed on the scale drawing of the lenses and moved vertically and horizontally to position the lens segment as it will appear in the frame. If the frame's lens

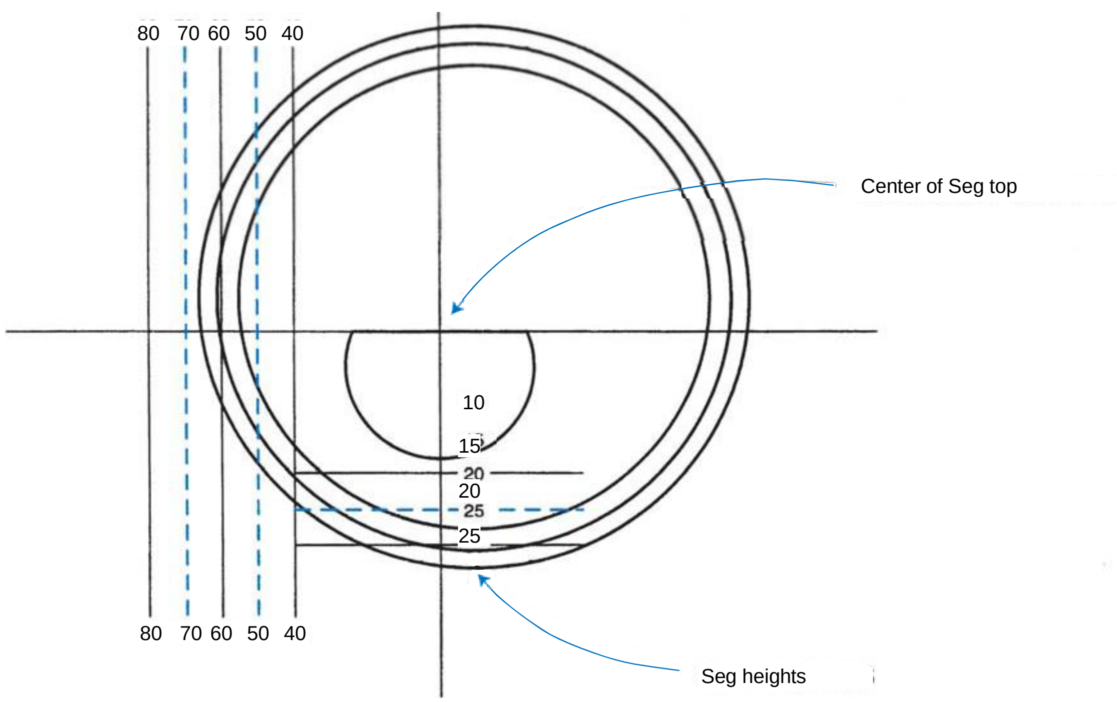


Figure 5-35. To use a multifocal minimum blank size chart, place the right side of the frame

face down over the chart. Move the frame left or right until the near interpupillary distance line corresponding to the ordered near interpupillary distance is directly in the center of the frame bridge. Move the frame up or down until the correct seg height corresponds to the lowest part of the inside bevel of the lower eyewire. The smallest circle that completely encloses the lens shape is the smallest blank possible for this manufacturer. Because manufacturers' lens blanks will vary, blank size charts for multifocal lenses are not interchangeabl opening is completely covered by the drawn lens, the real lens blank will be large enough (Box 5-6).

BOX 5-6

How to Use Scale Lens Drawings to Determine Minimum Blank Size for Multifocal Lenses

1. Place the frame face down on the drawing.
2. Move the frame up or down until the inside bevel of the lower eyewire is over the line corresponding to the correct seg height.
3. Move the frame left or right until the center of the bridge is over the line corresponding to the near PD.
4. Note whether the lens blank completely encircles the frame's lens opening.
5. If encirclement is complete, the blank is large enough. If it is not, the blank is too small.

If the Multifocal Lens Will Not Cut Out

Sometimes a lens will not cut out because the seg ordered is especially high or unusually low. If a lens will not cut out for this reason, it is possible to move the frame up or down until the drawn lens covers the frame's lens opening, thus determining how much the segment height will need to be decreased or increased so the lens will cut out. This modified height may be read directly from the drawing. Now the dispenser must make a judgment. Can the seg height be modified, or should a different frame or new multifocal lens style be chosen? Often a small change in seg height will allow the chosen frame to be used.

Sometimes a lens will not cut out because the wearer's near PD is too small to permit enough lens decentration. This may be a warning that the frame selected is too large for the wearer. Moving the frame left or right on the minimum blank size chart will show what the near PD must be so that the lens will cut out. (In some cases, it may be permissible to modify the near PD if the bifocal segment is wide enough. For more on this subject, see Brooks: *Essentials for Ophthalmic Lens Finishing*.[4])

Sample Questions:

1. A metal frame with adjustable pads and a 40 mm B dimension is selected. The frame and pads are adjusted so that the frame sits on the nose and face as it should after dispensing. The frame front is tilted to the correct pantoscopic angle and is observed to be straight on the face. Neither lens is higher than the other. The frame front has a 10- degree pantoscopic angle. Measure the MRP height and modify this amount to compensate for the pantoscopic tilt.

Solution

In measuring the pupil center height, the distance from the

Figure 5-10. If the chin is raised until the frame front is perpendicular to the floor, major reference point height can be measured without compensating for pantoscopic tilt.

is 28 D 5 or 23 mm. (Normally the MRP height would be on the horizontal midline at a height of 20 mm.)

2.**A new prescription calls for a D 2.00 add. It is possible thatthe wearer would benefit from an occupational, double-D segment. What power Fresnel seg should be chosen for demonstration purposes?**

Solution

Subtract 0.50 D from the D2.00 D add. This reduced D1.50 D add will be the add power of the chosen segment. Find this power in a Fresnel segment. Position the segment upside down so that it adheres to the upper portion of the wearer's old eyeglass lenses, exactly where the upper, occupational segment will be. This demonstration will be realistic if the distance power of the old prescription is not too muchdifferent from what the new prescription will be.

3

A wearer selects a new frame. The dispenser uses the newlyselected frame to measure seg height. Both right and left seg heights are measured as 21 mm. If the right lens has 3 D of base down prism, what segment heights should be ordered so that the pupils reach the segment lines at the same time once the prism is in place?

Solution

Because the right lens has base down prism, the righteye will turn upward toward the apex of the prism. The amount the eye will turn equals 0.3 mm for each diopter of vertical prism. Therefore the eye turns 0.3 × 3 D 0.9 mm, or1 mm, when rounded. This means that the right segmentheight must be raised 1 mm. The final seg height should be ordered as:

R: 22 mm.
L: 21 mm.

4

Suppose a wearer has a prescription that reads as follows:

R: D2.50 D 1.00 × 180 2.5 D Base Up
L: D2.50 D 1.00 × 180 4.5 D Base Down
D2.00 add

The selected frame is properly adjusted before seg height measurements are taken. Seg heights are measured using the empty frame. They are found to be:

R: 21
L: 21

How should the seg heights be adjusted to allow for the influence of the prescribed vertical prism once the lenses are in place?

Solution

To solve the problem, first decide which seg height will be raised and which lowered. Because the seg height will be displaced in the direction of the apex (i.e., opposite the base direction), the right seg height will be lowered and the left seg height raised.
To continue solving, next consider how far each seg height must be moved. Remember that each prism diopter yields
0.3 mm of movement. For the right eye, this is 2.5 D × 0.3
D 0.75 mm of movement. For the left eye we find 4.5 D ×
1.3 D 1.35 mm. Therefore, to the nearest millimeter the seg heights will be:

R: 20 mm
L: 22 mm

The same principles that are explained here for segment heights also apply to progressive addition lens fitting cross heights. For more information on how vertical and horizontal prism affects fitting cross heights and monocular PDs, see Chapter 20.

Example **5**

What would the MBS be for a finished, single-vision lens that is to be placed in a frame having the following dimensions?

A D 52 mm DBL D 18 mm ED D 57 mm

The wearer's PD is 62 mm.

Solution

First find total decentration.

Total decentration D (A D DBL) D PD In this case,
total decentration D (52 D 18) D 62
D 8 mm

Now that the total decentration is known, MBS is deter- mined by

MBS D ED D total decentration D 2 mm
D 57 D 8 D 2
D 67

Therefore, if the prescription has no prescribed prism, the smallest finished lens blank that could be used has a diameter of 67 mm.

Unit 8:

Ordering and Verification

Learning Objective:

This is basically a guide to procedures followed when ordering and verifying prescriptions from an optical laboratory. Using uniform terminology and a checklist approach assures a minimum of errors, which in turn improves the quality of service to the spectacle wearer.

1. At the end of this unit, students will be able to understand ordering, manufacturing and verification of lenses.

ORDERING

When ordering a prescription, use the manufacturers or supplier's own printed form or enter it online if possible. This will prevent many errors or omissions in processing. Online ordering can help prevent errors because the program will often keep the order from being sent until all necessary information is present.

With paper forms, it is very important to print the necessary information. Poor or illegible handwriting usually results in errors.

General Procedures for Forms

Use a separate form for each job ordered, since the form itself may travel with the materials during laboratory processing.

When ordering less than a total frame and both lenses, specify this clearly on the order form. For printed forms, write this in fairly large letters or check the appropriate places on the form.

Do not include superfluous data or information on any forms if such data are not necessary or applicable to the order. For example, do not supply eye size and bridge size if only a temple is being ordered.

Lens Information

When writing the prescription in paragraph form, such as in a letter, always write the data referring to the right lens first, followed by the data for the left lens. For example, "Mr. Hensley was issued a prescription of OD:
03.00 D sphere, OS: 02.75, 01.50 × 175." When written on a blank prescription pad, such a prescription would be written with the left lens value directly below that of the right lens. This would appear as follows:

OD: 03.00 D sph
OS: 02.75 01.50 × 175

("OD" is, in this instance, the abbreviation for "right eye" from the Latin words

oculus dexter, whereas “OS” is the abbreviation for the Latin words *oculus sinister*, or left eye.) Always use at least three figures for the sphere and cylinder components. If the dioptric unit is less than 1.00 D, use a prefatory zero before the decimal point, as for example, 00.75 D. Carry figures two places after the decimal point, as for example, 02.00 D (not 02 D) or
1.50 D (not 01.5 D). State the axis as *x*, but do not put a degree sign after the numbers representing the cylinder axis because it may be mistakenly read as an extra zero. For example, 10 degrees may be misread as 100 when written out with the degree sign in longhand as 10°. Many also use 3 numbers for the axis. Therefore it is normal to see a 5 degree axis written as 005.
Check the base curve of the wearer’s old lenses, particularly when only one lens is being replaced.

Frame Information

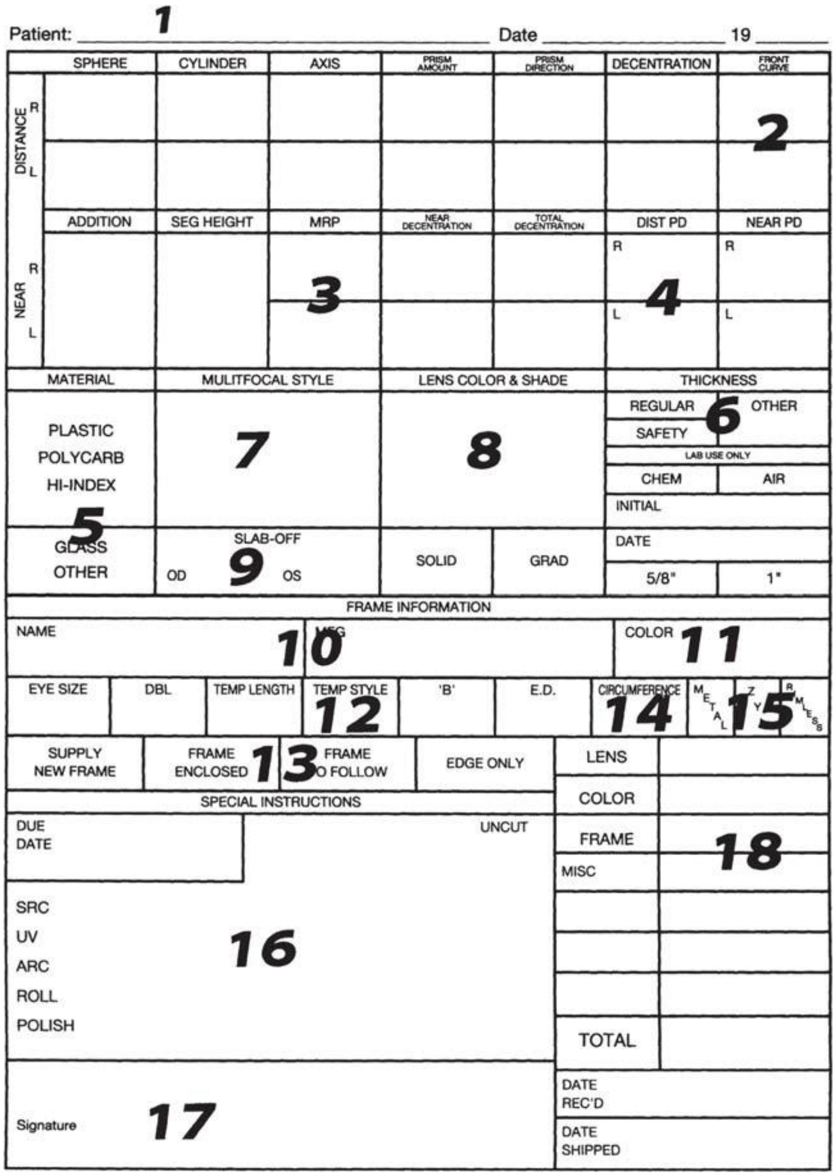
Be sure to specify the style of temple desired if more than one style is available. Print the name of the frame and include the name of the manufacturer (Figure 6-1).

REORDERING FROM EXISTING SPECTACLES

Sometimes it is necessary to use a person’s existing spectacle lenses as the basis for ordering another pair of glasses. This can occur in an emergency situation if the person has cracked or broken a lens and the lenses are still in the frame. It may also happen that an individual has a pair of glasses and wants a second pair, but no longer has the written prescription.

Obtaining Lens Information forExisting Spectacles

Although it is possible to read the prescription directly from the current eyeglasses, it is best to contact the prescriber or previous dispenser to verify what was ordered—not just what was received. For example, when taking a prescription from an existing pair of glasses, one may misread a cylinder axis as 170, when the lens is really axis 168. Yet the original order could have called for axis



E **Figure 6-1.** Example order form. Order forms vary considerably from laboratory to laboratory. It is crucial that an order form be completely and correctly filled out. Errors in complet- ing the order form can result in glasses being improperly made, necessitating a costly remake. At the very least, an incomplete order form could delay the order or require that the wearer return so that the missing information can be sup- plied. Instructions for completing each general area of the form are given below. Areas left blank are self-explanatory.

(1) Some recommend that the wearer's last name be written here in all capital letters, be underlined, and be listed before the first name. This is followed by a comma and the first name printed in small letters.

(2) List only if ordering special base curves. Otherwise leave blank.

(3) List the MRP height *only* if it is other than at half the B dimension. Otherwise

this is left blank. Often this is where fitting cross height is listed for progressive addition lenses.

(4) Do not give both binocular and monocular PDs. Use either one or the other, but not both. If you use a binocular PD, write it once, right on the line between left and right boxes.

(5) You must indicate a lens material.

(6) Normally you do not specify a thickness for the lens. Be sure to indicate if the lens is a regular thickness or is for safety eyewear, however. If the frame is a Z87 safety frame, circle “safety” and the lenses will be properly marked to conform to Z87 requirements.

(7) Indicate multifocal type and seg size, or progressive lens brand when appropriate.

(8) Indicate as specifically as possible what color lens you want. Indicate the desired transmission or shade. If the lenses have no tint, write either “clear” or “white.” Circle either “solid” for a uniform tint, or “grad” for a gradient tint.

(9) If slab-off is being ordered, indicate the prism amount of the slab-off.

(10) The frame name may be anything from “Harry” to “T849.” The name alone is not enough; the manufacturer must be listed as well. It is not uncommon for more than one manufacturer to use the same name or number.

(11) Color may be a number.

(12) Examples: skull, cable, riding bow, library.

(13) Circle one on this row. “Frame to Follow” means the frame is not with the order. It is to be sent later.

(14) If the order is for “lenses only” (edge only), one way to ensure a more accurate fit is to remove the lens from the frame and measure the circumference of the lens with a circumference gauge. This will allow for better duplication of the lens size. However, a digital frame tracer works best.

(15) Indicate whether the frame is metal, plastic, or rimless. This is especially important when the frame is not present. Be even more specific as to lens material if possible.

(16) “Special Instructions” is for calling attention to any- thing unusual about the prescription. “SRC” means scratch resistant coating; “UV” means add ultraviolet protection (plastic lenses only); “ARC” means antireflection coating (plastic or glass); “roll” means to roll the edges of the lens to make the lens look thinner; “polish” means to polish the edges.

(17) Signature of the person or the name of the office that is ordering the prescription.

(18) This section is for laboratory pricing.

165. So an axis 170 lens is ordered. But what if the new lens comes in as axis 172? The dispenser will likely accept the lens because it is only two degrees off and within ANSI standards. What the dispenser does not realize is that the axis of the lens is really off by 7 degrees, com- pared with the original prescription.

Take New Facial Measurements

Even when duplicating an old pair of glasses, it is still important to take new facial measurements. Retake the wearer's PD. You may still wish to use the distance between the OCs found in the old glasses, but you need to know the wearer's measured PD. Large differences may indicate the presence of prescribed prism. If the lenses are either bifocal or trifocal lenses, note where the segment line falls in reference to the lower limbus. This is important if the new segments are to match the old ones. If the lenses are progressive addition lenses, find the location of the fitting cross on the old lenses to verify that it falls in the center of the pupil (see Chapter 20, Progressive Addition Lenses).

When the Wearer's PD Does Not Match the Distance Between Optical Centers

If the wearer's PD that has just been measured does not match the distance between the OCs in the glasses that are being worn, the dispenser's best options are to:

1. Find out where the prescription originated and call to verify the prescription. Specifically ask if the prescription contains prescribed prism. This is always the correct first option, even when the prescription can be easily read from the existing glasses because an error still may have occurred.
2. If the wearer has no idea where the prescription originated and does not want to have a new eye examination, use the PD found in the existing glasses.* You cannot be sure this is not part of the

*The exception to this generalized rule would be for lenses with very low powers in the horizontal meridian. If the optical center of a very low powered lens is off, there is very little horizontal prismatic effect produced. This possibility will become more obvious once the reader is familiar with ANSI Z80 Standards for PD and horizontal prism. For low-powered lenses, the distance between optical centers can miss the wearer's ordered PD by a relatively large amount and still produce only a negligible horizontal prismatic effect. When this occurs, the glasses are still considered to be within tolerance.

For example: A lens pair has a power of 00.50 D sphere in both

eyes. The wearer's PD is 60. However, the measured distance between lens centers in the old glasses is 64 mm. This means that the resulting prismatic effect will only be 0.20 prism diopters. Unwanted horizontal prism of this amount is well within ANSI standards of acceptability. And it is also highly unlikely that the original prescription included prescribed prism of an amount less than even one quarter diopter.

To summarize, familiarity with ANSI standards for PD-horizontal prism will make it easier to discern when differences such as these are due to allowable tolerances and when there is a truly prescribed prism present in the prescription.

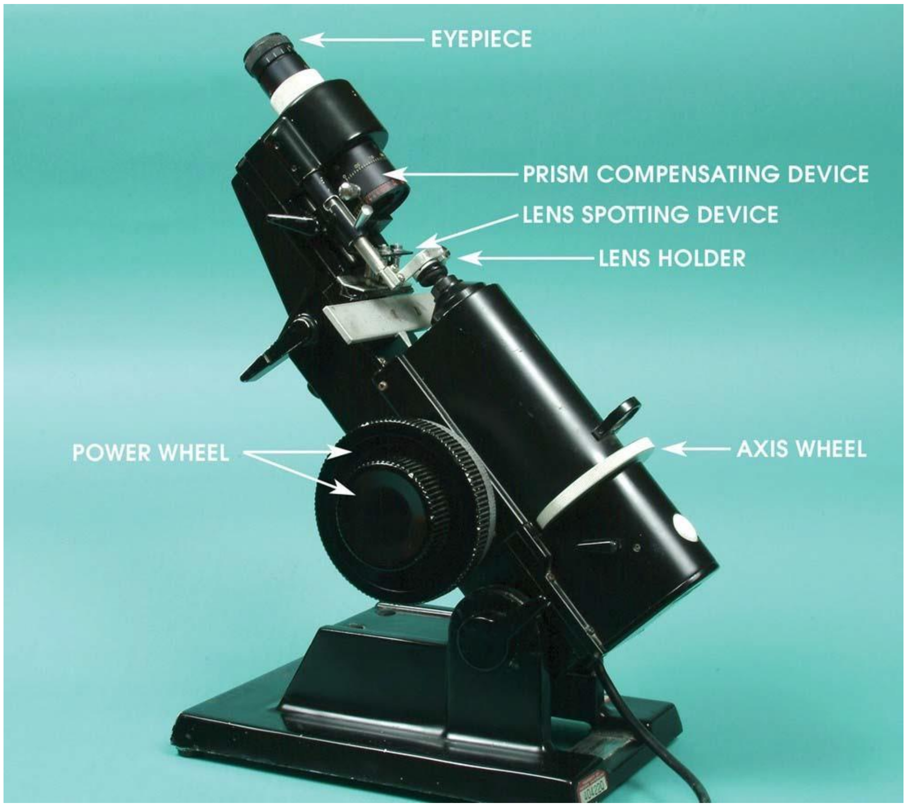


Figure 6-2. A manually-operated lensmeter has certain basic parts common to most instruments.

original prescription and thus should duplicate what is being worn. (Besides, changing an existing prismatic effect may present adaptation problems for the wearer.) You should be certain that the reason for ordering a PD other than the wearer's measured PD is well documented in the record.

Obtaining Prescription Information forSingle-Vision Lenses

The heart of the lens prescription is the sphere, cylinder, and axis. These measures of lens power are found using a *lensmeter* (Figure 6-2). Most lensmeters use line targets, but others have targets consisting of a circle of dots. There are lensmeters with internally viewed targets and those with targets projected on a screen. Lensmeters may also work manually or automatically. The most commonly used lensmeters are manual and use a crossed- line target.

How to Find Single-Vision Lens Powers Using a Crossed-Line-Target Lensmeter

When using a lensmeter, begin by focusing the eyepiece to assure an accurate reading. When looking through the eyepiece, imagine sitting on top of a tall building and looking at the street below. This will help relax your accommodation and keep your eye from changing focus,

which can contribute to inaccuracies. First, rotate the eyepiece so that it moves toward the operator's eye— away from the rest of the instrument. Then looking at the *crosshairs and concentric circles* (not the crossed-line, illuminated target), slowly turn the eyepiece back toward the rest of the instrument until the crosshairs and con- centric circles *fi rst* come into sharp focus. If you turn too far and pass the first clear focus, again rotate the eye- piece away from the instrument; then slowly rotate it back toward the instrument to the first best focus.

The focusing procedure is only done once and need not be repeated for each pair of spectacles being measured. However, this eyepiece focal adjustment will be different for each individual. When more than one person uses the instrument, the procedure must be repeated for each individual. (Time may be saved by having each person who uses the instrument mark the edge of the eyepiece for their own "zero point.")

Reading Sphere and Minus Cylinder Axis Powers. When reading a spectacle lens prescription, which lens should be verified first? Here is how to decide.

- It is proper to begin with the strongest lens first. For this purpose the strongest lens is defined as the lens with the strongest power in the 90-degree meridian.
- If the lenses have similar powers and there is also prescribed vertical prism in the prescription, then begin with the lens with the most prescribed vertical prism.
- If it is not evident which lens is stronger and there is no prescribed vertical prism, begin with the right lens.

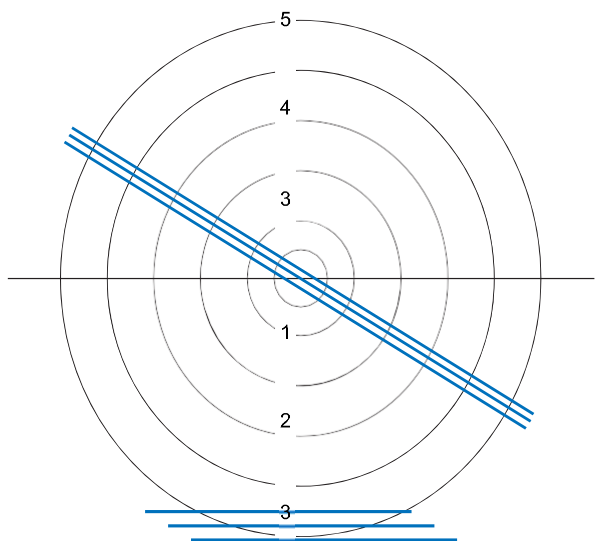
Place the glasses in the lensmeter so that the back side of the lens is against the lensmeter aperture.

There are two ways to read or write a prescription. One is to read the cylinder in the prescription as a minus cylinder. The other is to read the prescription so that the cylinder is given as a plus power. We will first consider the prescription as being a *minus cylinder form* prescription.

To read a prescription in minus cylinder form, begin by turning the *power wheel* in the high plus direction. Now slowly turn the wheel back in the minus direction. If the prescription is a sphere, with no cylinder component, the illuminated target will clear all at once as shown in Figure 6-3. In older instruments, the target may consist of a single line, which represents the sphere, crossed by three widely spaced lines, which represent the cylinder. A more common configuration consists of three closely spaced lines for the sphere, crossed by three widely spaced lines representing the cylinder.

If the prescription contains a cylinder component, the sphere and cylinder lines will not focus simultaneously. Thus after the power wheel has been turned to the high plus, slowly turn the power wheel in the minus direction. This will cause either the sphere or the cylinder lines to begin to clear. *The sphere lines need to be cleared fi rst.* If the narrower sphere lines begin to focus first, but do not fully clear, the *axis wheel* should be turned until the sphere lines do clear (Figure 6-4). (It may be necessary to alternately adjust both the power wheel and the axis wheel until the sphere power lines do clear.) If the cyl- inder lines begin to clear first, the axis wheel should be rotated 90 degrees, causing the sphere and cylinder lines to transfer places. The sphere lines will then be clearer than the cylinder lines. When the sphere lines appear

Figure 6-3. When the illuminated target shows both sphere and cylinder lines that are both clear at the same time, the lens is a sph



Out of focus cylinder lines

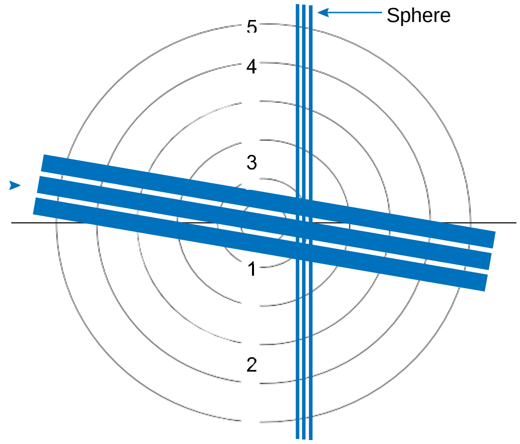


Figure 6-4. Whether the operator is reading a spherocylinder lens in plus or minus cylinder form, the sphere lines must come into focus before the cylinder lines.

Finding the Cylinder Power. To find the cylinder power, continue turning the power wheel farther in the minus direction. The sphere lines will blur and the three wide cylinder lines will come into focus (Figure 6-7). When the three cylinder lines are in focus, note the new power wheel reading. The difference between the sphere reading and this new reading is the power of the cylinder. This cylinder value is recorded as a negative number.

Reading a Lens in Plus Cylinder Form. Some prescriptions are written with the cylinder as a plus value instead of a minus value. When written this way, the prescription is said to be in *plus cylinder form.* To read a prescription in plus cylinder form, lensmeter measuring procedures are basically the same as when reading in minus cylinder form, with one exception. When finding the sphere power, turn the lensmeter power wheel first in the high *minus* direction, instead of the high plus

Cylinder lines

Out of focus sphere lines

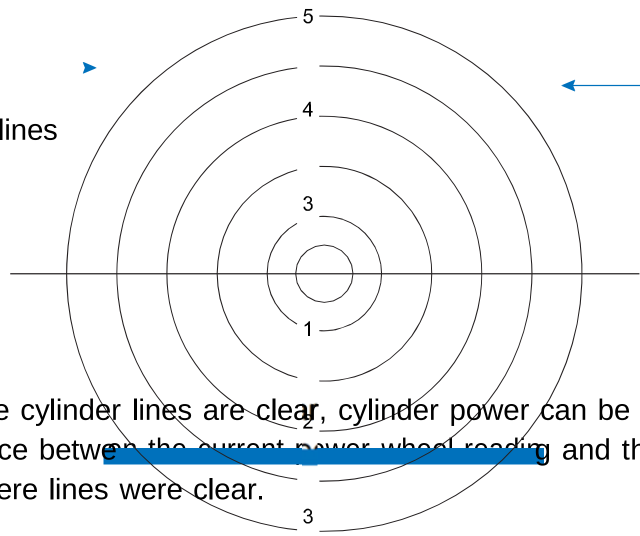


Figure 6-7. Once the cylinder lines are clear, cylinder power can be figured. Cylinder power is the difference between the current power wheel reading and the reading noted earlier when the sphere lines were clear.

BOX 6-1

How to Find Spherocylinder Lens Power Usinga Standard, Crossed-Line-Target Lensmeter

1. Focus the eyepiece.
2. Turn the power wheel into the plus until the illuminated target blurs out.
3. Turn the power wheel slowly in the minus direction until the sphere lines clear.
4. Adjust the axis wheel for optimum sphere line clarity.
5. Record sphere power and cylinder axis.
6. Turn the power wheel farther in the minus direction until the cylinder lines clear.
7. Take the difference between the two power wheel readings and record as a minus cylinder.

direction. When the target is blurred out and the power wheel is in high minus numbers, slowly turn the wheel back in the plus direction. If the prescription is a sphere, the illuminated target clears all at once. If the prescription contains a cylinder component, however, the sphere lines must come into focus first. Turn the axis wheel to achieve this. Sphere and cylinder axis may be recorded. (Note that the cylinder axis will be 90 degrees away from what it was when the lens was recorded in minus cylinder form. The sphere value will also be different.)

Next, turn the power wheel further in the plus direction until the three cylinder lines are clear. The difference between the sphere power reading and this new reading is the cylinder power. The cylinder power is recorded as plus.

Find and Spot the Optical Center of the Lens. After finding the sphere, cylinder, and axis, locate the optical center (OC) of the lens by centering the illuminated target at the intersection of the cross hairs in the eye- piece reticle. This is done by moving the glasses left or right on the instrument table, and moving the instrument table up or down. (In practice, this is done at the same time as sphere, cylinder, and axis values are being found.) Once centered, the lens is spotted using the lens-meter spotting mechanism.

If the cylinder power is high, the sphere and cylinder lines cannot be seen simultaneously. This makes centering of the lens difficult. To center the lens, move it until the sphere line crosses the center of the reticle cross hairs. Then focus the cylinder lines and recenter the lens so that the middle cylinder line crosses the center of the cross hairs. Then repeat the process, going back and forth between sphere and cylinder lines until both are centered without moving the lens.

After the first lens is spotted, move the second lens in front of the lensmeter aperture and determine sphere, cylinder, and axis values for the second lens. Locate the OC of the second lens by centering the target on the reticle horizontally. Do not try to center the lens vertically. Do not move the instrument table up or down.

If the target is not centered vertically, record the amount of resulting vertical prism seen in the instru- ment. (How prism is recorded will be explained in more detail later.) Spot the lens once. Now move the instru- ment table up or down until the target is centered verti- cally. Spot the lens a second time. The second spotting shows the OC height. It will also be used later on to tell if the prescription is within standards for unwanted ver- tical prism. The first spotting is used to measure the horizontal distance between left and right OCs.

If there is no prescribed prism in the prescription, this horizontal distance between OCs should equal the wear- er's PD. In practice, there is a certain amount of allow- able tolerance for error. Tolerances will be covered later in the chapter in the section on lens verification.

The heights of the OCs are measured as the vertical distance from the lowest portion of the lens bevels, up to the level of the spotted OC. When there is no pre- scribed prism present, the OC and MRP are one-and- the-same. When this is the case, measuring OC height is the same thing as measuring MRP height.

How to Find Single-Vision Lens Powers Using a Corona-Target Lensmeter

Some lensmeters use a circle-of-dots target instead of a crossed-line target to measure lenses. To find the power of single-vision lenses with a circle-of-dots (corona) type of instrument, begin by focusing the eyepiece. This is done in the same manner as previously described for the crossed-line lensmeter.

To find the sphere power, turn the power wheel into the high plus direction until the circle of dots disappears. Slowly turn the wheel back toward the minus direction. If the whole circle of dots clears simultaneously, the lens is a sphere. Sphere power is read directly from the power wheel.

If the dots elongate into clear lines as shown in Figure 6-8, the lens has a cylinder component and the reading

Figure 6-9. With a spherocylinder lens, the circle of dots will elongate a second time. Turn the eyepiece crosshair so that it parallels the direction of elongation. This is the cylinder axis. Here the cylinder axis reads 70 degrees.

BOX 6-2

How to Find Spherocylinder Lens Power Using a Corona-Target Lensmeter

1. Focus the eyepiece.
2. Turn the power wheel into the plus until the illuminated target blurs out.
3. Turn the power wheel slowly in the minus direction until the dots in the target elongate into clear lines.
4. Record the sphere power.
5. Turn the power wheel farther in the minus direction until the dots in the target elongate into clear lines in the other direction (90-degrees away).
6. Turn the measuring hairline until it parallels the direction of elongation.
7. Record the cylinder as the minus difference between the two power wheel readings, and the axis as the degrees indicated by the measuring hairline.

just found is the sphere component of this spherocylinder lens. To find the cylinder, turn the power wheel further into the minus direction. The elongated "dots" will blur and re-elongate at right angles to their original direction. When they are once again clear, note the power reading. The difference between the sphere power and this second power wheel reading is the cylinder power.

To find the cylinder axis, use the rotating hairline and degree scale found in the eyepiece. Rotate the hairline until it parallels the direction of elongation of the circle of dots. Note where the hairline falls on the degree scale. This is the axis of the cylinder (Figure 6-9). (For a summary of this procedure, see Box 6-2.)

Obtaining Prescription Information forMultifocal Lenses

Distance powers for multifocal lenses are measured in the same way that powers for single vision lenses are measured. A multifocal differs from a single vision lens because it has additional plus power for viewing at near. This near addition is plus power that is added to the power of the distance prescription.

To measure the distance power of multifocal lenses, place the glasses in the lensmeter in exactly the same way as would be done for single vision lenses (Figure 6-10). The distance power is measured in the manner previ- ously described for single vision lenses.

To measure the add (near addition) power, turn the glasses around backward in the lensmeter so that the front of the lenses are against the lensmeter aperture. Now remeasure the distance power. When measured this way, the power is called *front vertex power*. When measured in the normal way, from the back, the power measured is called *back vertex power*. For higher lens

Figure. To measure the power of single vision lenses or the distance power of segmented multifocals, the glasses are placed in the lensmeter as shown. This

measures the prescription in the correct manner. The power being measured is known as the back vertex power.

powers, it is not unusual to find a difference between front and back vertex powers.

It will be noted that the lensmeter-measured cylinderaxis for the front vertex power is the mirror image of the axis for the back vertex power. In other words, a lens having a 30-degree back-vertex-power axis will manifest an axis of 150 degrees when turned around.

When remeasuring the distance power as front vertex power, do not measure the lens at the OC. Instead measure the distance front vertex power at a location above the OC. That point should be as far above the OC and inward as the point where the add power will be measured is below the OC and inward (Figures 6-11 and 6-12). This technique ensures that any power variations caused by lens aberrations or lens thicknesses will be the same in distance and near power measurements.

Next measure the power of the lens through the near segment (Figure 6-13). (For a summary of measuring near add power, see Box 6-3). The difference between distance and near power readings is the power of the near addition. When the lens is a spherocylinder lens, the near addition is the difference between the distance sphere and the near sphere power components.

Figure 6-11. When measuring the add power of a lens, first turn the lens around. Remeasure the distance power at a point above the optical center. This point should be as far above the distance optical center as the near verification point is below the optical center.

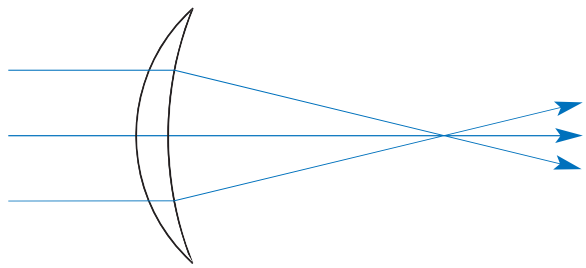


Figure 6-12. To measure multifocal lens power, the glasses must be turned around backward in the lensmeter and distance power measured again, this time as front vertex power. Note that the power is measured as far above the optical center of the lens as the near verification point in the multifocal segment is below the distance optical center of the lens.

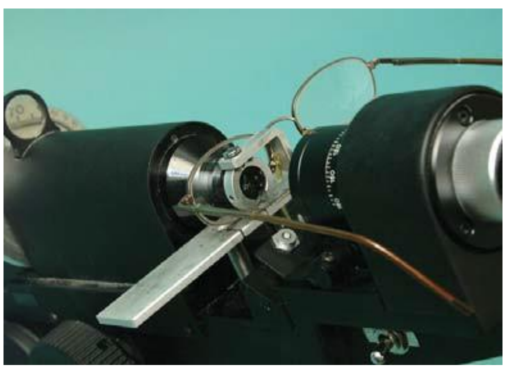


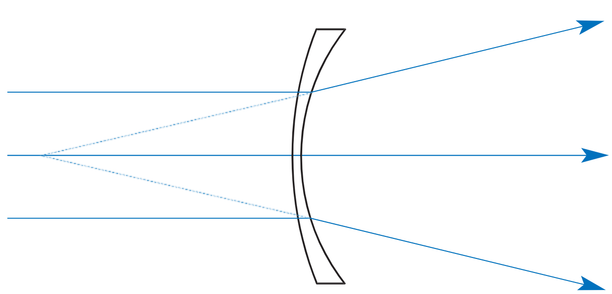
Figure 6-13. With the glasses still backward, the power through the multifocal segment is measured. This difference between distance and near powers is the power of the near addition.

BOX 6-3

How to Measure Multifocal Add Power

1. Turn the glasses around backward in the lensmeter.
2. Measure the sphere value of the front vertex distance power.
3. Measure the sphere value of the front vertex, near power.
4. The difference between the two values is the add power.

A



B

Figure 6-14. A distance lens is meant to meet the needs of a farsighted eye using a plus lens **(A)** or a nearsighted eye with a minus lens **(B)**. This is done by taking parallel light from a distant object and bringing it to focus at the far point of the ametropic eye.* A lensmeter is made to optically position the illuminated target at that far point. The light from the lens- meter target travels backward through the lens.

difference is still the same 02.00 D add power found using the sphere lines.

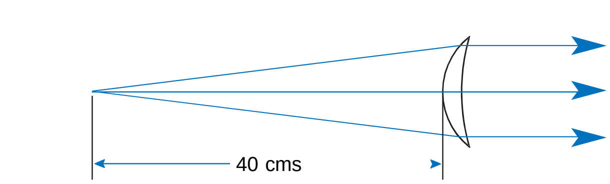
If the prismatic effect of the decentered lens causes the entire illuminated target to disappear off the viewing area, it may be necessary to use an auxiliary prism or prism- compensating device to bring it back into view. The use of auxiliary prisms or a prism-compensating device is described later in the chapter.

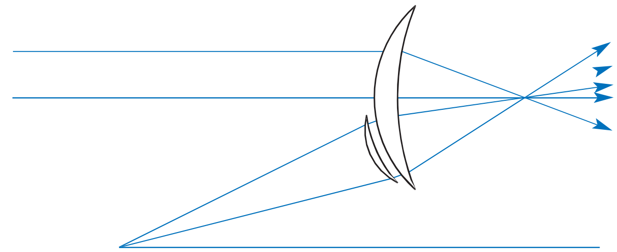
Why Spectacles Should Be Turned Around to Measure the Add Power

The purpose of a distance lens is to take parallel light and bring it into focus. For a plus lens, this will be a real image, and for minus lenses this will be a virtual image (Figure 6-14, *B*). To measure this type of lens, the illuminated lensmeter target is optically placed at the focal point of the lens. The light from the lensmeter target travels from behind the lens, going through the back of the lens, and out the front. When the light comes out the front of the lens, the rays are parallel and going into the eye piece section of the lens- meter. Thus the distance lens is being measured under the same circumstances as when it is being worn.[2] When being worn, parallel rays enter the lens from the front. (Light paths are reversible.) The focal length is referenced as the distance from the back side of the lens. Therefore the power being measured is called the back vertex power.

Whereas a distance lens is designed to take incoming parallel rays of light and bring them to a focus, a reading addition must take diverging rays of light coming from a near object and change them so they appear to be coming from farther away. In Figure 6-15 diverging light from an object at the focal length of the near segment is seen to be changed to parallel rays when going out the back side of the segment. This is easier to understand when shown together with a distance lens of zero power as shown in Figure 6-16. The person wearing this bifocal lens will not have to focus for a near object viewed through the segment of the lens.

*The ametropic eye has a refractive error and requires a lens prescription for distance vision.



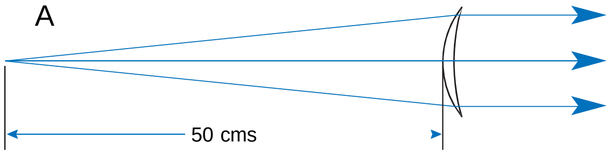


+2.50 D Add

A

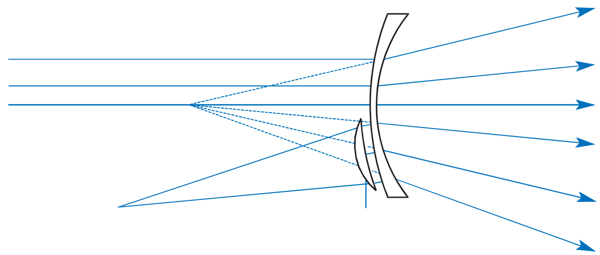
+2.0 D Add

A



B

Figure 6-15. The additional plus lens (which becomes the near addition) will change diverging light rays from a near object and make them diverge less. To test for add power accuracy, the reference is in front of the lens, making front vertex power the correct power measurement. Both a 02.50 D add (**A**) and a 02.00 D add (**B**) will cause light diverging from their respective focal points to appear as if coming from optical infinity.



B

Figure 6-17. The function of a near addition is to take light from a near object and reduce the divergence of the rays. For both a plus-powered distance lens **(A)** and a minus-powered distance lens **(B)**, a near add has the ability to convert diverging light from the near add focal point so that it enters the distance lens parallel.

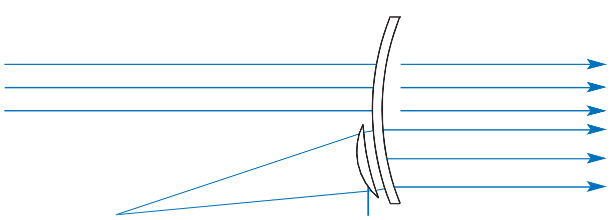


Figure 6-16. When a near object is located at the focal point of the near addition, diverging light is caused to leave the segment as parallel rays. When rays enter parallel, the emme- tropic eye* does not have to accommodate in order to see clearly.

*An emmetropic eye has no refractive error and does not require any distance prescription.

From the previous figure, it is evident how a near (reading) addition is really just a small plus lens which is “added to” the distance lens. To tell if this plus lens segment is focusing the light as intended, we find the focal point by turning the lens around in the lens- meter. This allows the illuminated target to be optically placed at the focal point and referenced from the front surface of the lens. We are now measuring front vertex power.

Combining both distance and near lenses together when the distance lens has plus or minus power gives the situation shown in Figure 6-17. The near addition takes light from a near object and refracts the rays so that optically the rays from the near object resemble light rays coming from a more distant object. Now the distance lens is able to bring the light to a focus to meet the refractive demands of the near or farsighted presbyope.

Measuring the Near Addition When Lens Powers Are Low

It should be noted that when distance and add powers are both low, there will be little difference between add powers found using front and back vertex powers. For this reason, many use the easier method of measuring adds with back vertex powers instead of turning the glasses around. As soon as distance or near powers increase, however, multifocal adds measured with back vertex powers will give wrong results.

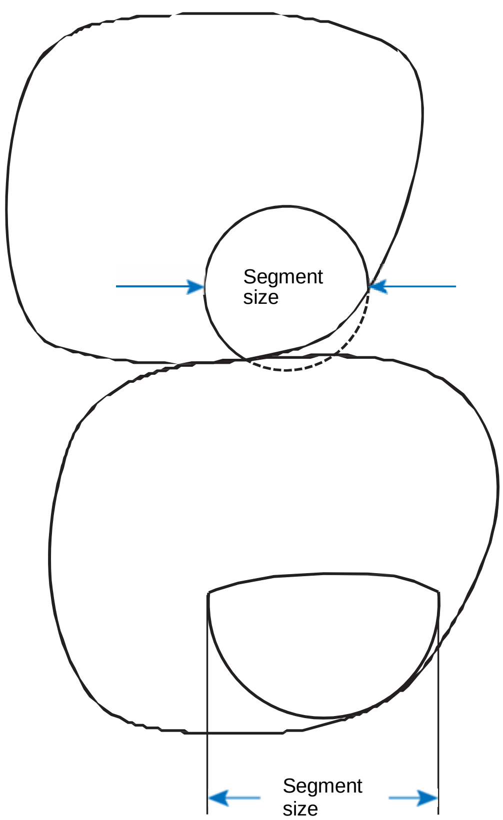


Figure 6-18. The width of a bifocal or trifocal segment is measured at the widest

part of the segment.

Identifying Multifocal Segment Style and Size When ordering a replacement pair or second pair of glasses from an existing pair, it is important to identify the multifocal type. Multifocals are identified by segment style. The most commonly used visible segment styles are flat-top (sometimes called "D" segs), curve-top, and round segs.

Measuring Segment Size

Once segment style is identified, segment size must be found. Segment size is measured across the widest portion of the segment—*not* the top of the segment. Trifocal sizes are identified by two numbers. The first number is the vertical size of the trifocal section in millimeters. The second number is the widest horizontal measure of the multifocal segment.

Measuring Segment Height

To measure and duplicate the segment height of an existing prescription, first the old segment height for the existing prescription is measured. If the frame will remain the same, so will the old segment height. If a different style frame is to be used, then the location of the old segment line as it appears on the wearer must be duplicated.

For record keeping purposes, the segment height of the existing prescription must be measured. Segment height is the vertical distance from the lowest part of the lens bevel to the top of the bifocal or trifocal segment line.

Identifying Base Curve

The front curve of a multifocal lens is called the base curve. If an individual has more than one pair of glasses of the same power, it is advisable to use the same base curve for both pair of glasses. This is more critical for multifocal lenses than for finished single vision lenses because multifocal base curves change in bigger steps. Changing the base curve may affect the way objects appear to the wearer. Straight lines may seem curved, objects may seem larger or smaller than they actually are, and the ground looks to be closer or farther away. Wearers usually adapt to normal base curve changes when lens powers change. But when base curves change and lens powers do not, switching back and forth between two pair of glasses is harder.

Base curves are measured using a lens clock* (lens measure).

[‡]It is important to note that a thick lens is not a safety lens unless it has been marked on the surface as a safety lens with the manufacturer's identifying mark.

Identifying Lens Material

It is important that an attempt to identify the lens mate-rial in the existing prescription be made. It is simple enough to tell the difference between glass and plastic. Lightly tapping the lens with a metallic object, such as a ring, will result in a characteristically different sound and feel.

Plastic materials are not as easy to differentiate one from another. When a polycarbonate lens is dropped on a surface with its backside down, some compare the sound to that of a poker chip. But a lens already in a frame will not be removed just to perform this procedure!

Polycarbonate and higher index plastics are often made thinner than regular plastic lenses of equal powers. Lens center thickness is measured with lens calipers. Center thickness can be used to help determine the type of material from which the lens is made. Minus lenses have their thinnest point at the optical center. Table 6-1 has some "center thickness clues" for determining what type of material was used to make minus lenses of certain thicknesses. Center thickness is measured at the location

*For aspheric and progressive lens surfaces, a lens clock is not a reliable method for finding base curves. Another method must be employed, such as measuring the back non-aspheric curve, lens thickness and back vertex power, then, knowing the index of refraction, calculate the base curve. (ANSI Z80-2005 Standards, pp 24-25)

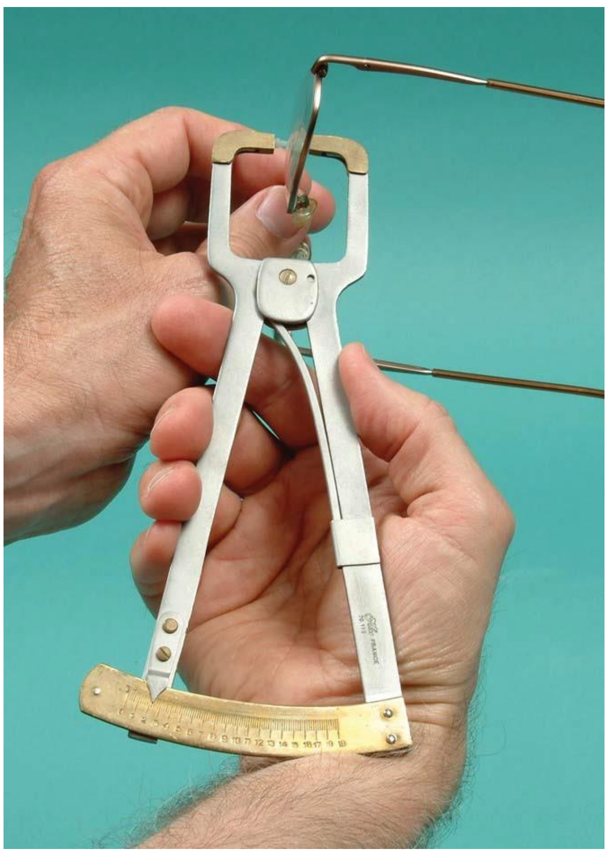


Figure 6-20. In preparation for measuring lens thickness, the optical center of the lens is spotted using the lensmeter. Then the center thickness of the lens may be measured with a pair of calipers as shown in this photo.

of the lens OC as shown in Figure 6-20. But the bottom line is this. *Whenever new glasses are made, the wearer must be advised of the safety factors related to the different available lens materials.*

Suppose a dispenser uses regular CR-39 material to replace a pair of glasses that had been made in a safer material, such as polycarbonate. Without active wearer involvement and documentation in the record, this decision could spell disaster. And since people do not always remember what material they have been wearing, their answer cannot be depended upon. In short, *the dispenser should treat the choice of lens materials as if the individual was getting glasses for the first time.*

Identifying Lens Tint

The lens tint of the old pair of glasses should be identified and recorded. Tints should be considered afresh each time new glasses are ordered. It should not be assumed that the wearer wants the same tint (or lack of tint) as he or she had before.

What to Keep in Mind When Ordering One LensInstead of Two

Occasionally, it becomes necessary to order one lens instead of two. This occurs when only one lens power changes from the previous examination or when one lens is damaged or broken.

When a single vision lens is being replaced, the major reference point (MRP) height of the remaining lens in the prescription should be measured. The MRP height of the new lens should match that of the remaining partner lens.

When only one lens is replaced in multifocal lenses, the lens should be ordered so that the two segment heights match. This is true unless there is a measured seg height difference between the wearer's left and right eyes.

It is also important that the MRP height of the lens that is *not* being replaced be measured. This is because many optical laboratories do not place the MRP on the 180-degree midline for multifocals with a segment that is set high in the frame. This means that in order for the new lens to match the old lens, *both* MRP and seg heights should be specified. This is true even if MRP height was never specified in the original order (Figure 6-21).

In some countries a lens manufacturer may place the major reference point on their bifocal lenses at a standard distance above the segment line, regardless of segment height. With increasing globalization, this may occur in some lenses sold in the U.S. With this in mind, ANSI Z80.1-2005 Prescription Recommendations defines the term *Distance Reference Point* or *DRP*. (DRP is commonly used with progressive addition lenses, but is not often used for segmented multifocals.) The Distance Reference Point is defined as "That point on a lens as specified by the manufacturer at which the distance sphere power, cylinder power and axis shall be measured."* Therefore if a certain lens manufacturer always places the MRP

*ANSI Z80.1-2005 American National Standard for Ophthalmic- Prescription Ophthalmic Lenses-Recommendations, Optical Laboratories Association, Fairfax, VA, 2006, p 8.

Horizontal midline

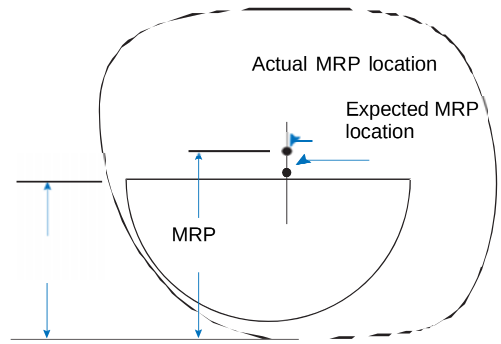


Figure 6-21. When a laboratory receives no specific instructions for MRP height, the MRP is normally placed at midlevel (on the horizontal midline). However, when the seg height is specified at a level that approaches or goes above this horizontal midline, many laboratories place the MRP 3 mm above the seg line. Therefore, when replacing only one lens of a multifocal prescription, the dispenser should either send the old glasses to the laboratory, or tell the laboratory the segment height *and* the MRP height for the new lens. This way the new lens will match the old lens. Failure to specify MRP height when ordering one lens only may result in unwanted vertical prism in the finished pair of glasses.

5 mm above the bifocal segment, then for this manufacturer the distance power would be measured at that point.

ORDERING LENSES ONLY

Ordering "Lenses Only" Using a RemoteFrame Tracer

Sometimes a wearer wants new lenses for an old frame, but does not have a spare pair of glasses. When the order cannot immediately be done in-house and the wearer must keep the frame, the order to the laboratory is for "lenses only." The danger in ordering "lenses only" and just specifying frame name and size is that the lens can easily be too large or too small. The error is only evident when the wearer returns, and the dispenser attempts to insert the off-sized lens pair into the old frame. In this situation the method of choice is to remove the lenses from the frame and use a remote frame shape tracer that is connected to the computer in the optical laboratory. With a frame tracer, a stylus can trace the inside bevel of the eyewire. Both shape and size are electronically sent directly to the laboratory (Figure 6-22). In the laboratory this frame information is downloaded into the laboratory computer. The lenses are cut exactly to the traced shape and size. Assuming that the frame did not distort during tracing, after the lenses are returned from the lab, the new lenses should fit into the old frame.

Ordering "Lenses Only" by C-Size

Sometimes there is not a frame tracer available. Without a tracer, it is still possible for the wearer to keep the

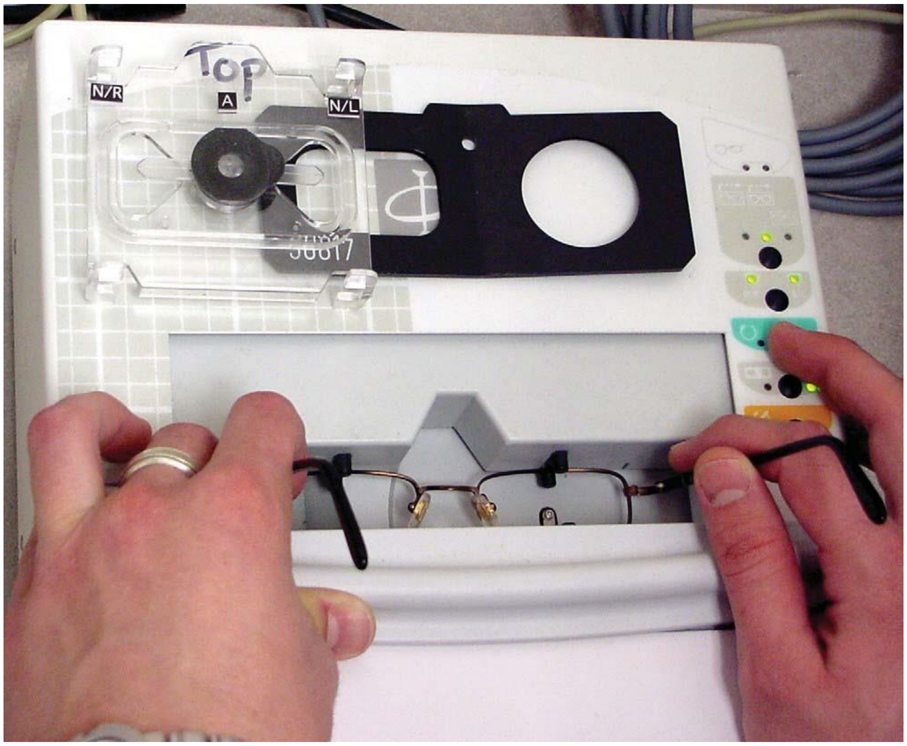


Figure 6-22. A frame tracer uses a stylus to trace the inside bevel of the frame, recording the shape. This shape is then sent to the optical laboratory and downloaded into their lens edger so that the lenses may be edged to exactly fit the measured frame.

frames and still order the lenses. When the shape of the frame is well known, the laboratory may have a factory pattern or an electronically stored shape on hand. However, there may be a variation in size. Simply ordering the size stamped on the frame may not be good enough. In this case, the lens may be removed and a circumference gauge (Figure 6-23) used to find the *C- size** or circumference of the lens (Figure 6-24). When lens circumference is known, lens size can be reproduced with more accuracy.

Ordering "Lenses Only" for a Frame ofan Unknown Shape

If the frame name or lens shape is unknown, or if the pattern is not readily available at the laboratory, then it will be necessary to trace the lens and measure for C- size. The procedures for shape tracing and C-size measurements are:

Using the lensmeter, spot the distance OCs and the 180-degree line.

Remove the right lens from the frame without disturbing the three lensmeter dots (this may require spotting over them with a non–water- soluble marking pen; non–water-soluble marks can be removed later using a solvent.)

Use a form, such as the one shown in Figure 6-25, and keeping the 180-degree line horizontal, center the lens as if making a pattern (Figure 6-26). In practice one of these forms may not be available. If not, draw an “x” and “y” axis on graph paper and record the necessary information. Graph paper will work just as well.*

Trace the lens onto the graph paper, using a sharp pencil. Keep the pencil perpendicular to the paper the whole time the lens is being traced.

Measure the actual lens A and B dimensions (not the dimensions of the lens tracing) and record these dimensions. An easy, more accurate alternative* to a simple ruler is to use a Box-O- Graph to measure the lens (Figure 6-27). The tracing is only used for shape, not dimensions.

*C-size should not be confused with the C dimension of the lens. The C dimension is used in the boxing system for measuring lenses and frames, and is the width of the lens along the horizontal midline.

Figure 6-23. A circumference gauge is used to find the circumference of an edged lens.

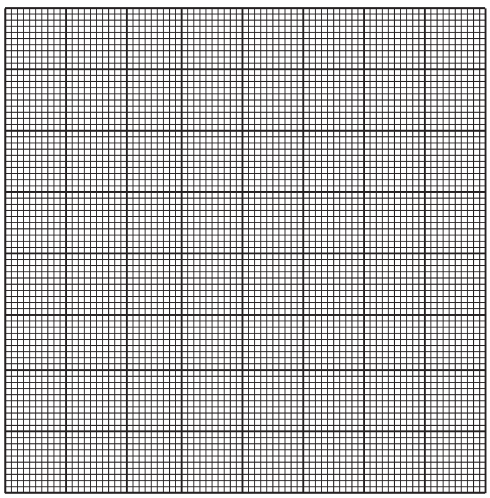
Figure 6-24. To measure the circumference of a lens, place the lens in the gauge front-side- up. Close the tape around the lens and read the circumference directly

from the tape.

Figure 6-25. Here is an example of one type of form that may be used to trace a lens of unknown shape for a “lenses only” order.

*It is even possible to draw a horizontal line on a blank sheet of paper, then place the lens on the paper with the three dots on the drawn line. Draw around the lens and record all the necessary measurements.

*An even more accurate method uses the same principle as the Box-o-Graph, but



Frame Name ______________________

Frame Manufacturer ______________________

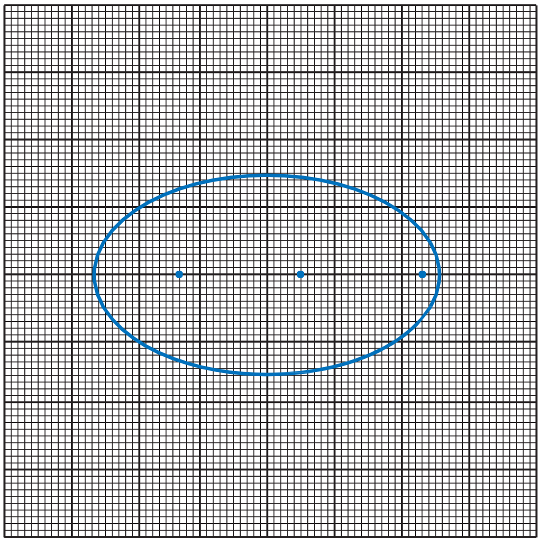
Men’s/Women’s (circle one)

A =____________ Measured DBL ______________

(or measured frame PD ______________________)

B = ____________

features a digital readout. This alternative, some- times used by optical laboratories, is the Digi-sizer by Precision Tool Technologies. (http://www.precisiontooltech.com)



Frame Name ____
Frame Manufacturer ____________
Men's/Women's (circle one)

A =_______________Measured DBL ______________

(or measured frame PD___________________________________)
B = _____________

Lens circumference = ________________

Frame Material (check one)

Plastic_____________Metal_______________
Rimless______________(Grooved? Y/N)
Other ______________

Figure 6-26. Center the lens so that it is exactly in the middle of the grid both horizontally and vertically. The three lensmeter dots must be exactly horizontal but do not have to be exactly on the line; nor does the center lensmeter dot need to be at the origin of the *x* and *y* axes.

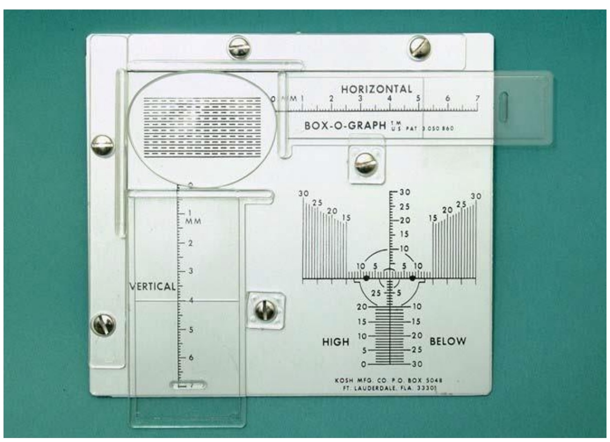


Figure 6-27. For a lens or pattern to be measured correctly using a Box-o-Graph, it must be placed on the surface of the Box-o-Graph in the same orientation as it has in the glasses. Therefore it is helpful to put three lensmeter dots on the lens first so that the 180-degree line is known. If spotted, the three dots on the lens should all fall parallel to the horizontal lines on the device. Both horizontal and vertical Box-o-Graph bars are pushed securely against the lens, and the A and B dimensions read from the scale.

Measure the DBL of the frame. Do not rely on the bridge size marked on the frame. Using a circumference gauge, measure the circumference of the lens and record.

Record whether the lens is for a plastic, metal, nylon cord, or other type of frame.

Indicate whether the lens is a right or a left lens. (It is preferable to use the right lens.) Mark "N" for nasal on the nasal side of the tracing.
Replace the lens in the frame and clean up the lenses.

VERIFICATION

Always use the original examination or prescription form rather than the actual order form to verify a pre- scription received from the laboratory. This will reveal any errors made when filling out the order form as well as any errors made by the laboratory.

Verifying Lens Powers and Determining Error Tolerances

Lens power is verified using the lensmeter, and in the United States tolerances for ophthalmic lens prescriptions are set by the *American National Standards Institute*. The American National Standards Institute, abbreviated *ANSI*, is a nongovernmental agency made up of representative segments of industry. The specific standard for prescription lenses is identified by the number Z80.1 and is titled "American National Standard for Ophthalmics—Prescription Ophthalmic Lenses—Recommendations." The main points of this standard are summarized in Appendix A in the back of the book.

Each aspect of a spectacle lens prescription has a small range of tolerance within which that particular variable of the eyeglass prescription can fall and still be considered acceptable. It must be recognized that it is a difficult task to fabricate a prescription that meets ANSI standards in all variables.

Tolerance for Error in "Sphere" Power and Cylinder Axis

The technique for using a lensmeter to measure a lens of unknown power was explained earlier in this chapter. Verifying a lens of known power with the lensmeter is much the same.

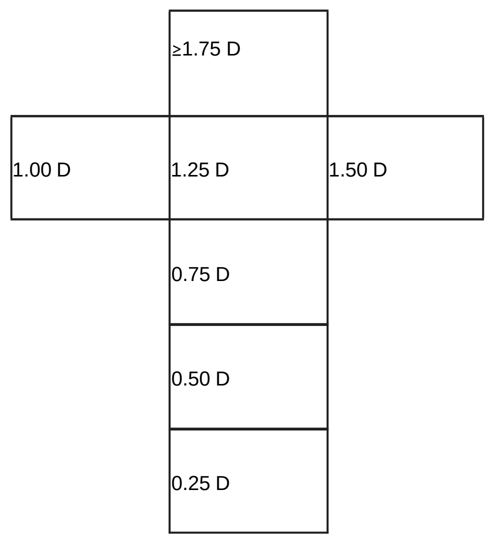
After focusing the eyepiece, the lens with the stron- gest power in the 90 degree meridian is placed in the lensmeter. If the lenses have similar powers and there is also prescribed prism in the prescription, then choose the lens with the most vertical prism and start with that lens.*

The power wheel of the lensmeter is preset for the expected sphere power, and the axis wheel is preset for the expected axis. If either of these two values is incorrect, the lensmeter's illuminated target will blur.

With the sphere power and axis preset, center the lensmeter target on the reticle. If the mires are unclear, focus the power wheel or axis wheel and note what the sphere power and cylinder axis reads compared with what was ordered.

The question is, how far away from the expected value can the sphere power of the prescription be and still be considered acceptable? According to older ANSI standards, for most lenses, the allowable error tolerance was

00.12 D and for higher powers, the allowable error toler- ance increased. Now the power standard is not based on the sphere power, but on the meridian of highest absolute power. To know if this power is off, we may need to finish reading the full spherocylinder prescription before we can tell if the power is acceptable. So before deciding on power acceptability, we will write our sphere finding down and go on to the cylinder.
Cylinder axis error tolerances vary, depending on the strength of the cylinder power. For small 0.25 D cylinders, the axis can deviate up to 14 degrees either way. If the cylinder power is equal to 1.75 D or greater, however, the tolerance drops to 02 degrees. An easy way to visualize axis tolerances is to think of a cross with the 0.25 D cylinder on the bottom and 1.75 D on the top. This is shown in Figure 6-28.
Cylinder power



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Cylinder Power Verifi cation and Error Tolerance Cylinder power verification is done by finding the difference between the sphere power reading (where the narrowly spaced sphere lines focus) and the power wheel reading where the three broadly spaced cylinder lines focus. The ANSI standard cylinder power tolerances vary depending on the strength of the cylinder. For cylinder with a power of 2.00 D or less, this tolerance is

Meridian of Highest Absolute Power Error Tolerance As stated earlier, the power standards for prescription eyewear have changed from looking at sphere power to looking at the power of the lens in the meridian of highest absolute power. So what does that mean? Basically, power standards are stricter for low powers. Up to

06.50 D, the tolerance is 00.13 D. For powers above 6.50, the standard is 02% of the power. (Slightly more error is allowed for progressive addition lenses.)

So what about power standards for a prescription written in minus cylinder form that has a power of 06.00

04.00 × 180? The sphere power is 06.00 D. This would give the appearance of requiring a standard of 00.13 D. But what if this lens were written in plus cylinder form? In this case, the lens would be written as 010.00 04.00

× 090. So is the sphere power for this prescription 06.00 D or 010.00 D? The answer to this question makes a big difference when applying standards that are stricter for low powers and less strict for high powers. For this reason, the power tolerance is no longer based on sphere power, but on the meridian of highest absolute power.

So how can the meridian of highest absolute power be found and verified? The meridian of highest absolute power can be found and verified in two ways.

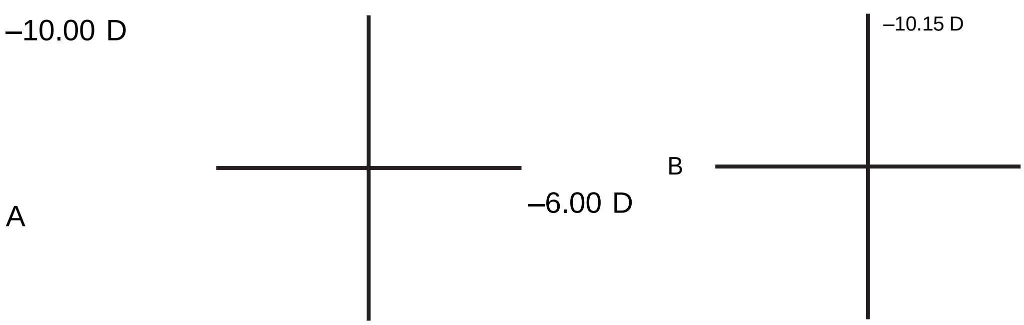


Figure 6-29. To help in reasoning through and understanding lens power verification, put the lens power that was ordered on a power cross. The ordered power in the text example is shown in **(A)**. After the completed eyeglasses have been returned from the lab, place those lens powers on a power cross. The text example for the completed pair is shown in **(B)**.

How to Write the Prescription So That the Sphere Power *Is* the Meridian of Highest Absolute Power		
If the sphere	**And the cylinder**	**Then do this:**

power is:	power is:	
Minus sphere	Minus cylinder	Convert the prescription to plus cylinder form
Minus sphere	Plus cylinder	Leave the prescription in plus cylinder form [Exception: If the cyl power is more than twice as strong as the sphere power, then convert the prescription to minus cylinder form.]
Plus sphere	Plus cylinder	Convert the prescription to minus cylinder form.
Plus sphere	Minus cylinder	Leave the prescription in minus cylinder form. [Exception: If the cyl power is more than twice as strong as the sphere power, then convert the prescription to plus cylinder form.]

To convert between plus and minus cylinder forms of prescription writing: Add the sphere and cylinder powers. This is the new sphere power.

Change the sign of the cylinder from plus to minus or from minus to plus. This is the new cylinder value. Add or subtract 90 from the cylinder axis. This is the new cylinder axis.

The first method is to put the ordered lens powers on a power cross. In our example, the power cross would appear as shown in Figure 6-29, *A*. The two meridians show 06.00 D and 010.00 D. The meridian of highest absolute power is the one with the 010.00 D power. Next we read the power of the lens. Suppose the lens verifies as 06.15 04.00 × 180. Initially this looks like the lens power fails the standard because the power standard for a 06.00 D power is 00.13 D. But if we place this on a power cross (Figure 6-29, *B*), we have 06.15 in one meridian and 010.15 in the other meridian. The power standard for a 06.00 D power is 00.13 D, but for a 010.00 D power the standard is 2% of the lens power, or 00.20 D. So looking at it this way, the lens would pass.

The second method for finding and verifying the meridian of highest absolute power is to rewrite the prescription so that the meridian of highest absolute power is the sphere. Then we can verify it as sphere power, cylinder power, and cylinder axis in the same manner we are accustomed to reading lenses. Box 6-4 shows how to write the prescription so that it always has the meridian of highest absolute power as the sphere power. So for our example, we convert the prescription to plus cylinder form, which is 010.00 04.00 × 090. We read the lens in plus cylinder form and find 010.15 04.00 × 090. We see that sphere power, cylinder power, and cylinder axis are all in tolerance.

For more on this subject, be sure to read and look at the examples in Appendix A in the back of the book.

Checking for Unwanted Vertical Prism

There are two methods for checking for unwanted vertical prism. The first is the more traditional method. It does not use the refractive power of the lens as part of the decision-making process. The second method uses a cut-off power to help in making the decision, simplifying the process some.

The Traditional Method for Vertical Prism Tolerances. After the sphere, cylinder, and axis for the first lens have been verified, spot the lens and slide the spectacles across the lensmeter table to measure the second lens. Remember the lens with the highest power

TABLE 6-2llowable Unwanted Vertical Prism Based on LensPower

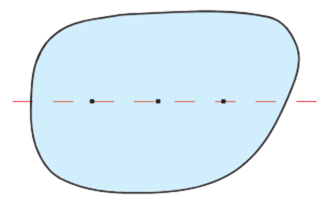


Figure 6-30. This lens has been spotted twice: once at the actual optical center and once where the optical center should be located. Does the vertical difference between the place

If the Power in the The Allowable Imbalance

Vertical Meridian is	Tolerance is
03.25 D or less	0.33 0 or less of vertical prism
3.50 D or more	1.0 mm or less of vertical difference in MRP locations

where the optical center should be and the place where it is really located exceed 1 mm? If it does and the amount read on the lensmeter is also above 0.330, then the lens pair will be out of tolerance for vertical prism.

in the 90-degree meridian is the first to be verified. When the second lens power has been verified, spot the OC of this second lens.

In the event that the second lens will not center, but shows the illuminated target above or below the inter- section of the eyepiece crosshairs, the lens is showing unwanted vertical prism. Prism amount is indicated by the numbered concentric circles on the reticle mires (or screen in some lensmeters.) With the illuminated target centered exactly above or below the middle of the cross-hairs, read the amount of vertical prism present. If the amount is 0.330 or less, the prescription is within ANSI tolerances for vertical prism. If it is greater than 0.330, the dispenser must double-check to be sure that the lens pair has too much vertical prism.

To make this additional check, be certain the lens is centered horizontally, even though the target is off vertically. When it is horizontally centered, spot the lens. Next move the lensmeter table up or down until the target centers vertically. Spot the lens a second time. Remove the spectacles from the lensmeter, and measure the vertical distance between these two spots. This is shown in Figure 6-30. If the vertical difference between these two dots is greater than 1 mm, the lens pair is out of tolerance for vertical prism.

It should be noted that *both* criteria must fail for the lens pair to fail. If the amount of vertical prism exceeds 0.330, but the vertical difference is less than 1 mm, the lens pair passes. If the vertical difference is greater than 1 mm, but the amount of vertical prism is less than 0.330, the lens pair passes. The lens pair only fails when the vertical prism is greater than 0.330 *and* the vertical difference exceeds 1 mm.

A Power-Based Method for Vertical Prism Tolerances. ANSI Z80 standards now show a power-based method for determining whether or not unwanted verti- cal prism is within acceptable standards. The same basic procedure is followed as was explained in the preceding section and the end result is exactly the same as the method just explained above. Here is how it works.

If the power in the vertical meridian of the lens is low (from zero to plus or minus 3.375 D), then the only thing to worry about is whether or not the amount of unwanted vertical prism is above $^1/3$ prism diopter. If it is above this amount, the prescription is not within allowable tolerances.

If the power in the vertical meridian of the lens is high (above plus or minus 3.375 D), the amount of vertical prism is not an issue. The only thing to be concerned with is how far the optical centers are away from each other vertically. If they are more than 1 mm apart, then the prescription is out of tolerance. These criteria are summarized in Table 6-2.

Here is the specific procedure for carrying out the power-based method of checking for unwanted vertical prism.

1. Verify the sphere, cylinder, and axis for the first lens.
2. Spot the lens and slide the spectacles across the lensmeter table. Verify and spot the OC of this second lens.
3. If the second lens will not center, move the lens sideways until the illuminated target centered exactly above or below the middle of the crosshairs. Read the amount of vertical prism present and spot the lens.
   a. If the prism amount is 0.330 or less, the prescription is within ANSI tolerances for vertical prism.
   b. If the prism amount is greater than 0.330 and the power in the vertical meridian is 3.25 D or less, the prescription fails.
4. If the prism amount is greater than 0.330 and the power in the vertical meridian is 3.50 D or more, the lens pair may still pass. To find out, continue on with the following steps.
5. Move the lensmeter table up or down until the target centers vertically.

Spot the lens a second time.

6. Remove the spectacles from the lensmeter, and measure the vertical distance between these two spots as was shown in Figure 6-30.
   a. If the vertical difference between these two dots is 1 mm or less, the prescription passes.
   b. If the vertical distance between these two spots is greater than 1 mm, the prescription fails.

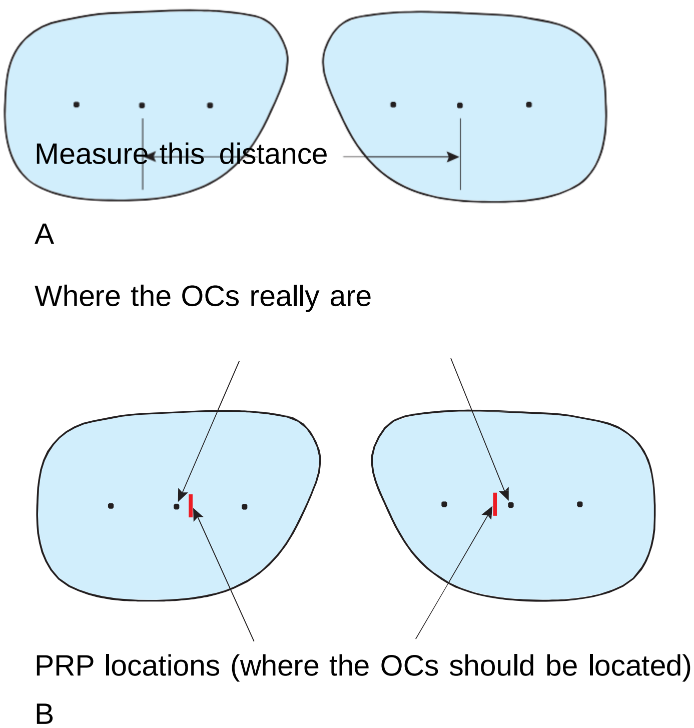


Figure 6-31. A, Measure the horizontal distance between the two center lensmeter dots (the locations of the lens optical centers). **B,** Now compare this distance to the distance between the Prism Reference Points. The PRPs are where the ordered distance PD locations should be found. If the difference is less than 2.5 mm, horizontal prism is within tolerance. If the dif- ference is greater than 2.5 mm *and* the lens pair shows greater than 0.670 of horizontal prism, the prescription is out of toler- ance. When there is prescribed prism in the prescription, the PRP location is where the prescribed prism should be correct (i.e., still at the distance PD.)

Checking for Unwanted Horizontal Prism

By now the spectacle lens pair has both lenses spotted. To check for unwanted horizontal prism, measure the horizontal distance between the center lensmeter dots on the two lenses as shown in Figure 6-31, *A*. Compare this distance to the PD that was ordered. If the differ- ence between the ordered PD and the measured PD is 2.5 mm or less, the prescription passes. If the difference is greater than 2.5 mm, the prescription might fail. We will not know this, however, until we check for horizon- tal prism tolerance limits.

There are two methods to check for horizontal prism tolerance limits. The first method is easier to under- stand, but harder to do. The second is harder to under- stand initially, but is finally easier to do. The second method is the one recommended by ANSI.

Method 1: Spotting the Location Where the OpticalCenters Should Have Been. The first method requires spotting the *prism reference point* or *PRP* location. The prism reference point is where the OCs should have been. This is done by measuring from the center of the bridge. Find the right PRP using the right monocular PD (or one half the binocular PD). It is measured from the center of the bridge. Mark this PRP location

on the lens by dotting or drawing a vertical line using a lens marking pen. Do the same for the left PRP using the monocular (or half binocular) PD (see Figure 6-31, B).

Next, center this new PRP mark on the right lens in front of the lensmeter stop. Read and note the amount of unwanted horizontal prism from the lensmeter. Do the same for the left eye. Add both left and right horizontal prism amounts together. If these two amounts are two thirds of a prism diopter or greater, the prescription is out of tolerance. If they are less than two thirds of a diopter, the prescription is within horizontal prism tolerance.

Method 2: Determining if the Wearer's PD is Within the Two-Thirds Diopter Limit. To check for the location of horizontal prism tolerance limits, put the spectacles back in the lensmeter and do the following:

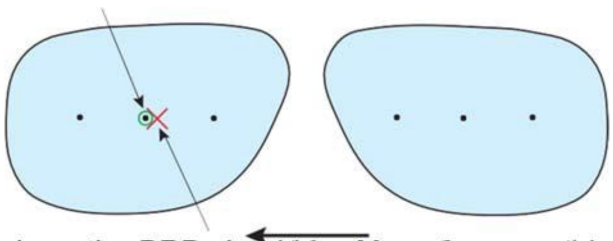
1. For the first lens, place the center lensmeter dot in front of the lensmeter stop. (The stop is that part of the lensmeter against which the back surface of the lens rests.)
2. Note where the wearer's PD *should* be. (This location is called the PRP or prism reference point.)
3. Move the spectacles so that the PRP (the point where the wearer's PD should be) moves toward the lensmeter stop. Watch the illuminated target as the glasses are moved. The prismatic effect seen will increase as the glasses are moved. Keep moving the glasses in this same direction until 0.330 results.
4. Spot the lens.
5. Repeat this procedure for the second lens.
6. Measure the distance between the two new lensmeter dots on the two lenses. If the distance between the two new dots equals or passes the wearer's PD, the prescription passes. If this distance does not reach the wearer's PD, the prescription fails.

A Power-Based Method for Horizontal Prism Tolerances. As with the vertical prism tolerances, there is a power-based method for determining whether or not unwanted horizontal prism was within acceptable standards. Again, the end results are exactly the same as in the previously explained methods for determining horizontal prism. This is the procedure.

If the power in the horizontal meridian of the lens is low (from zero to plus or minus 2.75 D), then the only thing to worry about is whether or not the amount of unwanted horizontal prism is above 2/3 prism diopter. If it is above 0.67 0, the prescription is not within allowable tolerances.

If the power in the vertical meridian of the lens is high (above plus or minus 2.75 D), the only thing to be concerned with is how far the optical centers are away from each other horizontally (i.e., how far the PD is off). If the OCs are more than 2.5 mm away from the wearer's PD, then the prescription is out of tolerance. These criteria are summarized in Table 6-3.

Location of the optical center.
This is the location of lensmeter stop before the frame and lenses are moved.
(As frame and lenses are moved to the left, the lensmeter stop does not move.)



This is where the PRP should be. Move frame and lenses to the left until
1/3 D results.

(The PRP is the expected location of the wearer's PD.) **Figure 6-32.** To check for horizontal prism tolerances, move the spectacles so that the lensmeter stop travels toward the Prism Reference Points. The PRPs are at the intended location of the wearer's PD. Keep moving the spectacles until 0.330 results.

Lensmeter dots indicating location of lens optical centers

Lensmeter dots indicating location where of 1/30 of horizontal prism is read

× PRP locations (The place where the optical centers should be so they will match the location of the wearer's actual PD.)

Verifying For Prescribed Prism

A lens that has prescribed prism included as part of the prescription is not centered the same in a lensmeter as a prescription without prism. The prismatic prescription is not centered correctly if the illuminated lensmeter target is at the intersection of the crosshairs. Centering of a prismatic prescription is correct when the illumi- nated target is located at the point that matches the prescribed prism.

When this happens, the lens may be dotted for verification.

Verifying High Amounts of Prism

When verifying high amounts of prism with the lensme- ter, it is not uncommon for the prism to displace the center of the illuminated target off the lensmeter viewing

Figure 6-37. An auxiliary prism is used to help verify a lens with a large amount of prism in the prescription. The prism base of the auxiliary prism is placed opposite the prism base direction found in the prescription.

screen. This will leave only sphere or cylinder lines in view, but not both. When this happens, the prism amount is read using one of two methods, depending on the type of lensmeter. One method uses a loose, compensat- ing prism. The other requires a prism compensating device.

Using Loose Auxiliary Prisms to Measure Large Prismatic Effects. Some lensmeters, such as the B&L Reichert, come with prism lenses that are placed in a special lens-holding cell in the instrument. The prism lens is oriented with its base direction opposite to the spectacle lens' prism base direction so that the illumi- nated target center will be returned to the screen. The sequence of steps for finding prism is as follows:

1. An attempt to read a prescription with a high amount of prism is made, but the lensmeter's illuminated target center is displaced off the viewing screen. Once this has happened, look at the prescription and estimate prism base direction.

Estimating is done by observing lens thickness differences. The thickest edge of the lens indicates prism base direction.

2. Measure or look up the wearer's PD. Dot the location of where the MRP should be for right and left lenses according to the wearer's PD. (This procedure was explained in an earlier section of the chapter called "Method 1: Spotting the Location Where the Optical Centers Should Have Been.")
3. Estimate the amount of prism that will be necessary and put the auxiliary prism

in the cell of the lensmeter so that its base direction is opposite to the base direction of the prism in the spectacle lens (Figure 6-37). Keep the auxiliary base direction of the prism either totally horizontal or totally vertical.

4. Set the lensmeter cylinder axis at 180 degrees and the sphere power on zero. Look into the lensmeter and slightly rotate the auxiliary prism until the center line of the illuminated lensmeter target crosses the middle of the crosshairs. This will ensure that the prism base direction is exactly zero or 180 (Base In or Base Out) with no vertical component.* If a large amount of vertical prism is being measured, this will ensure that the base direction is 90 or 270 (Base Up or Base Down), with no horizontal component.
5. Next, place the spectacle lenses in the lensmeter and center the MRP of the lens over the lensmeter stop. If the target does not appear, increase the amount of prism by choosing the next higher auxiliary prism. (Each time a different auxiliary prism is placed in the cell, the alignment process described in the previous step must be repeated.)
6. When the illuminated target is visible on the screen, note the prismatic amount seen in the lensmeter. To figure the total amount of prism, reverse the base direction of the auxiliary prism and add it to the prism amount shown in the lensmeter. In other words if the prism on the screen shows 10 Base Out and the auxiliary prism is 60 Base In, change 60 Base In to 60 Base Out and add it to 10 Base Out. The amount of prism present in the lens is 70 Base Out.

Using a Prism Compensating Device to Measure Large Amounts of Prism. Some lensmeters, such as the Marco and Burton lensmeters, come with a prism compensating device† (Figure 6-38). To find prism amount and prism axis direction using a prism compensating device, begin by placing the Prism Reference Point over the lens stop. The *Prism Reference Point* or *PRP* is “That point on a lens as specified by the manufacturer at which the prism value of the finished lens is to be measured.”* The PRP will correspond to the location of the wearer’s monocular PD or to one half the wearer’s binocular PD for a given pair of glasses. This is where the MRP of the lens should be.

Turn the power wheel to the sphere power of the prescription and the axis wheel to the correct cylinder axis. Next, move the illuminated target using the prism compensating device so that the larger prismatic com- ponent (either horizontal or vertical) may be read.

(Compensating prism power is increased or decreased by turning the knob on the compensating device. Base direction of the compensating prism is changed by physically moving the knob so that it rotates around the axis of the lensmeter.)

Again using the prism compensating device, move the illuminated target onto either the horizontal or vertical crosshair on the measuring reticle. This is done by using just horizontal or just vertical prism. In other words, leave the base direction of the prism compensating device at either 90 or 180. (Remember, the base direction for the lens may be estimated ahead of time just by looking at the thickness differences between temporal and nasal lens edges or by the thickness differences between top and bottom edges.) Read the larger prismatic component that has been neutralized from the prism compensating device. Read the smaller prismatic component directly from the reticle. (See Box 6-5 for a summary of these steps.)

†A prism compensating device is based on the Risley prism princi- ple. A Risley prism consists of two rotating prisms that work together to vary prism power. Prism power will be zero when the bases of the 2 prisms are oriented in opposite directions. Prism power will be at a maximum when the bases are both in the same direction.

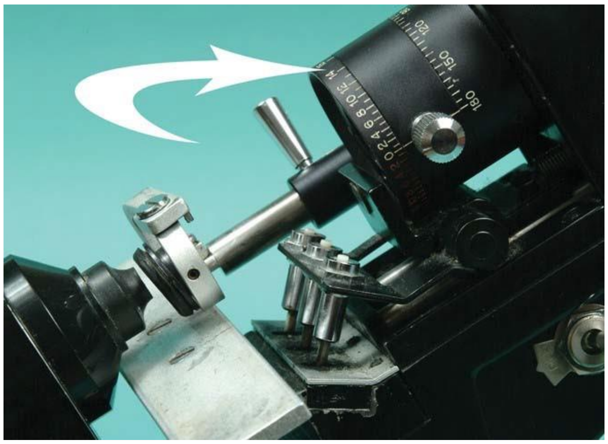


Figure 6-38. A prism compensating device, such as the one shown here, allows a highly prismatic lens to be verified. For lensmeters with prism compensating devices, the lensmeter must always be checked to ensure that the compensating device is zeroed. Otherwise the lensmeter appears to be detect- ing prism in a lens when there is none.

Using an Autolensmeter to Verify Lenses

An autolensmeter offers the advantage of requiring less operator expertise than that required for manual types. It also provides a permanent record of the reading when equipped with a printer.

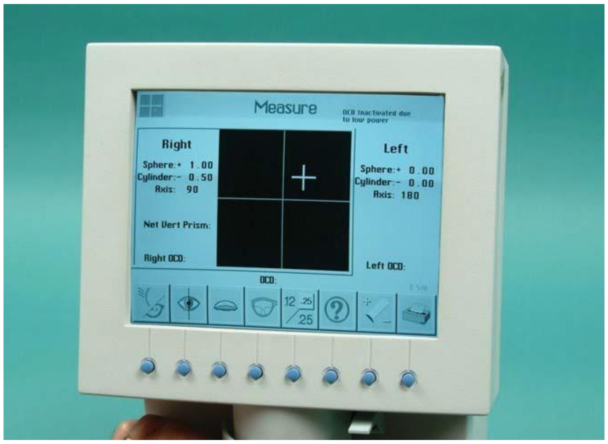
Autolensmeters come in varying degrees of sophistication. The basic sequence for use involves the following:

1. Select lens form and accuracy.

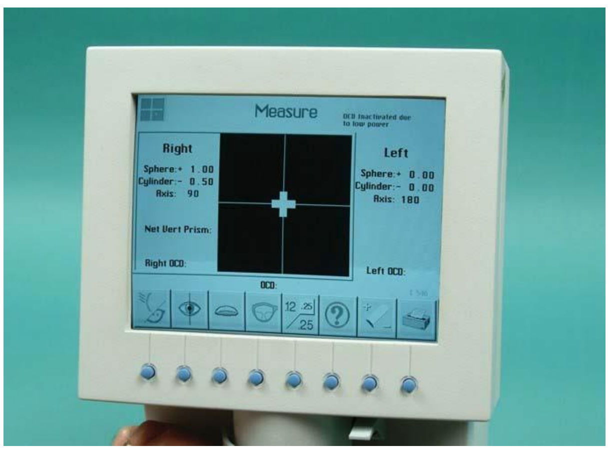
The operator indicates whether the lens is to be read in plus or minus cylinder form. The level of accuracy is also indicated, since many instruments will read lens power to the nearest quarter diopter, eighth diopter, or even hundredth of a diopter.

2. Position the first lens.

The lens is positioned by moving it until centered. Instead of viewing a conventional crossed-line or a corona target, the image may consist of a cross that appears on a small screen (Figure 6-39, *A*). As the lens is moved, this cross can be made to approach a large central cross. When the small cross reaches the center of the large cross, the smaller one may become bolder as with the Humphrey Instruments Lens Analyzer (Figure 6-39, *B*).



A



B

Figure 6-39. To center a lens with the Humphrey Lens Analyzer model LA 360, the lens is placed in the lensmeter. This may cause the viewing screen to appear as shown in **(A)**, with the small white cross off center. The lens is moved until the small movable cross is centered with the large stationary cross **(B)**.

Some instruments like the Lens Analyzer shown allow the instrument to be operated with or without centering the lens. In one mode, the spectacle lens is positioned with the location of the known PD in front of the instrument's reading stop. The instrument reads both power and prismatic effect at that point. This mode is used when monocular PDs are known.

The second mode allows a reading to be taken at any position on the lens. Once the second lens reading is taken, the instrument uses power and prismatic effect to calculate OC locations, giving the "PD" of the glasses.

3. Spot the lens.

The lens may be spotted with the customary three lensmeter dots if it has been centered as initially described in step 2 above.

Figure 6-40. Some models of the Humphrey Lens Analyzer autolensmeter will allow the transmission of a lens to be measured. The readout is in the form of a transmission curve.

4. Position and spot the second lens.

The next step for a single-vision lens pair is to position and spot the second lens. Some autolensmeters have an intermediate step for multifocals whereby the add is measured before the second lens.

5. Print out the results.

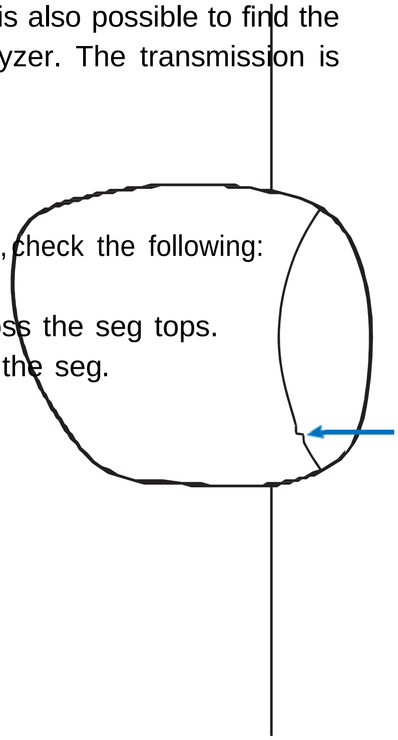
Using an Autolensmeter to Verify Transmission. The usual method for finding the transmission of a lens is to use a light transmission meter. (A photo of such a meter may be found in Chapter 22, Figure 22-3.) Yet it is also possible to find the transmission of a lens with the Hum- phrey Lens Analyzer. The transmission is given as a transmission curve. (Figure 6-40.)

Verifying Lens Segments and Surfaces

Verifi cation of the Multifocal Segment

To verify the size and location of the multifocal segment, check the following:

1. Check segment height.
2. Check flat-top bifocals for tilt by placing a ruler across the seg tops.
3. Measure seg width with a ruler at the widest part of the seg.



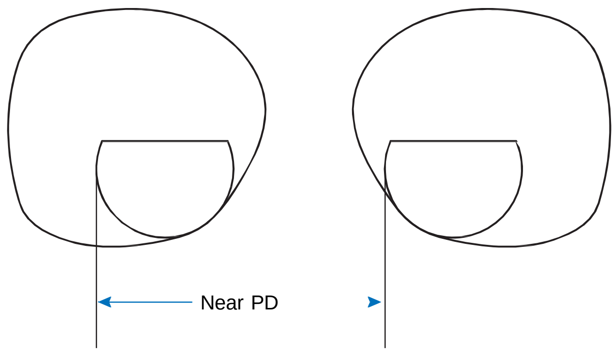


Figure 6-41. When both multifocal segments are identical, it is easier to measure near PD from the left side of one segment to the left side of the other than from center to center.

Wave

4. To verify the near PD ordered, measure the distance from the left side of one seg to the left side of the other (Figure 6-41). A lens pair should be within 2.5 mm of the ordered amount to be within standards.

Checking Lens Surface Curves, Size, and Tint

Using a lens clock, check the base curve and look for the presence of warpage. Warpage is revealed by two differ-ent surface powers (indicating cylinder power) found on both front and back surfaces instead of on just one surface.

Check the lens size, particularly in a "lenses only" order. Be sure the tint corresponds with that ordered.

Checking for Small Surface and Media Defects

Check for internal media defects, such as bubbles and striae in the lens material. A *stria* is a streak seen in a lens caused by a difference in the refractive index in the material. When seen, a stria occurs in a glass lens. The streak causes a distortion in the object viewed and is not a physical streak like a mark on or in the lens. Also inspect the surface for scratches, pits, or areas of grayness.

The surface is also inspected for waves. A *wave* is a defect in lens surface curvature, which causes a slight, irregular variation in the surface power. It is created during the lens surfacing process and can occur with any type of lens material. Check for waves by holding the lens about 12 inches from the eye and viewing either a grid or some object having a straight edge. Move the lens slowly back and forth. The straight edge should appear smooth. It should maintain its smoothness and become increasingly curved as the straight edge approaches the edge of the lens.

If there is a localized distortion present (Figure 6-42), mark the area and view it through the lensmeter. If the area distorts the lensmeter target, the defect makes the lens unacceptable. However, if the defect is outside of the 30-mm circle that is centered on the MRP, or if the defect is within 6 mm of the lens edge, the lens may be considered acceptable. In fact, the same applies to any small isolated material or surface defects and not just

Figure 6-42. To inspect for a wave in the surface of a lens, view a grid or straightedge through the lens, moving the lens slowly so that the image of the line traverses the surface slowly. An irregularity in the otherwise smooth image shows the presence of a wave.

waves. If small, isolated defects are outside of the 30-mm circle or within 6 mm of the lens edge, they are acceptable.

Verification of Frames and Quality of Mounting First check the quality of the mounting (the lens insertion). The security of the lenses will be revealed by the presence or absence of an air space between lens and frame. Note if the bevel is even, or if chips or other defects are present at the edges.

Check to be sure that the frame concurs exactly with all ordered specifications: (1) style and color, (2) eye size and DBL, and (3) length of temple. Be sure to inspect for possible frame damage, such as scratched or marred surfaces, or rolled eyewires.

Overall Verification

Check the extent of frame alignment (see Chapter 8). In many instances, frames will not be properly aligned but can be adjusted to standard alignment in the office. In some cases this may not be possible because the frame is distorted or stretched too greatly, or because the lens has been twisted because of an error in the position of the cylinder axis.

Errors that are adjustable in the office are probably best corrected by the dispenser. Much time is saved if the prescription does not have to be returned to the laboratory. Errors that cannot be salvaged by the dis- penser, however, should *not* be passed on to the recipient. This violates basic ethical principles, and it will eventually result in general dissatisfaction with the dispenser. It may also cause the laboratory to denote the dispenser as careless or unsuspecting. The dispenser who insists on correct and careful work from a laboratory generally receives it.

Sample Questions:

Example **1**

Suppose a prescription has a distance power of 00.75 D for both right and left lenses. The wearer's distance PD is 58 mm. We want to verify the prescription for horizontalprism. When the lens OCs are spotted, the distance between them is 63 mm. Is the prescription out of tolerance for hori- zontal prism?

Solution

Because the optical centers for this prescription are 63 mm apart when they should be 58 mm, the spectacles clearly exceed the 2.5 mm tolerance criterion for horizontal prism. The 2.5 mm criterion would only allow the OC distance tovary from 55.5 mm to 60.5 mm. But this alone does not indicate that the prescription fails ANSI standards. The lens pair has not yet been checked for 0.670 horizontal prism tolerance. (Since the power of the prescription is less than

2.75 D, the amount of prism is critical.) To check for hori- zontal prism tolerance, place the right lens in the lensmeter with the OC at the lensmeter stop as shown in Figure 6-32. Set the lensmeter for the correct sphere power and cylinder axis and be certain that the target is clear.

Because the wearer's PD is smaller than the distance between the OCs and this is a right lens, the glasses are moved to the left. Look into the lensmeter, move the glasses to the left, and watch the amount of horizontal prism increase. Stop and spot the lens when the prismatic effect reads 0.330.

Repeat this for the left lens. This time move the glasses to the right until the prismatic effect reaches 0.330. Spot the lens. The glasses now look like those shown in Figure 6-33.

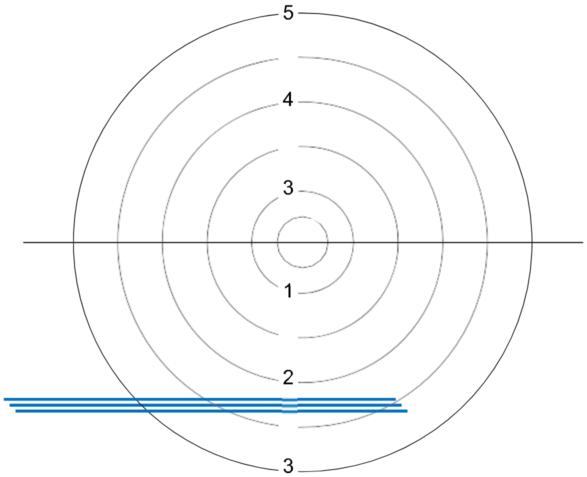
Next measure the distance between the new lens- meter dots. This distance proves to be 54 mm. Because this distance overshoots the wearer's PD, the prescription passes, even though it failed the 2.5 mm criterion. (For a summary of horizontal and vertical prism standards, see Appendix A.)

Example **2**

A right lens prescription reads:

03.00 0 1.25 × 135, 2.00 0 Base Out

How must the lens be centered before it is spotted?



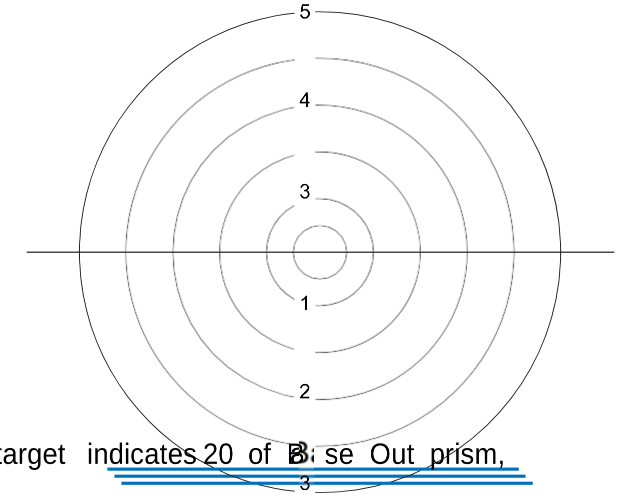


Figure 6-34. In this example, the illuminated target indicates 20 of Base Out prism, assuming the lens is a right lens. (If the

Figure 6-35. This prismatic

effect reads 10 Base Down

lens being measured were a left lens, the prism would be 20 Base In.)
whether the lens is a left or a right lens.

Solution

To verify this prescription, the lens must be placed in the lensmeter and moved until the illuminated target is located 20 units to the left (temporal) of the crosshair origin (Figure 6-34). (Target center location always corresponds to prism base direction. This is true whether the lens is plus or minus in power.)

Example 3

Another right lens prescription reads

03.00 0 1.25 × 135, 1.00 0 Base Down

How must the target be centered for this lens before it is spotted?

Solution

Everything except prism is identical to the previous prescription. Therefore in this case, the only difference is that the illuminated target is moved until it is located directly below the cross hair origin, 1 0 unit down, as shown in Figure 6-35.

Example **4**

Suppose a right lens prescription with the same refractive power as in the previous two prescriptions calls for horizon-tal *and* vertical prism. Prism values ordered were

10 Base Down and 20 Base Out. How must the illuminated target be positioned for accuracy in verification?

Figure 6-36. If a right lens is being verified for prescribed prism of 20 Base Out and 10 Base Down, it must be positioned as shown before the lens can be spotted.

Solution

When both horizontal and vertical prism is called for, the illuminated target must be moved both horizontally and vertically. The correct positioning is shown in Figure 6-36.

Example **5**

A lens cannot be read in the lensmeter without the help of compensating prism. A 50 Base In auxiliary prism allows the target to be seen. The illuminated target shows up at a point on the screen that measures as 40 Base Out and 10 Base Up. How much prism is there in the lens?

Solution

The 50 auxiliary prism is oriented with its base opposite that of the prism in the lens. To figure the amount of prism present in the lens, change 50 Base In to 50 Base Out. Now add the 50 Base Out that was neutralized by the auxiliary prism to the 40 Base Out and 10 Base Up that was viewed on the screen. This makes the total amount of prism 90 Base Out and 10 Base Up.

Unit 9:

Lens Insertion

Learning Objective:

At the end of this unit, students will be able to;

1. Insert a lens into a frame in a way that the end result is both neat and professional in appearance.
2. Learn and demonstrate numerous techniques available, and acceptable if the end product meets the expressed standards.
3. Presents the steps involved in lens insertion, some of the methods used, and also some of the difficulties that must be avoided.
4. To understand insertion of lenses in frames of different materials.

Inserting a lens into a frame requires a skill only developed by considerable practice. Numerous techniques are available, and any are acceptable if the end product meets the expressed standards. This chapter presents the steps involved in lens insertion, some of the methods used, and also some of the difficulties that must be avoided.

AN OVERVIEW OF INSERTING LENSES INTOPLASTIC FRAMES

The steps involved in inserting a lens are standard for most plastic frames. The major variant is whether or notheat is used in the process—and if heat is to be used, how much heat is required. When no heat is used, the lenses are "snapped" into place. This is called *cold snapping*.

Adaptations of these basic procedures of lens insertion for special materials are explained later in the chapter. Table 7-1 gives an overview of lens insertion for different frame materials.

Lens Insertion in to Normal Plastic (CelluloseAcetate) Frames

Here are the procedures used to insert a lens into a plastic frame. Although specific for cellulose acetate frame material, there is little difference in technique for other frames.

Heating the Frame

Lenses should be inserted into the frame without bumping the temples. When the endpieces of the frame are hot, if the temples are bumped, the hinge may loosen or become misaligned. Because most plastic frames have *hidden hinges*, which do not go all the way through the plastic, a loose temple is very difficult to repair.

Begin heating the frame by noting the curvature of the lens meniscus compared with the curve of the eyewire (Figure 7-1). Since the lens usually curves more than the eyewire, it is advisable to preshape the upper and lower sections of the eyewire to conform to the meniscus of the lens edge. This makes lens insertion somewhat easier. Before heating the frame, it is advisable to do a "dry run." Hold the lens frame in exactly the position you intend to use when actually putting the lens in the frame.

You must be able to return the frame to this position immediately after it has been heated. Frames cool rapidly and lose pliability quickly, and the few moments salvaged by this preparation may be vital.

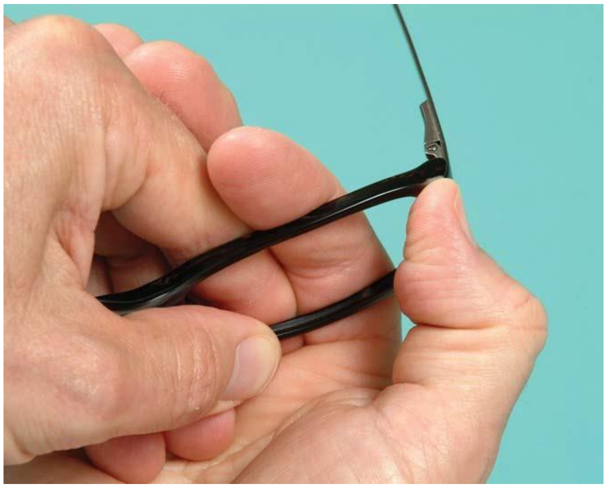
Hold the lens with one hand and the frame with the other, in exactly the same manner as they will be held when beginning lens insertion. It is much better to hold the frame by the frame front and not the temples. Holding the frame by the temples vastly increases the possibility of loosening a hinge. Heat only the portion of the frame that is actually going to be manipulated. In the case of lens insertion, this is just one half of the frame front (Figure 7-2, *A*).

Some frame warmers blow hot air onto the frame from both sides of a frame, others only blow air from one direction. When using an air blower that blows from one direction only, be sure to heat both the front and back or top and bottom of the frame front alternately to prevent overheating any one portion.

When using a salt pan, first stir the salt to equalize the temperature, then push some of the salt into a mound in one portion of the pan. Place the section of the frame to be heated just beneath the surface of the salt mound, leaving that portion not to be heated out of the salt and as parallel to the surface of the salt as possible (Figure 7-2, *B*). Move the frame continually and very slowly while under the salt to avoid marking the soft plastic with salt granules. Do not permit the frame to become so heated that it sags or distorts. If salt sticks to a dry frame, additional talcum powder should be added to the salt. (The only two components of the "salt bath" are salt and ordinary talcum powder. Salt conveys heat well, while talcum powder prevents salt from lumping and sticking to the frame.) CAUTION: Because many frame materials are sensitive to excessive heat and coated lenses can be damaged by the high heat of salt pans, it is much safer to use a hot air blower, rather than hot salt. An expensive anti-reflection (AR) coating can easily be ruined by using hot salt to heat the frame.

Inserting the Lens

As stated earlier, begin by noting the curvature of the lens meniscus compared with the curve of the eyewire as was shown in Figure 7-1. Heat the frame and preshape the upper and lower sections of the eyewire to conform



A

B

Figure 7-2. A, Heat only that portion of the frame that is going to be manipulated. Here a hot air frame warmer is being used to heat the frame. Hot air is the safer method of heating a frame compared with hot salt. **B,** If hot salt is to be used, the frame should be moved slowly under the surface of the salt to help heat it uniformly. Moving the frame also causes it to heat faster, since heat is continually leaving the salt immediately adjacent to the frame and entering the plastic. (Remember: With newer plastic frame materials and many lens treatments, it is not safe to use a salt pan.)

to the meniscus of the lens edge as shown in Figure 7-3.

Method 1—Insert the temporal (outer) edge of the lens into the corresponding portion (outer edge) of the frame (Figure 7-4, *A*). With the thumbs on the surface of the lens and the fingers on the nasal (inner) edge of the frame eyewire, snap the lens into the frame from the nasal (inner) side by applying pressure with both the thumbs and fingers (Figure 7-4, *B*).

Figure 7-3. To make the frame rim fit the lens better, pre- shape the rims to conform to the meniscus curve of the lens.

Method 2—Insert the upper outer (temporal) edge of the lens into the frame groove (Figure 7-5, *A*), push the upper inner (nasal) edge into the eyewire so that the whole upper edge of the lens is in the frame (Figure 7-5, *B*), push the lower temporal edge in (Figure 7-5, *C*) and conclude by snapping the lower nasal corner in (Figure 7-5, *D*). (See Table 7-2 for a review of these methods.)

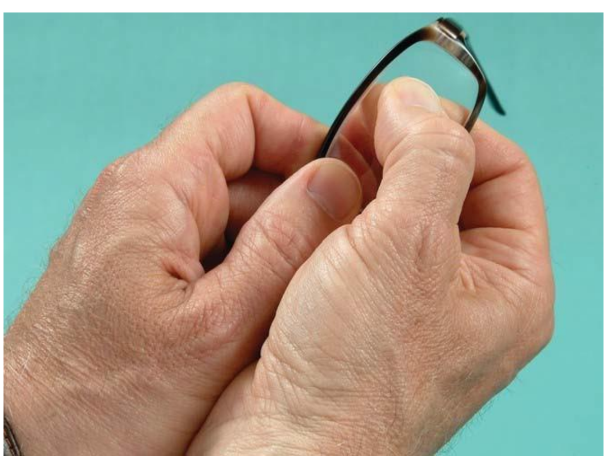
Most frame construction makes it easier to insert lenses from the front. Lenses should definitely be inserted into safety frames from the front so they will not be as likely to come out of the frame when struck from the front.

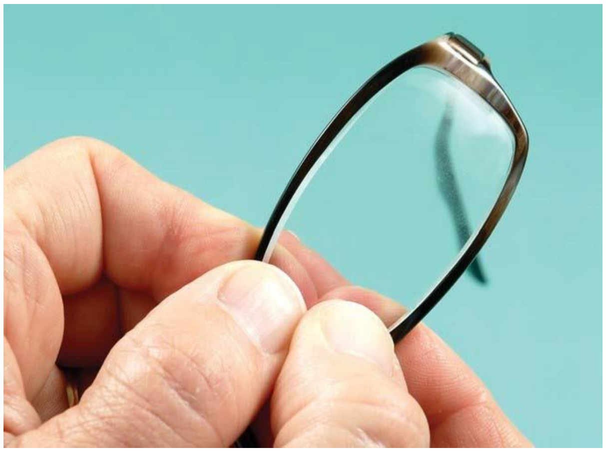
If the frame cools too much before the lens is fully inserted, by whatever method, it is advisable to totally remove the lens before reheating the frame. A heated lens is difficult to handle; also, a frame without lenses heats more uniformly and will stretch more evenly as the lens is inserted.

When pulling the eyewire using any of the methods, the pulling action must be *straight* and caution must be taken not to "*roll*" the eyewire. This rolling results in the front of the eyewire covering less lens than the back, or vice versa, as if the groove were turned at an angle (Figure 7-6). A rolled eyewire holds the lens less securely and disturbs the finished appearance of the spectacles. It also may cause some visual disturbance if the lens bevel is revealed and refracts light.

If during the insertion procedure, the eyewire appears to become rolled, it is helpful to change the direction of insertion (back to front, or vice versa) so that the stress put on one portion of the eyewire is equaled by stress on the other, reversing the direction of the roll.

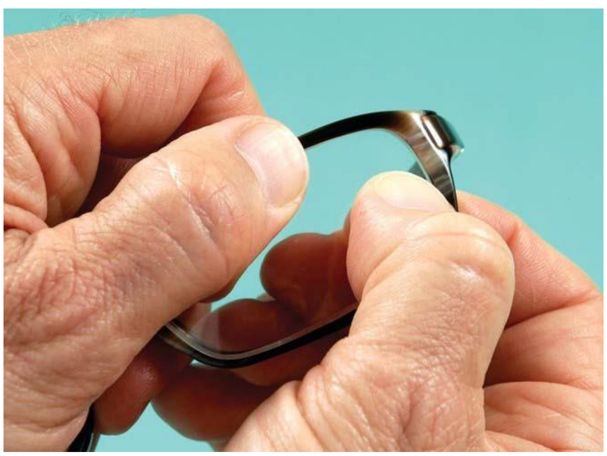
After inserting the lenses into a conventional plastic frame (made of cellulose acetate) and checking for adjust- ment, it may be helpful to plunge the frame and lenses into ice water to "set" them. This procedure shrinks the

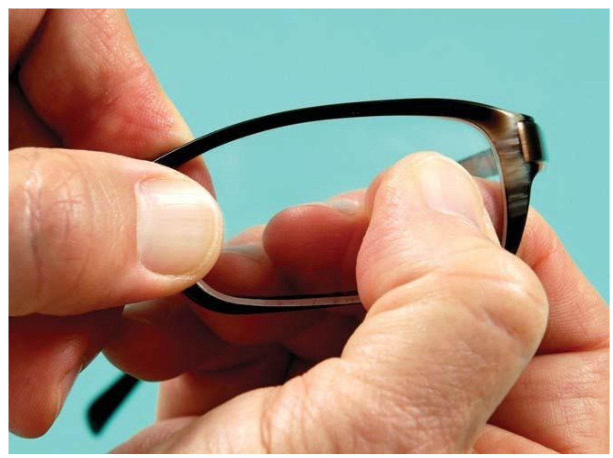




A B

Figure 7-4. Method 1. **A,** Place the temporal edge of the lens in the frame groove. (The first moments of lens insertion are crucial in proper alignment of the lens bevel with the frame groove and must be done quickly.) **B,** The lens should snap in place fairly easily. If extreme force must be used in attempting to snap the lens in place, the process is better carried out using method 2.





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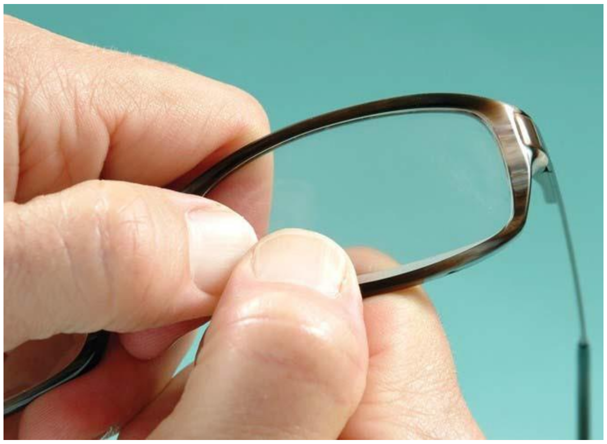


C D

Figure 7-5. Method 2. **A,** Method 2 also starts with alignment of the lens bevel and frame groove, beginning in the upper temporal corner. **B,** When the upper and lower rims of the eyewire have been preshaped to the lens configuration, lens insertion into the entire upper half of the frame may be completed well before the frame cools. **C,** When the upper part of the lens is in the frame, start temporally and begin pulling the lower eyewire around the lens. **D,** Conclude the insertion process by snapping the bevel of the lower nasal part of the lens into the groove.

Adapting for a Lens That is Too Small

If new lenses have been ordered for an old frame, they may be too small if the frame has been stretched around its old lenses. In these cases, it may be possible to shrink a regular plastic frame to reduce the circumference of the eyewire to accept the new lenses firmly.

First heat the frame front thoroughly until it is quite pliable, then immediately immerse it in very cold water— as cold as possible. Allow the frame to rest in the cold water until it is completely cold to the touch.

If the frame is still too large, repeat the process two or three times. If the frame is still too large after the third treatment, the technique probably will not succeed.

This process can also be used on new frames, although they rarely respond more than slightly.

Figure 7-7. After putting the first lens in the frame, lens orientation for the inserted lens should be compared with the empty eyewire. This frame shows too much temporal upsweep.

Checks After Lens Insertion

After inserting lenses, check to be sure the lens is entirely in the groove of the eyewire. Be sure the eyewire is flat or uniformly rounded on the outside; if it is slanted, the eyewire has been rolled. A roll can be corrected by heating that portion of the eyewire involved and either twisting it with the fingers or pressing the frame against a flat surface with a counter-rolling motion. If uncor- rectable by this method, it is best to remove the lens and correct the lower eyewire without the lens in it. Then reinsert the lens properly after heating the frame.

Compare the eyewire containing the lens with the empty eyewire adjacent to it. Be sure the lens fits squarely all around and has not been twisted. Note whether or not the eyewire containing the lens is still parallel to the empty eyewire. Observe the upper rim near the bridge and compare it with the empty side. If the plastic is humped or stretched in comparison, the lens is not matching the eyewire shape and is probably altering the initial frame shape (Figure 7-7).

When both lenses have been inserted, an empty sample frame of the same shape may be used to assess the inserted pair. This may be necessary, especially for an untrained eye, because the lensmeter will not reveal a twist of the lens in all cases, such as when the lenses are spherical, or if the bridge or endpiece is askew.

Lens-twisting pliers (Figure 7-8) are used to correct a rotated lens. First, heat the frame and inspect the lens and pliers to be sure that all surfaces are free of salt. Hold the frame in one hand with the upper eyewire toward

Figure 7-8. Many different types of *lens twisting* pliers are available. There are two important variations in these pliers.

1. One is the “throat depth” of the pliers. The farther the pads are from the central joint of the pliers, the less likelihood there is of inadvertently marking the frame in twisting.
2. The second variation is the vertical dimension of the pads that grip the lens surfaces. Some pads will be too large vertically for frames with narrow vertical depths to the lens.

Figure 7-9. Here the frame is being held correctly. However, carelessness in holding the frame results the palm. When working on the lenses, the forefinger, second finger, and thumb should grasp the area around the endpiece while the third and little finger brace the bridge area (Figure 7-9). Using the pliers to hold the lens, rotate the frame so that the upper eyewire always remains towards the palm when shifting from one lens to the other. The difference then is that for one lens hinges face away from the palm whereas for the other, they face towards the palm.

The pliers should grasp the lens close enough to the lower eyewire to prevent contact between the eyewire and the metal of the pliers. If the pliers press against the hot eyewire, they will invariably dent it.

The same lens adjustment can be made using the fingers of the free hand instead of the pliers to grasp the lens. This adjustment must be performed immediately after lens insertion and before the frame has cooled.

Figure 7-10. If the bifocal is a straight top, both bifocal lines will run parallel to the straight edge. Here there is an error present and the left lens is obviously twisted. It should be mentioned though that parallel bifocal lines do not guarantee that the lenses are not twisted in the frame. The frame front should still be examined for temporal upsweep or nasal humping.

Checking a Bifocal or Progressive Addition Lens

With *straight-top bifocals*, the position of the lenses can easily be checked using a straight edge. This is placed horizontally across the front surface of the lenses at the level of, and parallel to, the straight tops of the bifocal segments.

If both lenses are correctly inserted, both segment tops will run adjacent or parallel to the straight edge. If one or both lenses are improperly inserted, the segment top of one lens will appear at an angle to the straight edge when the straight edge is parallel to the segment top of the other lens (Figure 7-10).

If the segment tops of the lenses are parallel but one lens still appears poorly positioned by the criteria previ- ously mentioned (comparing the frame with lenses versus an empty frame), then the lens blank has been edged in a rotated position. The error cannot be corrected by adjustment; it requires the manufacture of a new lens.

By holding the lenses back to back, it is possible to determine before insertion if either bifocal lens has been edged in a rotated position. The bifocal portions should overlap exactly if equal seg height and decentration were ordered (Figure 7-11). This is true for any type of mul- tifocal lens.

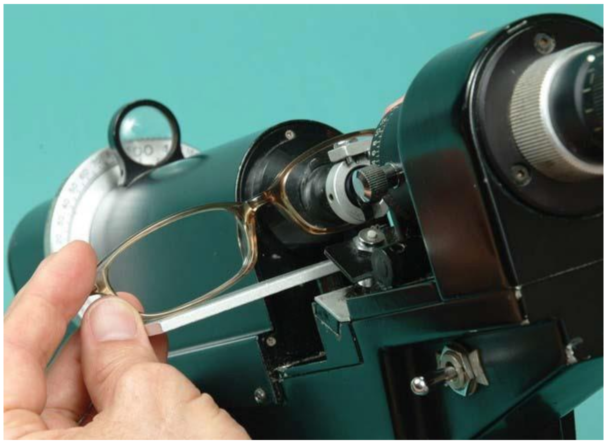


Figure 7-11. When two lenses are held back to back, any error in lens rotation becomes immediately evident. The same technique may be used to check a “lenses only” order when one bifocal seg has been ordered a different height from the other. Their differences will be obvious and measurable.

Figure 7-12. Ordinarily, during verification, glasses are positioned to rest flat on the lensmeter table. To aid in determining which way a rotated lens should be turned for lens realignment, it is helpful to set the instrument at the desired axis and rotate the glasses.

These same helps may be used with progressive addition lenses that still have lens markings in place. There are two circles or other marks that denote the 180- degree line. These may be used to check for lens straight- ness just like the tops of bifocals were.

Judgment of *round-seg bifocals* depends a good deal on noting whether the lenses look like they are straight in the frame and not rotated. (Again, compare the frame with lenses versus an empty frame.) A good reference point for observation is the point where the nasal edge of the seg meets the eyewire. If both bifocals were ordered with equal seg height and decentration, the inner edges of the segs should meet the eyewires at symmetrical points. If one point appears higher up the eyewire nasally than the other, use the lens-twisting pliers to correct it, provided this adjustment does not place the cylindrical correction off axis. If the axis is disturbed, the lens has been erroneously cut off pattern.

To be certain that *single-vision cylindrical lenses* are in the frame straight, preset the lensmeter at the correct sphere power and set the axis reading at the axis called for in the prescription. If the lines in the lensmeter appear to be “off axis,” the lens has been inserted in a rotated or twisted position. Raise one side of the glasses, then the other, from the lensmeter table until the lines in the lensmeter appear straight and unbroken (Figure 7-12).

Note the angle at which the frame is sitting, keeping in mind that the rotated lens has now been turned to the proper axis position. (In essence, the frame needs to be twisted around the lens until it sits flat on the lensmeter table again.) To bring the lens to its proper position, dot the lens with the lensmeter marking mechanism. Then heat the eyewire and twist the lens around until these three dots are horizontal in the frame. The lens is then at its proper axis, which should also result in a symmetrical-looking frame.

If there is nasal humping or a temporal upsweep present for one lens but not the other, the lens has slipped in the edging process or was improperly positioned at the time of the original edging. The only alternative is a new lens.

After the lenses are straight in the frame, adjust the frame into standard alignment.

Removing a Lens

To remove a lens, heat the frame front and place the thumbs on the back side of the lens in the lower, nasal area (Figure 7-13). Brace the front of the eyewire with the fingers. A towel may be placed around the lens to prevent burning of the fingers. (Lenses that were inserted with a “cold snap” method will also be removed cold.) Push the lens in one direction by pressing with the thumbs and bracing or pulling the eyewire in an oppo- site direction with the fingers.

Insertion Into a Cellulose Propionate Frame Cellulose propionate material is very similar to cellulose acetate. However, it is more heat sensitive. It may even be advisable to cold snap the lenses in place. When using heat, the frame warmer should be set for a low temperature (40º C/105º F). The closer the edged lens size is to the frame size, the less heat will be necessary. For that reason, it may be helpful to edge the lenses “on size.” Because it is not always possible to tell a cellulose acetate frame from a regular plastic frame, and because a number of other frame materials are also sensitive to heat, it is generally advisable to heed the following:[1]

- Use the lowest amount of heat necessary to accomplish the task.

Figure 7-13. To remove a lens, pressure is applied to the back of the lens at the lower nasal portion.

- Heat the frame until it is pliable; not until it actually softens.
- Never leave a frame unattended in a frame warmer.

Insertion Into a Nylon Frame

Insertion of lenses into a nylon frame must be done following the manufacturer's directions to prevent problems.

Because nylon frames do not stretch as much as ordinary plastic frames, the lenses must be edged closer to the frame size than usual. Care must be taken to avoid cutting the lenses too small; this hazard is a common tendency, encouraged by the difficulty of stretching the nylon about the lens. Lenses cut too small will fit loosely after insertion because of the depth of the bevel.

Nylon frames cannot be heated uniformly enough by the usual methods to permit the stretching necessary for lens insertion. The hot air and salt pan methods tend to heat the outer layers of the nylon excessively and leave the deeper portions too cool to stretch. Hot water penetrates the nylon better and permits the eyewires to stretch properly to accept the lenses.

To adjust a nylon frame, the best method is to heat the plastic, bend it as desired, and then hold the frame in the new conformation as it cools. If the frame is released before it is cool, it tends to resume its initial configuration. Holding the frame to the adjusted con- figuration while running cold water over it may help.

Insertion Into a Carbon Fiber Frame

There are many different carbon frames on the market. The actual material will vary, depending on the manufacturer. This means that the properties of the material will vary some as well. The recommendations of the individual frame manufacturers should be followed.

Great care must be taken if carbon fiber material is heated. Carbon fiber material does not lend itself to adjustment. Although carbon fiber will become somewhat pliable with heat, the recommended method of lens insertion for carbon fiber fronts without eyewire screws is to "cold snap" the lenses in place.

Cold snap lens insertion is just what its name implies. The lenses are cut to fit the size of the frame exactly. The frame front is not heated. Instead, the lenses are inserted without heat. They are pushed into the frame in the same manner as they would be for a normal plastic frame. Pressing on the lens “snaps” the lenses into the “cold” frame.

Because of the reputed tendency of a standard CR-39 plastic lens to shrink very slightly over time, some labs use a small amount of heat to insert the lens. The lens may then be ground slightly larger. If heating carbon fiber material, it is much better to use hot air instead of salt or glass beads. A hot air warmer should be on low temperature and the frame heated for 10 to 20 seconds. Be advised, however, that “heat can soften the frame finish, making it easy to scrape the coated surface with the sharp edges of the lens. This can result in a frame that is chipped or flaked, exposing the dull base material.[2]”

Many carbon fiber frame fronts come with an eyewire screw like that found in regular metal frame fronts. The screw opens and closes the eyewire to accept the lens. Lens insertion is done as if the frame were a metal frame (see *Lens Insertion into a Metal Frame* later in this chapter).

Insertion Into a Polyamide Frame

Most of the guidelines for working with carbon-fiber frames also apply to polyamide frames. The nylon-based polyamide material is thin, light, and resists adjustment. The lenses should be sized exactly and cold snapped into place. Oversized lenses simply will not go in, since the material will not stretch. One of the unique features of this material is its tendency to shrink slightly when heated in excess of 230° F.[3] Therefore heating a polyamide frame to insert a correctly sized lens will cause pro lems. A correctly sized lens would then be too large for the frame. On the other hand, this tendency to shrink somewhat can be an advantage if a lens is a bit too small. After the lens has been cold snapped into place, the lens fit can be tightened by heating the lens and frame together. The polyamide shrinks, and the eyewire contracts around the lens. Do not plunge the frame into cold water.

For polyamide frames, it is best to use a hot air type of frame warmer even when adjusting the temples.

Insertion Into a Polycarbonate Frame Polycarbonate material is used for certain sports eyewear frame fronts. Polycarbonate does not adjust. Because polycarbonate does not become pliable when heated,
lenses must be “cold snapped” into place. Lenses should be cut close to the actual frame size, since polycarbonate neither stretches or shrinks.

Insertion Into a Kevlar Frame

Kevlar is also a nylon-based material. It neither stretches nor shrinks with heat, but does exhibit a degree of pli- ability. This pliability allows for a more conventional lens insertion. In other words, the lenses do not have to be cold snapped into place. Yet the lenses still need to be cut exactly to size or insertion will prove troublesome.

Insertion Into an Optyl Frame

Optyl, first developed in 1968 by Wilhelm Anger Co. of Traun, Austria, is a material that belongs to the group of epoxy resins. Optyl frames are cast molded rather than cut. They are also 20% to 30% lighter than the more conventional frame materials.[4]

Optyl frames can be identified by trade name and by the characteristic clear colors in which the material is made. Originally, there was always an absence of a metal reinforcement through the temples. They were clear Optyl material and an identifying characteristic. However, Optyl frames also come with temples having traditional metal core reinforcements that have a differ- ent composition. Unlike the first type of Optyl temples, these are adjusted with little or no heat.

Because Optyl will not shrink, it is better to cut the lenses slightly oversize. A margin of 0.6 to 1.0 mm too large is customary.

Frames made from the original Optyl material do not begin to soften until the heating temperature reaches 80° C; they can safely be heated to a level of 200° C without bubbling or distorting. Should the frame become distorted, it will go back to its original molded shape on being heated. This can be an advantage when the frame is distorted during lens insertion, but it can also be a disadvantage during frame adjustment, because heating the frame may cause it to loose its adjustment and go back to its original molded form.

To allow lens insertion, the frame should be heated until pliable enough to bend of its own weight: usually about 30 to 60 seconds. The lenses are not so much pushed into the eyewires as placed in them. If the eyewires are not properly surrounding the lenses, the frame should be reheated; the eyewires will adapt to the lenses as the frame attempts to resume its original molded shape.

The lenses must never be forced into a frame that has not been heated to pliability, nor should the frame be plunged into cold water to try to shrink the plastic about the lenses. Optyl expands with heat and returns to size through slow cooling. Plunging the frame into cold water stops the shrinking process and has the exact opposite effect of that desired.

If a glass lens is off axis or inserted in a rotated position, it should be rotated into its proper position only after the frame has been reheated, never while cold. If the lens is plastic, however, it should be removed and reinserted. If plastic lenses are not removed but only rotated, they will be loose after the frame and lenses cool.

Frames made of the original Optyl material do not bend while cold. Attempts to adjust them without heating almost always result in breakage. Since the material bends only when heated, properly adjusted Optyl frames tend to stay in adjustment until again heated.

To adjust the frame, heat only the portion of the frame requiring bending. Since this may be difficult to do for limited areas, such as a portion of the temple about the ear, use a heating unit that can direct heat to a limited area, such as a forced-air unit with a cone attachment that directs the flow of heat. Hold the frame so that the portions adjacent to the area being heated are protected from the heat and do not lose their adjustment.

LENS INSERTION INTO A METAL FRAME

Lenses to be inserted into a metal frame must be edged to the exact size. Therefore, it is more likely that the order will be correct if the laboratory has the wearer's actual frame. In certain instances, however, it will be necessary to order "lenses only." When ordering "lenses only" for a metal frame, then the dispensary must trace the lenses using a remote frame tracer and send the digitized shape to the lab electronically.

If there is not a frame tracer in the dispensary, the laboratory must have the pattern for the frame in question. If there is any doubt about whether the laboratory has the pattern, they should be asked before the order is sent. Without an exact pattern, the frame will have to accompany the order. Once it is determined that the laboratory has the pattern, the chances of getting a good fit for a "lenses only" order are increased by measuring the circumference of the existing lenses.

To put a lens in a metal frame, begin by comparing the meniscus curves of the top and bottom of the lens to the corresponding curves of the upper and lower frame eyewires. If they do not match, the lens bevel will not seat squarely in the eyewire groove. Although in most cases these curves will match closely enough to allow a good lens fit, it will occasionally be necessary to use *eyewire forming pliers* (Figure 7-14) to reshape the frame eyewire. Eyewire forming pliers have curved nylon jaws. To increase the meniscus curve, position the pliers along the eyewire, as shown in Figure 7-15, and squeeze lightly. It may be necessary to continue to repo- sition the pliers stepwise along the upper and possibly lower eyewire until the new curve is evenly formed. (If the eyewire has *too much* curve, the eyewire forming pliers may be reversed to take some of the curve out of the eyewire.)

The best policy is to remove the eyewire screw, put the lens in the rim, and replace the screw. Simply loosening the screw until it is possible to place the lens in the eyewire may cause the lens to chip during insertion. It is helpful to use *eyewire closure pliers* (Figure 7-16) to aid in seating the lens in the eyewire groove. With closure pliers it is also possible to tell if the lens will be of the correct size (Figure 7-17).

If the lens is too large, some dispensers will attempt to reduce the size of the lens with a hand edger to make it fit. Before attempting this, the dispenser should remember these points:

1. Evenly reducing the size of a lens is difficult. Uneven size reduction will produce gaps between the lens and the frame.
2. Only nonglass lenses should be hand edged. Heat- treated glass lenses may the break during hand edging, and hand edging will destroy the effect of the lens hardening process. Hand edging chemically hardened glass lenses should be following by rehardening, as impact resistance is reduced by hand edging.

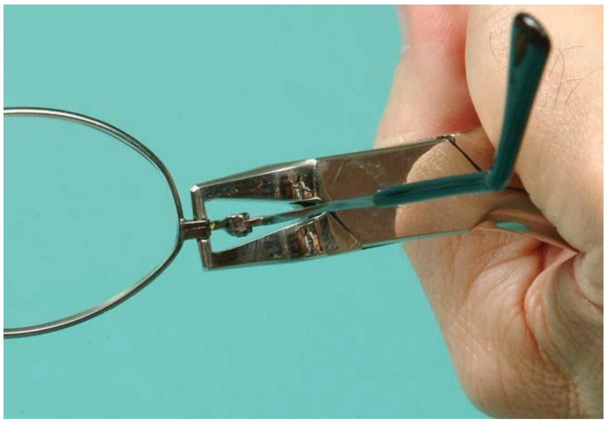
3. Once the lens is seated in the eyewire, the eyewire screw is tightened. Forcibly tightening the eyewire screw so that it places excessive stress on the lens may cause a glass lens to chip along the edge if struck or may cause a plastic lens to warp. Excessive edge strain may be checked for by using a colmascope, which is a set of crossed polarizing filters.

Figure 7-14. Eyewire forming pliers are used to cause the frame eyewire to conform to the meniscus curve of the lens bevel.

Figure 7-15. To increase the curve of the eyewire of a metal frame, position the eyewire forming pliers as shown in the photo and gently squeeze, repositioning the pliers as necessary.

Figure 7-16. Eyewire closure pliers are made to fit into the top and bottom of the eyewire barrel.

Figure 7-17. By using eyewire closure pliers to squeeze the eyewire around the lens, it is possible to see how well the lens will fit without having to replace the screw. Such pliers are especially handy in the edging laboratory.



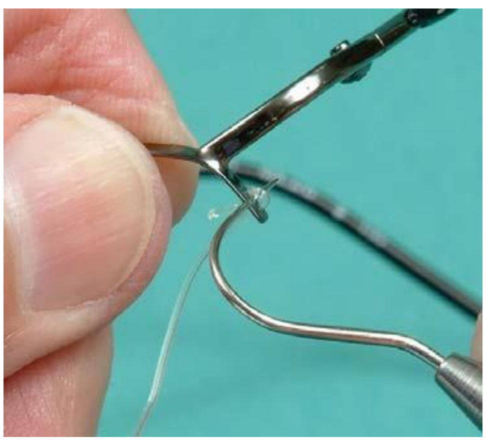


Figure 7-18. When it is difficult to remove a nylon cord from the frame channel of a nylon cord frame, a dental pick makes the job easier.

LENS INSERTION INTO A NYLON CORD FRAME

An alternative to the traditional method of beveling a lens and inserting it into a grooved frame is the nylon cord frame. A *nylon cord frame* requires that the lens be made flat on the edge. A small groove is cut into the edge, usually all the way around the lens. A thin nylon string, attached to the frame, is slipped into the grooved lens to secure it in the frame. A nylon cord frame is also referred to by a number of names, including *nylon supra*, a *string mount*, *rimlon, Nylor*, and *suspension mounting*.

Mounting a new grooved lens in a nylon cord frame or replacing an old or broken cord on an existing frame requires similar procedures. Once the technique for replacing an old or broken cord is mastered, mounting a new lens in a new frame can be easily done. Therefore, *the first procedure outlined is that of replacing an old or broken cord. We are assuming that at least part of the cord is missing, so we will have to resize the cord to match the lens.*

Replacing a Nylon Cord of Unknown Length

1. *First remove the old cord.* Sometimes it is difficult to remove the end of the cord from the frame groove because it has been wedged securely into the groove. If this is the case, a dental pick can be handy for pulling the end of the cord out of the
frame groove (Figure 7-18).
2. *Pull out the old cord*. Next catch the loop with the dental pick (Figure 7-19) and pull out the cord.

Figure 7-19. When removing an old cord from a nylon cord mounting, a dental pick can catch the tight loop to get the cord out of the holes.

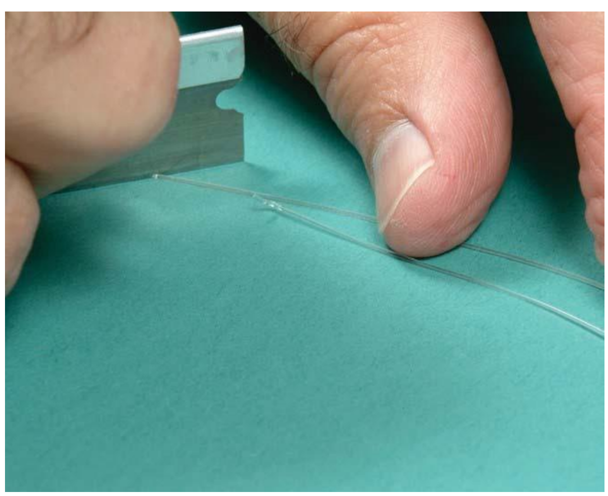


Figure 7-20. Cutting the nylon cord at an angle makes it easier to thread through the holes in the frame and allows it to seat smoothly in the groove under the lens.

Here the length of the new cord is being estimated from the old cord that broke off near the point of attachment.

3. *Cut the new cord at an angle.* Since the old cord is missing and the length unknown, start with a very long section of cord. Remember, whenever cutting the nylon cord, always cut the cord at an angle. Both ends of the cord should be cut at an angle to make threading easier and so that the cord seats nicely in the frame. Using a single-edged razor blade is best (Figure 7-20).
4. *Thread the cord into one side.* The cord will need to be attached to the mounting at two locations. Each point of attachment consists of two small holes. Some prefer to start with the nasal point of attachment, others the temporal. For illustration purposes, we will start temporally.

Starting with the temporal point of attachment, thread one end of the nylon line into the *lower* hole from the *lens* side. Then thread the same end into the upper hole, leaving a length of 2.0 to 3.0 mm (Figure 7-21).

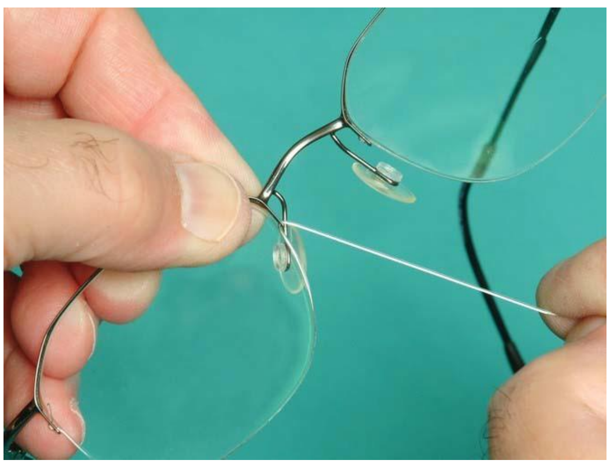
1. *Size the cord to the lens.* Slip the other end of the cord through the lower hole at the nasal point of attachment. Do not thread it through the upper hole. Remember, the cord is first threaded from the lens side. With the end of the nylon cord still loose, slip the lens into the upper part of the frame. Thread the cord around the lens and pull the cord snug (Figure 7-22). Do not forcibly pull the cord so that it stretches.
2. *Remove the lens without "losing your place."* Hold the excess end of the cord with the thumb, so that it does not slide out, and remove the lens. (Since the cord was not pulled tight, it should be possible to remove the lens without losing the point of reference for length on the cord.)
3. *Take up the slack in the cord.* Because the cord was not pulled tight around the lens, it is necessary to pull the cord 1.5 to 2.0 mm *farther* through the lower hole so that the lens will be tight enough.
4. *Thread the excess cord through the remaining hole.* Thread the excess cord through the upper nasal hole while maintaining the new position of the cord in the lower hole.

5. *Clip off the excess cord.* Clip the excess cord, leaving

2.0 to 3.0 mm inside the eyewire. (If the cord is clipped at an angle it may lay down in the groove more smoothly. Nail clippers work as well as regular cutting nippers.)

6. *Press the end of the cord into the frame groove.* First press the cord into the frame groove with the thumb (Figure 7-23, *A*). To get it all the way into the groove, it is helpful to next use a pair of half- padded nylon jaw pliers to push the loose end of the cord down into the groove (Figure 7-23, *B*). (Failure to tuck the cord into the groove will cause the lens to chip or flake because of the pressure of the cord between the edge of the lens and the edge of the eyewire.) Do this both nasally and temporally.

7. *Secure the lens in the upper half of the frame.* The lens is inserted into the frame, beginning in the nasal area (Figure 7-24, *A*), followed by the temporal area (Figure 7-24, *B*). The lens should come in *behind* the nylon cord so that the cord rests on the front surface of the lens.
8. *Stretch the cord into the groove around the lens.* To secure the lens in the frame, the cord must be stretched to fit into the lens groove. This is done using a plastic strip. (Some use a fabric ribbon. However, a ribbon will often fray, leaving threads wedged between the lens and the cord. It is extremely difficult to remove these threads.) Start out with the cord on the front side of the lens. Slip the plastic strip between the nylon cord and the lens, folding the strip back and grasping both ends together. Begin temporally and use the strip to pull the cord around the edge of the lens, seating it into the lens groove on the way around (Figure 7-25).



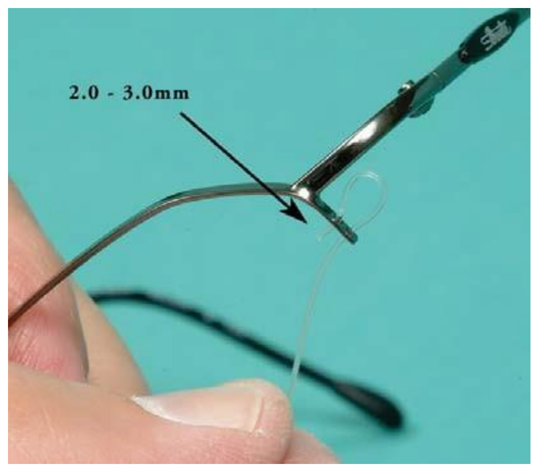
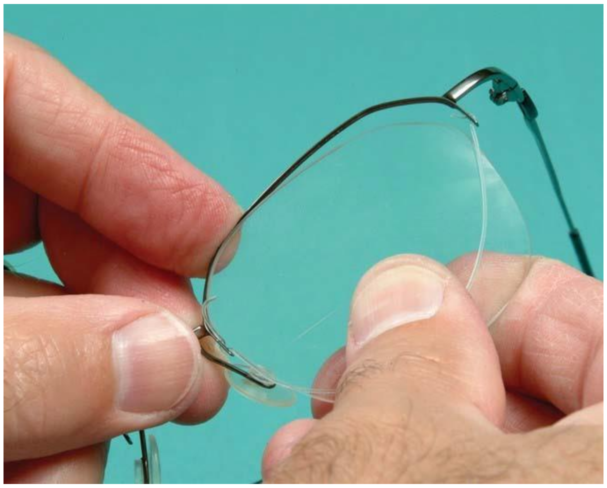
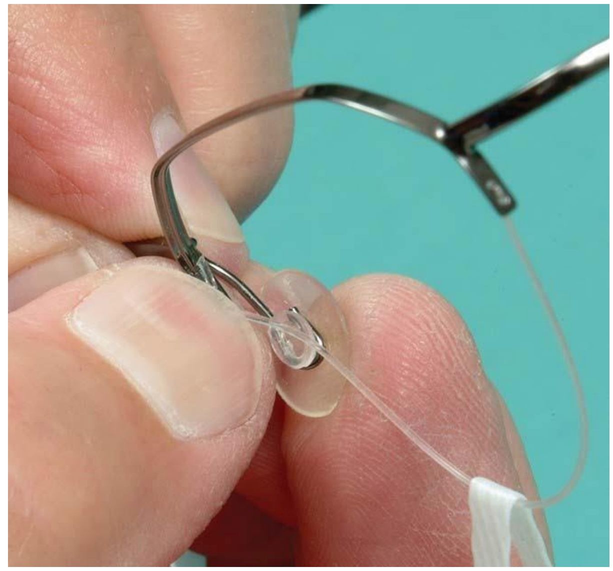
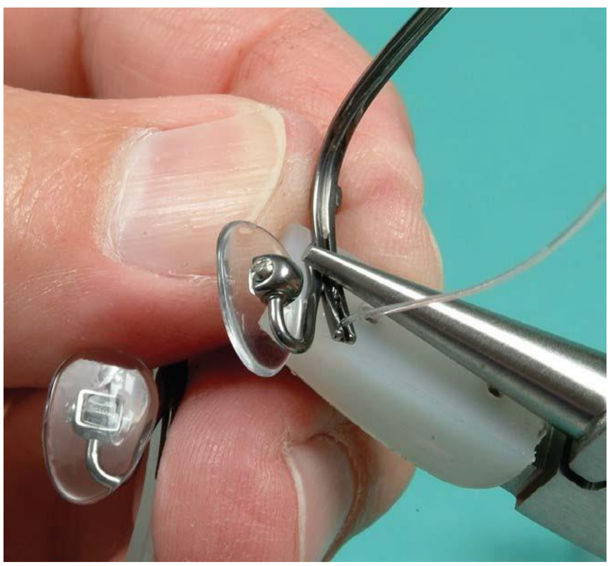


Figure 7-21. The cord is threaded into the lower hole from the inside and back into the upper hole.

Figure 7-22. In this instance, we need to find the necessary cord length when the cord, or a good portion of the cord is missing. When replacing a nylon cord of unknown length, the cord is pulled snug around the lens, but not stretched.

A



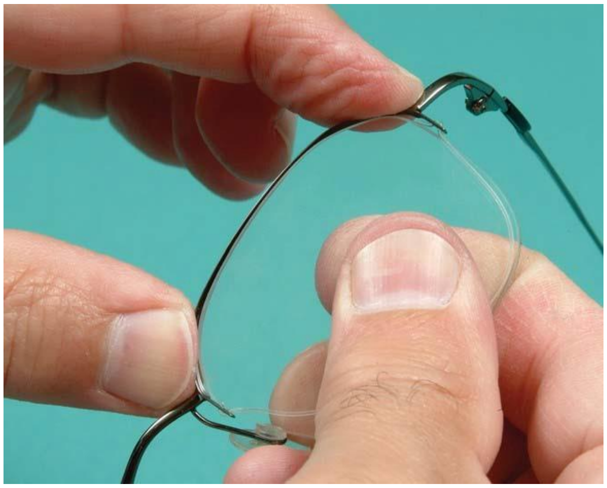
B

Figure 7-23. The cord is cut to the correct length and threaded. Before putting a lens in the frame, the end of the cord is pressed into the groove of the frame. In **(A)** the end of the cord is being pressed into place with the thumb. This may not get the cord all the way in the groove, but will get it started. In **(B)** half-padded pliers are used to press the end of the cord fully into the groove.

9. *Check the cord tension.* Cord tension can be checked in one of at least two ways.
   a. Check the tension at the corner of the lens right after the cord drops into the groove (Figure

7-26), or

A



B

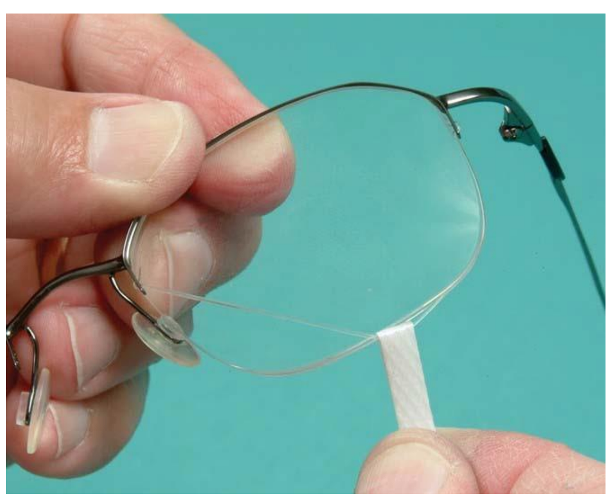
Figure 7-24. To put the lens in the frame, begin with the upper nasal corner as shown in **(A)**. Once the upper nasal corner of the lens is in place, the upper edge of the lens can be more easily aligned by moving across the upper rim, as shown in **(B)**.

b. Check the tension of the cord by sliding the plastic strip toward the bottom of the lens until it is close to the midpoint of the lens cord. Pull fairly hard on the cord with the strip. The strip should pull the cord about 0.5 to 1.0 mm away from the edge of the lens.

10. *Try to rotate the lens.* Once the lens is in place, grasp the lens as shown in Figure 7-27 and attempt to rotate it in the frame. If the lens rotates easily, the cord is not tight enough.

If the tension is incorrect, the lens should be removed and the length of the cord altered.

(It may be necessary to use the dental pick to free the end of the cord from the frame groove. Most often when the fit is wrong, the cord will



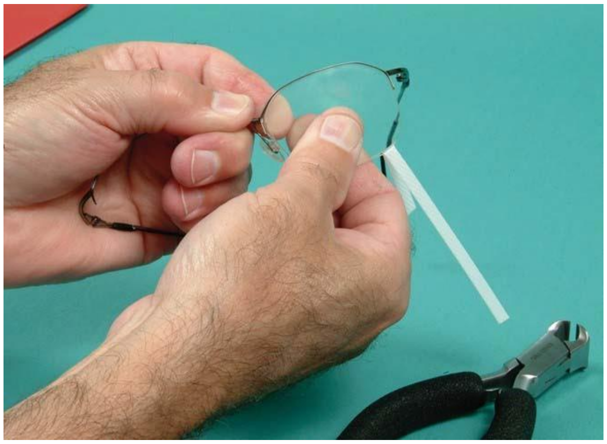


Figure 7-25. The cord must now be pulled around the lens. To slip the nylon cord into the groove in the lens, begin tem- porally and pull the cord around the lens in a nasal direction. The cord must start out on the front side of the lens.

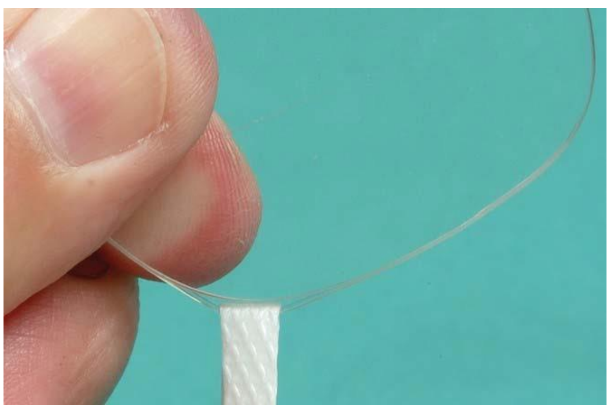


Figure 7-26. Pull fairly hard on the plastic strip to check the tension of the cord. As shown in the figure, the cord should stretch some, but there should be no more than 1.0 mm between the cord and the lens. (Some prefer to check for cord tension at the center of the bottom of the lens.)

be loose and will have to be shortened. If this is the case, repeat the above steps, beginning with step 8.

11. *Remove the plastic strip.* Once the lens is securely seated, move the plastic strip to the center of the lens edge, release one end of the plastic strip and pull it from between the lens and cord (Figure 7-28). Trying to remove the strip at a corner can pull the cord out of the groove. (For a review of these steps, see Box 7-1.)

Replacing an Old or Broken Nylon Cord

If the nylon cord is old or broken with both parts still intact, the new cord can be cut to match the length of

Figure 7-27. Once the lens is in, grasp the lens between thumb and fingers and try to rotate the lens. If the lens rotates easily, the cord is not tight enough.

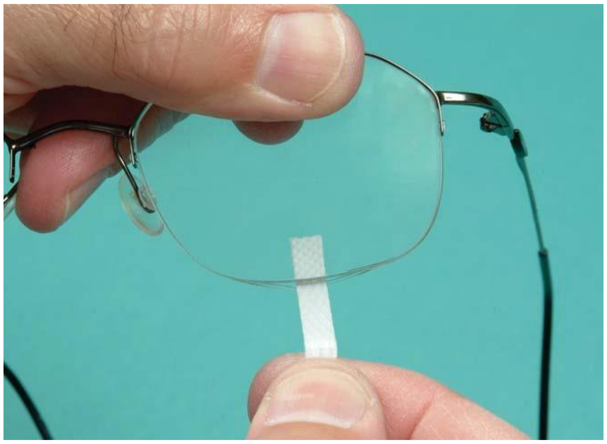


Figure 7-28. Move the strip to the center of the lens before attempting to remove it. If the strip is at or near a corner of a lens when being removed, it may pull the cord out of the groove.

the old cord. The procedure is basically the same as just described for replacing a missing cord, except that we can line up the new cord with the old cord and cut it to match. Remember to cut both ends of the new cord at an angle. If the old cord is in two pieces, line up the longest piece of the old cord and allow extra for the estimated length of the short piece of the broken cord. Cut the new cord to match.

Both temporal and nasal edges are threaded into the frame as described above. Hereafter the remaining steps are the same as previously described.

Cautions for Lenses With Thin Edges

When a lens used for a nylon cord frame has thin edges, the edge may not leave much room for the groove. This means that thin lens material on either side of the groove

BOX 7-1

Procedure for Inserting Lenses Into a Nylon Cord Frame

1. If necessary, remove the old cord.
2. Cut the end of the new cord at an angle.
3. Thread the nylon cord through the lower, temporal hole from the lens side and continue through the upper hole leaving 1.5 to 2.0 mm.
4. Put the lens in and pull the cord snug to size the lens.
5. Hold the excess end of the cord with the thumb and remove the lens.
6. Take up 1.5 to 2.0 mm of slack in the cord.
7. Thread the remaining cord through the upper hole.
8. Cut the cord off 1.5 to 2.0 mm past the hole.
9. Press the excess cord into the frame groove on both sides.
10. Insert the lens in the upper half of the frame.
11. Stretch the cord around the lower half of the lens using the plastic strip.
12. Check cord tension. (Cord should give 0.5 to 1.0 mm.)

may have a tendency to chip, especially during insertion and removal. Plus lenses and thin, high index minus lenses with narrow vertical dimensions may have notably thin areas. Here are some suggestions to avoid chipping thin lens edges:[5]

When putting the nylon cord into the lens, if possible, start with the thinnest part of the lens and finish with the thickest.

To remove a nylon cord, do the reverse; start with the thickest part of the lens edge and end with the thinnest.

Retightening a Loose Nylon Cord Lens

If a lens in an old nylon cord frame is loose or has fallen out, it is prudent to simply replace the cord, as above, rather than retightening the existing cord. Over time an old cord may have lost some of its elasticity. The new cord will have more elasticity, and replac- ing the old cord avoids the possibility of it breaking later on.

Some dispensers have resorted to removing the lens and heating the old cord. The heat will cause the cord to shrink. When the lens is reinserted, it will be tighter—but only temporarily. Tightening a lens in this manner is not a good practice. The cord will not remain tightened long, and the lens may fall out unexpectedly, this time to break or become badly scratched.

Nylon Cord Frames With Liners

Some nylon cord frames have liners that fit into the top eyewire channel of the frame. These liners are called *figure 8 liners* because when viewed from the end (in cross section) the liner looks like the number 8. One part of the 8 is smaller than the other.

If it is necessary to replace the figure 8 liner in the top eyewire, take a knife blade, file, or dental pick and dig into the liner, sliding it out either end. Measure the old length of liner and cut a new piece of the same length. To aid in inserting the figure 8 liner back into the top eyewire, make sure the new piece is cut at an angle.

Using the smallest side of the figure 8 first and beginning either nasally or temporally, slide the liner into the top eyewire channel. Feed in the entire piece of liner and center it in the channel. If the liner seems loose, turn it around and use the larger side. Care should be taken not to block any of the four holes used to hold the nylon cord in place.

Frames With Metal "Cords" for Rims

Some frames are made with very thin metal rims. When lenses for these frames are edged with flat edges and then grooved, the rim of the frame slips into the groove in the same manner as a nylon cord would. Because the metal rims are thicker than a nylon cord, the groove must be made wider than it would for nylon cord frames.

CLEANING FRAMES AND LENSES

In the past, the simplest method of cleaning frames and lenses was to immerse them in a mild detergent solution, rub with the fingers or a soft cloth, and dry with a soft, lint-free cloth. Difficult-to-remove lens spots were taken care of using acetone, with care being taken to avoid getting any acetone on the plastic frame. Now, however, the situation is not so straightforward.

Sample Questions:

Ms. Maheen just received her new single-vision glasses with cylindrical correction. While examining them, she notices the frame appears slightly tilted even though it sits flat on the table. Additionally, the lens markings seem "off" when checking them through the lensmeter.

1. What could be the issue, and how can you easily verify it using the information provided in the passage?
2. What are the key characteristics of a "neat and professional" appearance when inserting a lens into a frame?
3. How can you ensure the lens is centered and aligned correctly within the frame?
4. What potential finishing touches would contribute to a professional look?
5. Can you describe different techniques for inserting lenses into plastic frames?
6. When might each technique be preferable depending on the frame material or lens type?
7. Are there any techniques that are generally NOT recommended? Why or why not?
8. List the sequential steps involved in the lens insertion process for plastic frames.
9. What specific challenges or difficulties might arise during each step?

10. How can you troubleshoot and prevent common problems associated with lens insertion?
11. How does the lens insertion process differ for frames made of different materials (e.g., metal, nylon)?
12. What are the specific considerations for each material type in terms of heat application, fitting techniques, and potential risks?
13. Can you identify any universal principles that apply to lens insertion regardless of frame material?
14. What personal safety precautions should be taken when handling lenses and using tools during the insertion process?
15. What resources or equipment are essential for successful lens insertion?
16. How can you ensure the quality and durability of the finished product after lens insertion?

Unit 10:

Standard Alignment

Learning Objective:

At the end of this unit, students will be able to;

1. Bring a frame into proper alignment before he or she can make a pair of glasses fit properly. Actual manipulative procedures required in fitting are first studied and mastered while learning to “true” the frame.
2. To incorporates skills and teaching of both, proper standard alignment and prepares the groundwork for frame fitting.

STANDARD ALIGNMENT OR “TRUING” OF FRAMES

A frame received from an optical laboratory is theoretically supposed to have been *trued* (i.e., brought into standard alignment). A frame in standard alignment has been adjusted to certain impersonal standards that are independent of the type of face to which it is to be fitted. Standard alignment is intended to ensure that adjustments required to fit the wearer are responsive to the wearer’s physical characteristics and not to irregularities in the frame itself that may be produced while the frame is fashioned in the laboratory.

Since, in actual fact, some frames may not have received this adjustment in the laboratory, it is essential that it be performed by the dispenser before attempting to adjust the spectacles for the individual wearer. The best time to preadjust is when the prescription is being verified.

“Truing” spectacles is a good starting point for adjusting them, especially spectacles that have been worn for a long time without recent adjustment. The same would apply to spectacles brought in by someone other than the wearer, or spectacles that have been stepped on, run over, or damaged in some other way. These frames must be brought back into standard alignment before additional adjustments can be attempted.

A general rule for standard alignment is to begin with the bridge, then work with the endpieces, and handle the temples last. Obviously, changes made in one part of a frame may influence the alignment in another part. Bending the bridge, for example, may change the relationship of the temples. Handling the bridge first, and heating, except for metal parts that are covered with plastic.

This chapter is divided into sections on bringing plastic frames, metal frames, nosepads, and rimless frames into standard alignment. For instructional purposes, it is easier to consider each of these as separate and distinct types. In practice, however, there are a great variety of frames having characteristics that cross over. Some frames are hybrids of two or more types. This means that, in the end, the dispenser must often use the techniques learned in more than one section on a single frame.

It is advisable to first read the section on plastic frames before jumping to the metal or rimless sections. This is because the first section introduces terminology that is used, but is not as thoroughly explained, in the later sections.

SECTION A

Standard Alignment of Plastic Frames

HEATING THE FRAME

Standard plastic frames* must be heated for any alignment. Standard procedure for adjusting the frame should be followed, beginning with the bridge.

Only that area of the frame requiring adjustment should be heated to avoid the possibility of disturbing an aligned area by mistake. Frames may be heated using forced hot air, or a “salt pan” containing heated table salt, or a pan containing heated small glass beads. The method of choice for heating frames is forced hot air.

Hot Salt or Glass Beads

Even though an explanation of how to use hot salt or glass beads is included, it should be noted that it is not recommended. Forced hot air is preferable because some of the newer frame materials are adversely affected by heating them using a salt pan. In addition, lens coatings may be damaged by the heat and abrasion of hot salt against the surface. Even if the coating appears undam- aged after heating using a salt pan, the coating may not the other parts in order, helps to eliminate having to go back and realign parts.

Adjustable plastic frames must almost always be heated to be aligned. Metal frames and parts do not require last as long. If lenses are returned in an unexpectedly short time because of a haziness or crazed* surface when normal care has been exercised by the wearer, the difficulty may have begun right in the dispensary. New dispensers have difficulty identifying frames or lenses that would be damaged with indiscriminate use of a salt pan. Therefore, if a salt pan is being used in the practice, it is safer to require novices to use a forced air warmer.

When using a salt pan, stir the salt to equalize the heat before inserting the frame. A wooden spoon is an excellent tool for this purpose; it does not get hot to the touch and can also be used to push the salt into mounds for heating specific parts.

Insert the frame into the salt just under the surface and as parallel to the surface as possible. The frame may bubble or distort if it is angled so that one portion is too close to the heating element (Figure 8-1). Moving the frame about while in the salt also helps to prevent this problem. If the frame is not moved, even cellulose acetate frames may acquire small indentations in the plastic surface. These small indentations will appear to dull a smooth, highly polished jet black frame. For this reason, some advise against using a salt pan for black frames.

Talcum powder may be mixed with the salt to prevent the salt from sticking to the frame and from lumping. Salt will also stick to a frame that has been cooled in cold water and again placed in the salt while still wet. For this reason, warm-air heating is preferable for a wet frame.

DCellulose acetate and cellulose propionate frames are considered to be standard plastic frames.

Figure 8-1. An example of a frame that has been overheated, resulting in bubbling of the plastic on the upper rim.

Forced Hot Air

The method of choice for heating frames is forced hot air. When using hot air to heat a frame, move or rotate the frame to prevent overheating of one area and to ensure even heating of the different surfaces, especially

*Surface crazing is micro cracking that looks like dried mud.

if the hot air warmer only supplies air from one direction. The surface plastic of a frame will bubble if overheated by forced hot air on one side only. This may happen before the frame is hot enough to become pliable.

For a summary on heating frames, see Box 8-1.

Points to Remember in Heating Frames

WITH HOT AIR:

1. Heat only the portion of the frame to be worked on.
2. Rotate the frame in the heat. (This is especially important for wamers having heat coming from one direction only.)
3. Check the type of frame material. Some materials can stand more heat than others.

WITH SALT OR BEADS:

1. Ask yourself, “Should this frame material or these lenses be subjected to salt or beads?” If there is any doubt, use hot air.
2. Always stir the salt (or glass beads) first.
3. Keep the area of the frame being heated parallel to the surface of the salt.
4. Keep the frame moving slowly.
5. Heat only the portion of the frame to be worked on.

THE BRIDGE

Since a number of things may be in error in relation to the bridge, the bridge itself is judged mainly by the effect it has on the plane of the lenses. Readjusting the lenses to their proper planes is accomplished by first heating the bridge area, then grasping the frame by the lens areas and adjusting according to the correction desired.

When using a salt pan to heat the bridge, stir the salt in the pan and form it into a centrally located peak running across the pan. Place the frame in the pan, temples up, and draw the bridge through the peak of the salt mound. Repeat until the bridge is pliable enough to be bent (Figure 8-2).

When using hot air, concentrate the air stream on the bridge. This may be done with a cone attachment placed over the air exit or by partially closing the exit depending on the type of warming unit being used. Move the bridge through the hot air stream until it becomes pliable. Once the bridge is pliable, it can be adjusted as necessary to effect the desired correction.

The bridge can be out of alignment because one lens is pushed up or one lens is pushed back in relation to the other. If one lens is higher than the other, they are said to be out of *horizontal alignment*. If one lens appears to be farther forward or backward than the other, they are said to be out of *vertical alignment*.

Figure 8-2. To heat the bridge area, first form the salt into a centrally located peak running across the pan, then draw the bridge through the peak of the salt mound.

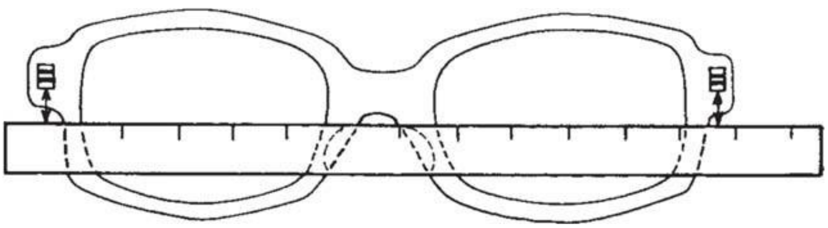


Figure 8-3. Checking for horizontal alignment. This frame shows proper alignment because the distance between ruler and endpiece reference point is equal on both sides.

Horizontal Alignment

It is not easy to check for horizontal alignment of a plastic frame because there are not always clear reference points. To check for horizontal alignment, place a ruler or straight edge across the back of the frame at the top of the pads, if any. If there are no pads, there may be a point where the sculptured shaping of the bridge area ends (this area serves as a nosepad). Both endpieces should be equidistant from the straight edge when it is aligned horizontally (Figure 8-3). A practiced eye may be more helpful than a ruler.

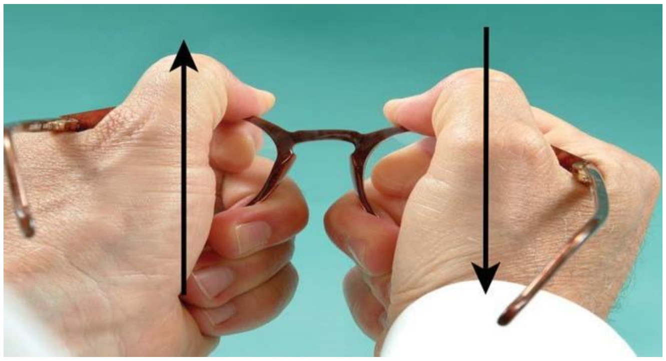
Rotated Lens

There are two common causes for a frame being out of horizontal alignment: a rotated lens and a skewed bridge. A lens rotated in the frame will cause the top of the eyewire to either hump up at the nasal bridge or one endpiece to appear upswept in shape. (See Figure 7-7 in the previous chapter.) To correct the problem, use lens rotating pliers.

Skewed Bridge

When viewed from the front, a skewed bridge will cause one lens to appear higher than the other (Figure 8-4). This problem usually only happens after the glasses have been dispensed and something has happened to them.

Figure 8-4. An example of a skewed bridge. It will be noted that neither of the lenses shows any twisting. The error is manifested by one lens being higher than the other. (This photo shows the frame from the front. The next photo, correcting



the problem, is taken from the back of the frame.)

Figure 8-5. To correct for a skewed bridge, heat the bridge and force one side up and the other down. This is the same frame as was shown in the previous figure, but the frame is now facing in the other direction. (Note which way the temples are pointing.)

To correct a skewed bridge, first heat the bridge, then grasp the front with an eyewire in each hand as shown in Figure 8-5. Force the eyewires in opposite directions until the tops of the eyewires are parallel. Of course, the lens must be in the frame for this procedure to succeed. When pressing the lenses in opposite directions, it is important that their frontal planes be kept parallel so that X-ing of the frame is not inadvertently introduced. X-ing will be described in more detail below.

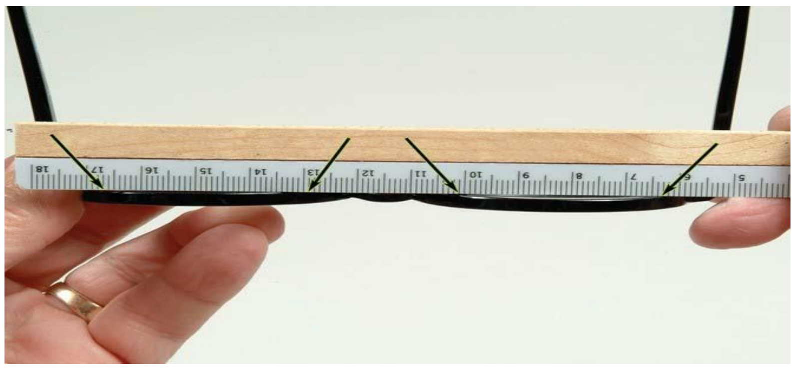


Figure 8-6. Checking for four-point touch. The frame eyewire touches at each place where the ruler crosses the eyewire. This indicates correct alignment when the "frame PD" equals the wearer's interpapillary distance.

Vertical Alignment (Four-Point Touch)

To check for vertical alignment, or *four-point touch*, place a ruler or straight edge so that its edge goes across the inside of the entire front of the spectacles below the nose pad area. Theoretically the frame eyewire should touch at four points on the ruler (i.e., at each place where the ruler crosses the eyewire [Figure 8-6]). However, this ought to only be the case if the frame is small com- pared with the wearer's head size,* otherwise face form is required.†

Face Form

Face form or *wraparound* is when the frame front is just slightly rounded to the form of the face. Most frames are constructed with at least a degree of face form. This is especially true of large frames and thick metal frames. Frames with face form will not conform to the four- point touch test, but must be symmetrical nonetheless. The temporal sides of the eyewires should touch, and the nasal sides should be equidistant from the ruler (Figure 8-7).

Too much face form would be evident if the two nasal eyewires are a great distance from the ruler. Too little face form is the case if neither temporal eyewire, but only the nasal eyewires, touch (Figure 8-8).

The remedy for either too much or too little face form is to alter the bridge. First warm the bridge until it is pliable, then grasp the frame by the lenses and eyewires with thumbs on the inside and fingers on the outside. Bend the bridge by turning the lenses inward or outward (Figure 8-9).

DA strict four-point touch should be used only if A + DBL = wearer's PD.

†For an explanation of why the frame should have face form and how much it should have, see the section on "Face Form"

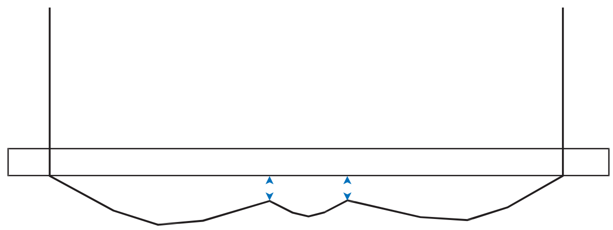


Figure 8-7. For those frames that will not or should not conform to a perfect four-point touch, the nasal sides of the eyewire should be equidistant from the ruler.

Figure 8-8. An example of a frame with negative face form.

Figure 8-9. As is often the case in dispensing, symmetry is important. To achieve a good bend when changing the face form of a frame, the glasses are grasped symmetrically, immediately adjacent to the bridge.

X-ing

Another type of vertical misalignment may also be dis- covered while checking for four-point touch. The frame front may be twisted so that the planes of the two lenses are out of coincidence with each other. This is called *X- ing* because the eyewires of the frame front form an X when viewed from the side (Figure 8-10). From below, the frame with X-ing appears as shown in Figure 8-11.

X-ing causes the temples to be out of line with each other. Whenever the temples do not appear parallel, the frame should first be examined for X-ing before other methods of realigning the temples are tried.

X-ing is corrected by grasping the eyewires as shown in Figure 8-12, and rotating the hands in opposing direc- tions until the planes of the lenses are parallel.

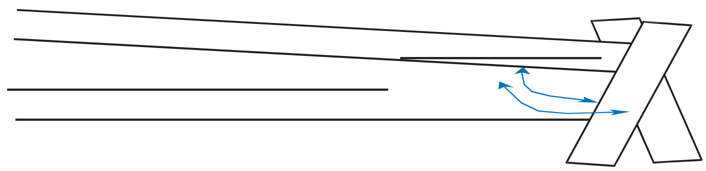


Figure 8-10. X-ing may be identified by the characteristic “X” the eyewires make with one another when viewed from the side.

Figure 8-11. This is how a frame with X-ing appears when viewed from below.

Variant Planes

Another form of vertical misalignment is when the lens planes are *variant*, or *out of coplanar alignment*. In this situation, the lens planes are parallel, but one lens is farther forward than the other (Figure 8-13). This error usually becomes apparent when the four-point touch test is used, although it may easily be overlooked otherwise.

To correct a frame with lenses out of coplanar align- ment, first heat the bridge and grasp the frame in the manner shown in Figure 8-9, just as would be done in correcting a frame having too much face form. This time, however, push the entire eyewire away from you on one side, and pull it toward you on the other side, all the while keeping both lens planes parallel to each other.

Figure 8-12. In grasping the frame to correct an X-ing error, the wrists move in opposite directions.

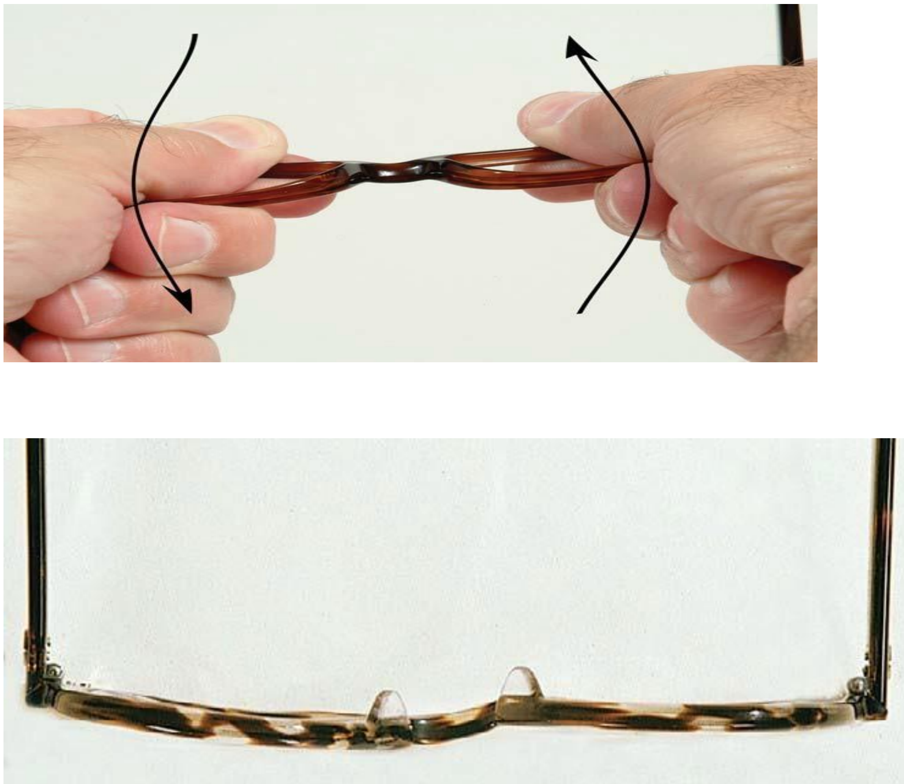


Figure 8-13. Here is an example of lens planes that are variant or out of coplanar alignment. In spite of the improperly bent bridge, the lenses remain parallel to one another.

THE TEMPLES

After horizontal and vertical pre adjustments have been made to the bridge and eyewires, the third area considered in truing a frame is the temple area. The open temple spread is checked first because the adjustments may affect the endpieces. After this, temple parallelism is considered, followed by alignment of the temple ends. Finally the temple fold angle is corrected.

Open Temple Spread

The *open temple spread*, or *let-back*, is that angle that each open temple forms in relationship to the front of the frame. To afford a true picture of the temple spread ini- tially, the temple shafts must be straight. Before going further, stop and straighten the temple shafts. Any curve to the temple shaft should be eliminated by heating the temple and straightening it with the hands.

It is the normal condition of the temple to be opened out slightly farther than a 90-degree angle; usually 94-95 degrees. Before actually fitting the wearer, it is not always desirable to spread the temples to more than 90 degrees because it may be necessary to bring the temples back in again. This often proves more difficult than was flaring them out originally.

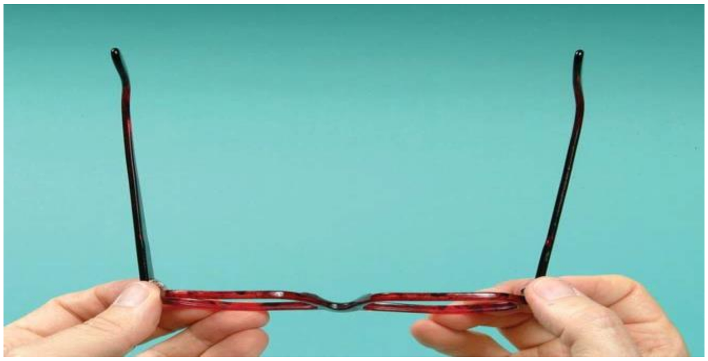


Figure 8-14. The temples on this frame are spread too far for a frame in proper alignment. The spread should be decreased until the temple and the frame front are at a 94- to 95-degree angle to one another.

Temples Spread Too Far

Temples flaring out more than 95 degrees are spread too far for standard alignment (Figure 8-14). There are several methods for correcting this problem, but all involve the same principle: The endpiece must be heated and bent around so that the temple will not be able to open out as far.

With the temple spread to the wide-open position, begin the procedure by heating the desired area. Having the temple fully spread makes it easier to tell when the endpiece has been bent enough. This is because it is pos- sible to see the extent to which the temple is being forced inward. If the frame has a hidden hinge, take care to avoid bumping or knocking the temple because this can loosen it.

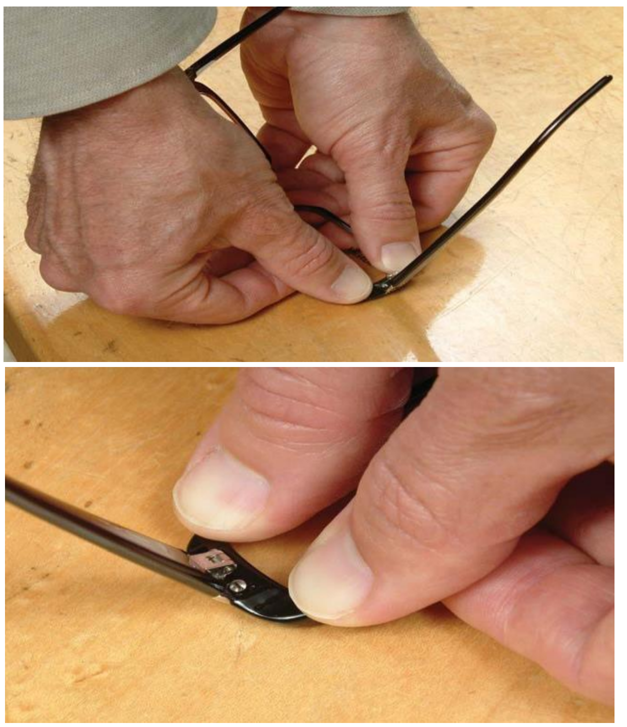
The following methods can be used for endpiece adjustment to reduce temple spread:

1. *Using the thumb*—When the endpiece is hot, hold the frame by the eyewire and push on the endpiece with the thumb (Figure 8-15). If there is a metal shield on the frame front, place a cloth between the thumb and the front to prevent burning the skin.

Figure 8-15. One method of decreasing temple spread involves holding the frame by the lens and eyewire while pushing the endpiece back with the thumb with

the fingers. This will pop the lens back into the frame. This may occur several times during the procedure in especially difficult cases and is to be expected.

2. *Using a flat surface*—Heat the endpiece and grasp the eyewire and lens with both hands. Use a flat surface, and press the endpiece of the frame down on the surface to force it backward (Figure 8-16, *A* and *B*). The surface must be smooth and free from grit or salt grains. An irregular surface or foreign matter, such as salt grains, will mark the front of the frame when the frame is pressed against the surface. Often the corner of the lens may pop out when this method is used. If this happens, turn the frame around and push the corner of the lens with the thumbs while supporting the eyewire from behind



A **B**

Figure 8-16. One of the easiest and most successful methods of reducing temple spread is pressing the endpiece against a flat surface. **A** and **B,** Here are two views of how this is done

3. *Bend eyewire and endpiece*—When the endpiece will not bend enough using the above two methods, take the lens out of the frame. With the frame empty, the eyewires and endpiece may be bent backward more easily (Figure 8-17). After reshaping the frame, reinsert the lens. Before concluding that the temple has been brought in sufficiently by any of the above methods, however, check between the endpiece and the end of the temple. If a salt pan was used, a few grains of salt can become lodged here

and prevent the temple from opening as far as it normally would. The frame appears to be aligned until it is washed off, then the salt dissolves and the temple opens back out.

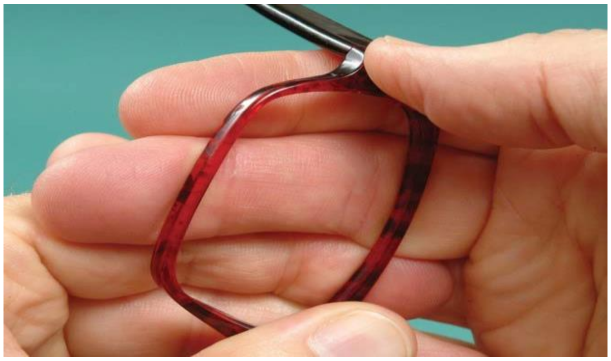


Figure 8-17. Brace both eyewires with the forefinger and press the endpiece with the thumb to decrease the temple spread.

4. *Bend the butt portion of the temple*—If none of the previous three methods proves successful, this method can be used. It is usually only employed with older frames, and as a last resort because the cosmetic appearance of the frame suffers. Heat the temple and grasp the butt end of the temple with half-padded pliers as near the hinge as possible. (Half-padded pliers are shown in Figure 8- 18.) Then grasp the temple near the pliers with the free hand and bend the temple inward (Figure 8-19).

Figure 8-18. Half-padded pliers hold the frame securely. The nylon-padded jaw prevents the frame from being marred by that jaw of the pliers. The unpadded jaw may be flat or rounded.

Figure 8-19. If no other method proves successful, it is possible to bring the temples in by grasping the temple butt with half-padded pliers and bending the temple with a free hand.

5. *Sink the hidden hinge deeper into the frame front*—In cellulose acetate frames with hidden hinges, the temple spread can be reduced by sinking the front hinge slightly deeper into the plastic. This is done by removing the temple and heating the hidden hinge with a soldering iron or a Hot Fingers unit. It does not take very much depth change to significantly decrease the temple spread. (For more on how to do this, see the section on Hidden Hinges in Chapter 10.)

Temples Not Spread Enough

Occasionally the temples are not spread enough after the lenses have been inserted and the bridge area straightened. There are at least three things that may be done to correct the problem when this occurs:

1. *The lens may not be completely in the frame at the endpiece.* Check to see if the lens is in place. If not, press the lens back into the groove. This may solve the problem.
2. *The endpiece needs to be bent outward.* Heat the endpiece area and pull the endpiece outward with the fingers while supporting the lens with the thumbs (Figure 8-20). Never pull on the temple because this will only loosen it and will not get to the root of the problem.
3. *File the butt end of the temple.* When neither of the previous methods work, it may be necessary to file the temple. This may occur when the temples come inward considerably, as when lenses with steep front curves are used. The reason may be the additional curve added to the frame front because the eyewires are shaped to conform to the curved lenses.

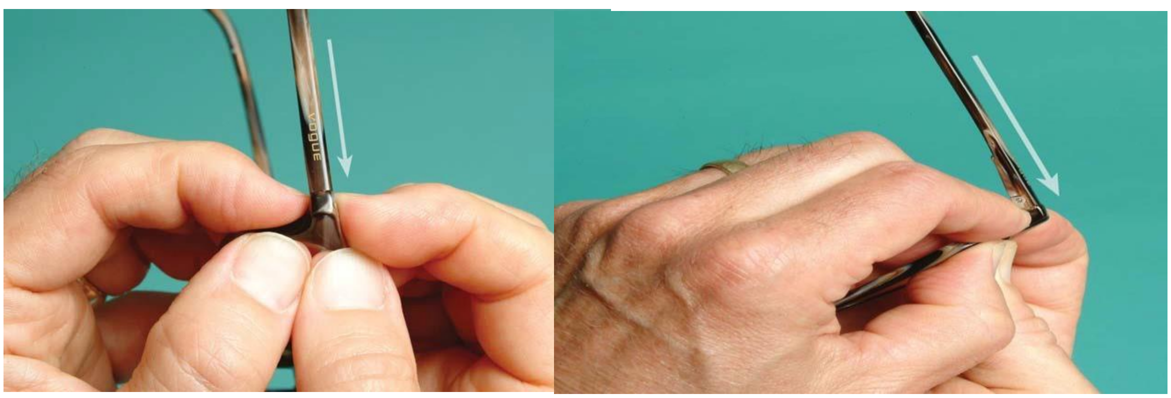
To correct this problem, file the end of the temple at the hinge area where it contacts the front of the frame, using a fairly rough file (Figure 8-21). It is extremely important to note that filing for this purpose is done only on the temple—never on the frame front. Individual replacement temples of identical manufacture will often fit at varying angles on the same front. If the front were filed instead of the temple, the result might be an unusually large temple spread if the temples were replaced.

To file the temple, brace the glasses against something solid or hold the frame with the temple folded, with the knuckle of the index finger over the edge of a tabletop for support (Figure 8-22).

File the end evenly and uniformly. Periodically, open the temple fully so that its abutment against the endpiece may be observed. Note whether or not the end of the temple is fully touching the endpiece.

One common filing error results in a gap at either the top or bottom of the butt end area of contact with the endpiece (Figure 8-23). A second common error, if the temple is filed too much on the inside, leaves only a small area of contact between the temple and the frame front (Figure 8- 24). The first error is particularly undesirable cosmetically. Both errors cause difficulty after a period of wear because the area under concentrated pressure eventually gives way and allows the temple to flare out too far, loosening the glasses.

It is usually not possible to file very far before hitting what appears to be a metal reinforcing piece, which is actually a part of the hinge itself. It does not damage or weaken the frame to file on this piece; in fact, it is unavoidable if much filing is required.



A B

Figure 8-20. To spread the temples, heat the endpiece and pull back with the fingers while pressing with the thumbs. (This is shown from two different views in **A** and **B**.) This should cause the angle of temple spread to increase. If, by chance, the lens was not completely in the temporal groove of the frame, it could be a major cause of the temple being insufficiently spread. If the lens is not in the groove, this action should also cause the lens to pop back into place.

4. *Bend the temple outward.* If none of the above solutions are possible, as a last resort bend the temple outward at a location approximately ¾-inch down the temple from the endpiece. This is usually done using half-padded pliers to hold the butt end of the temple and the other hand to bend to temple outward, similar to the bend that was shown in Figure 8-19.

For a summary of temple spread problems and their solutions, see Table 8-1.

Figure 8-21. Standard files used in dispensing. From top to bottom: *1, Zyl file*—used to file plastic parts of a frame. Although both ends are coarse, one is less coarse than the other for variations in speed of filing. *2*, *Pillar file*—finer than the zyl file, this file is often used to file metal parts of a frame.

5. *Riffler file*—this spoon-shaped file is good for getting at small, hard- to-reach areas. It is used with thumb or finger in the arc of the "spoon." *4, Slotting file*—used for reslotting screws, or making a slot where none previously existed. *5, Rat-tail file*—for classic-type rimless mountings this file was used to reduce lens thickness in an area to allow for proper lens strap grasp. It is also used to smooth the inside of a drilled lens hole.

Temple Parallelism

For frames to be in standard alignment, the temples need to be parallel to one another. One temple should not be angled down more than the other. When looking at the glasses from the side, the angles the temples make with the frame front determine temple parallelism. The angle spoken of here is often called the *pantoscopic angle*. Pantoscopic angle is the angle the frame front deviates from the vertical when the glasses are held with the temples horizontal.*

Viewing the frames from the side, the angle is designated as "pantoscopic" when the lower rims of the frame front are closer to the face than are the upper rims. A proper pantoscopic angle may vary from as little as 4 degrees up to 18 degrees. If the glasses were to be adjusted so that the lower rims are tilted *outward* from the face, the glasses are said to have "*retroscopic*" instead of pantoscopic tilt. Retroscopic tilt is seldom ever appropriate.

In any case, to test whether or not the temples are parallel, position the glasses *upside-down* on a flat surface with the temples open. Then note if both temples sit flat or if one temple is not touching the flat surface. If it is difficult to tell, first touch one temple and then the other to see if the frame wobbles back and forth or if it sits solidly. This procedure is known as the *flat surface touch*

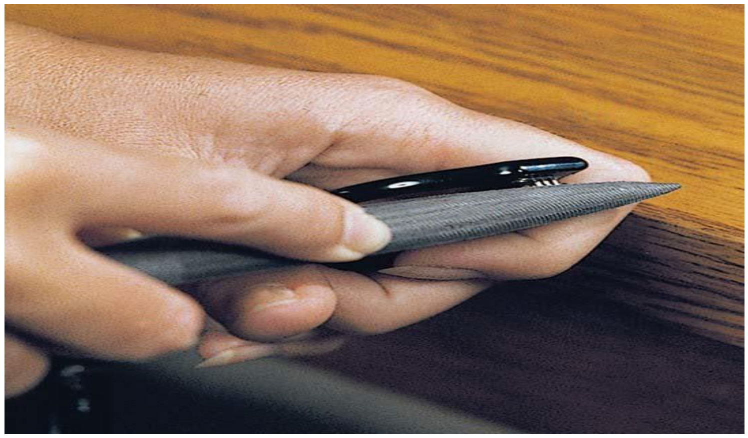


Figure 8-22. Even though a specially designed bench brace is the method of choice, a frame may be successfully held for filing by bracing one knuckle over the edge of a table.

*The technically correct definition of the pantoscopic angle refers to the angle formed between the frontal plane of the face and the plane of the frame front when the glasses are being worn.

A **B**

Figure 8-23. The frame pictured in **(A)** shows the proper abutment between temple and frame front, whereas the frame in **(B)** is the result of uneven or hurried filings.

A **B**

Figure 8-24. Viewed from the top, the frame in **(A)** shows how temple and front should abut. The improperly filed temple in **(B)** will not hold alignment. Because so much force is on such a small area, within a short period of time the plastic will be compressed, allowing the temple to open too far.

test (Figure 8-25). If the frame wobbles, it needs correction or it will sit on the face at an angle.

A common mistake is to check for temple parallelism with the glasses placed on the table right side up instead of upside down. If this is done and the bent-down portion of one temple is bent down even the slightest bit more than the other, or if one temple bend is located even the least bit farther forward than the other bend, the flat surface touch test for temple parallelism will not work.

Figure 8-25. Testing for parallelism using the flat surface touch test

There are five possible sources for incorrect temple parallelism:

1. Incorrect temple parallelism will result if the *endpiece* is not straight. This can happen because:
   a. The lens is not inserted into the frame squarely at the endpiece area. Check this first. It will cause the overall temple angle to be affected. If the lens is only slightly out of the eyewire, heat that area of the frame and press the lens back into the groove. It is usually not necessary to remove and reinsert the lens.
   b. The endpiece is simply angled improperly. If the endpiece was bent upon insertion of the lens, heat the endpiece area. Use the fingers, protected by a lab towel, to bend the endpiece.
2. Another cause of error could be a bend in the *temple shaft* itself (Figure 8-26). This should also be checked early on as it can easily occur, but is also easily corrected. This situation is readily solved by heating and straightening the temple shaft.

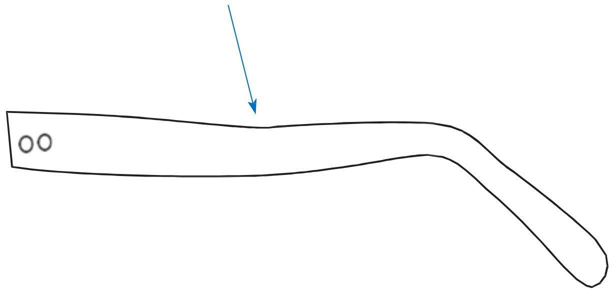


Figure 8-26. A bend in the shaft of one temple may cause the glasses to wobble when placed on a flat surface with the temples open.

3. It is even possible for temples to stray from parallel because the bridge of the frame has been twisted. This problem should have been discovered earlier in the alignment process and is called X-ing. It was explained earlier.
4. For frames without hidden hinges, the problem might be that of loosened or broken *hinge rivets*. This should also be ruled out. The rivets are most likely involved if the temple seems wobbly even after the screw has been fully tightened. (For more on this, refer to the section called *Repairing the Hinges* in Chapter 10.) A loose hidden hinge could also cause the same problem. (Again, see Chapter 10.)
5. After the above problems have been ruled out, the *hinges* themselves are likely at fault and may require straightening. Here is how to solve the problem. Close the temple a few degrees from the completely opened position. Grasp the frame front near the endpiece with one hand. Angle the temple by grasping it with the other hand near the butt area and forcing it up or down (Figure 8-27).

Figure 8-27. This photo shows a commonly used method for changing the pantoscopic angle of the temple. This will not be successful if the temple is fully opened. If it is, there is no space to angle the temple. The butt of the

temple must not quite be in contact with the frame front.

Since it is not always possible to change the pantoscopic angle using the hands only and no tools, here is a tool-based method to change the angle:
If the endpiece has enough space, grasp it with half- padded pliers. The padded jaw of the plier should be in the front and the unpadded jaw in the back. The jaw in the back is braced against the hinge rivets in the endpiece to support them. Use a second pair of *angling pliers* (Figure 8-28) to grip the hinge by the top and bottom of the screw. Angle the hinge by twisting the pliers until one temple is level with the other (Figure 8-29). As when making the adjustment without pliers, the temple should be closed very slightly so that the temple butt end is not in contact with the endpiece. If this is not done, the bend is hindered by contact between temple and endpiece.
If there is not enough space to grasp the endpiece, use the angling pliers alone, and hold the frame front with the hands to change the pantoscopic angle.

A B

Figure 8-28. Angling pliers. Traditional angling pliers are shown in **(A)**. Note the indentations on the inside of the jaws used to grip the screw. Since these pliers are a bit bulky and sometimes difficult to get into hard-to-reach areas, a modified, a narrower version is shown in **(B)**.

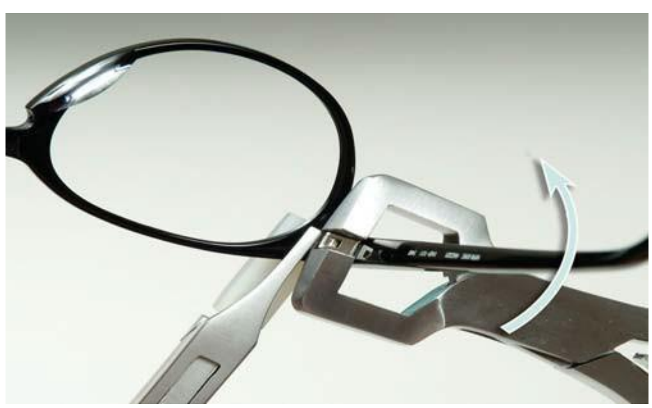


Figure 8-29. This technique for changing the pantoscopic angle is excellent, but cannot always be carried out because of endpiece design. With wrap around

endpieces, the endpiece can be grasped at another location.

For a summary of possible sources for unevenness of pantoscopic angles, see Box 8-2

NOTE: The frame should *not* be heated when any of the pantoscopic angling operations are performed, since softening of the plastic may result in loosening of the rivets. A hidden hinge may accidentally be detached entirely from the front if the frame is heated.

.A**ligning the Temple Ends**

Proceeding toward the back of the frame, the next area to be aligned is the bent-down portion of the temple: the temple ends. When the temple ends are to be bent down, a good standard alignment demands that both ends of both temples be bent down equally as viewed from the side (Figure 8-30).

BOX 8-2

Possible Problems If Pantoscopic Angles Are Uneven (The Frame Fails the Four-PointTouch Test)

1. The lens is not fully in the temporal frame groove.
2. There is a bend in the endpiece.
3. The temple is bent along the shaft.
4. The frame has a twisted bridge (X-ing).
5. For frames with hinge rivets, a rivet is loose or broken.
6. The hinge is bent, or needs to be bent.

Figure 8-30. In this photo, the temple ends are not bent down equally. Standard alignment requires that both be bent to the same angle.

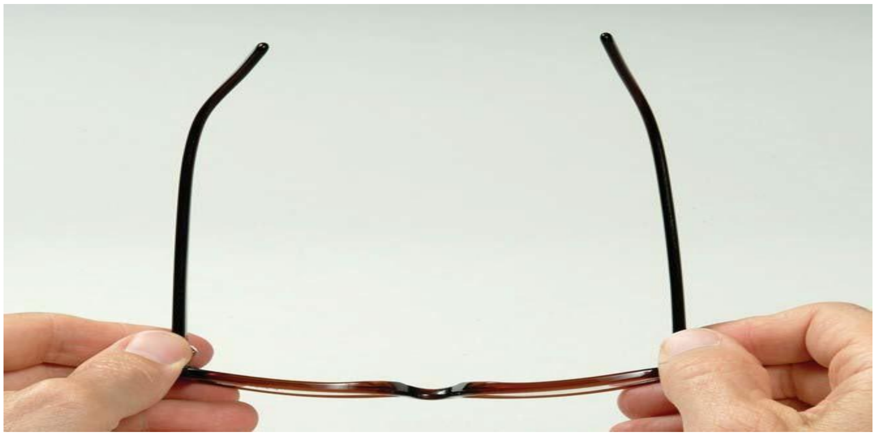


Figure 8-31. The ends of temples should be bent inward slightly to conform to the average head shape. The inward bend should be symmetrical, not like the example shown where the left earpiece is bent farther inward than the right.

Both temple ends should also be bent inward very slightly (Figure 8-31) because the average head has this conformation. If heating is done with a salt pan, it is important that the ends of the temples be held in the pan parallel to the surface (Figure 8-32, *A*) and not perpendicular (Figure 8-32, *B*). If the temple end is inserted into the salt, the tip is usually overheated.

A **B**

Figure 8-32. In heating the ends of the temples, it is important that they be held in the salt parallel to the surface, as shown in **(A)**. Sticking the temple end perpendicularly into a salt pan as shown in **(B)** often results in overheating the tip and should be avoided.

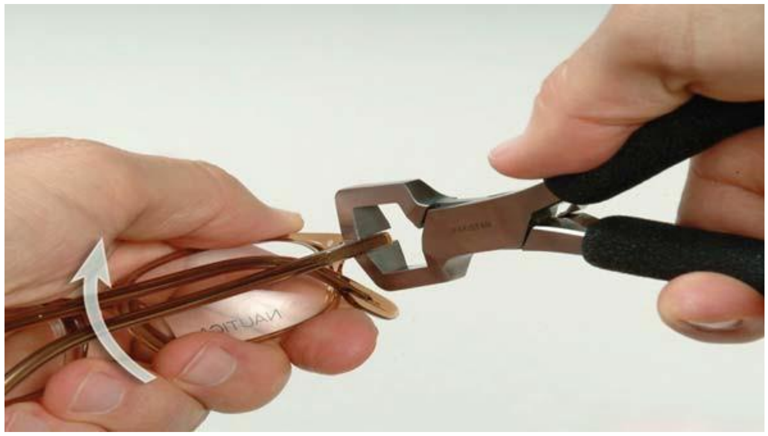


Figure 8-33. Changing the temple-fold angle using a pair of angling pliers.

Temple-Fold Angle

The final alignment step is to fold the temples to the closed position and observe the angle formed as the temples cross. The temples should fold so that they are parallel to one another or form slight angles from parallel.

These angles should be symmetrical and should cross each other exactly in the center of the frame, in line with the center of the bridge. Proper adjustment to this con- figuration permits the spectacle to easily fit into a standard case for glasses. There are two common methods of changing the temple-fold angle:

1. In the first method, the frame front is held with one hand. Angling pliers grasp the top and bottom of the hinge screw and are used to do the actual bending (Figure 8-33). Since the hinge being bent is metal, it is not necessary to heat the frame.
2. The second method of angling the temple fold uses *fi nger-piece pliers*. These pliers have jaws that are parallel and have space between the jaws when fully closed (Figure 8-34). They are also referred to as *Fits-U* pliers. These pliers were originally designed for adjusting the old finger-piece mountings, but are also excellent for adjusting the temple-fold

Figure 8-34. Finger-piece pliers were originally designed for adjusting the old

finger-piece mountings. These pliers are an excellent tool for adjusting the temple-fold angle. Angle With the temple folded, the pliers are held parallel to the endpiece hinge screw, so that the hinge is grasped on both sides (Figure 8-35). While the frame front is held with the other hand, the hinge is angled until it reaches the proper position (Figure 8-36).

Changing the temple-fold angle by simply bending the temple with the hands does not work as successfully as using pliers as in the techniques described above. Using hands alone, without pliers, may cause the temple to split at the hinge.

For an overall summary of steps to follow in standard alignment, see Box 8-3.

Figure 8-35. With the temple folded, finger-piece pliers are held parallel to the endpiece hinge screw so that the hinge is grasped on both sides.

SECTION B

Standard Alignment of Metal Frames

Metal frames are aligned according to the same principles as plastic frames and, when in standard alignment, should meet approximately the same standards as well. The primary difference lies in the methods of manipulation used to bring the frame into alignment and the presence of adjustable nosepads.

Metal frames require heating only in those places where plastic coats the metal. All other bends are done "cold."

Pliers are used for the majority of adjustments. Since the pressure of metal jaws may mar or disfigure the finished surface of the frames, it is essential to use

padded pliers or to cushion at least one jaw of non-padded pliers by attaching friction or adhesive tape to it.
The order of procedure for aligning metal frames is the same as that used for plastic frames, beginning with the bridge.

THE BRIDGE

As with plastic frames, the planes of the lenses are observed to determine bridge alignment as it relates to the overall vertical and horizontal alignment.

Horizontal Alignment

To check for horizontal alignment of a metal frame, place a ruler or straight edge across the front of the frame at the point of attachment of the pad arms. In most frames, the endpieces will be considerably higher than the level of the pad arms, making the horizontal alignment judgment difficult. The endpieces should be equidistant from the ruler.

Rotated Lens

For metal frames, like plastic, there are two common causes for a frame being out of horizontal alignment. The first is a rotated lens, a condition characterized by a nasal or temporal upsweep in one lens causing the tops of the lenses to be out of parallel. To correct for a rotated lens in a metal frame, loosen the eyewire screw and turn the lens until it aligns correctly with its partner; then retighten the screw.

BOX 8-3

Steps in Standard Alignment or Truing of Frames

Step 1. Horizontal alignment

a. Check for a rotated lens.
b. Check for a skewed bridge.

Step 2. Four-point touch (vertical alignment)

a. Check for X-ing.
b. Check for variant planes (or lenses out of coplanar alignment).

Step 3. Open temple alignment

a. Check the temples for straightness of shaft.
b. Check for angles of the temples when fully opened for symmetry.

Step 4. Temple parallelism (fl at surface touch test)

a. Check for bent endpiece.
b. Check for loose or broken rivets or loose hidden hinge.
c. Check for bend in the temple shaft.
d. If none of the above is at fault, the hinge is to be bent.

Step 5. Alignment of the bent-down portion of the temple

a. Check for equality of downward bend.
b. Check for equality of inward bend.

Step 6. Temple-fold angle

a. Check for central crossing of the temple shafts when folded.
b. Check for a fold that permits the insertion of the spectacles into a standard case.

Figure 8-36. While the frame is held with the other hand, the hinge is angled until it reaches the proper position as shown.

Skewed Bridge

The second cause of horizontal misalignment is a skewed bridge, in which case both lenses are oriented identically but one lens is somewhat higher than the other. Correcting a metal frame with a skewed bridge can be difficult, depending on the bridge design.

To correct bridge skewing with only the hands, grasp the front as was done for a plastic frame, with one eyewire in each hand as was shown in Figure 8-5. Force the eyewires in opposite directions until they are level. Much care must be exercised with this procedure because it is carried out with the lenses in place, making the danger of chipping a lens high.

Horizontal skew cannot always be corrected using pliers because of bridge construction. Metal frames of a bridge construction similar to the rimless variety may be altered as described in the section on rimless and semi-rimless mountings.

Vertical Alignment (Four-Point Touch)

As when performing the four-point touch test with plastic frames, a ruler or straight edge is necessary to determine whether or not the frame is in alignment. Metal frame construction is so varied, however, that establishing a four-point touch when straddling the inner parts of the frame eyewires is more often impossible than possible. The test is used to analyze the symmetry of the frame front.

Face Form

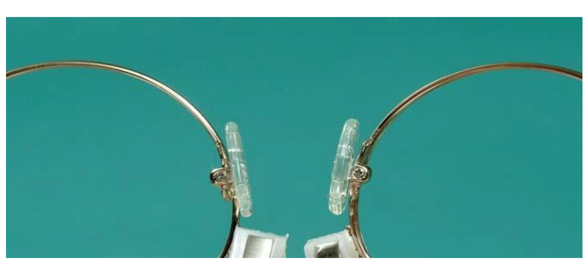
Metal frames are usually designed with face form, especially in the larger eye sizes. Some very stout metal frames are not intended to meet the literal requirements of the four-point touch test and cannot be adjusted to do so. When checking vertical alignment, there are two questions to keep in mind:

1. Does the frame have a four-point touch or a face-form curve?
2. If the frame has face form, are the two nasal eyewires equidistant from the ruler or is one farther from it than the other?

Either pliers or hands may be used to change the degree of face form in a metal frame. If using pliers, use two pairs to grip the bridge near each eyewire. Rotate the pliers in opposite directions to each other to either increase or decrease the bridge curvature (Figure 8-37). The jaws of both pairs of pliers should be padded to prevent marking the frame.

Frames with reinforcing bars at the bridge do not lend themselves readily to the application of pliers. Most metal bridges may be altered by grasping the lenses and eyewires between the thumbs and forefingers and care- fully bending the bridge (Figure 8-38). Undue stress at the lens/eyewire area must be avoided because at this point stress may result in flaking (chipping the edge) of the lens.

Figure 8-37. These double-padded pliers are rotated in oppo- site directions to either increase the bridge curvature (add face form) or decrease it. Pliers' jaws coming in contact with metal, especially the outer side of a metal frame, should be padded to avoid marring the finish.



8-37. Pull on one plier while pushing on the other to make the lenses parallel. Using pliers may reduce stress otherwise placed on the eyewires.

Figure 8-38. This is how the hands are held to either change the face form of a metal frame or to remove X-ing. Care must be taken because undue stress at the lens/eyewire area may result in chipping of the lens edge.

X-ing

The misalignment known as X-ing is exactly the same in metal frames as in plastic and can be discovered by the same means. With metal frames, X-ing may be corrected by grasping the lenses and eyewires between the thumbs and fingers as in changing the face form, but apply the pressure in a rotary or twisting manner to align the lenses. As noted, care must be exerted to prevent stress at the lens/frame edge.

It may be possible to correct X-ing with two pairs of pliers. Using double-padded pliers, grasp the bridge in a manner similar to that shown in the previous Figure

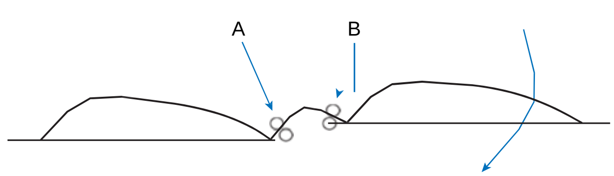


Figure 8-39. When lenses are out of coplanar alignment in a metal frame, the correct procedure for realignment is considerably harder than that with zyl frames.

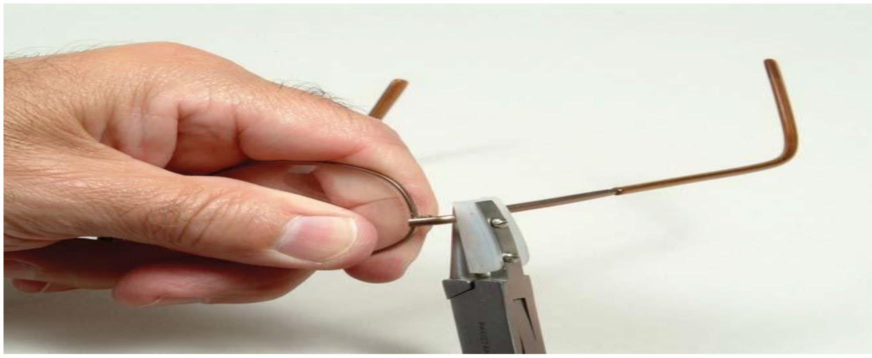


Figure 8-40. In beginning the correction of lenses out of coplanar alignment, the pliers holding the bridge portion nearest the wearer's face (pliers A) are used to hold the frame, while pliers B serve as the bending pliers.

Variant Planes

When the misalignment is that of the two lenses being in different lateral positions, yet still parallel to each other (Figure 8-39), the frame can be corrected in one of two ways.

A metal frame with the problem of lenses out of coplanar alignment can often be handled in the same manner as was done for a plastic frame, but without heating it. The frame is bent with the hands by grasping the lenses and eyewires with the thumbs and fingers and forcing the frame into alignment as was seen in Figure 8-9.

If the first method will not work, the second method for variant plane correction uses two pair of pliers and involves two procedures. First, grasp the bridge with two pliers, each a short distance from either eyewire. The pliers holding the bridge portion nearest the wearer's face (pliers *A*) are used to hold the frame, whereas the pliers gripping the bridge portion farthest from the face (pliers *B*) serve as the bending pliers (Figure 8-40). Bend the bridge as if increasing the face form, until the nasal side of the bridge (which had been forward) is on the same plane as that of the other side of the bridge. The lenses will now appear to be angled in relation to each other (Figure 8-41).

Now using pliers *B*, which previously did the bending, as a holding pliers, move pliers *A* to that portion of the bridge between the eyewire and pliers *B* (Figure 8-42). Bend the bridge outward at this point with pliers *A* until the lenses are parallel (Figure 8-43).

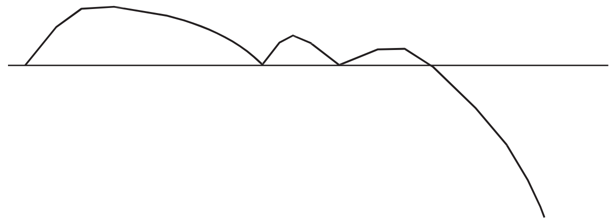


Figure 8-41. The bridge is bent as if the face form were to be increased until the nasal side of the bridge, which had been forward, is on the same plane as that of the other side of the bridge. The lenses now appear angled in relation to each other.

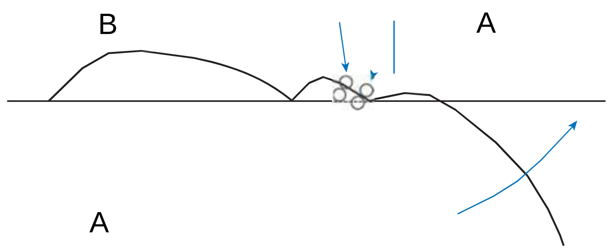


Figure 8-42. Now pliers B that previously did the bending are used as holding pliers. The other pliers (pliers A) are moved to that portion of the bridge between the eyewire and pliers
B. The bridge is bent upward at this point by pliers A until the lenses are parallel.

Figure 8-43. The final stage in correcting for lenses out of coplanar alignment returns the metal frame to a proper four- point touch configuration.

THE TEMPLES

As with plastic frames, the temples are used to gauge how the next area is adjusted, starting with the open temple spread. Adjustments often affect the endpieces. After open temple spread, temple parallelism is again checked, temple ends are aligned, and lastly the temple fold is adjusted.

Open Temple Spread

The temple should be at the same angle to the front as it was for a plastic frame; that is 94 to 95 degrees. Also as in the case of plastic frames, it is not usually desirable to spread the temples to more than 90 degrees before fitting them to the wearer.

Temples Spread Too Far (Decreasing the Temple Spread)

If the temples are spread too far apart, there are several ways to bring them back into alignment. Here are a few selected methods.

First method: Use a pair of half-padded pliers as bending pliers. Half-padded pliers have a small metal jaw on one side and a nylon-padded jaw on the other. Grip the outside of the endpiece (Figure 8-44). Hold the front firmly near the endpiece with the free hand. (When the endpiece is wide enough, use a second pair of thin pliers to hold the endpiece where it joins the eyewire.) Rotate the bending pliers around until the temple has reached the desired temple-spread angle.

B

Figure 8-44. If the temples are spread too far apart, a pair of half-padded pliers may serve as bending pliers and grip the outside of the endpiece. **A,** Side view. **B**, Top view.

Second method: Close the temple and grip the hinge from below with the thin pliers. (Since no visible external frame areas are being gripped, it is not essential that the pliers be padded.) Rotate the pliers, bending the endpiece area inward (Figure 8-45). Because of the risk of chipping the lens, whenever there is sufficient space available, use a second pair of pliers to grip the frame near the lens so that the eyewire area is not stressed (Figure 8-46).

Third method: The endpiece can be bent using another method that does not involve pliers, but only a smooth flat surface. With both hands, hold the frame by the lens and eyewire just adjacent to the endpiece. (The closer to the endpiece the frame is held, the less danger there is of breaking a lens.) Hold the frame front perpendicular to the table surface, and push the endpiece against the surface until there is enough bend to hold the temple at its proper spread angle (Figure 8-47).

Temples Not Spread Enough (Increasing the Temple Spread)

When the temple spread is too small, it can be increased by using the reverse of the first two methods described above for decreasing the temple spread.

First method: This is exactly the reverse of method one above. Grasp the outside section of the endpiece with padded pliers. (This was shown in Figure 8-44.) Bend the endpiece outward to the proper spread while supporting the front at its junction with the endpiece.

Second method: Use the reverse of the second method listed above. Close the temple, grasp the hinge, and bend the endpiece outward. As noted before, certain kinds of frames allow enough space at the endpiece to permit a second pair of pliers next to the eyewire as holding pliers. This takes any possible strain off the eyewire, reducing the possibility of chipping a lens.

For a summary of temple spread problem solutions, see Box 8-4.

BOX 8-4

Alternative Methods of Increasing or Decreasing the Temple Spread on Metal Frames

1. ..a. Grasp the endpiece with the hand (or when possible, use thin half-padded pliers as holding pliers).

   b. Use thin-padded or half-padded pliers as bending pliers and grasp the endpiece near the hinge. Bend the endpiece in or out.
2. Close the temple, grip the hinge barrels, and bend the endpiece either inward or outward.
3. Push the outside of the endpiece against a flat surface to bend the endpiece inward.

Figure 8-45. Use the hand to grasp the frame front firmly at the endpiece. Decrease temple spread with the pliers. If there is risk of chipping the lens, remove the lens first.

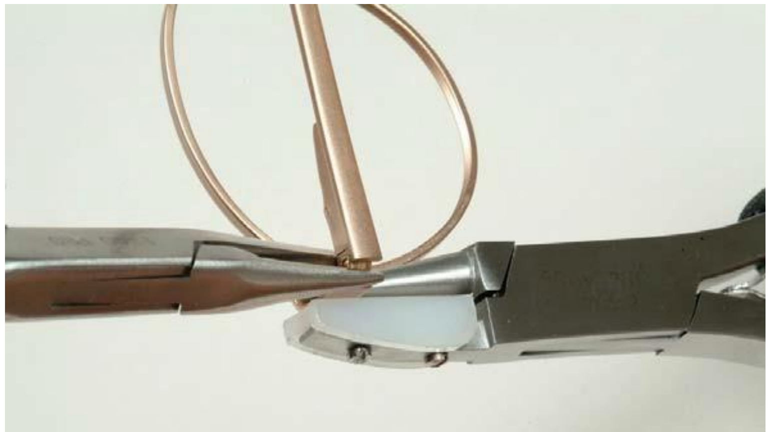


Figure 8-46. The risk of lens chipping can be reduced by using holding pliers while reducing temple spread.

Figure 8-47. To decrease temple spread, the frame front may be held perpendicular to a flat surface and the endpiece pushed against it.

Temple Parallelism (Changing thePantoscopic Angle)

Temple parallelism refers to the relative pantoscopic angles as viewed from the side. Testing proper temple parallelism is done in exactly the same manner for metal frames as for plastic.

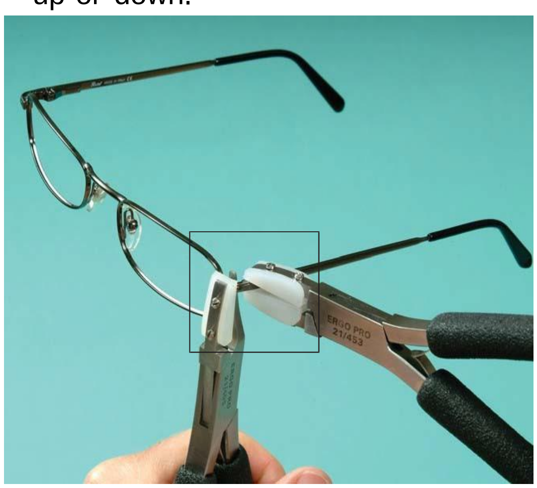
Place the glasses upside down on a flat surface and note if one or both temples touch the surface (flat surface touch test). If the frame wobbles, the pantoscopic angle must be adjusted.

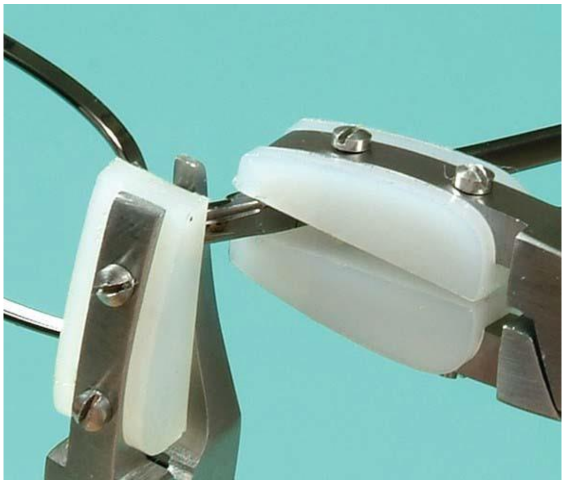
The normal pantoscopic angle varies anywhere from 4 degrees to 18 degrees. By keeping this in mind, it is relatively easy to decide which temple to bend up or down. If the difference between the two angles is extreme, it may be necessary to bend one temple up and one down to make the angle equal on both sides.

Figure 8-48. Double-padded pliers help to prevent marks on the frame during frame adjustment.

There are several ways to change the pantoscopic angle of a metal frame:

1. *Hands only.* The simplest way is to grasp the eyewire and lens close to the endpiece on the same side of the frame as the temple that needs to be angled and bend the temple up or down by hand. The frame will bend at the endpiece or at the hinge. Though not desirable, it is sometimes necessary to close the temple a few degrees to allow the hinge to bend. One disadvantage to this method is that it may leave a V-shaped gap at the point where the temple butt and endpiece join. This should be avoided.
2. *Two padded pliers.* Using a pair of bracing pliers with one metal and one nylon jaw (half-padded pliers), hold the endpiece on the front of the frame if there is room, or just anterior to the hinge if there is not. The second pliers, used for bending, should be double-padded pliers (Figure 8-48) to grasp the temple close to or directly on the hinge. It may be prudent to remove the lens if the frame is stiff or there appears to be a possibility of chipping the lens. Grasp the frame as shown in Figure 8-49, and reangle it up or down.





A B

Figure 8-49. To change the pantoscopic angle, hold the end- piece, grasp the top and bottom of the hinge area, and re-angle the temple.

3. *One hand and one double padded pliers.* It may be possible to do the bend as described in the previous method without a pair of bracing pliers. This may be done by grasping the endpiece and temple from the front with the double-padded pliers parallel to the temple as shown in Figure 8-50.
4. *One hand on frame front and angling pliers.* Another method of changing the temple-angle is to bend the endpiece with angling pliers. Grip the hinge by the screw head and tip of the screw with the angling pliers (Figure 8-51, *A* and *B*). Holding the frame front firmly, rotate the angling pliers until the desired angle is reached. The front may be held by the hand near the endpiece, or the endpiece may be secured with pliers to better ensure against chipping the lens.
5. *Gripping the eyewire screw.* When one method does not seem to work, or helps but does not fully accomplish the task, there must be other ways to do the same thing. With some frames it is possible to change the pantoscopic angle by grasping the eyewire screw and angling the temple as shown in Figure 8-52. Only frames constructed in certain ways will allow for this. And this should not be used as the first attempt to change the pantoscopic angle, either.
6. *Angling pliers and one hand on temple.* Angling pliers may be used to change the pantoscopic angle without affecting the endpieces. This may be useful if the endpieces appear to be even. Grip the hinge with angling pliers in the customary manner. This time, however, do not rotate the pliers; instead use them as holding pliers. With the other hand, bend the temple shaft down (Figure 8-53). The pantoscopic angle correction is produced by a change in the hinge angle instead of by a change in the endpiece angle.

For a summary on changing the pantoscopic angle with metal frames, see Box 8-5.

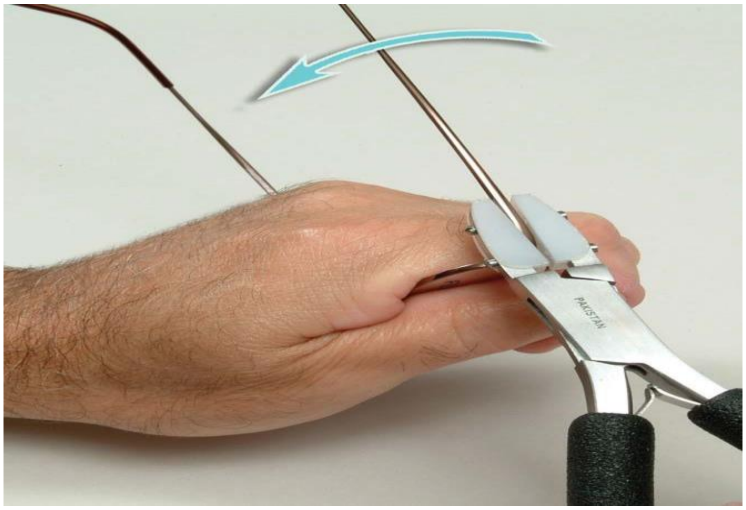
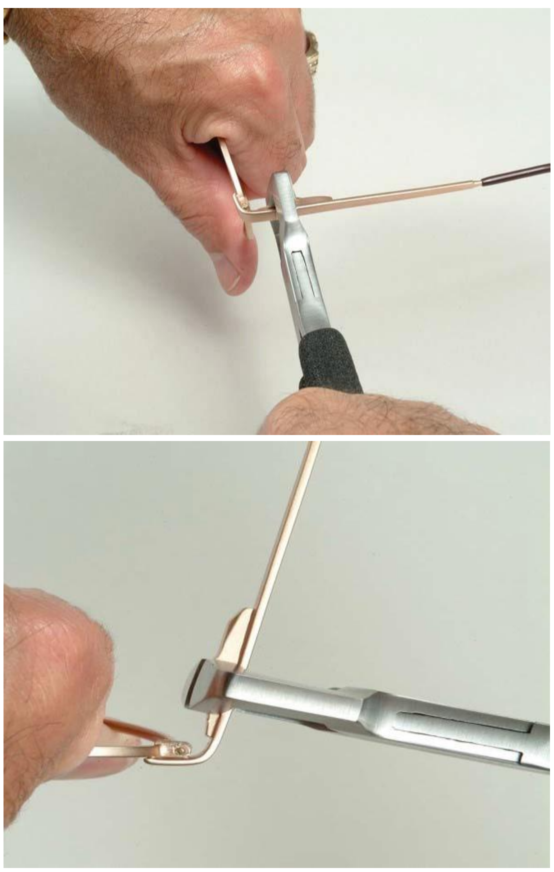


Figure 8-50. When the endpiece is too small, the pantoscopic angle can be changed without holding pliers. If the frame does not have enough flexibility, the lens may be removed first.



A B

Figure 8-51. The pantoscopic angle of the temple angle may be changed by gripping the top and bottom of the temple screw with angling pliers and bending the temple upward or down- ward. This is shown from a side view in **(A)** and from a top view in **(B)**.

BOX 8-5

Alternative Methods of Changing the PantoscopicTilt on Metal Frames

1. a. Grasp frame front close to hinge.
   b. Bend temple down by hand.
2. a. Hold the endpiece with half-padded pliers (seeFigure 8-48).
   b. Grasp temple on top and bottom of hinge withdouble-padded pliers.
   c. Bend up or down.
3. a. Hold frame front with hand (see Figure 8-50).
   b. Grasp temple on top and bottom of hinge withdouble-padded pliers.
   c. Bend up or down.
4. a. Hold front near endpiece with hand (see Figure8-51).
   b. Grip hinge with angling pliers.
   c. Bend with pliers.
5. a. Hold front near endpiece with hand.
   b. Grasp eyewire screw with angling pliers (seeFigure 8-52).
   c. Bend with pliers.
6. a. Hold hinge steady with angling pliers (see Figure8-53).
   b. Grasp temple with hand and bend down.

Figure 8-52. Here the pantoscopic angle is changed by grasping the eyewire screw instead of the hinge. Notice that thin angling pliers are used because the standard angling pliers may be too bulky to get into this small area.

Aligning the Temple Ends

The endpiece, or bent-down portion of metal frame temples are aligned in the same manner as that used forplastic frames. Several precautions must be taken, however, to keep from damaging the frame during the adjustment process.

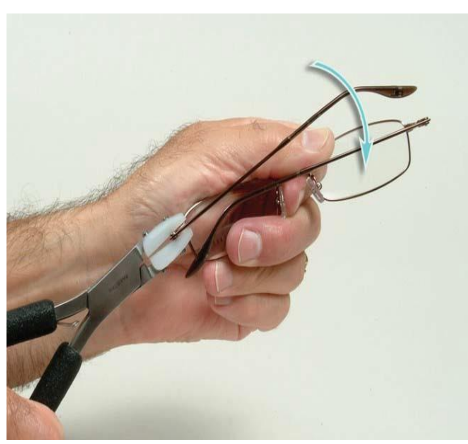


Figure 8-53. The temple angle may be changed by bending the hinge instead of the endpiece itself. This can be done using angling pliers to hold the hinge while the temple shaft is bent down with the other hand.

The conventional skull temple on a metal frame usually has a plastic covering over the end of the temple. This affords a more comfortable fit. Because of the plastic, it is usually necessary to apply some degree of heat to this part of the frame before it can be manipulated to effect adjustments. Different types of temples require varying amounts of heat.

Temples with a clear plastic covering heat very quickly and should be heated only slightly (just slightly warmer than body temperature). The plastic can easily be bubbled by overheating or distorted by being bent while too pliable. New frames bend quite satisfactorily at low or no temperature. The plastic in old frames, however, is usually too brittle to bend without more extensive heating.

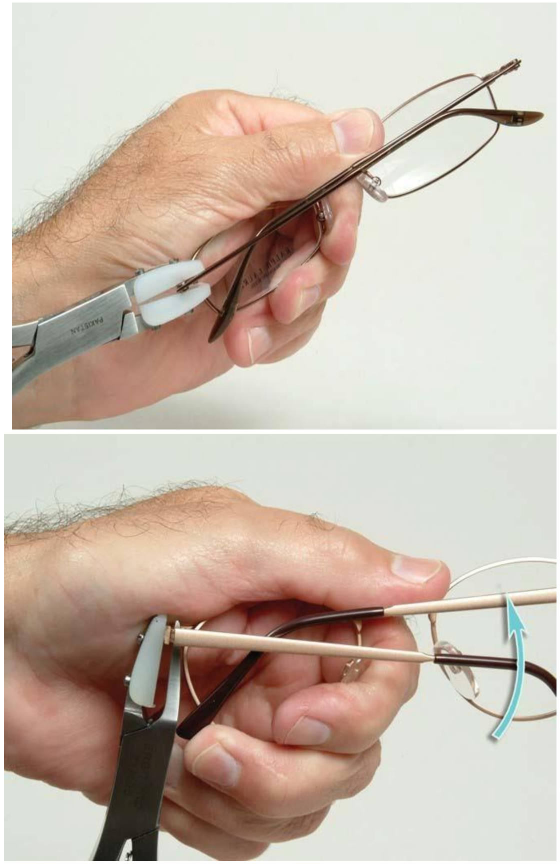
Other frames have a fairly heavy piece of metal running through the temple ends. These frames exhibit more resistance to bending because of the thickness of the metal. A common error is to assume that this resistance is due to insufficient heating. The result is over- heating and distortion of the plastic when it is bent. To prevent this error, heat the entire plastic portion slightly, but concentrate the heat on the portion that must absorb the bend. Quite a bit of force may be necessary even when the heating is done correctly.

Temple-Fold Angle

The procedure for changing the temple-fold angle in a metal frame varies according to the type of endpiece being used. Two common methods are presented here. One uses double-padded pliers and the other uses half- padded pliers.

In the first method, hold the frame front firmly in one hand and grip the top and bottom of the hinge area with double-padded pliers similar to the manner pictured in Figure 8-54, *A*. Rotate the pliers in the direction necessary to line up the temples in their correct parallel alignment (Figure 8-54, *B*).

In the second method, the frame front is held by hand in the same manner as method one. With temples closed, the endpiece is gripped with the half-padded pliers as shown in Figure 8-55. The temple is turned until parallel.



A B

Figure 8-54. To change the temple-fold angle on commonly used types of metal frames, hold the frame front in the hand firmly, temples closed. Grip the top and bottom of the hinge area with double-padded pliers as shown in **(A)** and bend the temple so that it returns to and maintains its correct parallel alignment as seen in **(B)**.

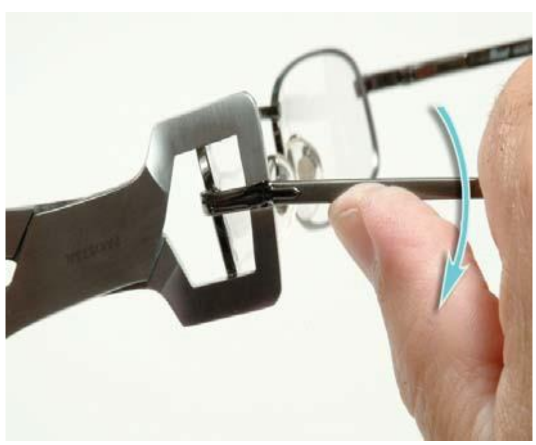


Figure 8-55. The temple fold angle may be changed using half-padded pliers on the endpiece and bending the folded temple to parallel.

SECTION C

Standard Alignment of Nosepads

As with the frame front and the temples, there is a specific standard alignment for nosepads that should be used during the preliminary adjustment of the frame. Obviously, final adjustment of the pads will vary extensively with the individual shape and flare of the nose of the intended wearer. However, pads adjusted to a proper standard initially facilitate individual adjustment later.

There are three basic angles that are used for reference when aligning nosepads. These are the frontal, splay, and vertical angles. To be in standard alignment, these angles must fall within certain limits and be the same for both right and left nosepads.

FRONTAL ANGLE (VIEWED FROM THE FRONT)

The *frontal angle* of the nosepads refers to the vertical position of the pads in relation to each other when viewed from the front. The tops of the pads should be closer together than the bottoms, angling in toward each other approximately 20 degrees from a true vertical (Figure 8-56).

Most pads can be “rocked” about a swivel joint. The pads should be slanted for the frontal angle by the same amount. This is most easily done using pad-adjusting pliers to grip the pad as a whole. Pad adjusting pliers are made in a variety of ways, depending upon the construction of the nosepads for which they are intended (Figure 8-57). The frame front is held securely in one hand and the pad angled by turning the pliers to the angle desired (Figure 8-58).

When evaluating one of the pads, the play exhibited by that pad should be equal on each side of the desired position for the correct frontal angle. In other words, a pad should not have to be rocked to one extreme in order to match the frontal angle of the other pad.

If one pad has a lot more play in the *amount* of rock it shows, the amount of play may be reduced on some pad types by tightening the looser pad with pliers. The way this might be done depends upon how the pad is made.

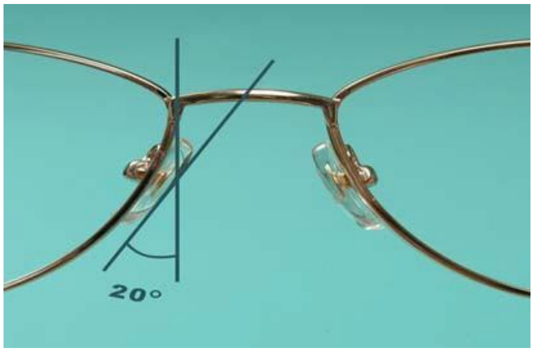


Figure 8-56. In standard alignment of nosepads, the angle most clearly seen when viewing from the front is termed the *frontal angle.*

Figure 8-57. The type of pad-adjusting pliers used will depend on the type of pad on the frame.

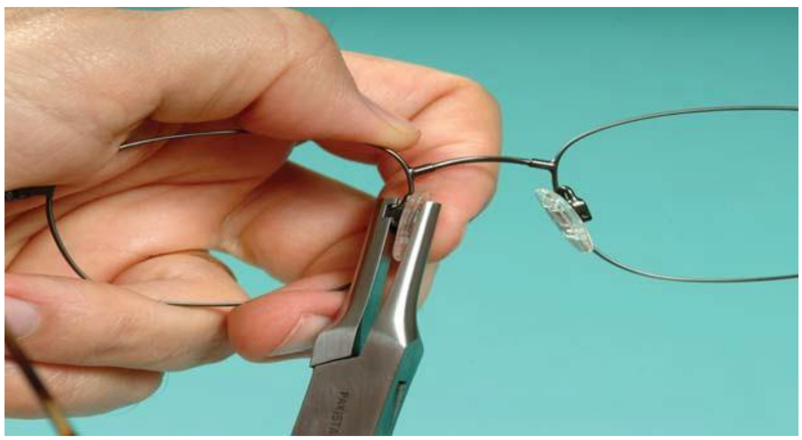


Figure 8-58. The correct method for using pad-adjusting pliers.

For example, it may be done on some pads by pressing on the attachment point with one jaw while the other rests on the face of the pad. For pads which slip into a small box on the pad arm, tighten the amount of rock by crimping the box into which the back of the pad snaps.

Pad Spacing

While viewing the frontal angle, observe the amount of space between the eyewires and pads. Both pads should be equidistant from their respective eyewires. An esti- mated ideal position is for the face of the pads to appear approximately 1 mm closer to the nose than the eyewire itself (Figure 8-59). If the pads are spread too far apart, the rim of the frame could possibly rest directly on the nose. Both pads should also be equal distances from their respective eyewires; otherwise, the frame will not center properly on the face. Proper correction procedures for these errors are described in detail in Chapter 9 when discussing changing the distance between pads.

Pad Height

A third point of observation is whether or not both pads occupy the same horizontal plane (again, see Figure 8-59). If one pad appears higher than the other, the pad arm may be bent upward. It is essential that both pads be in identical rocking positions because if one is erect and one is slanted, their heights may appear dissimilar. Again, specifics of adjustment technique are described fully in Chapter 9 in the sections that review changing the height of pads.

Figure 8-59. An estimated ideal position is that in which the faces of the pads appear approximately 1 mm closer to the nose than the eyewire itself. Both pads should also be at the same height, as shown by the horizontal red line.

SPLAY ANGLE

Remembering that the nose is wider at the base than at the bridge and that the face of the pads should rest fully on the nose, it is apparent that the back edges of the pads should be farther apart than the front edges. This difference then between the back and front edges of each pad, viewed from the top or the bottom, is the *splay angle*.

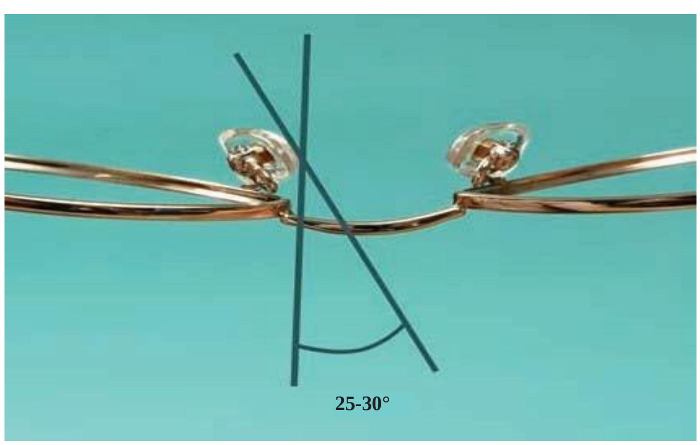


Figure 8-60. The second angle of concern in the proper alignment of nosepads may be seen by viewing the frame from above. This angle is referred to as the *splay angle.*

For initial alignment, a splay angle of 25 to 30 degrees is satisfactory (Figure 8-60) and may be achieved through the use of the pad-adjusting pliers.

VERTICAL ANGLE (VIEWED FROM THE SIDE)

The angle most often neglected in the standard alignment of nosepads is the *vertical angle*. This angle is especially important in ensuring proper weight distribution under the pad. Ideally the longitudinal (top to bottom) axis of the pad face is in contact with the nose surface in the direction of gravity. In other words, the longitudinal axes of the pads should be vertical on the face. (If the nosepads are round instead of elongated, there is no vertical angle.)

Since most spectacles are worn with a certain amount of pantoscopic tilt, the pads will need to be inclined so that the bottoms are slightly closer to the frame front than the tops. Then when the glasses are positioned on the nose with their proper pantoscopic angle, the pads will be approximately vertical (Figure 8-61). For the initial alignment, a vertical alignment angle of approximately 15 degrees is acceptable. This may be achieved in one of three ways:

1. *Using pad-adjusting pliers.* Grasp the pad on its surface with the pliers as was shown in Figure 8-58 and rotate. (In some instances it may be necessary to grip the pad from the top instead of the bottom to adjust the vertical angle.)
2. *Thin-nosed pliers on the pad arm.* For adjusting the vertical angle, because there may not be room to do this adjustment with pad adjusting pliers, thin-nosed pliers are used. The pad arm is grasped directly behind the pad from above or below.
3. *Grasping the box behind the pad arm.* Some nosepads are attached to the pad arms with a small box. It is possible to reangle some pads by grasping the box behind the pad. This is shown in Figure 8-62.

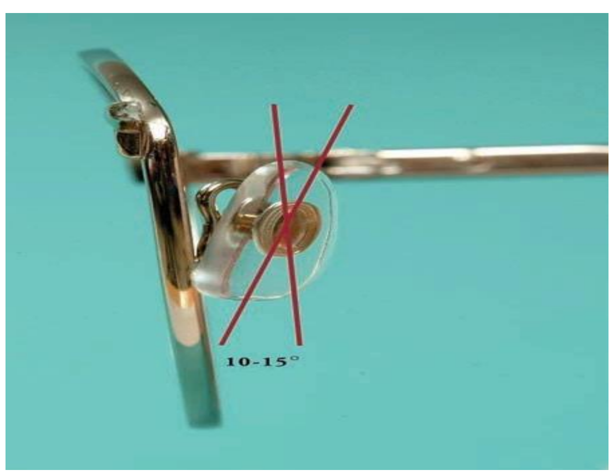


Figure 8-61. The angle most often neglected in the standard alignment of nosepads is the *vertical angle*. This angle is especially important in ensuring proper weight distribution under the pad. When the glasses are worn, the frame front will not be straight up and down, but will be angled. The long axis of the pad will be straight up and down.

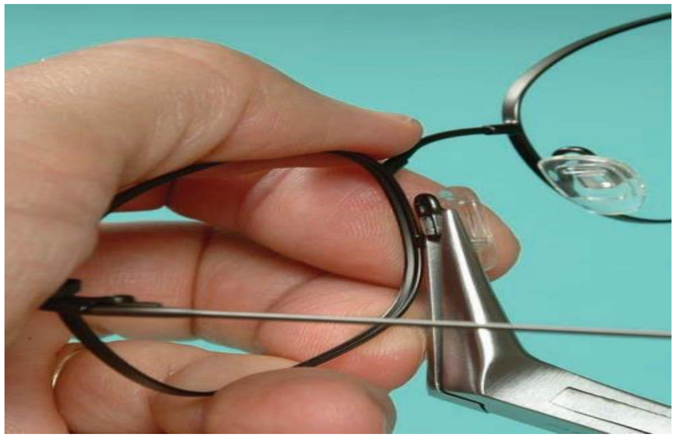


Figure 8-62. If one of the pad angles is out of adjustment, it is possible to correct the angle by grasping the box behind the pad with the pliers and adjusting the angle. Some silicone pads have a tendency to split or tear with stress. This technique avoids the pressure that would be applied to the pad were the pad face to be grasped.

Pads Must Have Equal Distances From the Frame Front

While viewing from the side to check for the proper vertical angle, also note the distance of each pad from the front of the frame. Both pads should extend back an equal distance. The pads should be equal not only in height and inclination, but also regarding this distance. If these three details are precise, one pad will practically hide the other when the pair is observed directly from the side. To correct for an error of this nature, use the techniques described in Chapter 9 in the sections on changing the height and vertex distance of pads.

A Humorous Way to Remember the Three Pad Angles*

Here is a clever way to remember which pad angle is which and how they move:

1. Put your thumbs under your arms and flap your arms like a chicken. This movement corresponds to the frontal angle.
2. Hold your hand straight up in front of you and rotate your wrist in the typical “Miss America” wave. This mimics the splay angle.
3. Imagine being the person on the tarmac at the airport using two orange flashlights to direct an airplane taxiing toward you. To get the plane to move directly toward you, you hold the flashlights straight up and down. Now, bending your elbows, move both flashlights forward and backward. This corresponds to the vertical angle.

SECTION D

Standard Alignment of Rimless Eyewear

RIMLESS CONSTRUCTION AND LENS MATERIALS

In the past, rimless eyewear was the most fragile of eyewear. This made the alignment and adjusting of rimless glasses tedious and risky because it was very easy to chip the lens. This is still the case when older mountings or inappropriate lens materials are used. Rimless are still more difficult to adjust than plastic and metal frames.

Yet when the appropriate tools are used and procedures followed, results and safety are excellent.

Newer mountings use a variety of methods to give extra stability to the mounting. In the past, the lens was held in place with one hole nasally and one hole temporally. Now there may be more than one hole, or a hole and an edge notch used in combination. As a result, these constructions hold their adjustment.

Appropriate Lens Materials

If appropriate lens materials are used for rimless mountings, lens chipping is vastly reduced. At the time of this writing, the best lens materials for rimless mountings are Trivex and polycarbonate. Both hold up extremely well, but Trivex is less likely to develop small stress splits next to the drilled hole. Some labs will only warranty Trivex or Trivex and polycarbonate.

Many high index plastic materials are suitable for rimless, though not performing as well as Trivex and polycarbonate. Though still used some, conventional CR-39 plastic is not a good choice.

Although glass lenses used to be used in rimless mountings years ago, they should not be used now. Chemically tempered glass is physically possible to use with rimless, but inappropriate. Heat-treated glass lenses are impossible. The combination of strain patterns produced by the heat treatment and the induced strain at the mounting points will result in a broken lens in short order.

ALIGNING THE BRIDGE

Whereas the bridge or pad arm origins and the end- pieces serve as the line of reference for frames, the *mounting line* serves as a line of reference for rimless mountings. The mounting line is defined as "the line which passes through the points on the eyewires or straps at which the pad arms are attached.[1]" The end-pieces may be attached on this line, or as may be the case, above or below this line.

Horizontal Alignment

Horizontal skew can be noted by placing a straight edge at the mounting line or parallel to it. If the temples are attached to the lenses on the mounting line, all four points should line up on the straight edge. If the temples are not on the mounting line, the nasal points should be on the straight edge, and the points of attachment of the temples should be equidistant from the straight edge (Figure 8-63).

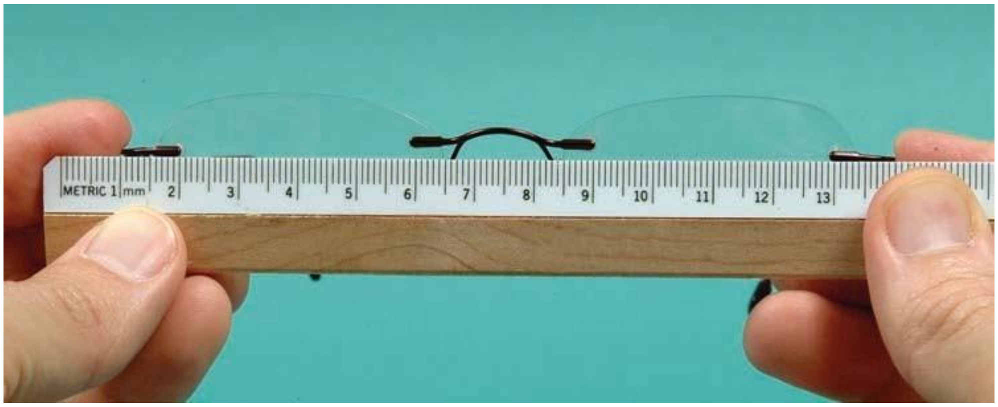


Figure 8-63. Checking the horizontal alignment of a rimless pair of glasses. Here the ruler is placed on the temporal holes. The nasal holes should be equidistant from the ruler.

If the lens is out of horizontal alignment and the frame is new, there is a chance that one lens has been improperly drilled. It may be more likely, however, that the bridge of the frame is bent. Figure 8-64 shows a mounting that is out of horizontal alignment. The problem may be corrected as follows:

1. *Using rimless bracing pliers and double-padded pliers.* One of the issues with rimless mountings is protecting the lens mounting points from stress during the adjustment process. Too much stress on the lens at the mounting point can cause the lens to loosen or fracture. The type of pliers that is designed for reducing stress is referred to as rimless bracing pliers. One example of such pliers is shown in Figure 8-65. The bridge may be realigned by holding a nasal drill point with bracing pliers, grasping the bridge with double-padded and bending the bridge as shown in Figure 8-66.,
2. *Using two pair of double-padded pliers.* A rimless bridge can also be corrected for horizontal misalignment using two pair of double padded pliers as shown in Figure 8-67

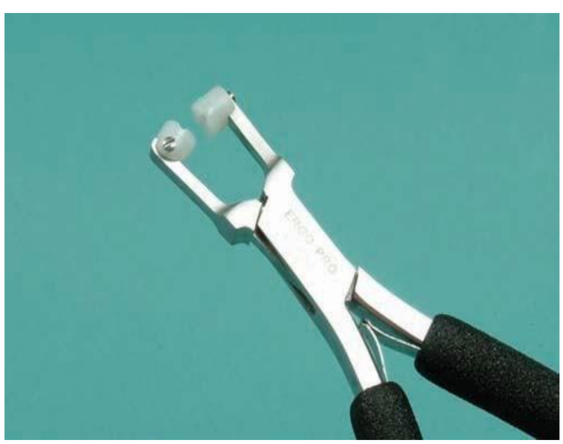


Figure 8-64. This rimless mounting is out of horizontal alignment.

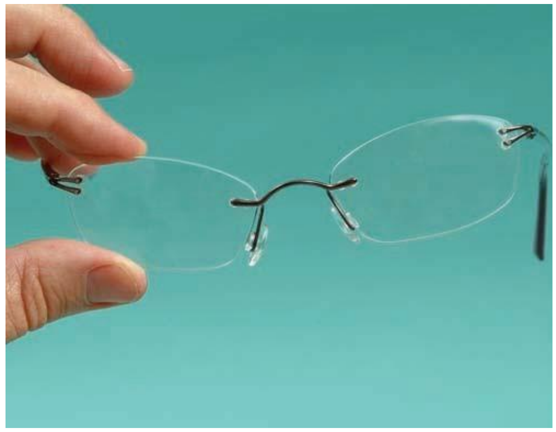


Figure 8-65. Rimless bracing pliers are used to hold rimless eyewear at the point of attachment to the lens. With this particular type of pliers, one jaw is fixed and one jaw pivots. The jaw that pivots (in this figure, the jaw on the left) is to be placed on the front surface to compensate for the lens base curve.

Vertical Alignment (Four-Point Touch)

After the horizontal alignment has been corrected, the next step is checking for a four-point touch. This is done in approximately the same manner as for plastic or metal frames. Place a straight edge on the inner sides of the lenses somewhat below the pads (Figure 8-68, *A*).

In theory the nasal and temporal sides of both lenses should touch the straight edge. Then repeat the test by placing the straight edge somewhat above the pads (Figure 8-68, *B*). The nasal and temporal sides of both lenses should again touch the straight edge. (In practice, because the wearer's PD is usually smaller than the "frame PD", the nasal lens edge may not necessarily touch the straight edge, but must be equidistant from it.)

X-ing

If the nasal and temporal sides of both lenses in ***both*** upper and lower positions do not touch the straight edge, X-ing of the lenses has occurred. Because of the way rimless lenses are mounted, it would be possible to have a four-point touch exactly in the center of the lenses but still have X-ing. For that reason, the four-point touch test is done at both the top and the bottom of the lenses.

Face Form

While testing for a four-point touch, it may be found that too little or too much face form exists. To increase or decrease face form, grasp the mounting at a nasal point of attachment with rimless bracing pliers and bend the bridge backward or forward using double-padded pliers (Figure 8-69). The bend in the bridge will take place between the two pliers. For maintaining symmetry, it may sometimes be helpful to partially bend the bridge, then switch the rimless bracing pliers to the nasal point of attachment of the other lens and complete the bend.

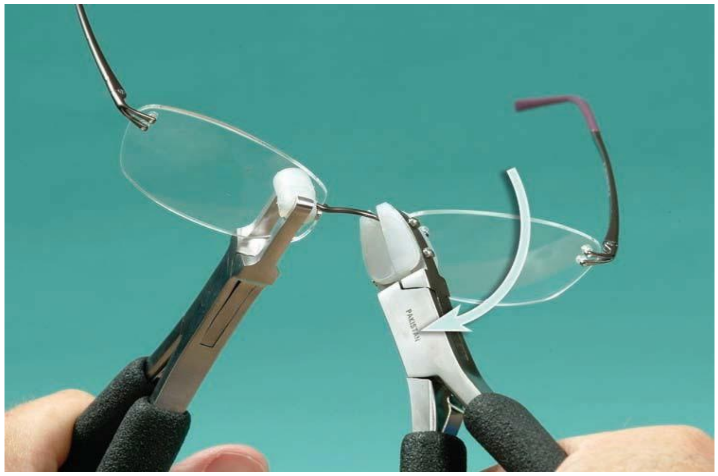
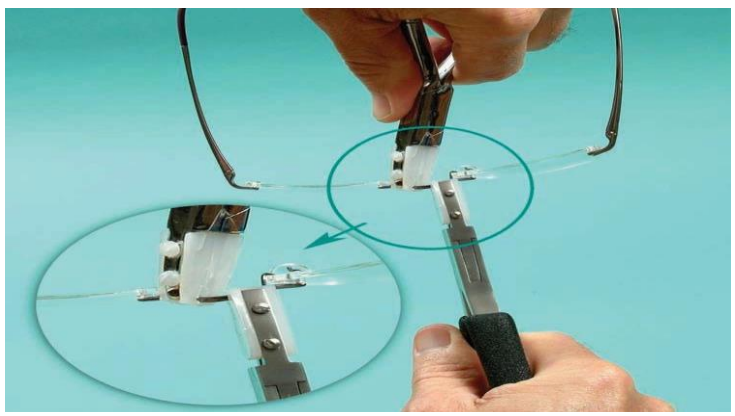
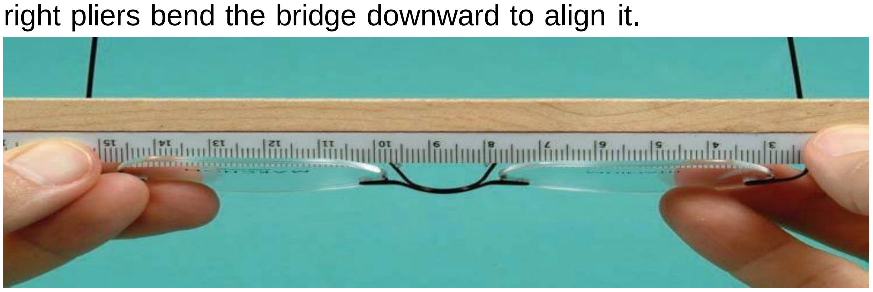


Figure 8-66. Here is one method for adjusting horizontal alignment using a combination of rimless bracing and double-padded pliers. To correct the horizontal misalignment shown in Figure 8-64, hold the nasal point of attachment with the rimless bracing pliers and bend the bridge downward with the double

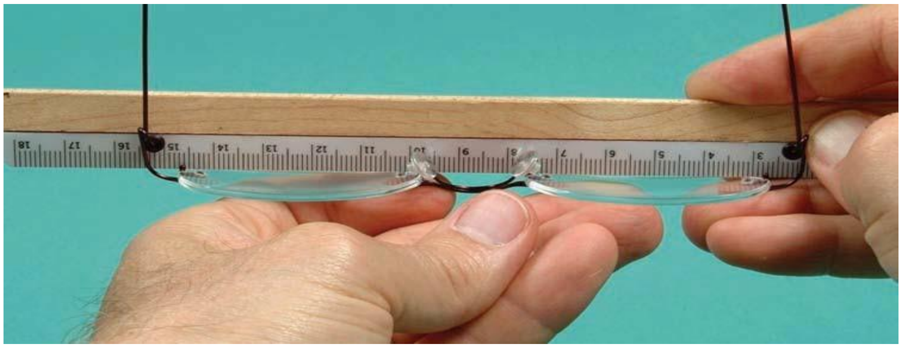


padded pliers.

Figure 8-67. Horizontal misalignment may also be corrected by grasping the bridge with two pair of double-padded pliers. This is still the same frame with the same misalignment as was shown in Figure 8-64. Here the frame is viewed from the top. The left pliers hold the bridge, replacing the rimless bracing pliers. The right pliers bend the bridge downward to align it.



A



B

Figure 8-68. A, The check for four-point touch on a rimless mounting is begun by placing the straight edge on the inner side of the lenses ***below*** the pads. **B,** The check for four-point touch on a rimless mounting is completed by placing the straight edge on the inner side of the lenses ***above*** the pads. By checking both above and below the nosepads, it is easier to tell if the bridge has any propeller-like, X-ing effect.

THE TEMPLES

In the sequence of standard aligning rimless mountings, the temple area is considered next, just as it is with plastic and metal frames.

Open Temple Spread

If the spread of one or both temples is at too great (Figure 8-70) or too small an angle, the error may be corrected by *bending the endpiece.* To do this, grasp the temporal point of attachment of the lens with rimless bracing pliers. Then grip the endpiece with half-padded pliers from either above (Figure 8-71, *A*) or below (Figure 8-71, *B*). The unpadded jaw of the pliers must be on the inside of the endpiece. If the temple is spread too far, the endpiece is bent inward as is shown in Figure 8-71, *C*.

It is also possible to increase or decrease the temple spread by using tri-angling pliers. Tri-angling pliers* have two round parts to one side of the pliers and a single, rounded section on the other jaw. By positioning and squeezing the pliers as shown in Figure 8-71, *D*, the temple spread may be increased or decreased. (This type of pliers may also be used to adjust other types of frame corners or to reshape a clip-on to match the shape of the frame.) Care must be taken not to mark the frame.

If it is not possible to bend the endpiece, then *bend the temple.* Do this by gripping the butt end of the temple with pliers as close to the hinge as feasible. Then grasp- ing the temple as close to the pliers as possible with the thumb and forefinger of the free hand, bend the temple itself.

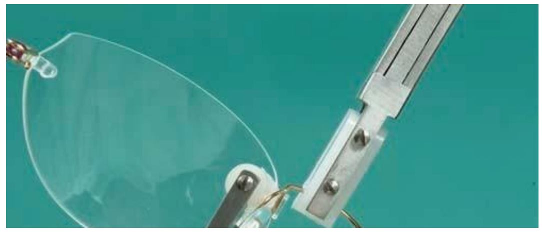


Figure 8-69. To increase or decrease face form, grasp the mounting at a nasal point of attachment with rimless bracing pliers and bend the bridge backward or forward using double-padded pliers.

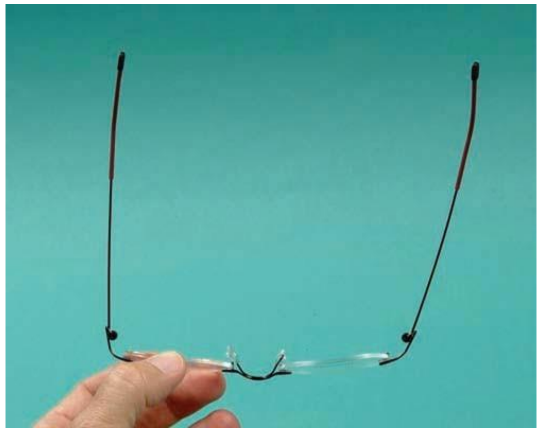


Figure 8-70. The right temple of this rimless mounting is spread too far and must be realigned.

Temple Parallelism

Using the flat surface touch test previously described for plastic and metal frames, check the parallelism (relative pantoscopic angles) of the temples. If one temple does not touch, the cause may be a bend in the temple itself, either at the attachment to the frame or just before the curl of the endpiece. This can easily occur with comfort cable temples, as seen in Figure 8-72. Or the bend may also be gradual, extending the length of the shaft. The solution here is to remove the unwanted bend, usually using the hands alone.

*Available from Western Optical Supply, Inc. Santa Fe, New Mexico.

If the temple itself is not bent, the fault lies in the angle of the endpiece. Figure 8-73 shows what this error looks like. Here are some commonly used methods for correcting this problem (basically a difference in right and left pantoscopic angles).

Using rimless bracing and double-padded pliers. Open the temple and grasp the lens at the temporal mount- ing point with the rimless bracing pliers. Using double-padded pliers, grasp the endpiece as shown in Figure 8-74, *A* or *B*. Then rotate the double-padded pliers so that the pantoscopic angle of the temple is increased or decreased, causing the temple to move down or up.

Using rimless bracing and endpiece angling pliers. This method is the same as the one above with one differ- ence. Instead of double-padded pliers, endpiece angling pliers are used to grasp the top and bottom of the temple screw (Figure 8-75). The endpiece angling pliers are rotated, bending the endpiece and moving the temple upward or downward.

Bending the temple by hand. It is possible to hold the lens at the temporal point of attachment and bend the temple up or downward by hand as shown in Figure 8-76. This is probably the least satisfactory method because it is not as easy to control the place where the frame is actually bent. Using two sets of pliers assures that the bend takes place between the locations of the two pliers.

Aligning the Temple Ends

Procedures used to align the bent-down portion of the temple for skull temples on a rimless mounting are the same as outlined for metal frames.

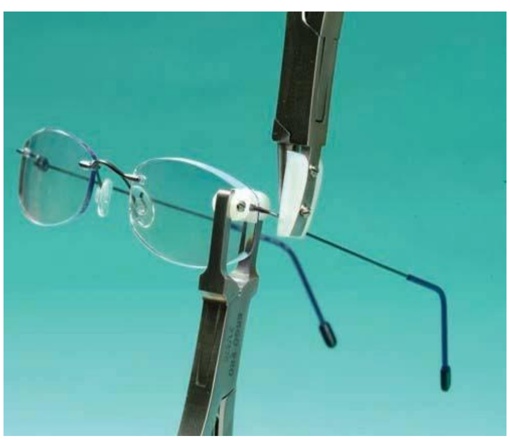
Cable temples are best aligned using the hands alone. Cable temples must be bent much farther than other temples because they tend to spring back to where they were before.

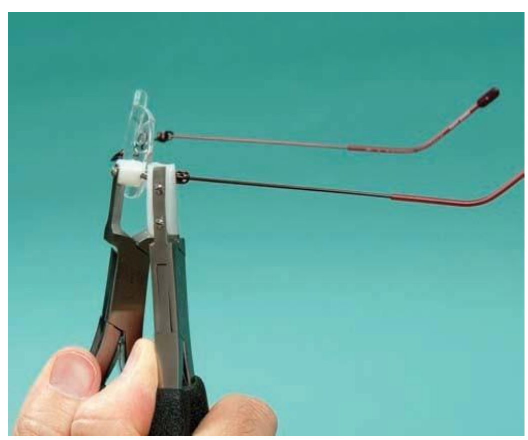
Temple-Fold Angle

The temples, when folded, should meet the same require- ments as described for plastic and metal frames. The same general adjustment routine is followed as for plastic and metal frames, except that the point of attachment to the lens must be held with rimless bracing pliers to prevent undo stress on the lenses and their points of attachment.

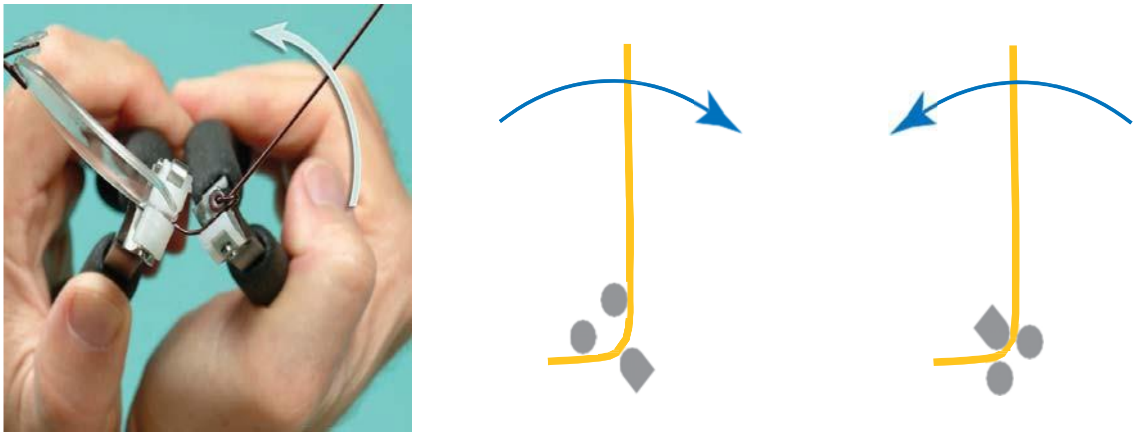
Fold the temples to a closed position and look at how they cross one another. They should preferably overlap, or at least cross at the center of the frame. Figure 8-77 shows a rimless mounting with uneven temple fold angles.

To correct the temple fold angle, grasp the temporal point of attachment with rimless bracing pliers and the endpiece and butt portion of the closed temple with double- padded pliers. Angle the temple upward or downward with the double-padded pliers as shown in Figure 8-78.





A B



C D Spreading the temple Bending the temple inward

Figure 8-71. A, To increase or decrease the temple spread for a rimless mounting, grasp the temporal point of attachment of the lens with rimless bracing pliers. Then grip the endpiece with half-padded pliers from above and bend the endpiece either outward or inward. **B,** Some may prefer to grip the endpiece area from below with both pliers to bend the endpiece in or out. **C,** Hold the frame front steady with rimless bracing pliers (*left*) and rotate the half-padded pliers to bend the endpiece, bringing the temple inward or outward. **D,** Tri-angling pliers may be used to increase or decrease temple spread on certain rimless frames without putting stress on the lenses.

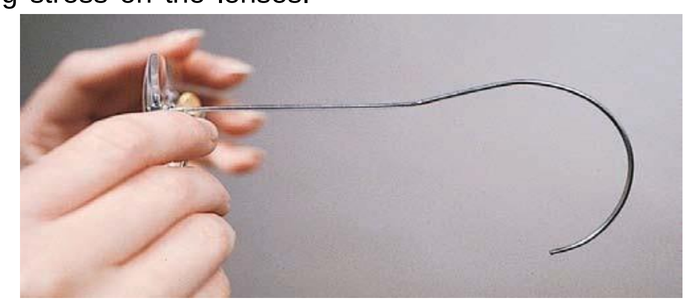


Figure 8-72. An unwanted bend may occur at the position on a cable temple where metal coiling begins.

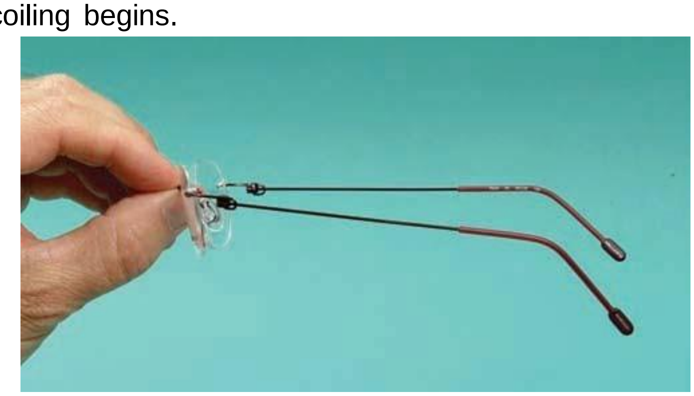


Figure 8-73. The temples of this rimless drill mount are not parallel. The

difference in the two pantoscopic angles will cause the frame to fail the flat surface touch test.

OTHER RIMLESS ADJUSTMENTS

Rimless Nosepad Alignment

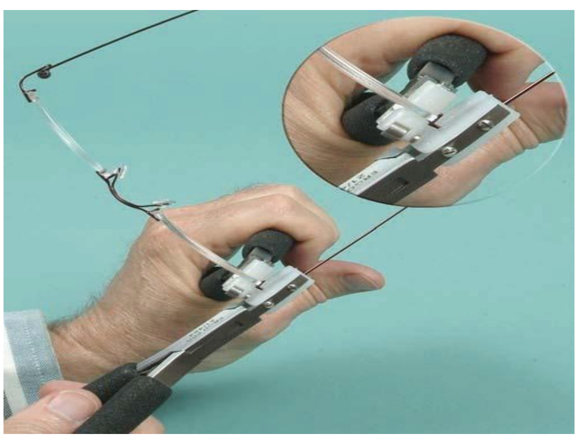
The nosepads of rimless mountings should meet the same specifications laid down for metal frames. The chief distinction in technique is that the bending of the pad arms should not be attempted unless the base of the pad arm is sufficiently supported to prevent stress on the mounting point and lens.

This support can be given by holding the mounting point with rimless bracing pliers while adjusting the pads with pad adjusting pliers. Sometimes it may be sufficient to support the lens mounting point by holding the mounting point tightly between thumb and forefinger.

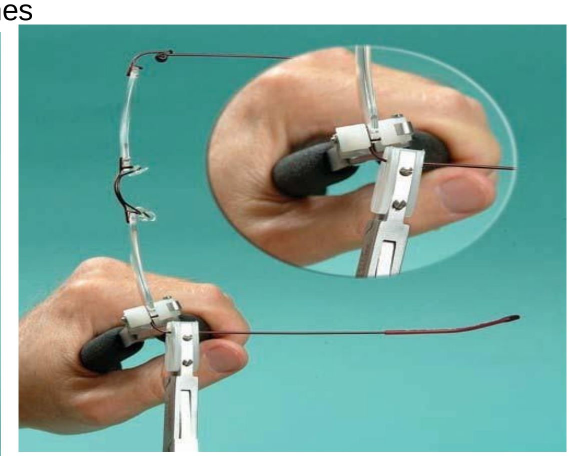
A Loose Lens

Any drilled rimless lens may loosen if the lens screw is not tightened down sufficiently.

If the fault lies with the *screw*, it need simply be tight- ened. The screw may be tightened using a regular screw- driver, but care must to taken not to slip off the screw and scratch the lens. There is a screwdriver with a sleeve around the blade that helps to stabilize the screwdriver and keep it from slipping onto the lens (Figure 8-79). Keep in mind that an overtight screw may crack the lens. This lens screw used for a rimless lens is sometimes



A



B

Figure 8-74. A, To correct for unequal pantoscopic angles, the dispenser grasps the lens at the temporal mounting point with the rimless bracing pliers and rotates the temple with double-padded pliers. **B,** This method of grasping the end- piece of a rimless mounting is just a variation of that shown in

A. The temple is still rotated upward or downward.

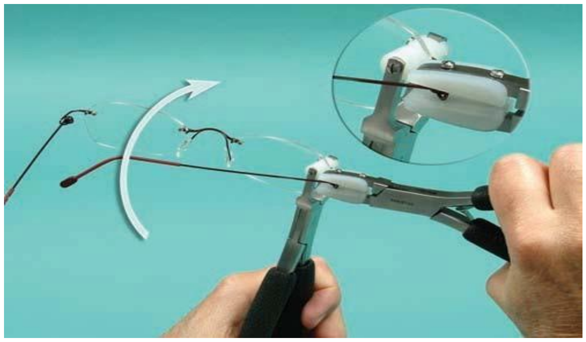


Figure 8-75. A very popular variation on changing the pantoscopic angle uses endpiece angling pliers to angle the temple.

Figure 8-76. A quick alternative for changing the temple's pantoscopic angle uses rimless bracing pliers to hold and makes the bend with the free hand.

Figure 8-77. A rimless mounting with unequal temple fold angles.

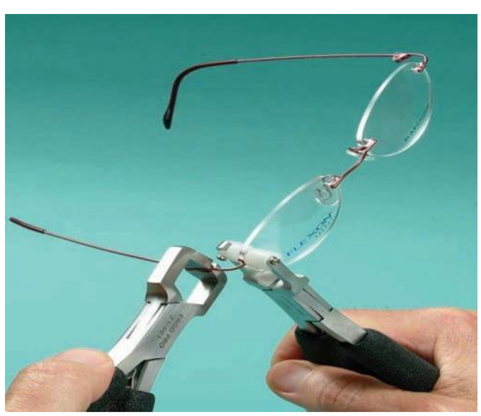


Figure 8-78. Holding the temporal mounting point of the lens, angle the temple with double-added pliers.

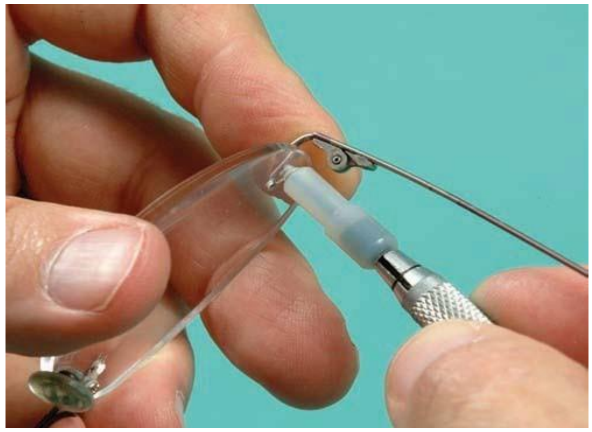


Figure 8-79. A screwdriver made especially for rimless lens screws. The plastic sleeve stabilizes the screwdriver and lessens the risk of slipping off the screw and scratching the lens referred to as a “glass screw” because in former days the screw went through glass lens material.

Some find it helpful to protect the surface of the lens by placing several layers of transparent tape over the lens surface so that if the screwdriver slips, it is less likely to damage the lens surface. If the tape leaves a residue, remove it with alcohol.

Sample Questions:

1. **What is Horizontal Alignment? Discuss its causes?**

It is not easy to check for horizontal alignment of a plastic frame because there are not always clear reference points. To check for horizontal alignment, place a ruler or straight edge across the back of the frame at the top of the pads, if any. If there are no pads, there may be a point where the sculptured shaping of the bridge area ends (this area serves as a nosepad). Both endpieces should be equidistant from the straight edge when it is aligned horizontally (Figure 8-3). A practiced eye may be more helpful than a ruler.

Rotated Lens

There are two common causes for a frame being out of horizontal alignment: a rotated lens and a skewed bridge. A lens rotated in the frame will cause the top of the eyewire to either hump up at the nasal bridge or one endpiece to appear upswept in shape. (See Figure 7-7 in the previous chapter.) To correct the problem, use lens rotating pliers.

Skewed Bridge

When viewed from the front, a skewed bridge will cause one lens to appear higher than the other (Figure 8-4). This problem usually only happens after the glasses have been dispensed and something has happened to them.

2. Discuss Points to Remember in Heating Frames

WITH HOT AIR:

1. Heat only the portion of the frame to be worked on.
2. Rotate the frame in the heat. (This is especially important for warmers having heat coming from onedirection only.)
3. Check the type of frame material. Some materialscan stand more heat than others.

WITH SALT OR BEADS:

1. Ask yourself, “Should this frame material or theselenses be subjected to salt or beads?” If there is any doubt, use hot air.
2. Always stir the salt (or glass beads) first.
3. Keep the area of the frame being heated parallel tothe surface of the salt.
4. Keep the frame moving slowly.
5. Heat only the portion of the frame to be worked on.

Unit 11:

Adjusting the Frame

Learning Objective:

1. At the end of this unit, students will be able to demonstrate the skills and learning of adjustment of frames by using different angles and tilts.

The purpose of this chapter is to convey the fundamental principles required for the mastery of an art: fitting the frame properly. If the material covered here is not mastered, many of the other principles learned in other sections of the text will not work because the spectacles may not be worn as intended.

CAUSES OF COMPLAINT

The role of the physical features of a pair of spectacles and how well they are fit to the individual is crucial to satisfaction and the ability of the individual to adapt to the new prescription. Kintner,[1] in his study of the relative role of the physical features serving as factors affecting the wearing comfort of spectacles, concluded that the overwhelming majority of complaints were related to the fit of the frames—a direct result of the frame selection and spectacles adjustment. Many wearers seem more likely to tolerate spectacles in which the prescriptions are slightly awry if the frames fit comfortably. A wearer is not as likely to tolerate spectacles if the frames fit poorly even if the prescription is correct.

The comfort and suitability of the fitting seem to be the most significant criteria for satisfaction.

SECTION A

Overall Frame Adjusting

THE FITTING PROCESS

A new frame should be in standard alignment (refer to Chapter 8) when it is received by the fitter. As discussed previously, however, this is not always the case, so it is wise to check the frames and put them into standard alignment, if necessary, before attempting to adjust them to the wearer's face.

All rules applying to the fitting of new frames for a first dispensing will also apply to the readjustment of frames that have been worn over a period of time and have come out of alignment.

Putting the Frames On

It is preferable to begin the fitting procedure by having the fitter put the frame on the wearer's face for the first time. If the frame requires a good deal of additional adjustment, the fitter should recognize this and remove the frame immediately so that the wearer does not become falsely concerned that the glasses may not be right for him or her.

To place the spectacles on the wearer, hold them by the temples, pulling slightly outward to facilitate slip- ping the glasses on easily, and guide the ends of the temples just over the ears and down (Figure 9-1). If the temples must be spread a great deal to get them on, use one of the methods outlined in Chapter 8 to adjust the temple spread. This will allow the temples to open wide enough to permit the frame to rest on the nose without pressure against the side of the head.

Triangles of Force

The fitting triangle described by Stimson[2] is composed of the three points where the spectacles contact or put pressure against the head. The apex of the triangle is the contact point on the crest of the nose, and the endpoints of the base of the triangle are the two pressure points just above the roots of the ears, one on each side of the head (Figure 9-2). Since pads are often used for frames, there may actually be two resting points to the apex of the triangle.

Achieving the Proper Temple Spread

The temple-spread angle of the frame should be such that the shafts of the temples exert no pressure, even if touching, on any area of the face or temple before the point of the head at which they should exert pressure— *just above the root of the ears*. This position is usually the widest portion of the head.

Temples Not Spread Enough

If the temples are not spread far enough, there will be too much pressure on both sides of the head, causing the temples to bow out (Figure 9-3). This forces the frame forward until the temples are opposite a narrower part of the head. When the frame slides forward, the pressure that tends to bend them is somewhat relieved (Figure 9-4).

If the glasses are fitted in this manner and the temple spread is never corrected, the glasses will not only tend to slide down, but as they do so, the bent-down portions of the temples will pull against the backs of the ears.

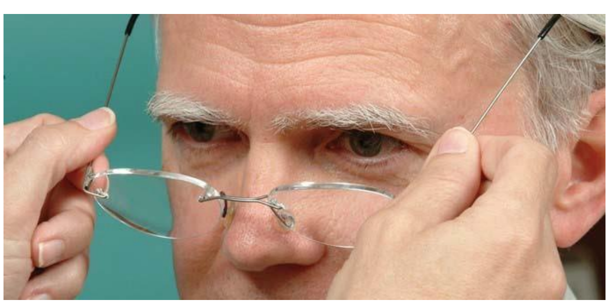


Figure 9-1. The fitter holds the spectacles by the temples, usually spreading them a bit more than they are set for to avoid forcing them on the head.

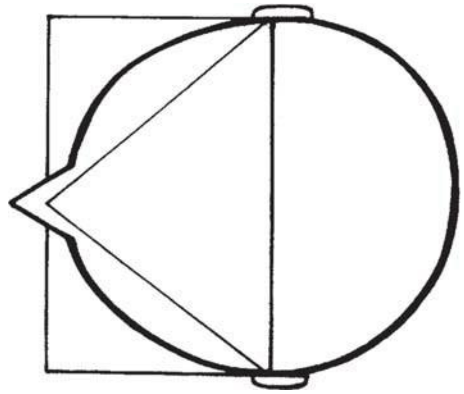


Figure 9-2. The fitting triangle is the connection of only three points upon which "pressure" may be exerted. These are the crest of the nose and the sides of the head just above the roots of the ears. The pressure on the nose is from the weight of the frame.

Then not only do the glasses slip down as if they were loose, but they hurt behind the ears as well. The wearer experiences the disadvantages of both loose and tight glasses at the same time.

The first step in the entire adjustment procedure is to achieve the temple-spread angle that permits the front to rest easily on the nose without being forced forward. This is done by adjusting the endpieces so that the temples do not exert pressure against the sides of the head at any point in front of the ears. The temple shafts may touch the sides of the head, but should not exert pressure. The adjustment should be such that the corner of a sheet of paper may be slipped between the temple shaft and the side of the head. The only place where pressure is allowable is above the root of the ears.

If the head is very round or is wider in front of the ears than above the ears, it may be necessary to bend the temples into an arc that follows this wider portion of the head, but eventually presses the head only at the desired point (i.e., immediately above the root of the ear).

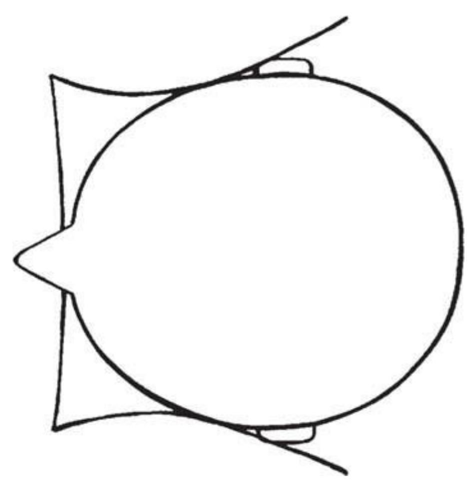
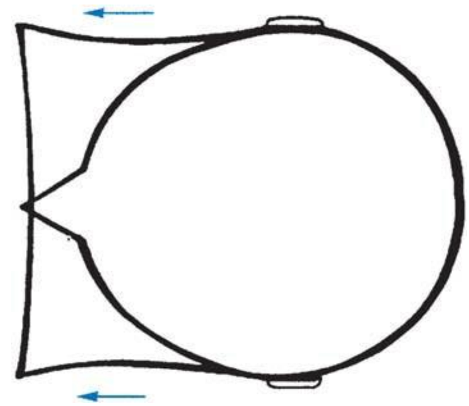


Figure 9-3. Even though the illustration is exaggerated, it can be seen how pressure is exerted on the head and a negative bow in the temples created.

Figure 9-4. In an attempt to return to their original shape, the temples cause the glasses to slip. This creates a situation with the worst characteristics of both tight- and loose-fitting glasses. Not only do the glasses slip forward, but they may also hurt behind the ears.

Temples Spread Too Far

If the temple angle is too wide for the patient's head, the glasses will tend to slide down the nose. More often this occurs if the frame has been worn for some time. The specific methods used to reduce the temple-spread angle can be found in



Chapter 8.

Equality of Lens Vertex Distance

At this point, it is advisable to check the glasses for equality of vertex distance. This is done by having the wearer tilt his head forward while the dispenser views the glasses from above (Figure 9-5). If the glasses have been properly aligned and the wearer's head is symmetrical, both lenses will be the same distance from the wearer's face. If, however, the temple spread is unequal with one temple angling farther in or out than the other, or if one side of the wearer's head is somewhat wider than

Figure 9-5. The lens in front of the wearer's left eye is closer because one temple is pressing harder on the side of the head than the other.

the other, one lens will be closer to the face than the other.

The necessary correcting procedures for this inequal- ity will be directly indicated by the way the frame posi- tions itself. If, as in Figure 9-5, the wearer's right lens is farther from the face, there is more pressure over the wearer's right ear than the left, forcing the right side out. (The principle is the same as was described in Figure 9-4, except that one temple is under more stress than its partner, forcing that side forward.) The remedy to the problem can be approached two ways.

1. It may be that the right temple is not spread far enough, making this side fit too tight. The solution is to open the temple out farther. This is done in the same manner as for standard alignment.
2. It could also be that the right temple is correctly

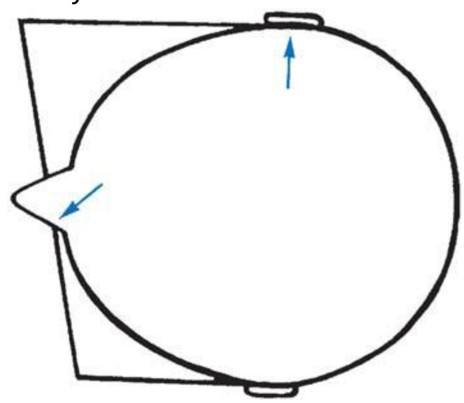
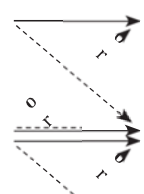


Figure 9-6. If the wearer complains of the frame hurting one side of the nose, unequal temple-spread angles might be suspected.

Problem	Solution
If left lens is IN	Bring left temple IN (and)
If right lens is OUT	Bring right temple OUT
If right lens is IN	Bring right temple IN (and)
If left lens is OUT	Bring left temple OUT



fitted, but the left temple is too loose. The right only has the *effect* of pushing its side forward because of the lack of counteracting pressure on the left side. Here the solu- tion is to bring this left temple inward, decreasing the spread. Again, the techniques used are the same as those described for standard alignment of the frame.

In practice, often both temples are adjusted somewhat, one being brought in, the other opened out. As stated before, regardless of whether the problem lies with the glasses or the head shape, the solution is the same, and is indicated by the way the frame positions itself. Table 9-1 presents a simple way to remember these adjustments.

If the glasses should be dispensed incorrectly, with one temple not spread sufficiently, after being worn for some time the ear on this same side *and* the opposite side of the wearer's nose will become sore. This results from the clothespinlike effect of the tighter side of the frame pinching the face (Figure 9-6). Therefore if a person complains of the frame hurting one side of the nose, an improper temple-spread angle might be suspected.

It should be noted that in approaching the problem of vertex distance inequality, it is a good idea to first check to see if one of the temples is not straight, but bowed in or out. If the temple is bowed or bent, straighten it first.

A single bowed temple can cause a vertex distance inequality in the same way as differences in temple- spread angles.

THE FRONT

The adjustment of the frame front takes place after making certain the temple spread angles are right. Here is the two step overview:

- First, the proper pantoscopic angle or tilt of the frame front is set.
- Next the straightness of the frame on the face, when viewed from the front, is adjusted.

It is clear that proper pantoscopic angle and frame straightness should precede any bridge adjustments. This is because changes in the angle of the frame front will directly affect how the nosepads rest on the nose. If the nosepads are adjusted so they sit flat on the nose first, and then the whole frame front is reangled for a new pantoscopic angle, a problem has been created—the pads will no longer be sitting flat on the nose.

Pantoscopic Angles

The usual tilt of the frame front may be anywhere from 4 to 18 degrees from the vertical. It will only approach the upper (18 degree) extreme in the case of exceptionally protruding eyebrows. In evaluating the pantoscopic angle, the lenses or rims of the frames should touch neither the brows nor the cheeks.

Straightness of the Frame on the Face

If the frame is crooked on the face, adjustment of the pantoscopic angle at each endpiece will allow the frame to be leveled when viewed from the front.

The first possible cause of a crooked frame is incomplete standard alignment. If the temples are not parallel and fail the flat surface touch test, then the frames cannot be expected to sit straight on the face. However, even if the temples are parallel, there may still be a problem.

Most heads are not symmetrical. One ear is often slightly higher than the other. In such instances, even previously standard-aligned glasses with temples parallel will appear tilted on the face when viewed from the front.

The solution is the same whether the cause is the frame or the face. The pantoscopic tilt* (or more con- cisely, the angle the temple makes with the frame front) needs to be changed on one or both sides.

If the right side of the frame is too high, the right temple must be angled up. This allows the frame to drop down farther on that side before the temple contacts the top of the ear.

However, it may not be advisable to decrease the pan- toscopic angle on the higher side. Sometimes this will cause the frame front to have too little pantoscopic tilt when viewed from the side. If this is the case, the oppo- site temple may be angled down instead. This increase in the pantoscopic tilt of the opposite side accomplishes the same result because it raises the side that is too low.

Often both raising one temple and lowering the other are required. One bend alone may be insufficient to level the frame. Stated simply, if the right side of the frame front is up, bend the right temple up. Or looking at it from the other side—if the left side is down, bend the left temple down. Table 9-2 shows this in an easy-to- memorize chart. When the ears are at unequal heights on the head, changing the pantoscopic angle to straighten the glasses

*The primary definition of pantoscopic angle that relates to fitting is "the angle that the frame front makes with the frontal plane of the wearer's face when the lower rims are closer to the face than the upper rims" (see Glossary). However, during the standard alignment process, pantoscopic angle usually refers to "that angle by which the frame front deviates from the vertical . . . when the spec- tacles are held with the temple horizontal."

TABLE 9-2

To Move One Lens Higher on the Face (UP With UP, DOWN With DOWN)

Problem	**Solution**
If left lens is UP	Bend left temple UP (and)
If right lens is DOWN	Bend right temple DOWN
If right lens is UP	Bend right temple UP (and)
If left lens is DOWN	Bend left temple DOWN

on the face will cause the glasses themselves to lie crooked when placed on a flat surface. If this is not pointed out to the wearer, he or she may think the glasses are in error and be suspicious of the quality of the fitting. Always call this to the wearer's attention.

Reference Points

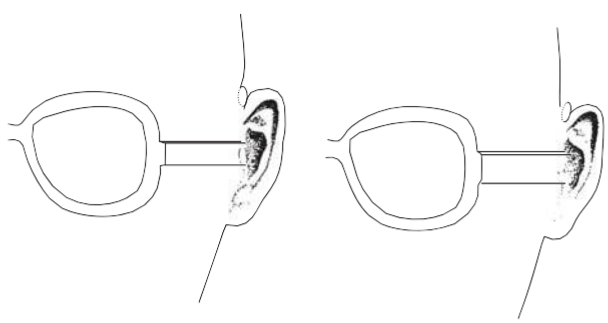
Although it is helpful to refer to the eyebrows when determining the level of the frame, facial asymmetry can cause one lens to appear higher than the other even when this is not really the case. The frame front should not be aligned solely on the basis of eyebrow height or the position of the eyes in the head because either of these features may be asymmetrical. Instead, overall appearance of both eyes and brows should be used. If due to facial asymmetry the frame conforms better to facial features when fitted slightly higher on one side, then it should be fit that way.

If bifocals are being dispensed and have been correctly measured using a properly adjusted frame for each eye independently, the logical reference point is the relationship between the bifocal line and the lower edge of the pupil. To judge this objectively, tilt the wearer's head back and note whether or not both segment lines inter- sect the pupils at the same point. (For a more complete description of both objective and subjective techniques, see Chapter 5.) The same may be said for the fitting cross markings of progressive addition lenses. Fitting crosses should be centrally positioned before the pupils.

Other Sources of Error Causing the Frame Front to Appear Crooked

When the glasses are crooked, the following areas should also be checked in determining the source of error.

1. Are the unequally angled temples caused by bent endpieces or just the hinges?
2. Are the temples themselves bent?
3. Is the bridge skewed?
4. Is one ear farther back than the other? (If the temples are the same length, this may cause one bent-down portion to strike an ear at a different position of the bend than the other, giving the same effect as one ear being higher.)



THE TEMPLES

When all adjustments having to do with the front of the glasses have been done—open temple angle, pantoscopic angle, height, vertex distance, and pad positions on the nose—final attention is paid to the adjustment of the temples.

If the previous front adjustments are satisfactory, the spectacles will stay in proper position on the face *if the head is held erect* even though the temples are not fully adjusted. This is true as long as the first point of contact of the temples is at the sides of the head just above the ears. Note: This is the correct time to adjust the nose- pads. We have not yet covered nosepads. If the frame does have nosepads, they need to be adjusted before the ends of the temples are adjusted. Nosepads are covered in

Section B of this chapter.

Lateral pressure—The pressure of the temples against the sides of the head just above the ears is increased, if necessary, by decreasing the temple spread. This can be done by any of the methods described earlier in Chapter 8, such as bending the endpiece areas in.

The correct amount of lateral pressure is such that the patient feels no pressure or, if pressure is felt, no discomfort. The glasses should stay firmly in place even if the head is lowered. This should be true even though the backs of the temples have not as yet been adjusted.

An important point to remember in fitting temples is that the best way the glasses are held in place is with friction, not pressure. Friction is increased when the contact with the side of the head is maximized. With that in mind, adjustment of any type of library or skull temple will work best if the inside of the temple is paral- lel to the head in three places: 1) along the temple shaft,

2) above the root of the ear (Figure 9-7), and 3) along the slope of the head behind the ear.

This may require rotating the temple about its long axis. To do this, heat and twist the temple.

Earpiece or curl—When the lateral pressure is satisfac- torily applied, attention is given to that portion of the temple that lies past the top of the ear. Adjustment varies depending on the type of temple used and will be con- sidered according to temple type.

Fitting Straight-Back and Skull Temples

A straight-back or library temple has no vertical bend behind the ear. As the name implies, it goes straight back. A skull temple is bent down behind the ear.

Many temples can be fit with or without a bend at the ear as a skull or straight-back temple. To begin with, we will consider how to fit a temple without a bend. In doing so, we can consider first the way the temple fits against the side of the head. Later we can add the bend.

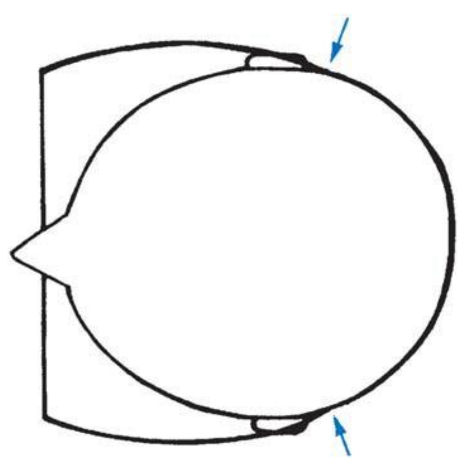
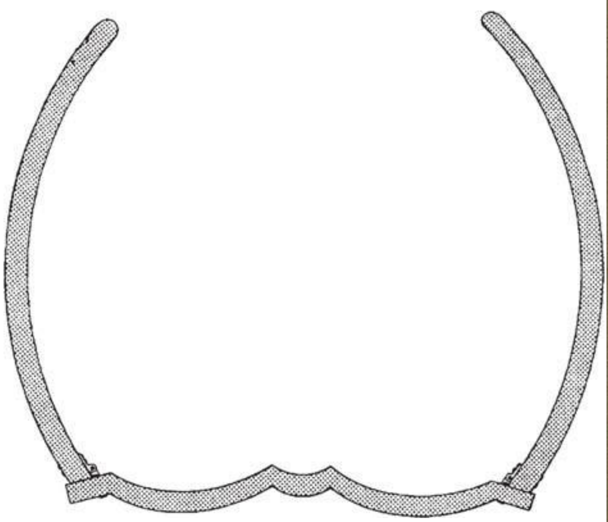


Figure 9-8. A common dispensing error committed by an untrained fitter is that of bowing the temples to achieve a snug fit.

All the principles applying to a straight-back or library temple also apply to the skull temple.

Adjustment of straight-back temples consists of bending inward that portion of the temple that lies just past the top of the ear. This is done in such a way that the inside surface of the temple lies fully against the portion of the head directly behind the top of the ear. The temple must contact the head continuously from the top of the ear back, exerting uniform pressure all along that area.

A common error used to tighten up a frame that slides down the nose is to bend the very last portion of the temple too far inward. The result is that the end of the temple exerts excessive pressure at a single point on the head. This maladjustment usually bows the rest of the temple away from the head (Figure 9-8). At first the wearer is happy because the glasses no longer slide down the nose. But the inward bend of the temple displaces the upper lobe of the ear and eventually digs a painful



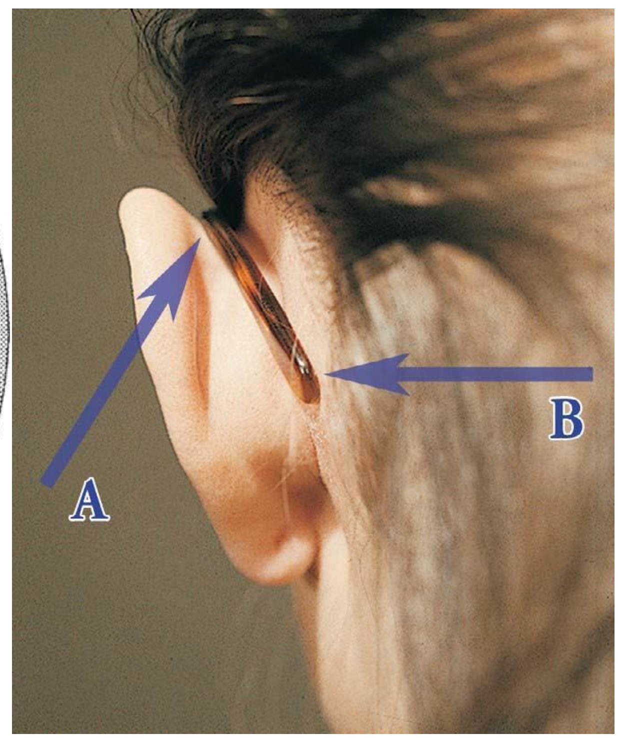


Figure 9-9. The error in the previous figure is shown in this photo of a skull temple. Note how the temple presses both outward on the lobe of the ear (*arrow A*) and inward against the side of the head (*arrow B*).

pit into the side of the head where the tip presses against it (Figure 9-9). This all too common error is seen with both straight-back and skull temples.

When bent inward too far, the excessive pressure of the tips against the head causes the endpieces and the bridge to give, bending out. This in turn eventually releases the lateral pressure that holds the frame up. For the inexperienced fitter unaware of the source of error, the erroneous "remedy" is usually more of the same. This means increasing the temple arc to restore the tip's contact against the side of the head. A vicious circle occurs, resulting in widely bowed temples and an excessively bent frame front (Figure 9-10).

If the structure of the skull is such that there is a dip or hollowed-out convolution in the side of the head, heat the temple and bend it to follow the side of the head as precisely as possible. The objective is to establish as much friction through contact of the surfaces as possible so that a "disc brake" action is introduced. The dispenser may heat and press an indentation into the bent-down portion of a skull temple with both thumbs. Because of this, many call this "adding a thumbprint" to the temple. If this is too difficult to do with the thumbs, eyewire forming pliers can be used as shown in Figure 9-11. (These pliers were pictured earlier and are normally used to shape the eyewire of a metal frame as was seen in Figures 7-14 and 7-15.)

Figure 9-10. Pressure created by bowing the temples is transferred to frame bridge and endpiece areas, causing them to give over a period of time. The illustration shown is a natural outcome of continually increasing temple bowing to maintain a snug fit.

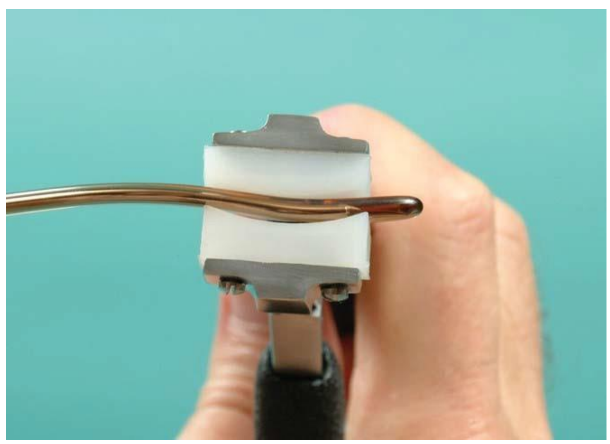


Figure 9-11. The end of this temple is being shaped to conform to a slight hollow in the side of the wearer's head. This dip in the temple is often referred to as a "thumbprint" because it may be pressed into the temple using both thumbs. Here it is being pressed into the temple using eyewire forming pliers.

If the frame front has been properly adjusted, the lateral temple pressure correctly applied, and the friction contact of the temple ends well established, then the spectacles will remain secure without hurting.

Positioning the Temple Bend

The proper position of the bend in the temple lies just ***past*** the top of the ear. The downward slant of the ear- piece should parallel the slope of the back of the root of the ear. If it even touches the root of the ear, it should just barely touch it (Figure 9-12). Above all, the temple

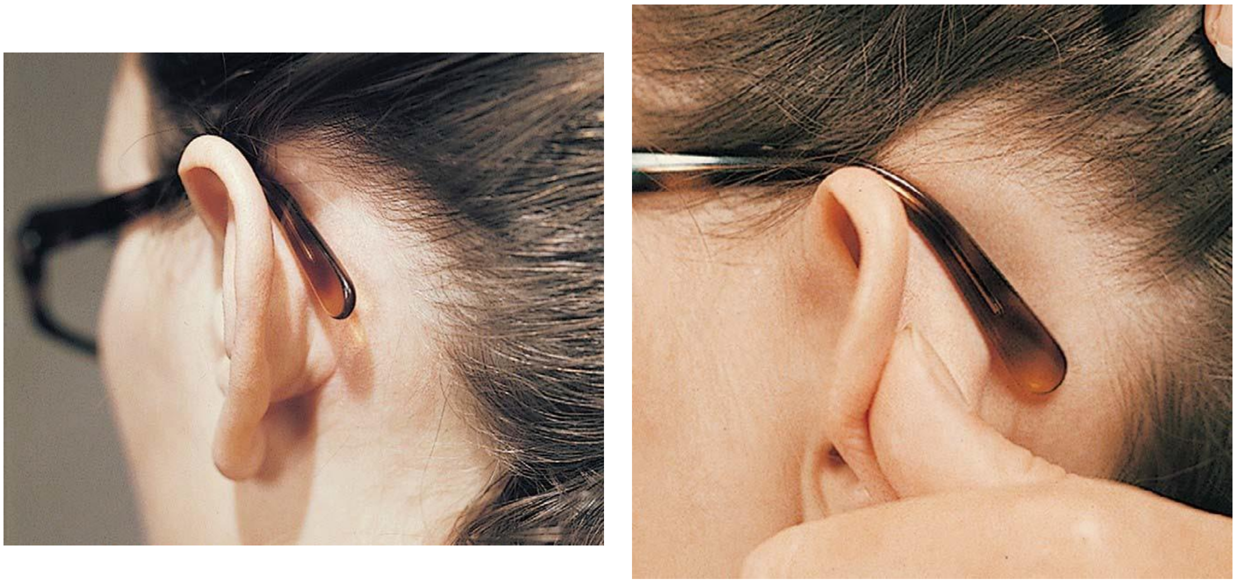


Figure 9-12. A properly positioned temple bend occurs just behind the top of the ear. This allows the bent-down portion of the temple to parallel the upper root of the ear.

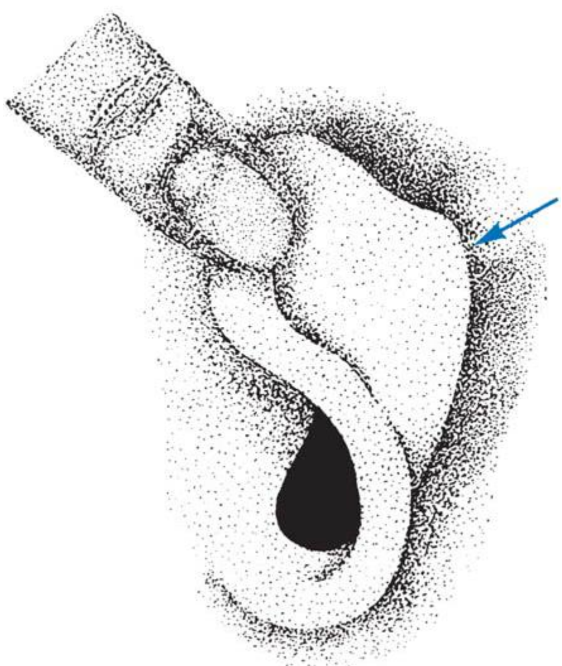


Figure 9-13. With the ear folded forward, the arrow points out the most sensitive portion of the ear. Pressure from the temple on this area should be avoided.must not press into the crease between ear and head or on the small cord of cartilage that helps in connecting the ear to the head (Figure 9-13).

The earpiece portion of the temple should not be just bent down (Figure 9-14). It must be positioned against the side of the head, usually requiring inward angling.

Figure 9-14. Properly positioning the location of the bend is incomplete if the bent-down portion of the temple stands away from the side of the head.

Shape the descending earpiece portion to match the convolutions of the mastoid process, which is a lump on the side of the head behind the ear. It should exert even pressure throughout its length, just as with the straight-temple types.

Temples Too Long or Too Short

If the temples are too long or too short, the position of the temple bend can be modified. There are, of course, limits as to how far the bend can be moved because too radical a change will result in the earpiece being too long or short. A change of the bend position is more easily and satisfactorily performed for plastic temples than for temples made entirely from metal. Some metal temples may need to be replaced by properly sized temples.

Since temples are manufactured in steps of 5 mm, there is always a possibility that a temple may not fit quite as precisely as desired on a given head. If this is the case, the position of the bend can be changed. The position of the bend also needs to be changed in cases where the correct length is not available or where an error in ordering the correct length has been made. The suggested procedure for changing the position of the bend is as follows:

1. *Note bend position*—The front should be positioned so that the glasses are seated as they will be when worn. Often new glasses or frame samples fit much too loosely, allowing the glasses to slip down on the nose. When this happens, the temple slips forward until stopped by the ear. As a result, the temple bend appears to be properly situated, when in actuality the temples are too long. To avoid this problem, stand with the wearer seated, and grasp

the glasses around both endpieces with the left hand. Hold them on the face where they should

Figure 9-15. The desired location of the temple bend is accurately determined only if the glasses are properly positioned. Error in bend placement is prevented by holding the frame in place.actually sit. The right hand is then free to move the hair back or bend the ear forward to inspect for proper fit (Figure 9-15). For the left temple, switch hands and repeat the procedure. It cannot be assumed that both temples will fit the ears correctly just because one does. Faces are not symmetrical; sometimes two separate temple lengths are indicated.

If the shaft is *too long*, the bend will occur beyond the desired position, which is just barely past the top of the ear (Figure 9-16). This permits the spectacles to move forward until the earpiece rests against the cartilage in back of the ear.

It is possible to simply increase the angle of the bend in the temple until the bent-down portion just touches the back of the ear. The fallacy here is that there are only two points of contact—the top of the ear and the back of the ear—resulting in an extremely painful spot behind the ear after continued wearing. Instead the position of the bend in the temple should be moved so that the temple fits correctly.

If the shaft is *too short*, the bend will occur forward of the top of the ear, causing the bent-down portion to rest on the posterior slope of the cartilage. This usually raises the temples up off the ear so that the bend itself is visible along the side of the head and the end of the temple pushes against the back of the ear (Figure 9-17).

2. *Estimate new bend position*—Observe the relationship of the bend to the position it should occupy above the ear and estimate a new position for the bend. Observe each ear separately because the two sides of the head and face may not be symmetrical.
3. *Straighten and bend, or bend and straighten*—Heat both the original bend area and that portion of the shaft where the new bend is desired. Hold the shaft of the temple firmly in one hand and grasp the bent portion with the fingers of the other hand, with the thumb braced on the bend (Figure 9-18). Pull the end up so that the entire temple is straightened.

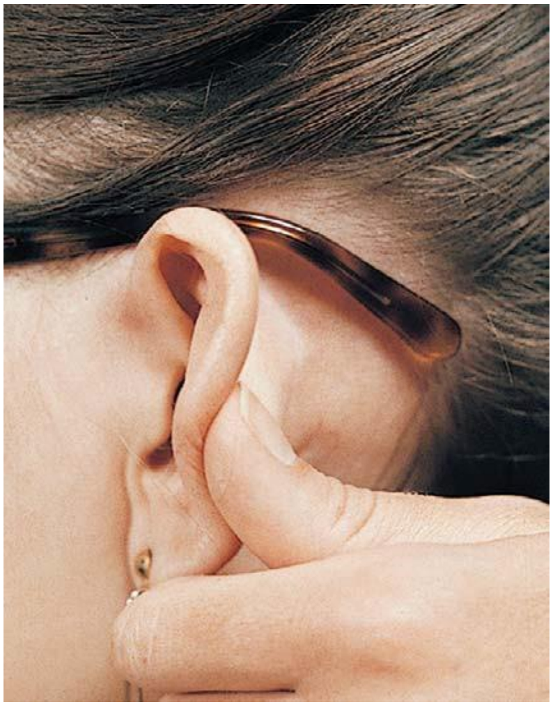


Figure 9-16. If the temple shaft is too long, the bend will occur past the desired position.

Move the fingers of the hand holding the temple shaft so that the temple is braced at the new bend point by the thumb and forefinger. Push the protruding end with the thumb of the other hand until it bends over the forefinger of the holding hand to the desired angle (Figure 9-19).

For some, it may be too difficult to add a new temple bend with the hands alone. In this case, there is a pair of pliers that is designed for this use. *Temple bend pliers* may be positioned at the desired location of the temple and the bend added as shown in Figure 9-20.

The desired position of the bend may be more exactly marked with a water-soluble felt-tipped marking pen or a grease pencil to eliminate the guesswork. It may be necessary to reheat the temple before adding the new bend if the resistance to bending is great.

Physically Lengthening and Shortening of Temples Some metal frames come with bent-down portions that have a metal core, but a plastic outer portion. These types of temples are unique in that they may be shortened or lengthened beyond what would be expected. It is even conceivable to shorten some plastic temples.

Figure 9-17. If the shaft is too short, the bend will occur too far forward. Note how this raises the temple up off the ear so that the bend itself is visible.

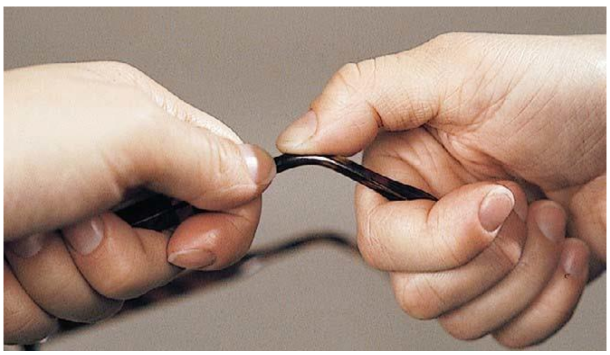


Figure 9-18. Straightening the temple to move the bend to a new location may be done as shown. If the bend is to be moved forward, it may also be done by first placing a new bend at the desired location; then removing the old bend.

Summary of Temple Fitting Criteria

In summary, the temples should meet all of the following criteria:

- The shaft of the temple should not exert pressure on the face or head at any point in front of the position just above the ears. The point just above

Figure 9-19. A well-fitting bend is a sharp bend. Creating a good, sharp bend may be done by forcing the end of the temple over the knuckle.

Figure 9-20. A temple bend may be added using temple bend pliers. The temple will still need to be heated, but should not be overheated to avoid marking the plastic.

the ears should receive the lateral pressure of the temples.

- The bend should be just at the point immediately following the top of the root of the ear, so that it does not rest on either the top of the root of the ear or push against the back of the origin of the ear

(Figure 9-21).

- The bent-down portion should be angled so that it approximately parallels the posterior descending slope of the root of the ear (crotch of the ear)

without either pressing into the crease between the ear and the head or the cord located there.

- The cross section of the shaft, if other than round, should be parallel to the slope of the head and lie with its widest part against the head.
- The bent-down portion (earpiece) should slope with its widest part flat against the side of the head. It should be so shaped and convoluted that it follows the depression behind the ear (the ischium hollow) and the elevation following below it known as the mastoid process. There should be even pressure

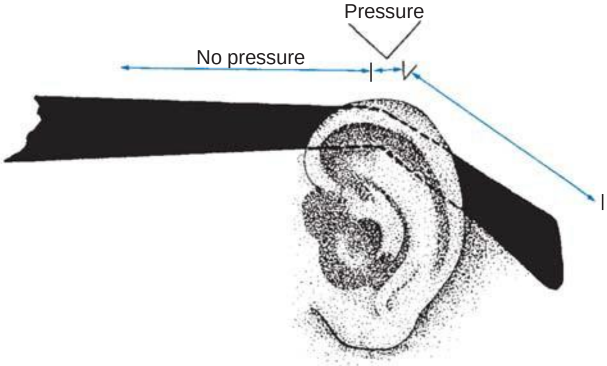


Figure 9-21. The proper location for the temple bend is at the point immediately

behind the top of the root of the ear. The only place where pressure is indicated is against the side of the head immediately above the ear. Beyond this point, the hold should be by friction on the order of a disc brake.

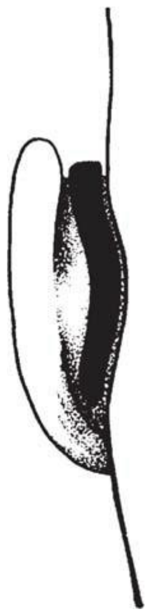


Figure 9-22. A temple will be more comfortable and hold the frame in place better if it parallels the anatomical shape of both head and ear.

throughout the entire area (Figure 9-22). The ends of the temples should not gouge the back of the head or exert greater pressure than the balance of the earpiece.

Optyl Temples

Temples made of Optyl are adjusted to meet the same criteria as temples made of other materials. There are two basic types of Optyl temples. The first is made from the same material as the Optyl frame front and can be identified by the lack of a metal reinforcement running the length of the temple. A special technique is required for this type of temple, since Optyl frames will return to their original molded form when heated. The second type is called LCM, or light coated metal.

Adjusting Temples Made From Original Optyl Material

Adjusting temples made from the original type Optyl material requires sufficient heat for bending. Attempts to bend an Optyl temple without heat or without suffi- cient heat will result in a broken temple. Heat only that portion of the frame that requires bending. Hold the rest of the temple so that the adjacent portions not being adjusted are protected from the heat. After heating and bending the temple to the desired position, hold the temple in that position until it cools enough to retain the new shape. (Some frame warmers have a cool air option that can be used to cool down the heated area.) Because heated Optyl material will return to its original shape, failure to hold it in position will allow it to revert some- what. When making a second bend in a new area of the temple, the first area must be shielded from heat. Oth- erwise the progress made thus far will be lost.

It is possible to extend the length of an Optyl temple having no metal reinforcing wire by heating the temple so that it is hot enough to allow it to be pulled and stretched. In so doing, it may be possible to use a temple that would otherwise be too short even if the bend were moved as far back as possible.

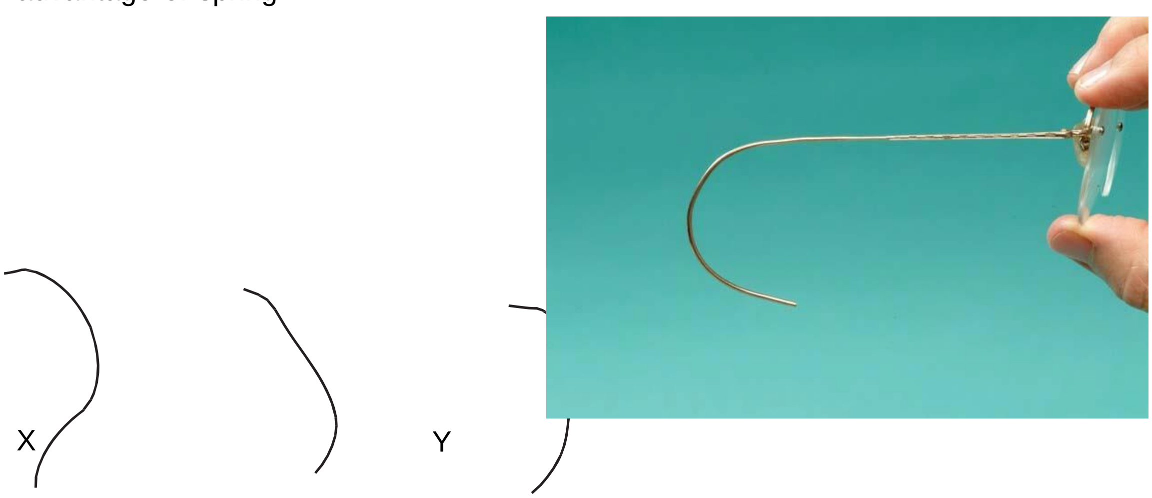
Adjusting Optyl LCM Temples

The second type of Optyl temple has a plastic of a dif- ferent composition covering a metal core. It is referred to as an LCM temple and should be marked with the letters “lcm.” These LCM temples are extremely mal- leable and can be adjusted with only a minimum of heat. In contrast to the original Optyl material temple, the LCM temple does not return to its original shape when heated. Remember, to tell the difference between the two temples, look for a lack of a metal reinforcing wire to identify the original material temple, and the presence of the initials “lcm” to identify the light-coated metal temple.

Spring Hinge Temples

Temples with spring-loaded hinges have been much improved. When spring temples were first introduced, they were much more appealing to the wearer than to the dispenser. Because they did not originally have the strength and resiliency of today’s designs, it was neces- sary to fit them so that they were stretched halfway open when fit. In other words, the midpoint of the tension- spread area would fall at the natural position of the temple when placed on the wearer.

Better engineered spring hinges have changed all that. Now the spring hinge temple is fit in exactly the same manner as any other temple. It should fit on the head so that under normal wearing circumstances, the spring hinges are not flexed. The advantage of spring



A B C

Figure 9-23. The so-called crotch of the ear may follow different contours, three of which are shown. (Redrawn from Stimson RL: Ophthalmic dispensing, ed 2, Springfield, Ill, 1971, Charles C Thomas.)

temples is not that they hug the head any differently than normal, well-fitted temples. They do not. The advantage of a good quality spring hinge is that it allows the frames to retain their adjustment longer.

When people put their glasses on and take them off day after day, there is a certain amount of stress placed on the frames. The temples are forced open beyond the point for which they were adjusted. Eventually, they begin to loose their adjustment. Temples with spring hinges prevent that stress because the spring in the hinge absorbs it.

Frames with spring hinges are less likely to require readjustment or repair when struck with a ball, an elbow, or when knocked from the face. This is because, once again, the spring hinge allows the temple angle to bend outward, then rebound, rather than to bend and stay bent.

Spring temples are adjusted behind the ears exactly as any other temples. The same rules apply to the position of the temple bend as well.

Riding Bow and Cable Temples

Riding bow or cable temples can be used in situations where a skull temple will not hold the spectacles adequately, such as for children or for individuals engaged in rough physical activity. Riding bows are made from plastic; cable temples from coiled metal.

To fit a cable or riding bow temple, the temple should follow around the root of the ear but should not press against the root of the ear at any point before point X at the back of the ear as shown in Figure 9-23, *A*. The cable should lie close to the root of the ear from point X to the end of the temple because it is this contact that holds the spectacles in place. The very last few millime- ters of the temple should be turned back away from the ear to keep the end from digging in. Figure 9-24 shows the end of the temple before it has been adjusted. The end of the cable should be bent back and slightly away from the side of the head. This is done with double- padded pliers as shown in Figure 9-25. The completed bend is shown in Figure 9-26.

When the shape of the cable corresponds to the shape of the portion of the ear, which attaches the ear to the

Figure 9-24. Here is what the end of a cable temple looks like before the tip of the temple has been adjusted.

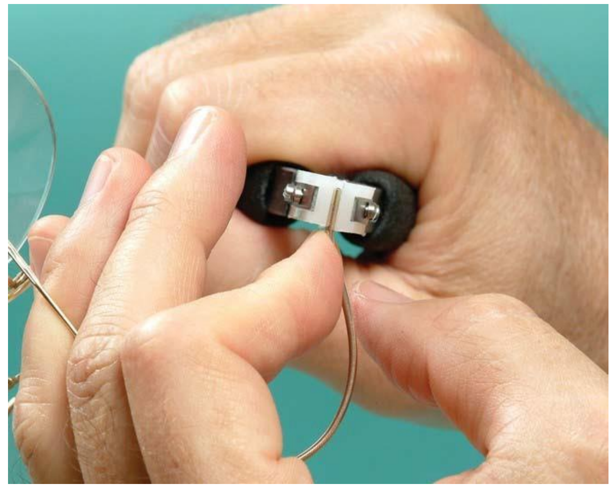


Figure 9-25. The end of the cable temple is bent so that the end will not dig into the crotch of the ear. Hold the temple right next to the double-padded pliers so that the bend will be sharp and well-defined.

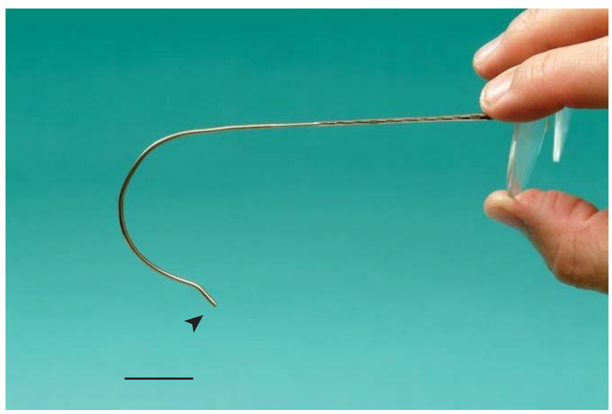


Figure 9-26. Here is what the tip of the cable temple will look like after the bend at the tip is complete. head, as shown in Figure 9-23, *B,* the cable should pass the point marked Y without pressure before curling to grasp the balance of the ear.
When the ear is shaped as shown in Figure 9-23, *C,* the temple should exert pressure on the ear only during the last 10 or 15 mm of the temple length. This type is difficult to adjust because the temple bend is almost at right angles.

Temple Length

When the necessary cable temple is not on an available sample, the proper length may be estimated by adding
1.75 inch, or approximately 20 mm, to the length of the equivalent, correctly fitting skull temple.
A cable temple of the correct length should stop just short of the lower lobe of the ear

(Figure 9-27, *A*). Cable temples that are too short will not have enough length to grip the lower area where it is needed (Figure 9-27, *B*). Cable temples fitted too long have a tendency to dig into the lower earlobe (Figure 9-27, *C*).

Hearing Aids and Fitting Eyewear

For a time, a large number of hearing aids were made to fit in the temples of a person's spectacle frames. With the continued development of smaller hearing aids, com- bined with rapidly changing eyeglass frame fashions, in-temple hearing aids are now rare. Most aids fit in or behind the ear, or are a combination of both. In-the-ear aids require no special considerations when fitting and adjusting temples. Hearing aids with a behind-the-ear component work best if the temple style chosen is as thin as possible. One of the very best choices, although not readily available, is the cable temple. The cable hugs the base of the ear and is out of the way of the hearing aid.

Skull temples that are thin enough can sometimes be adjusted to closely match the fit of a cable temple, at least for the upper part of the back of the ear. They must closely follow flush against the side of the head. The thinner the bent-down portion of the temple is, the less will be the interference with the aid.

GENERAL INSTRUCTIONS TO THE WEARER ON FRAME HANDLING

There are many different sets of instructions appropriate for different types of wearing situations. Bifocal wearers will be given different advice on use than progressive addition lens wearers. Those instructions and precautions are addressed in the section of the text that covers each particular topic. As for the handling of eyeglasses in general, here are a few suggestions:

1. To keep eyeglasses in adjustment better, glasses are best taken off using two hands.
2. When removing glasses with the right hand only, grasp the right endpiece, lift the right temple off the ear, and move the glasses to left side of the face so

A

B

C

Figure 9-27. In judging correct cable temple length, observe where the temple ends as it wraps around the ear. **A,** The correct length cable temple should stop just short of the lower lobe of the ear. **B,** Cable temples that are too short do not have the length to grip the lower portion of the ear where it is most necessary. **C,** Cable temples fit too long have a tendency to dig into the lower ear lobe. If no shorter temples are available, it is possible to clip off the end of the temple with cutting pliers and solder the new end. A small ball of solder at the tip will make a smooth surface and keep the coiled cable from unraveling.that the left temple comes off the ear easily. Do the opposite for the left hand only.

3. For frames with cable and comfort cable temples, grasp the right endpiece with the right hand and the tip end of the left cable temple with the left hand (Figure 9-28). Pull the left temple off the ear and

Figure 9-28. Taking frames with cable temples off the face is done by grasping the tip of one temple and pulling it back and around the ear while holding the other temple near the frame front.swing the glasses to the right so that the right cable temple comes off the ear easily.

4. To lay the glasses down on a table or dresser with the temples open, place the glasses on the surface upside down. When the temples are closed, place the glasses with the folded temples down. Never place the glasses on a surface with the lenses facing down.
5. Do not leave the glasses on the dashboard of a car or where they will be exposed to heat.
6. When not being worn, glasses do best in a case. This is especially true when being carried in a purse or pocket.
7. Rinse the lenses before wiping them with a cloth, unless the cloth is specifically designed for the lenses. Remember that the frames need cleaning too. Washing frames and lenses in a mild detergent, as when doing dishes, is appropriate.

For more on cleaning frames and lenses, see Cleaning Frames and Lenses, Chapter 7, including Tables 7-3 and 7-4.

SECTION B

Fitting Adjustable Nosepads

Adjustable nosepads give tremendous versatility when fitting and adjusting frames. Unfortunately, many are unfamiliar with the basics of how to adjust nosepads correctly and are afraid of making changes. This section presents step-by-step methods for doing just what is needed to correctly position the frame.

Where adjustable pads and pad arms are available, the frame can be altered in height by widening or narrowing the distance between the pads. It should be remembered, however, that increasing or decreasing the distance between pads will not only lower or raise the frame on the face, but also allow the frame to fit closer to or farther from the eyes.

There are primarily two types of adjustable pad arms. The older type is shaped like a question mark; the more common like an upside down U or a gooseneck.

PROPER PAD ANGLES FOR ADJUSTABLE PADS

With any pad adjustment that moves a pad arm, it can be expected that afterwards the face of the pad may no longer sit flat on the nose. The pads must then be realigned to their proper positions so that frontal, splay, and vertical angles are once again correct. These angles were explained in Chapter 8, pages 161-164.

Remember: Adjust the pantoscopic angle (tilt of the frame front) *fi rst* before adjusting the three pad angles. The tilt of the frame front changes how the pads sit on the surface of the nose. Adjusting the pantoscopic angle after aligning the pads means that the pads will have to be aligned all over again a second time.

Achieving the Proper Pad Angles forAdjustable Bridges

The adjustment of rocking pads is most easily performed using pad-adjusting pliers. (See Figure 8-57 in Chapter 8.) These special pad pliers come in a variety of configu- rations. They should be chosen for the pad attachment type on the frame. Attachment styles change with the times, so the type of pad adjusting pliers that has been in the office for years may no longer be appropriate for the frames being currently used.

Pad adjusting pliers, when chosen properly, have one jaw that holds the base of the pad securely without crush- ing the pad socket or attachment, and another jaw that cradles the face of the pad. The pad can readily be adjusted for splay, vertical, and frontal angles using these pliers. Snipe-nosed or other flat-jawed pliers can also be used and are intended to be used on the pad support arm. If used on the face of some pads, they may indent or mar the pad face surface.

For pads to be adjusted to rest correctly on the sur- face of the nose, they should fulfill the following criteria:

1. The pads should rest halfway between the crest of the nose and the inner corner of the eye

(Figure 9-29).

2. The long diameter of the pads should be perpendicular to the floor when the head is erect (as also seen in Figure 9-29).
3. The full surface of the pads should rest uniformly on the nose. If either the lower, upper, inner, or outer edge of the pad presses unevenly on the surface of the nose, the nose will show imprint or

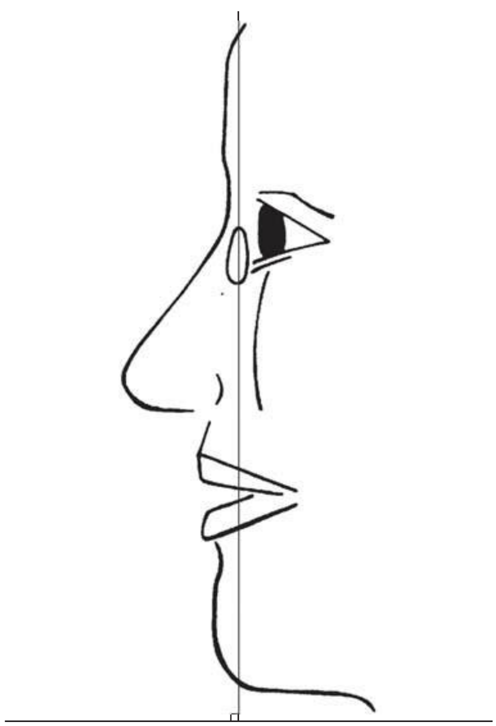


Figure 9-29. The proper resting position for adjustable pads is halfway between the crest of the nose and the inner corner of the eye. The long axis of the pad should

be perpendicular to the floor.cutting marks after wear, or may become too sensitive for continued wear.

To correct these problems, the pad face should be readjusted as listed below:

1. If the lower edge cuts in (as in Figure 9-30), change the frontal angle by moving the bottom of the pads apart.
2. If the top edge cuts in (as in Figure 9-31), change the frontal angle by moving the lower part of the pads closer to each other.
3. If the front edge cuts in (as in Figure 9-32), decrease the splay of the pads.
4. If the back edge cuts (as in Figure 9-33), increase the splay of the pads.
5. If the cutting edges seem oblique, the pad is not vertical. Alter the vertical angle and readjust to correct for one or more of the errors listed above.
6. If the upper part of the pad surface seems to be parallel to the nose, but the lower part cuts in, or vice versa, change to a flexible, silicone pad that will conform more readily to changes in nasal angles.†

When Pad Angles Are Correct, But Still SlideDown or Hurt

Sometimes even when the pad angles are correct and the frame is adjusted properly, the glasses still have a ten- dency to slide. This may occur when the frontal angle of the nose is almost straight up and down. When this happens, replace the nosepads with replacement pads

†If the wearer does not like the feel of silicone pads, it is possible to heat the stiff plastic pads and bend them to match the curve of the nose surface. This condition may occur where the very upper part of the bridge of the nose is thin and straight, and the nose suddenly flares and splays widely within the dimension of the pad.

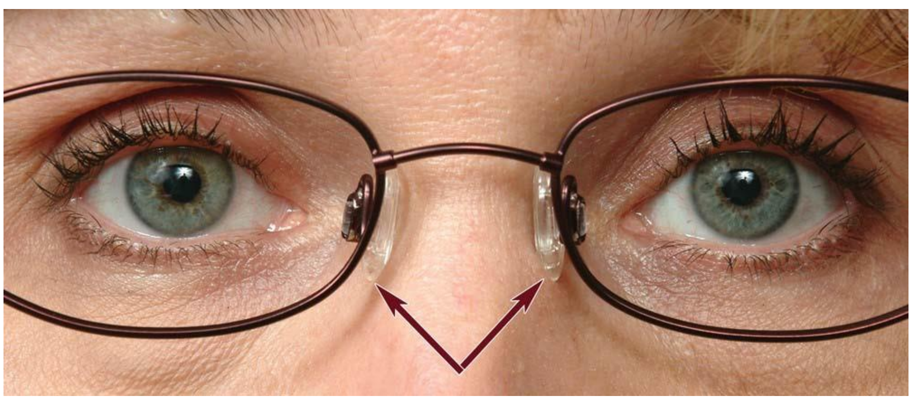


Figure 9-30. Here the lower edges of the pads cut into the nose surface. If the skin on the nose is flaccid, the error is not as visible. It can be detected if the glasses have been worn for a period of time by U-shaped red marks on the nose. The frontal angle is wrong and must be corrected.

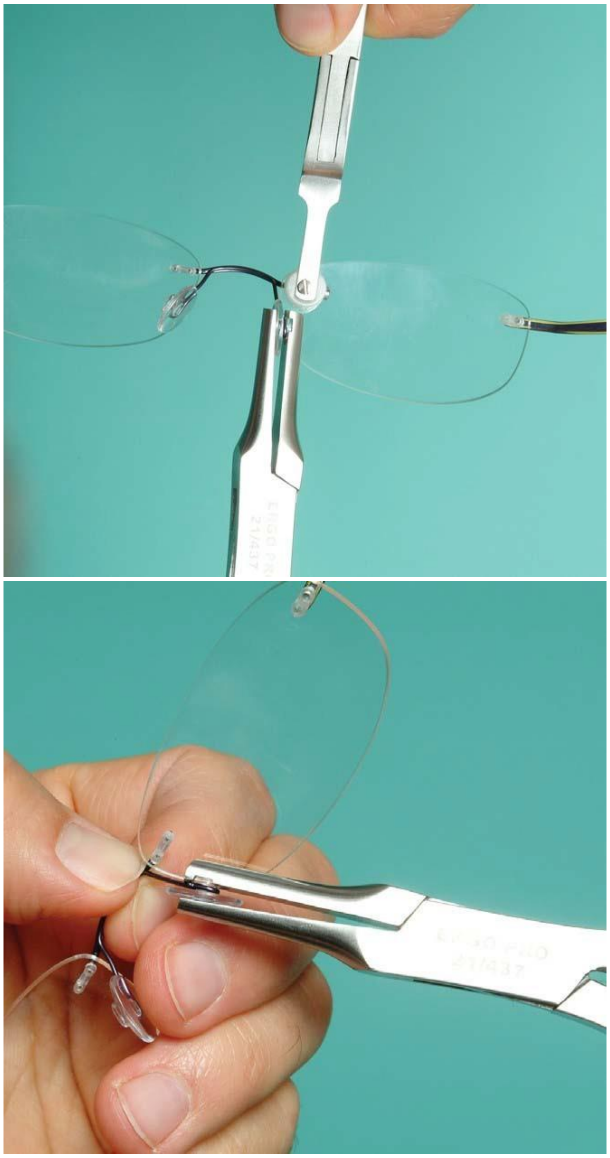
Figure 9-31. If the upper edges of the pads indent, the frontal angle must be more vertically oriented.

Figure 9-32. This illustration, viewed from the top in cross section, shows a pad splay angle too great for the nose. The splay angle of the pads must be decreased.

A

B

Figure 9-33. In **A** the splay angle of the pads needs to be increased. The back edges of the pads will cut into the flesh of the nose unless corrected. In **B** the same situation is shown schematically in cross section.



A B

Figure 9-34. A, Depending upon frame construction, holding the lens with rimless adjusting pliers while adjusting the pad angle may prevent damage to the lens at its point of attachment. For this particular frame this is actually not the best option since the pad arm is attached directly to the bridge. A better option is shown in **B. B,** If the frame is constructed with the pad arm attached more to the bridge, holding the bridge while adjusting the pad may be sufficient. made from silicone material. This assumes, of course, that the pads are not already of the flexible silicone variety.

Another alternative is to replace the existing pad with a larger pad. This is especially helpful when the pad is causing an irritation to the skin, as often happens in older wearers as the skin loses its elasticity.

A third possibility is to replace both pads with a *strap bridge*. A strap bridge is like two adjustable nosepads that are joined together in straplike fashion. The strap bridge increases the surface area upon which the frame weight rests and is shown in the next chapter as Figure 10-44. Strap bridges are adjusted like regular nosepads because each side of this flexible bridge has its own pad arm. To get full benefit from the replacement bridge, care should be taken to assure that the upper strap area rests on the crest of the nose and assists in bearing the weight of the frame.

Adjusting Pad Angles for Rimless or Semirimless Mountings

When adjusting the pads of a rimless mounting, certain precautions should be taken to prevent damaging the lens at the point of attachment. A good option is to use rimless adjusting pliers (as were shown in Figure 8-65) to hold the lens at its nasal point of attachment, while adjusting the pad angle with pad adjusting pliers (Figure 9-34, *A*). Some frames may not make this an absolute necessity because the pad arm is attached to the top of the bridge. In this case, or when rimless adjusting pliers are not available, it is possible to hold the bridge of the frame while adjusting the pad, as in Figure 9-34, *B*. Another option is to hold the lens with the thumb and forefinger at the point of attachment while adjusting the pads (Figure 9-35). Which option may be best may depend upon the construction of the frame.

FRAME HEIGHT AND VERTEX DISTANCE

Achieving the Correct Frame Height

Once the pantoscopic angle has been established satis- factorily, the next step is to place the frame at the correct height. Most judgments for single-vision lenses are based on the position of the frame relative to the brows and orbits (Figure 9-36). It is not difficult to change the vertical height for frames with adjustable pad bridges. For frames with adjustable pad bridges, frame heights can be changed by widening or narrowing the distance between pads.

The primary reasons for widening or narrowing the bridge area are shown in Box 9-1.

Proper Vertex Distance

On occasion it becomes necessary to change the distance between the frame and the face. This is referred to as changing the *vertex distance*, or more specifically, the distance from the front surface of the eye to the back of the spectacle lens. This type of change might be required if, for example, the top of the frame were resting against the brows or the bottom eyewire touching the cheeks and neither error could be corrected by a change of pantoscopic angle. Increasing the vertex distance is also

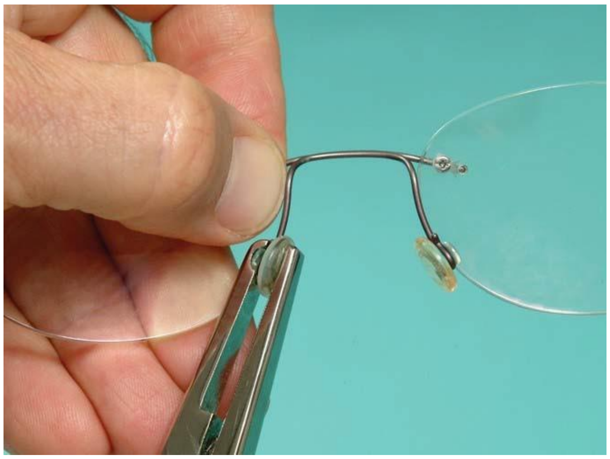


Figure 9-35. If there are no rimless adjusting pliers available, a precaution while adjusting pad angles is to hold the lens tightly between thumb and forefinger at the point of attach- ment. This helps remove some of the stress from the lens during adjustment. The most appropriate procedure from the three shown in this and the previous two figures will depend upon frame construction. In this figure sequence (Figures 9- 34, *A*, 9-34, *B*, and 9-35) the most appropriate procedure for the frame is shown in Figure 9-34, *B*.

A

BOX 9-1

B

C

Reasons for Widening or Narrowing the Frame Bridge Area

WIDENING THE BRIDGE AREA WOULD BE APPROPRIATE IN CASES IN WHICH:

1. The frame is too high on the face.
2. The bifocal or trifocal segments are too high.
3. The progressive addition fi tting cross heights are too high.
4. The bridge is toosmall for the nose.
5. The lenses are too far from the eyes

NARROWING THE BRIDGE AREA WOULD BE APPROPRIATE INCASES

Figure 9-36. For conventional eyewear, frame height is based on a combination of eye, eyebrow, and orbit positions. In **A** the frame rides too high. In **B** the height is correct for the frame shown. In **C** the frame is too low. In the past, some large frames have even been designed with upper rims above the brows. As fashion continues to circle around, this could happen in the future. In any case, such frames should still be fitted at a height that conforms to standards discussed in Chapter 4, Frame Selection.

tilt also increases the lower field of view (Figure 9-37,
B).

often necessary to keep the eyelashes from brushing against the back surface of the lens.

Decreasing the vertex distance, or bringing the frame closer to the face, may be required for purely cosmetic reasons. Decreasing the vertex distance will also provide a wider field of corrected vision. For example, the closer a person stands to a window, the farther to the left and right he or she can see. By the same principle, the closer the frame is to the face the more side area is visible through the lens, with a resulting increase in the overall field of view (Figure 9-37, *A*). Increasing the pantoscopic

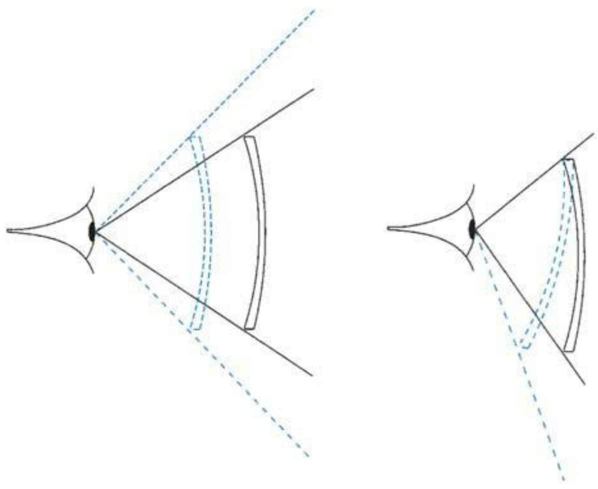
For the bifocal wearer, moving the frame closer to the face increases the field of view above the bifocal without the necessity of lowering the segment. (This same effect can be produced by increasing the pantoscopic tilt. See Chapter 5 for specifics.)

When quite strong lenses are involved, precise vertex placement becomes very important. In some instances, small alterations in the vertex distance of the finished spectacles may affect vision profoundly.

ADJUSTING NOSEPADS WITH INVERTED U-SHAPED PAD ARMS

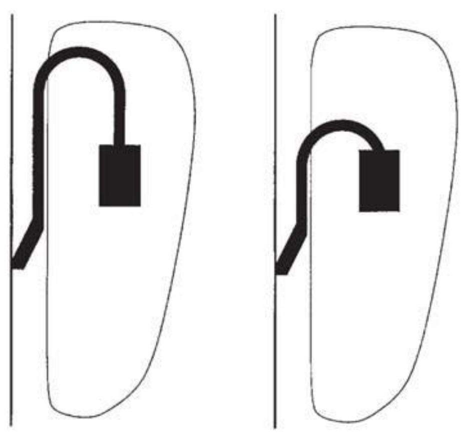
Changing the Distance Between Pads for "Inverted U-Shaped" Pad Arms

The inverted U-shaped pad arm varies in how much it may be adjusted, depending upon how high the U arches. If there is not much length to the pad arm, the extent that it may be adjusted is limited. But if there is "extra"



A B

Figure 9-37. When a lens is moved closer to the eye, the field of view increases **(A)**. Pantoscopic tilt also increases the field of view in the lower lens area **(B)**. This is particularly helpful for increasing the near viewing area through bifocals, trifo- cals, and progressive add lenses.



A B

Figure 9-38. The U-shaped pad arm **(A)** has sufficient length to allow frame height and vertex distance changes. The pad arm **(B)** will allow only minimal changes in height and vertex distance, although it may allow some change in the distance between pads. length to work with, the dispenser will have more lati- tude in making frame height and vertex distance changes (Figure 9-38).

Most pad adjustments may be done in two move- ments. The fi rst move makes the change; the second move completes the change and restores the proper padangle. (This assumes we get it right the first time!)

Widening the Distance Between Pads

When the distance between pads is too small and does not fit the nose, we need to widen the distance between pads. To *widen* the distance between pads, grasp the pad with pad adjusting pliers (Figure 9-39, *A*).

1. First tilt the top of the pliers outward (temporally). *The pivot point is at the point of attachment of the pad arm.* This will cause the top of the U to tilt away from the nose, bending the pad arm at its base (Figure 9-39, *B*). This moves the pad temporally and changes the frontal angle.
2. Next, without removing the pliers from the pad, tilt the bottom of the pliers outward. *Now the pivot point should be the top of the pad arm's inverted U.* This will cause the U to bend at the top, with the center of the pad moving temporally (Figure 9-39, *C*). While the first bend will change the frontal angle of the pad, the second bend will restore it. Figure 9-39, *D* shows the left pad "widened" and the right pad still in the original position.

Narrowing the Distance Between Pads

To *decrease* the distance between pads, the same type of two-step sequence occurs as was described for widening the distance between pads, except that the bends are in a nasal or inward direction instead of outward.

1. For the first bend, the top of the pliers are tilted inward (nasally). *Again the pivot point is at the point of attachment of the pad arm.*
2. For the second bend, follow up by tilting the bottom of the pliers inward, completing the bend, and restoring the frontal angle. *The pivot point is the top of the pad arm's inverted U.*

Moving the Frame Left or Right

(This adjustment uses a combination of the two adjustments that have just been explained: narrowing the distance between pads and widening the distance between pads.)

A frame may sit too left or right on the face as shown in Figure 9-40. There are two possible causes for this problem.

1. The nosepads on the frame are asymmetrical.
2. The wearer's nose is asymmetrical.

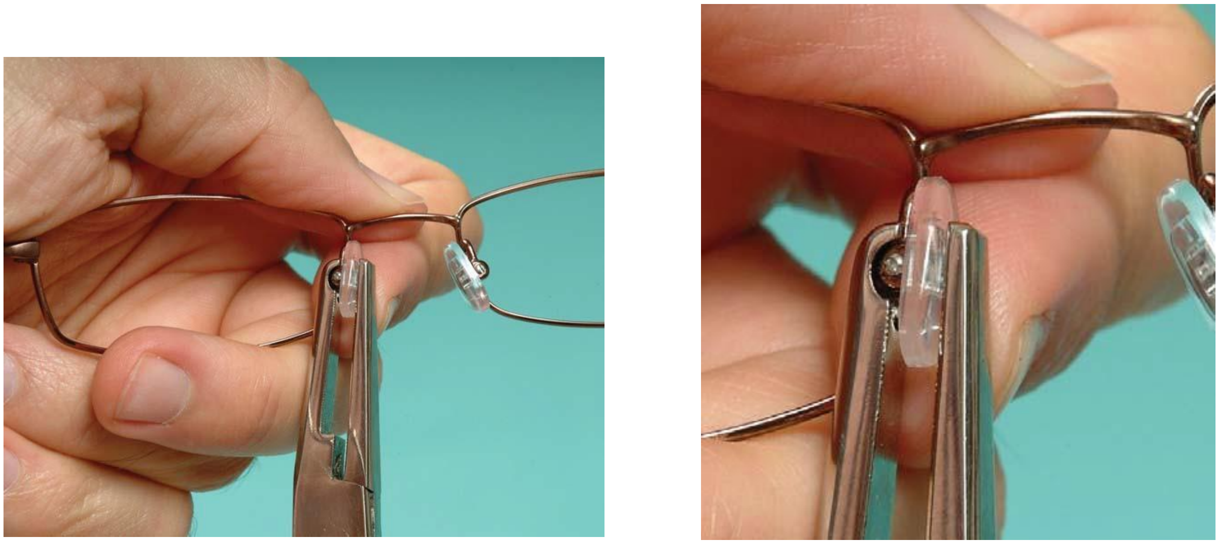
When the Nosepads Are Asymmetrical

The first possible cause for a frame sitting too far to the left or right on the wearer's face is that the nosepads on the frame are asymmetrical. If the fault is with the frame, the pads themselves are moved slightly too far to one side or the other, even though they may sit flat on the nose and be comfortable (Figure 9-41). The problem is corrected by moving one pad nasally and the other pad temporally. The procedure for moving one pad nasally is the same as was described for decreasing the distance between pads. The procedure for moving the other pad temporally is the same as was described for increasing the distance between pads.

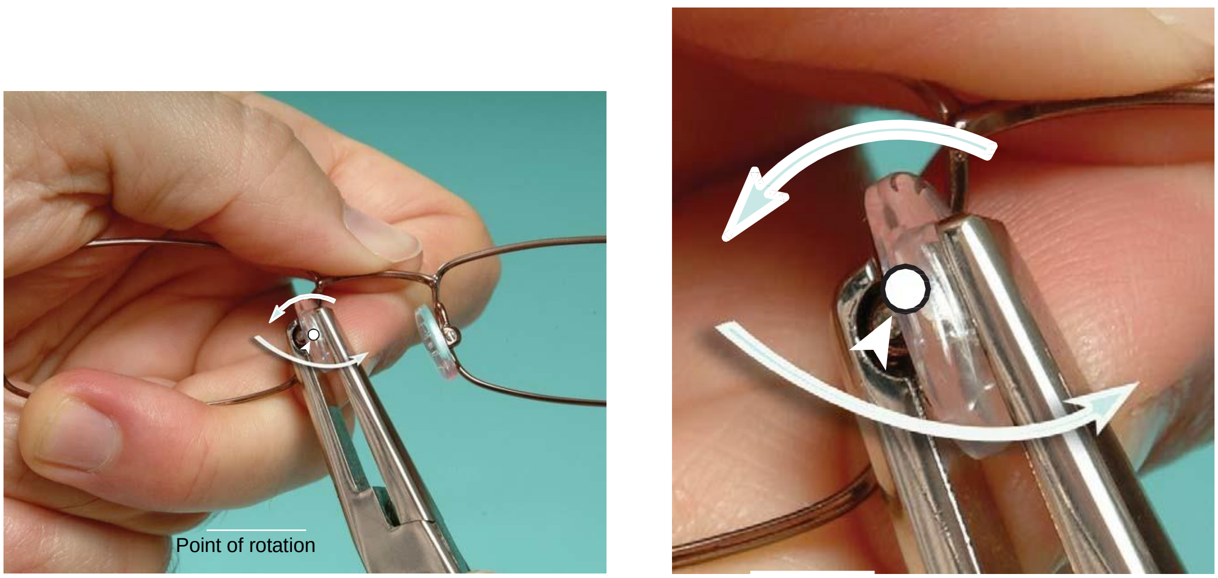
Adjust both sets of pad arms so that they are mirror images of each other. The left and right pad arms are made to be symmetrical.

When the Wearer's Nose Is Asymmetrical

The second possible cause for a frame being too far left or right is that the person's nose is asymmetrical. This



A

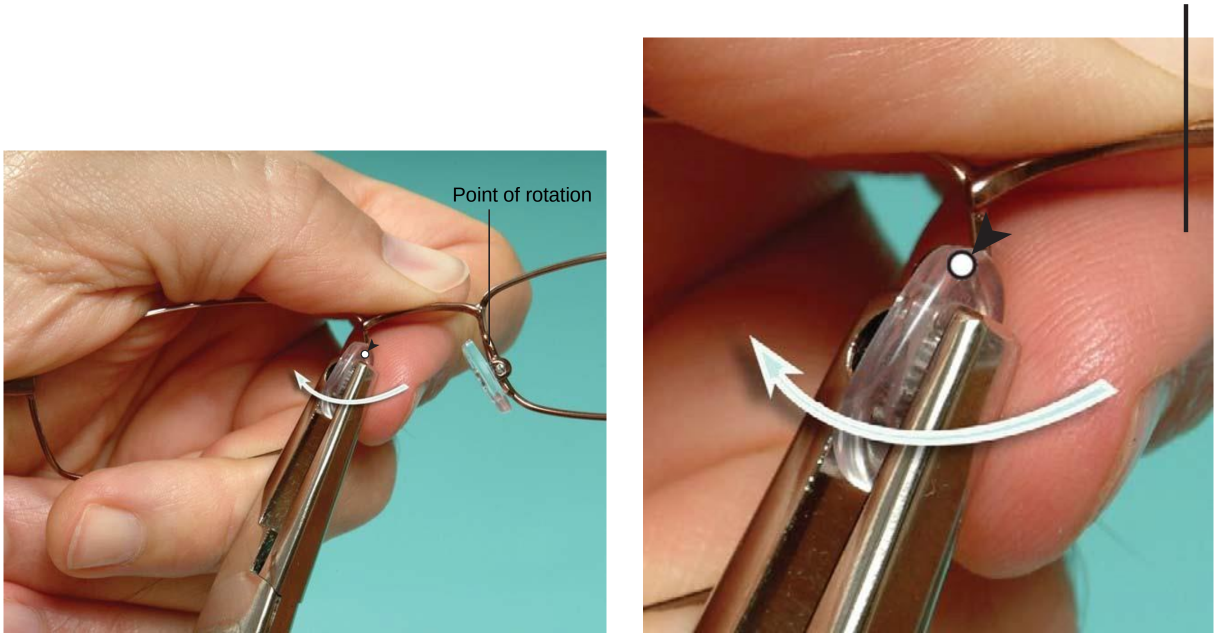


B

Figure 9-39. To increase the distance between pads for frames having U-shaped pad arms:

- Grasp the pad with pad-adjusting pliers **(A)**.
- Tilt the top of the pliers outward temporally **(B)**. The point of rotation is at the point of attachment of the pad arm. This will decrease the frontal angle.

Continued



C

Figure 9-39. cont'd

Next turn the bottom of the pliers temporalward with the pivot point being the top of the pad arm's inverted U **(C).** This will move the face of the pad temporally and will allow the frontal angle of the pad to be returned to the necessary angle.

D, The pad on the left pad has been "widened" (moved
D outward).

is quite a common occurrence because many people have had a broken nose at one time or another. If the break was far enough back on the nose it will cause the frame RIGHT-RIGHT," and "Frame to the left, move pads to the left. LEFT-LEFT.* to sit off center, even though the pad arms and pads are

symmetrical.

To check for such an error, look at the frame from the straight-ahead position. If the frame is toward the *right side of the wearer's face*, bend the pad arms at their *bases in the direction of the wearer's right lens* and then realign the pad angles. If the frame is toward the *wearer's left*, bend the pad arms toward the *left lens*. The direction of the bend may be remembered logically by keeping in mind that moving the pad arms one way pushes the frame in the opposite direction. It may be remembered by rote by thinking "Frame to the right, move pads to the right.*Up to this point we have simple consistency for memorization pur- poses between observed error and proper correction of that error. The consistent relationship between the direction of the error and the direction of correction for that error helps simplify any required memorization.

For equality of vertex distance: One lens in, bend same temple in: IN-IN. One lens out, bend same temple out: OUT-OUT.

For straightness of the frame on the face: One side up, bend same temple up: UP-UP. One side down, bend same temple down: DOWN-DOWN.

For symmetry of the frame on the face: Frame to the right, move pads to the right: RIGHT-RIGHT. Frame to the left, move pads to the left: LEFT-LEFT.

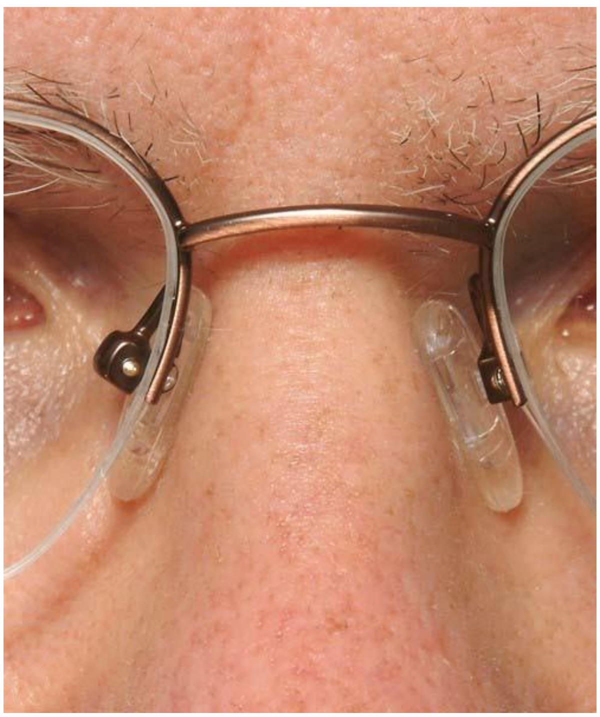


Figure 9-40. An example of a frame that sits too far to the wearer's left. Note that when the pads are shifted to the wearer's right, the frame shifts to the wearer's left.

Figure 9-41. In this photo, the pad angles are basically sym- metrical, but the pads themselves are moved too far to one side. This defect as shown from above will cause the frame to sit too far to the wearer's left, as was shown in the previous figure.

Changing Frame Height, But NotVertex Distance

Changing the Height of Pads for Inverted U-StylePad Arms

Most of the time a frame will be moved higher or lower on the face by narrowing or widening the distance between pads. (This procedure was described earlier.) However, narrowing or widening the distance between pads will also cause the frame to move farther from or closer to the eyes. The distance from the lenses to the eyes is called the vertex distance. To keep the vertex distance the same, the distance between the pads must remain the same. This means that in order to change the height of the frame, the location of the pads relative to the frame front must move up or down.

Moving the frame higher or lower on the face without changing the distance between pads is accomplished for inverted U-style pad arms by changing the location of the bend or loop at the top of the U in the pad arm. Lowering the frame can be accomplished by one of two

methods. The first is easier and requires only two primary bends.

Lowering the Frame: Method 1. To lower the frame on the face without changing the vertex distance, the location of the bend in the pad arm is moved closer to the pad. This is shown in Figure 9-42. The adjustment itself may be made with two bends. These are:

1. Grasp the pad with pad adjusting pliers as seen in Figure 9-43, *A*. While exerting an upward pull onthe pad, bend the pad arm until the posterior part of the U is almost perpendicular with the frame front (Figure 9-43, *B*). The pad arm is now shapedmore like an "L" than a "U."
2. Bend the pad arm back down, while pushing upwardwith the pliers (Figure 9-43, *C*).

It may be necessary to repeat these two steps if the pad has not moved up enough.

Without an upward pull during step 1 and an upward push in step 2, there will not be any appreciable change in pad height. The fin- ished pad is shown in Figure 9-43, *D*. The other pad is then adjusted to match.

This method will usually work. But if the frame pad will not move enough using this technique, then the more complicated Method 2 technique may be used.

Lowering the Frame: Method 2. Using this method to move the frame lower on the face, the bend in the inverted U must still be moved closer to the pad. The new bend can be placed more easily if the old bend is removed first.

Here are the Method 2 steps for moving the frame lower on the face:

1. Begin by grasping the pad with pad adjusting pliers as shown in Figure 9-44, *A*.
2. Bend the pad up far enough to practically straighten the pad arm (Figure 9-44, *B*).
3. Once the pad arm is straight, use square-round, snipe nose, bent-snipe, or a similar type of thin pliers to grasp the pad arm closer to the pad (Figure 9-44, *C*). How close the pliers are positioned in reference to the pad will depend upon how much higher on the face the frame must be moved.
4. Rotate the pliers until the full U-shaped bend is restored (Figure 9-44, *D*). By comparing the position of this pad to the other one (Figure 9-44, *E*), it can be seen that the newly adjusted pad is noticeably higher.
5. Next equally alter the other pad.

In the end, both pads should still have the same hori- zontal distance between them. Therefore they will rest on the same position of the nose as before. Because they have been moved higher, the frame will be lower on the face.

Raising the Frame Without Changing the Distance Between Pads

Raising the Frame: Method 1. To raise the frame on the face without changing the vertex distance, the location of the bend in the pad arm is moved closer to

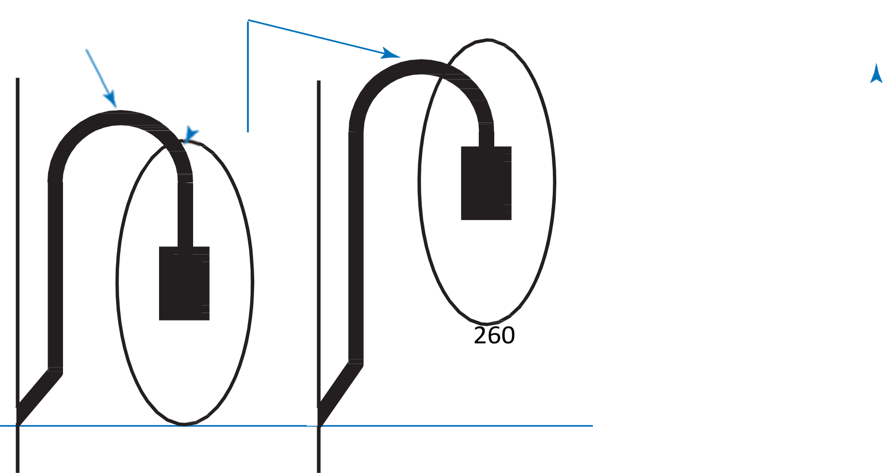
To lower frame height only:
move pads up by changing bend location

Move frame bend from here

To here

Pad moves up relative to frame front

A.



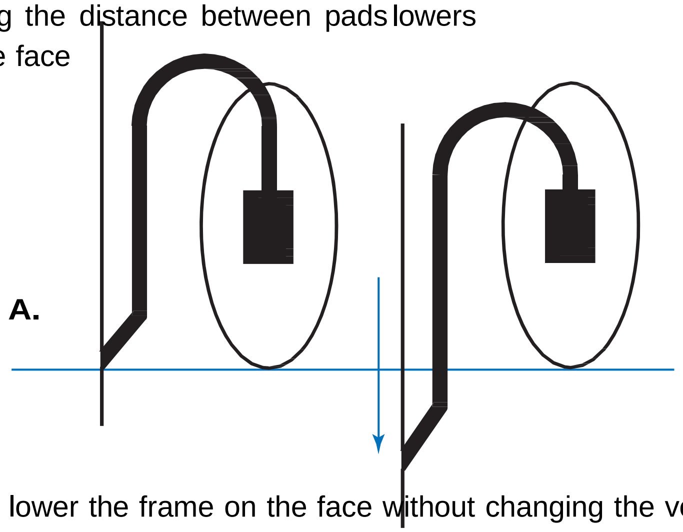
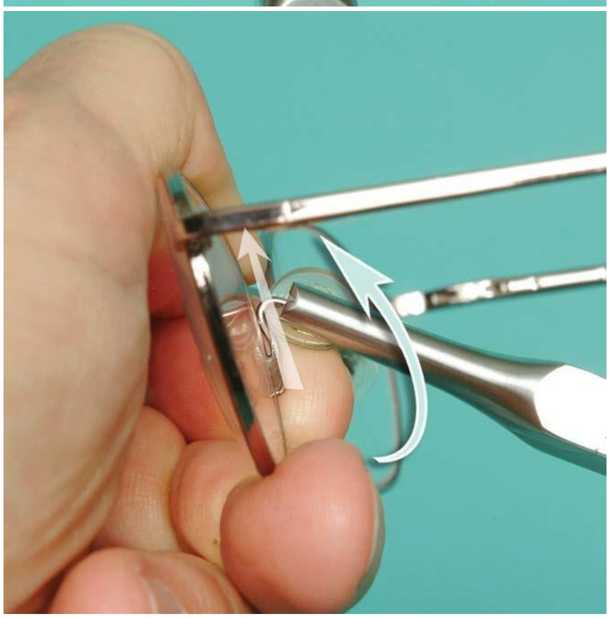


Figure 9-42. To lower the frame on the face without changing the vertex distance, the pads are moved up, but the right and left pads are still the same distance apart. This means that the pads will rest on the nose as they did before. However, this means that the frame, being lower relative to the pads, will also be lower on the wearer's face. **A,** If the bend in the pad arm is moved closer to the pad, the pad moves up. **B,** Because the pad will sit on the nose where it did before, the frame will be lower.the frame. This method is the reverse of that described in Method 1 for lowering the frame and does not work as easily. Even though it is theoretically feasible to make this adjustment with two bends, it may need to be repeated.

1. Grasp the pad with pad adjusting pliers. While exerting a downward pull on the pad, bend the pad arm until the posterior part of the U is almost perpendicular with the frame front.
2. Still exerting a downward pull on the pad, bring the pad arm back to its correct angle. (Care should be taken so as not to inadvertently pull the pad away from the frame front.)

Raising the Frame: Method 2. Method 2 for lower- ing the frame is practically a repeat of Method 2 for raising the frame, with only minor changes. Here is how it is done.

1. Begin by grasping the pad with pad adjusting pliers.
2. Bend the pad up far enough to practically straighten the pad arm.
3. Once the pad arm is straight, use square-round, snipe nose, bent-snipe, or a similar type of thin



A

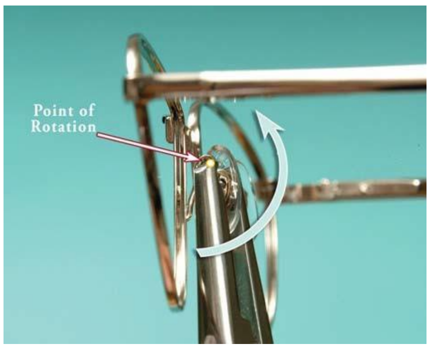
B

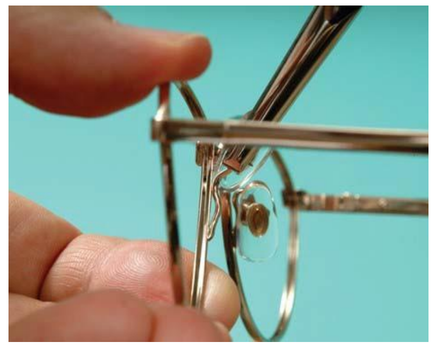
D

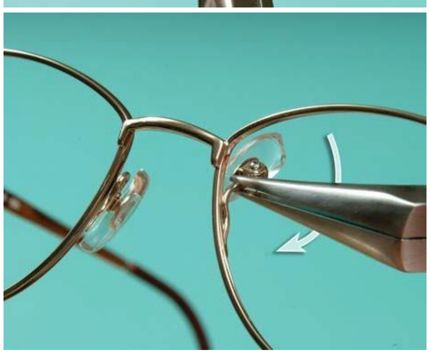
2

C

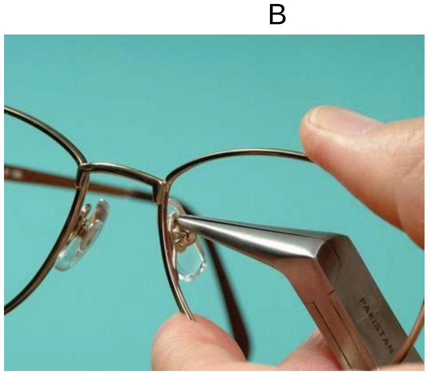
Figure 9-43. To raise the pad (lowering the frame on the face), grasp the pad with the pad adjusting pliers **(A)**. The pad may be raised in two moves. First bend the pad horizontally while pulling up **(B)**. Second the pad is returned to its former location. While turning the bottom of the pad back downward, simultaneously push the top of the pad upward as shown in **(C)**. The upward pull **(B)** and upward push **(C)** cause the location of the bend in the U to move closer to the pad. This raises the position of the pad relative to the frame front. **D,** The difference in pad height produced by this adjustment.

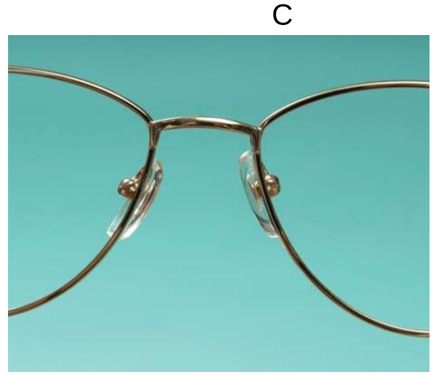






A B C





D E

Figure 9-44. A, To begin Method 2 for moving the frame lower on the face, start by grasp- ing the pad with pad adjusting pliers. (It is also possible to use thin-nosed pliers and grasp the pad arm instead of the pad.) The point of rotation will be the top of the bend in the pad arm. **B,** The pad arm has just been straightened. By removing the bend, the pad arm can be rebent at a new location. (At this point in the sequence, the pad could either be raised or lowered, depending upon the location of the new bend.) **C,** In this figure, bent snipe-nosed pliers have been moved closer to the pad in preparation for placing the new bend. When the bend occurs, the point of rotation will be where the pliers are grasping the pad arm. **D,** The new bend location is much closer to the pad than it had been. **E,** The bend is now complete and pad height location between left and right pads may be compared. The pad on the right is considerably higher. After the pad on the left is adjusted to match, the frame will be higher on the face by an amount equal to what now shows as the difference in pad heights.

pliers to grasp the pad arm *closer to the point of attachment of the pad arm to the frame front*. How close the pliers are positioned depends upon how much lower on the face the frame must be moved.

4. Rotate the pliers until the full U-shaped bend is restored.
5. Next equally alter the other pad.

Both pads should still have the same horizontal dis- tance between them, will rest on the same position of the nose, and because they have been moved lower, will cause the frame to sit higher on the face. This is illus- trated in Figure 9-45.

Changing Vertex Distance, But Not Height

It is possible to change the vertex distance by narrowing or widening the distance between pads. A secondary effect is an increase or decrease in the overall height of the frame. When frame height changes must be avoided, pad bridges should be adjusted another way.

Moderately Increasing the Vertex Distance for Frames With Inverted U-Style Pad Arms

The sequence for moderately increasing the vertex distance can be done with just two bends. This is shown in Figure 9-46. Here is how it is done:

1. The pad is grasped with pad-adjusting pliers and the top of the pad is rotated away from the frame front (Figure 9-46, *A*). The point of rotation is at the point of attachment the pad arm. The pad arm bends at the point of attachment. This changes the vertical angle of the nosepad.
2. The vertical angle can be immediately corrected without repositioning the pliers. The angle is changed by moving the lower part of the pad away from the frame front. The point of rotation is the top of the inverted U. The rotation of the pliers is indicated by the arrow shown in Figure 9-46, *B*. This corrects the vertical angle (Figure 9-46, *C*). The end result is seen in Figure 9-46, *D*.

To raise frame height only:
move pads down by changing bend location

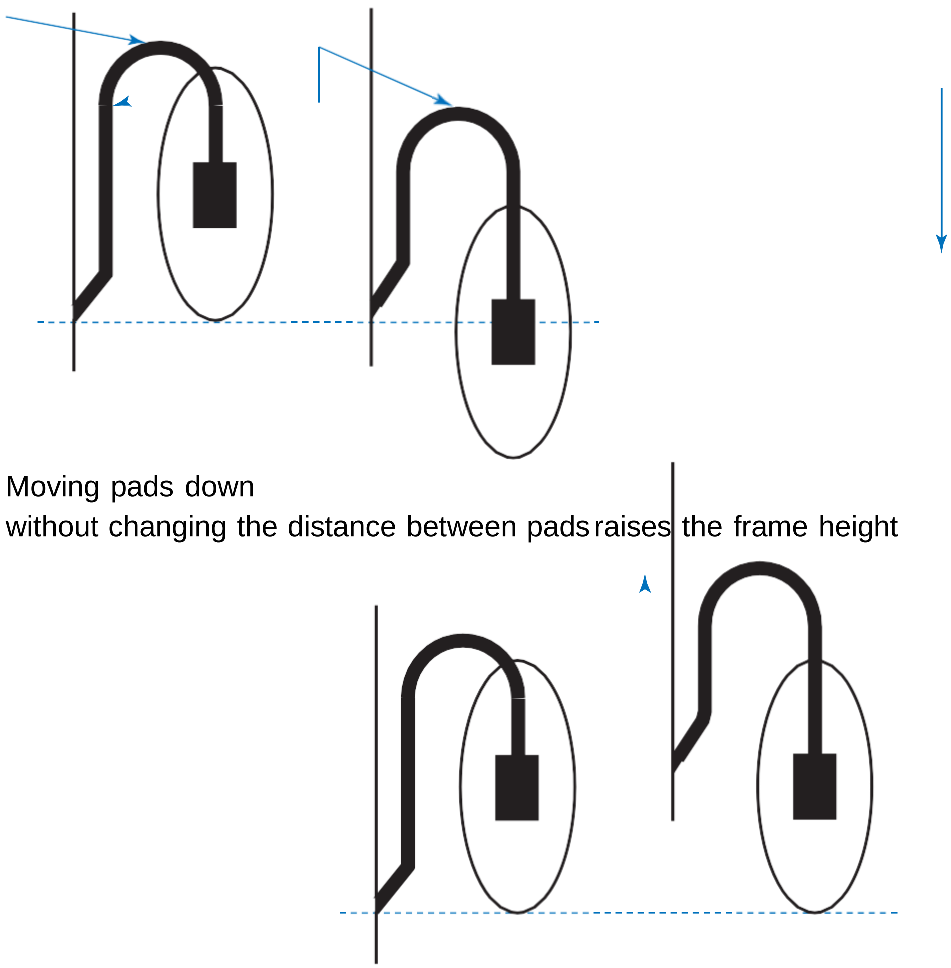


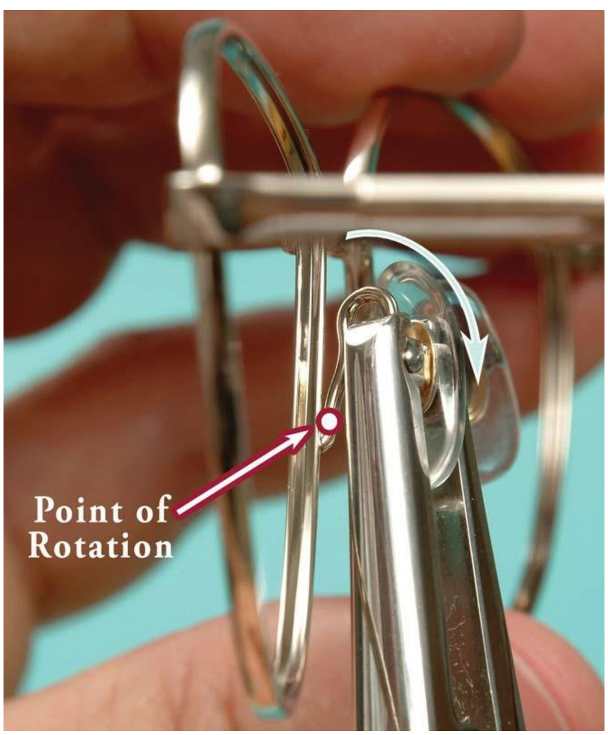
Figure 9-45. To raise the frame on the face without changing the vertex distance, the pads are moved down, but both right and left pads are still the same distance apart and rest on the nose where they did before. But the frame will be higher on the wearer's face. **A,** If the bend in the pad arm is moved closer to the pad arm's point of attachment, the pad moves down. **B,** Because the pad will sit on the nose where

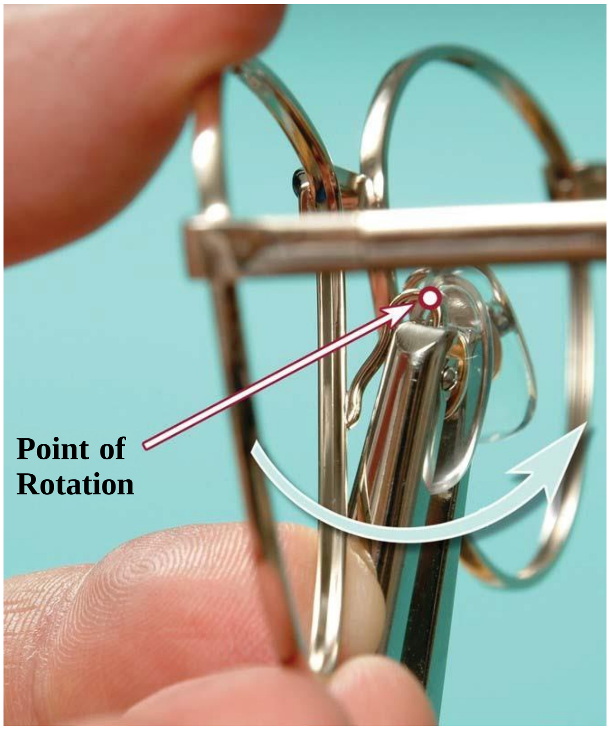
it did before, the frame will end up higher.

Signifi cantly Increasing the Vertex Distance for Frames With Inverted U-Style Pad Arms

The idea behind significantly increasing the vertex distance with upside down U-shaped pads is a simple one. Imagine a piece of coat hanger shaped into an upside down U. To increase the distance between the legs of the U, imagine grasping both legs and strenuously pulling them apart. The coat hanger wire is malleable and yields easily. The legs are now farther apart, but the top of the upside down U is longer and flat. Fortunately, this radical adjustment is seldom required.

To significantly increase the vertex distance for a frame having inverted-U style pad arms, we must flatten the top of the pad arm. To begin the process, use square- round pliers and position them at the upper area of the bend in the pad arm. Remove the bend by rotating the pliers as shown in Figure 9-47, *A*. Next, position the pliers closer to the pad arm's point of attachment. Position the round jaw where the inside of the bend will be (Figure 9-47, *B*). Rotate the pliers so that the pad arm turns straight back (Figure 9-47, *C*). The new bend causes the pad arm to have an approximately 90- degree angle. Now slide the pliers closer to the pad





A

B

creasing the vertex dis- tance without face. **A,** The pad is grasped and the top of the pad moved away from the frame. **B,** The bottom of the pad must now be moved away from the frame to complete the adjustment. **C,** The adjustment is complete. **D,** The pads are shown from the top and the difference between left and right pads is evident. Now the pad on the left will be adjusted in an identical manner to match the pad on the

C right.

(Figure 9-47, *D*) and place another 90-degree angle in the pad arm. When complete, the pad arm should appear as seen in Figure 9-47, *E*.

Decreasing the Vertex Distance for Frames With Inverted U-Shaped Pad Arms

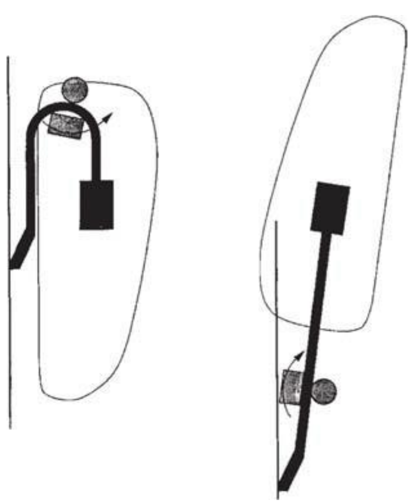
To decrease the vertex distance, the pads must be posi- tioned closer to the frame front. As with most of the more common pad adjustments, this adjustment may be done with just two bends. The pad is grasped with pad adjusting pliers as in Figure 9-48, *A*. Here is the sequence:

Bend the bottom of the pad away from the frame front while pressing the top of the pad in toward the frame front as shown in Figure 9-48, *B*.

Next swing the bottom of the pad toward the frame front without allowing the top of the pad to move

A B

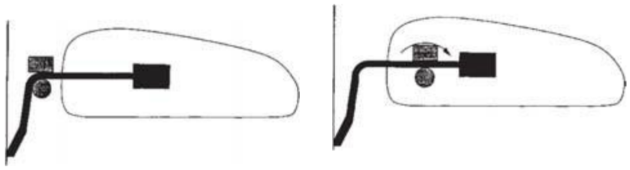
(Figure 9-48, *C*). If the pliers do not have enough room to swing the lower part of the pad inward, turn them upside down and grasp the pad from above.

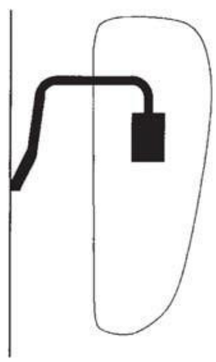


The completed work is shown from the top in Figure 9-48, *D* where right and left pad distances can be com-

C D

pared. The pad should still have the same alignment angles as before (frontal, splay, and vertical). It is just farther forward. When both pads are completed, the frame will rest closer to the eyes.





E

Figure 9-47. A, To remove the bend, the pliers are rotated as shown. Here the square-round pliers are shown with the square jaw on the inside so that the point of rotation is the center of the round jaw. (If the bend is too tight to allow this, the round jaw may need to be placed on the inside of the curl.) **B,** To effectively lengthen the pad arm, a new bend will be placed nearer to the point of attachment with the frame. The new bend will not be the only bend. **C,** In accomplishing this bend, the round jaw of the pliers was placed on the inside of the bend. The pad arm has been bent so that the top of the new curl will be flat. **D,** Next the pliers are rotated as shown. **E,** This is the theoretical appearance of a completed vertex distance change. The individual bends will not always look as neatly squared off in practice.

ADJUSTING NOSEPADS WITH QUESTION MARK–STYLE PAD ARMS

Nose pads supported by pad arms that look like a question mark when viewed from the top were the predominant type of pad arm. Now they are definitely a minority. However, they do continue to appear, sometimes as part of a “hybrid” combination of the inverted U and question mark. These types of pad arms are very versatile and in some ways allow easier changes in frame height and vertex distance.

Changing the Distance Between Pads for Question Mark–Style Pad Arms

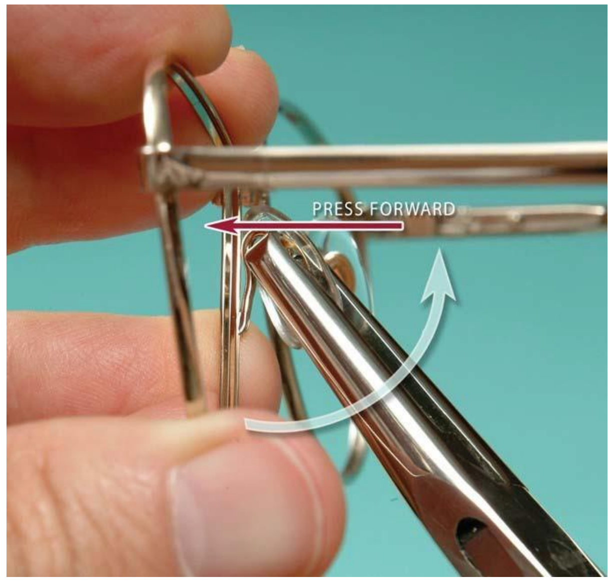
Regardless of pad or pad arm style, widening the distance between pads will lower the frame and allow it to sit closer to the face. Narrowing the distance between pads will raise the frame and cause it to sit farther from the face.

Widening the Distance Between Pads (Question Mark Style)

When working with question mark style pads, some prefer to use pad adjusting pliers on the face of the pad; others would rather use thin-nosed pliers and grasp the pad arm directly.

Square-round pliers as shown in Figure 9-49. When using square-round pliers, the round jaw will be the pivot point of the pliers (Figure 9-50). It is easier to use

A



B

Figure 9-48. The vertex distance may be reduced in just two movements. **A,** The pliers are positioned, but have not been moved yet. **B,** The top of the pad is pressed forward. To get the top of the pad solidly forward, the bottom of the pad is rotated back some. **C,** The bottom of the pad is pressed and/or rotated forward. (If there is not enough room for the pliers from below, grasp the pad from above or use thin pliers to grip the pad arm itself.) **D,** The pad on the right is seen to be closer to the frame front than the pad on the left. When the pad on the left is equally adjusted, the frame will sit closer to the face

C and eyes.

Figure 9-49. The square-round (flat-round) pliers are used for pad arm manipulation. **A,** The left side of the jaw is round, the right side is squared off and flat on the inner surface. This is seen more easily from above **(B)**. The design allows the pad arm to be solidly gripped and smoothly

A B bent.

thin-nosed pliers with question mark style pads than with inverted U-shaped pad arms because the pad arm is more easily accessible from the top or the bottom.

Widening the distance between pads can be done in two moves with either type of pliers. The first changes the position of the pad arm, but messes up the splay angle. The second move reangles the splay angle. Here are the two moves for widening the distance between pads using ***pad adjusting pliers*:**

1. Grasp the pad with pad adjusting pliers and move the pad arm temporally (outward). The bend takes

place at the point of attachment of the pad arm and rotates around that point (Figure 9-51, *A*).

2. Correct the splay angle by rotating the pliers with the point of rotation at the center of the pad-arm

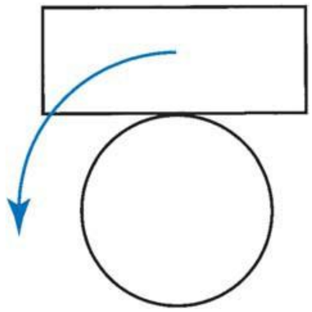


Figure 9-50. To use square-round pliers most effectively, position the pliers so that the round jaw is the pivot point for the bend.

A

Figure 9-51. A, To widen the distance between pads for frames with question mark style pad arms, there are two moves required. This sequence uses pad adjusting pliers. The first move is to grasp the pad with and bend the pad arm outward. The bend takes place at the pad arm's point of attachment. **B,** Here, for the second move in widening the distance between pads, the splay angle is corrected. The pad face is rotated as shown. **C,** The left pad has been moved to the widened position, the right pad has not yet been adjusted. The center line is for reference so that the change in pad distance will be more readily evident.curl (Figure 9-51, *B*). Compare the right and left pads in Figure 9-51, *C*. The pad distance on the left has been widened; the one on the right has not.

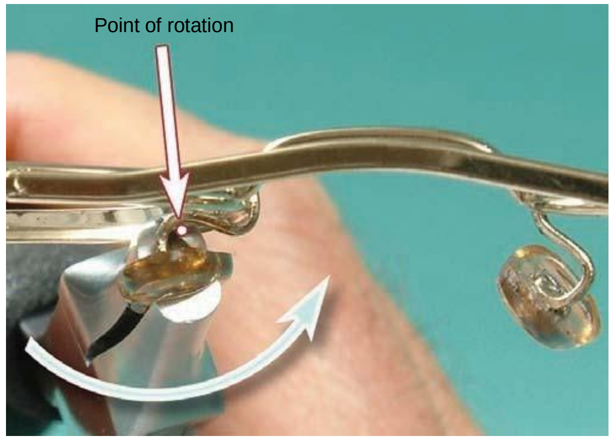
Here are the two moves for widening the distance between pads ***using square-round pliers***:

1. Grasp the pad arm near the base with square-round pliers held vertically. Bend the pad arm outward. Remember to place the round jaw on the side of the direction the pads are to be moved. Pivot the pliers around the round jaw.
2. Holding the pliers vertically, grasp the pad arm directly in back of the pad and reangle the splay angle.

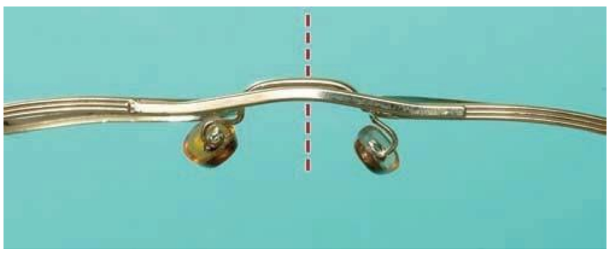
Narrowing the Distance Between Pads (Question Mark Style)

Narrowing the distance between pads is done the same as widening the distance between pads, except the direc- tion of movement is nasal (inward) instead of temporal (outward). Here are the moves (Figure 9-52):

1. Bend the pad inward.
   a. When using pad adjusting pliers, grasp the pad and bend the pad arm inward so the bend takes place at the point of attachment of the pad arm.
   b. When using square-round pliers, grasp the pad arm near the base with square-round pliers held vertically and bend the pad arm inward. Place the round jaw on the side of the direction the pads are to be moved and pivot the pliers around the round jaw as shown in Figure 9-50.



B



C

A

B

C

D

Figure 9-52. Summarization of the sequence of steps for nar- rowing the distance between pads with question mark type pad arms. Only one pad is adjusted for the sake of comparison.

2. Correct the splay angle of the pads.
   a. Use pad-adjusting pliers to correct the splay angle of the pad, or
   b. Use square-round pliers to do the same thing as shown in Figures 9-51, *B* and 9-53.

Moving the Frame Left or Right With QuestionMark–Style Pad Arms

(Remember that this adjustment uses a combination of the two adjustments that have just been explained: narrowing the distance between pads and widening the distance between pads.)

When the frame sits too far left or right on the face as was shown in Figure 9-40, remember that there are two possible causes for this problem:

1. The nosepads on the frame are asymmetrical.
2. The wearer's nose is asymmetrical.

To correct the problem, bend one pad arm inward (as in narrowing the distance between pads) and the other outward (as in widening the distance between pads). The entire sequence when using square-round pliers is shown in Figure 9-54.

Changing Frame Height but not Vertex Distance for Question Mark–Style Pad Arms

To change the frame height, but not the distance from the frame to the eyes, the distance between the pads must remain the same, but the pads must be either higher or lower. This will move the frame down or up.

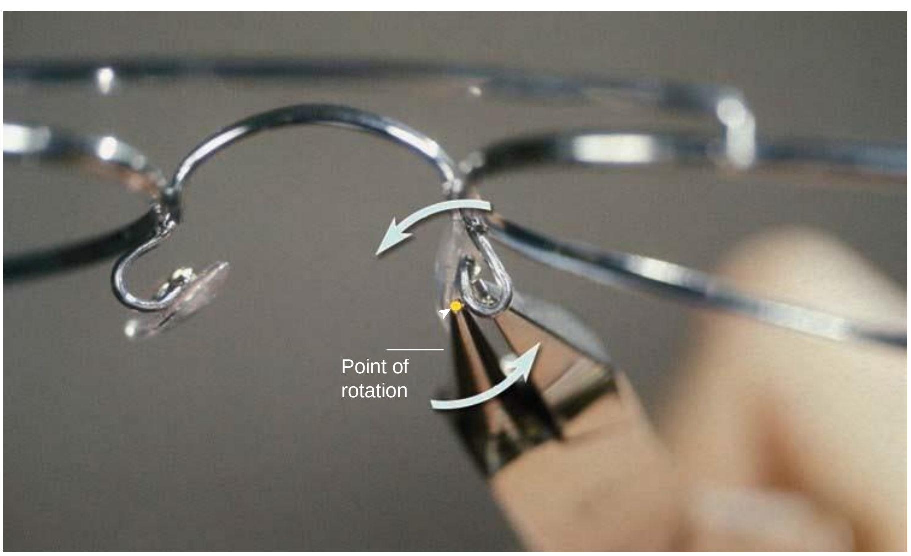


Figure 9-53. Square-round pliers being used to correct the splay angle of the nosepad and complete the pad narrowing process (*top view*). The point of rotation is at the

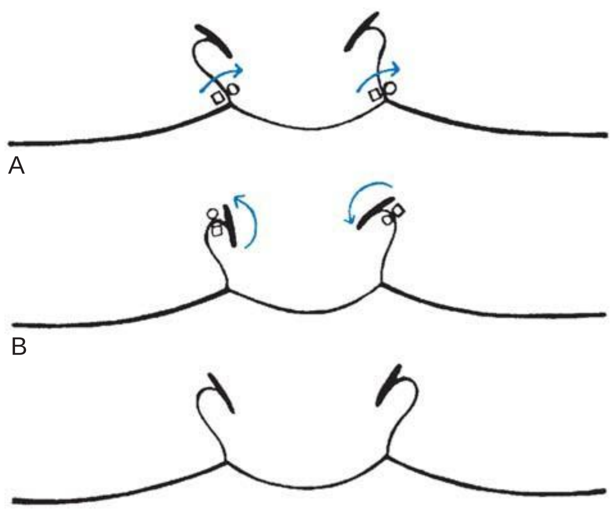
center of the round jaw of the pliers.

aising the Frame: Question Mark Pad Arms

To raise the frame, the sequence is the same as for lower- ing the frame with one exception—the pad arm is bent downward instead of upward. The procedure is:

With the pliers held horizontally, grasp the entire pad arm between the pliers' jaws and bend the pad arm upward.

Correct the vertical angle of the pad. To adjust the angle of the pad, use square-round pliers held vertically and grasp the pad arm behind the pad.



C

Figure 9-54. A, Even though both pad surfaces are correctly angled, both pads are too far to the left. This will cause the frame to be shifted to the right. Bending the pad arms back to their proper position throws the pad angles off **(B)**. These must be reangled as shown in **B** to achieve correct alignment **(C)**.

Suppose we change the question mark style pad arms so they angle downward when leaving the eyewires instead of coming off at right angles. If the pads now rest on the same place on the nose as previously, the lenses will be situated higher on the face in relation to the eyes than previously. The reverse is true if the pad arms are angled up.

Lowering the Frame: Question Mark Pad Arms

To lower the frame, the adjustment is done in two moves. The first bend moves the pad upward; the second corrects the messed-up vertical angle. Here is the procedure:

1. With the pliers held horizontally, grasp the entire pad arm between the pliers'

jaws and simply bend the arm upward. (Figure 9-55, *A* shows how the bend is done, and Figure 9-55, *B* shows what the pad looks like after this first step is completed.)

Correct the vertical angle of the pad. To adjust the angle of the pad, use square-round pliers held vertically. Grasp the pad arm behind the pad halfway into the curl area and return the pad to its original angle (Figure 9-55, *C* and *D*). It may be necessary to grasp the pad arm from above to complete the bend and to fully return the pad to the correct vertical angle.

2. Pad-adjusting pliers can also be used to correct the vertical angle if sufficient room between pad and eyewire is present and if care is taken not to accidentally bend the pad arm back to its original position.

Increasing the Vertex Distance Only for Frameswith Question Mark–Style Pad Arms

Extending the pad arms will increase the vertex distance between the lenses and the eyes. Here is the sequence of adjustments for pad bridges with question mark style pad arms:

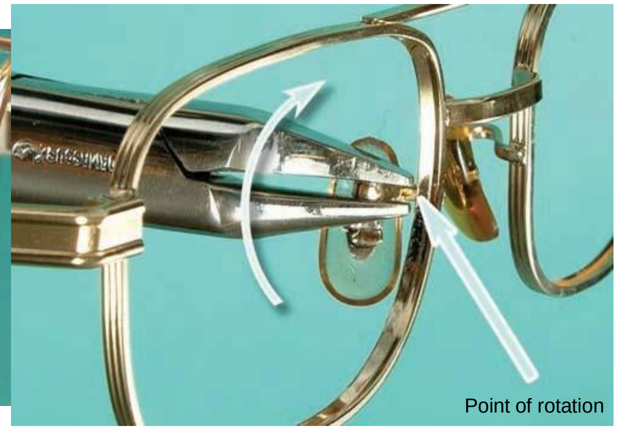
1. Open the pad arm curl. Position the square-round pliers so that the square jaw is inside the pad arm curl and the round jaw is outside. Open out the curl of the pad arm by compressing the jaws and rotating the pliers slightly (Figure 9-56, *A*). This adjustment increases the distance from the lens to the pad.

When a radical increase in vertex distance is necessary, it is possible to open the pad arm out completely (Figure 9-56, *B*). This is done by squeezing a section of it at a time, gradually moving the positions of the jaws closer to the pad while squeezing with the large part of the pliers near the pliers' throat until the pad arm is absolutely straight.

2. Replace the curl nearer to the pad. Flattening the curl of the pad arm, by whatever method, will turn the pad away from its proper angle so that its surface faces straight back, or nearly so. The pad arm will now require a new curl, which should be placed closer to the pad than it was previously. To put the curl in correctly, hold the square-round pliers vertically and grip the pad arm at the desired position of the curl. Position the round jaw so that it will be on the inside of the new curl (Figure 9-56,

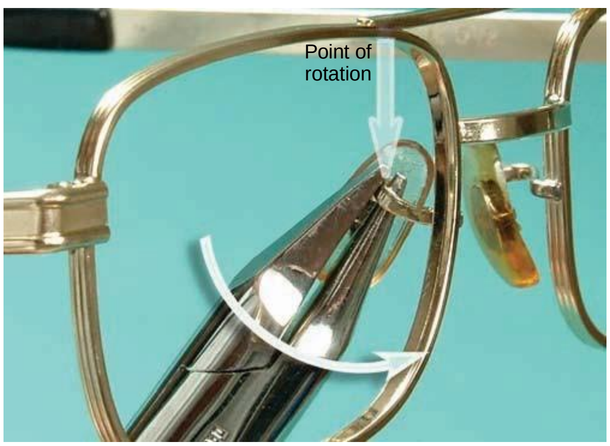
C). Using the round jaw as a pivotal point, rotate the pliers until the pad reaches its proper position. Figure 9-56, *D* shows an example of how the pad arm should look when finished.

If difficulty is experienced in getting the curl to bend exactly at the desired place, it may be helpful to use a second pair of pliers as holding pliers. With these, the pad arm can be held firmly at a point approximately halfway between the pad and the point of attachment to the frame. This two-pliers technique is extremely useful for antique rimless mountings where bracing is neces- sary to prevent chipping the lens near the pad arm. It also allows the pad arm to be curled without inadver- tently bending it at its base.



B

A



C

Figure 9-55. A, To raise the pads on frames with question mark pad arms, thin pliers are used to grasp the entire pad arm and bend it upward. This will lower the frame on the face. **B,** After the question mark type pad arm has been bent upward, the pad will be considerably higher, but has an incorrect vertical angle. The pad must be reangled. **C,** Reangling the pad to correct the vertical angle after having raised the question mark style pad arm is done by grasping the curl close to the pad. This can be done with square round (or thin-nosed) pliers as shown here. **D,** Note how much higher the pad on the right is than the pad on the left. When both pads are adjusted, the frame will sit considerably lower than previously.

Decreasing the Vertex Distance Only for Frames with Question Mark–Style Pad Arms

Bringing the pads closer to the lenses will decrease the vertex distance. Here is the two-step sequence used to bring about this change for pad bridges with question mark style pad arms. (See Figure 9-57, *A* to see what the pads look like before starting the adjustment.)

1. Grasp the pad arm at its base with the round jaw toward the temporal side of the frame (Figure 9-57,

B). Bend the pad arm towards the lens. This will throw the splay angle off (Figure 9-57, *C*).

2. Position the square-round pliers in the curl of the pad arm with the round jaw on the inside of the

curl (Figure 9-57, *D*). Tighten the curl by rotating the pliers around the round jaw. This should move the pad closer to the frame, correct the splay angle, and return the pad it to the original distance between pads.

When the adjustment is complete, the reangled pad should duplicate its original angle (Figure 9-57, *E*).


B

A


C

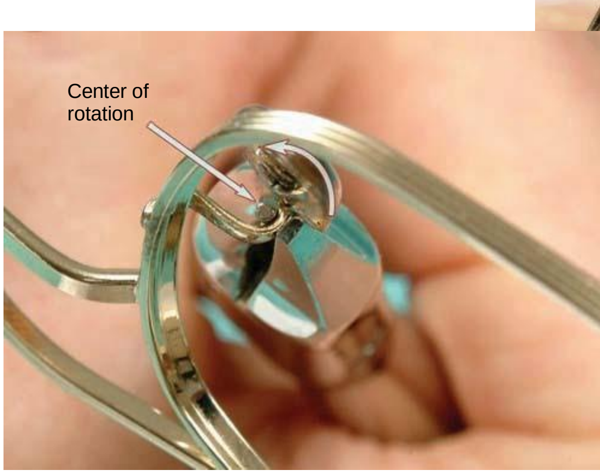
Figure 9-56. A, Increasing the vertex distance without changing frame height: To straighten the question mark type pad arm, the curl of the arm is flattened by compressing the jaws and rotating the pliers slightly. Note the location of square and round jaws. Because the curl must open up, the square jaw is on the inside of the curl. (Frame shown from below.) **B,** Here the pad arm curl has been opened up and the pad faces back. (Frame shown from above.) **C,** A new curl is to be placed in the pad arm so that it has a longer effective length. By noting the position of the square-round pliers, it is possible to predict the location of the new curl. (Frame shown from above.) **D,** The pad arm on the left has been lengthened. That on the right is in its normal position. (Frame shown from above.)

A

C

B

E



D

Figure 9-57. A, Here is how the pads and pad arms appear before shortening the effective length of the pad arms. This will decrease the vertex distance from frame to eyes. The pad on the left will be moved. (Frame shown from above.) **B,** To decrease the vertex distance, bend the pad arm temporally. The bend takes place at the point of attachment of the pad arm. (Frame shown from below.) **C,** The pad arm on the left has been bent outward at the base in the first part of decreasing the vertex distance. The splay angle has been thrown off. (Frame shown from above.) **D,** To complete the decrease in vertex distance, tighten the curl of the pad arm. This moves the pad closer to the frame, corrects the splay angle, and returns it to where the distance between pads will be the same as it was before. Note that the square-round pliers grasp the curl with the round jaw on the inside of the curl. (Frame shown front view from below.) **E,** The pad arm on the left has been effectively shortened. The pad arm on the right is positioned normally. After the pad arm on the right has been adjusted, the vertex distance will be considerably less than before. (Frame shown from above.)

Figure 9-58. Use hot salt scooped up in a wooded spoon to heat fixed pads on a plastic frame in preparation for changing their splay angle. Hot air works equally well or better.

SECTION C

"Nonadjustable" Bridge Adjustments

ACHIEVING THE PROPER FITTING ANGLES FOR NONADJUSTABLE PLASTIC BRIDGES

For plastic frames without adjustable pads, checking for correct bridge fit at the time of frame selection is essen- tial. The size must be right and all fitting angles correct. Nonetheless, in certain circumstances it may still be possible to correct a problem after the fact.

Modifying Fixed Pad Bridges

A limited number of plastic frames have a bridge with small, "built-in" pads made from the same material as the frame. They should sit flat on the nose from the beginning and should not have to be adjusted. But suppose a frame bridge without adjustable nosepads, but with these small, fixed pads has the correct width and is parallel to the nose when viewed from the front. The bridge size and frontal angle have been correctly chosen. In spite of this, the splay angle is incorrect, and the attached plastic pads flare in such a manner that their inner edges project into the backward sloping surface of the nose and indent it. This condition will produce both visible and potentially painful signs.

The flare of the pads can be altered by heating the pads and modifying their angle of attachment to the front. To heat the nosepads, use a spoon to scoop up some hot salt from the salt bath and hold it against the pads (Figure 9-58), or direct a concentrated stream of hot air against the pad. To flare the pads outward, use pressure from a smooth flat object, such as a spoon bowl (Figure 9-59).

Modifying Sculptured Bridges

A frame with a “sculptured bridge” has no pad at all. Rather, the bridge area of the frame rests directly on the

Figure 9-59. Bending the pads back on a plastic frame using the back surface of a wooden spoon. If hot salt is used to heat frames, a wooden spoon is commonly used to stir the salt and makes a handy flat surface to angle the fixed pad back.nose. Frames that have a sculptured bridge rather than pads cannot be altered in angle unless the plastic is filed to a new form. When a coarse file is used, the area should be subsequently smoothed down with fine-grain emery paper. Buffing the area afterward using a rag wheel and buffing rouge will restore a good polish to the frame for cellulose acetate or propionate frames. If no wheel is available, acetone may be applied repeatedly until an acceptable smoothness results. (Newer frame materials may require the application of a polyurethane furniture finish.) It should be kept in mind that filing the bridge as described may cause the frame to sit somewhat lower on the face than previously. When a sculptured bridge does need alteration, it is usually a result of poor frame selection.

FIXED BRIDGE HEIGHT AND VERTEX DISTANCE CHANGES

Properly selected fixed bridge frames should already be at the correct height. If they need to be changed in their height, there are certain limited ways to accomplish it.

In plastic frames and other “nonadjustable” fixed- bridge frames, the height can be affected only by altering the distance between the lenses—either by narrowing or widening the bridge. This adjustment forces the frames to ride on either a wider or narrower part of the nose. Since the nose widens from top to bottom, the frames will be correspondingly either higher or lower than they were before the change in bridge width.

In fixed-bridge frames, even the vertex distance posi-tion can usually only be attained by widening or narrowiing the bridge. (Again the necessity of altering vertex distance should have been prevented by proper bridge or frame selection during the fitting.)

A

B

Figure 9-60. A, Bridge-widening pliers. **B,** The procedure for using those pliers. The design of the pliers works better for keyhole bridges than saddle bridges.

If the bridge is widened, it will not only lower the frame but also permit it to sit farther back on the nose, bringing it closer to the eyes. On the other hand, if the bridge is narrowed, it may not only raise the frame, but will cause it to sit forward on the nose, farther from the eyes.

It should be noted that when the physical width of the bridge is widened or narrowed, this will also widen or narrow the distance between the optical centers of the lenses. While this may be tolerable for lower-powered lenses, it may cause problems with unwanted prismatic effect as the power of the lenses increase. Thus, if any adjustments to the physical width of the bridge are being considered, remember:

1. Low-powered lenses may make alterations to the distance between lenses acceptable. “Acceptable” would mean that the change would not cause the lens prescription to go outside of ANSI Z80 Recommendations for Prescription Ophthalmic Lenses.
2. Adjustments to the physical bridge size that will affect the distance between lens centers should be done before the lenses are ordered so that the wearer’s PD will be correct when worn.
3. If the above two situations cannot be accomplished, then the adjustment should not be done.

Plastic Frames

Changing the distance between lenses in plastic frames can be accomplished in several different ways. The fol- lowing methods are those primarily used:

Using Pliers to Change Bridge Size

To use pliers to change the bridge size of a plastic frame, measure the width of the bridge from lens to lens to obtain a starting measurement. Heat the bridge area of the frame. To widen the bridge, place bridge-widening pliers (Figure 9-60, *A*) in the bridge area, and squeeze (Figure 9-60, B).

To narrow the bridge, bridge narrowing pliers are sometimes used (Figure 9-61, *A*). Again, place the pliers on the heated bridge area and squeeze (Figure 9-61, *B*). Note the amount of change by remeasuring until the proper width is achieved, then try the frame on the wearer to verify the alteration. The use of widening or narrowing pliers does not guarantee success. In actual practice, such pliers are successful with only a very
limited number of plastic frames.

Using a Dowel Rod to Change Bridge Size

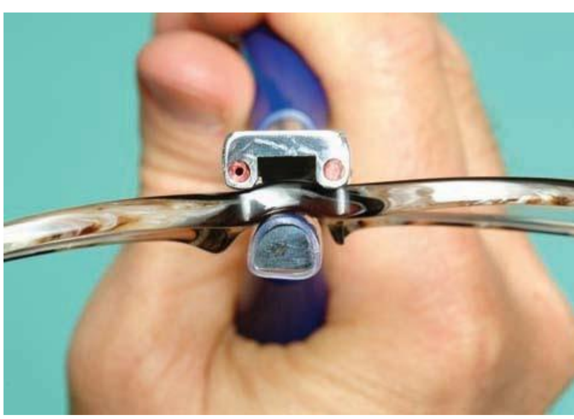
Vertical sections of dowel rods are used for changing bridge size. A $^3/8$-inch rod is used for narrowing, and a $^5/8$-inch rod for widening the bridge. To change bridge size using a dowel rod, hold the frame by the eyewires and pull the preheated bridge around the dowel while keeping the lenses parallel (Figure 9-62).

On the narrow dowel rod, this procedure increases the bow of the bridge and moves the lenses closer to one another. On the wide dowel rod, the bridge is stretched, decreas- ing the bow and separating the lenses farther apart.

Using a Staking Tool to Change Bridge Size

A staking tool is a multiple-use tool used in the repair of frames. It is possible to purchase an accessory for the tool that allows the bridge to be reformed (Figure 9-63). It works in a manner similar to the bridge-reducing pliers. This does not have a very good success record either.

There is no staking set accessory for widening a bridge.



B

A

Figure 9-61. A, Bridge-narrowing pliers. **B,** The procedure for using narrowing pliers is shown.

Figure 9-62. The technique used for narrowing a plastic bridge when using a dowel rod.

Using the Hands Alone to Change Bridge Size

Many dispensers prefer to modify the bridge using only the hands. This preference is a personal one and may be due to the possibility of marking the frame or because of either a lack of or dissatisfaction with other tools. To change the bridge size using the hands alone, do the following:

Heat the bridge *only*. Leave the lenses in the frame and try not to heat any other part of the frame.

To widen the bridge, heat the bridge considerably and grasp the frame around each lens. Pull outward. With materials used today, it may only be possible to widen the bridge by ½ millimeter.

To narrow the bridge, heat and reheat the frame. That is, heat the bridge until it is very hot (but not so hot as

Figure 9-63. A bridge reducing accessory is available for staking sets. The accessory works on the same principle as the bridge-narrowing pliers. (Courtesy Hilco, Plainville, Mass.)

to bubble the plastic) and wait just a bit, then reheat it till very hot again. Repeat this several times. Set the frame down for about 10 to 15 seconds, and then reheat the bridge one last time. Now wait about 8 seconds before pushing the lenses together. Grasp the frame front by the eyewires, hold the frame against the midsection of the body for stability, and either push the eyewires together or pull them apart, depending on the modification desired.

The reason for heating and reheating the frame in this manner is so that the outer "skin" of the bridge will be cooler than the inside of the bridge. Now when the bridge is compressed, the center will bulge forward without wrinkling the outer surface.[3] When attempting to widen or narrow the bridge, take care to avoid simply pushing the lower sections together or pulling the bottoms of the eyewires apart (adding unwanted upsweep to the frame). This is especially important when the prescription has a cylinder compo- nent because the axis can be shifted. Recheck the cylin- der axis after changing the bridge to make sure that such a shift has not occurred. If none of these four methods work very well, there are ways to customize the frame that may do the job.

Changing the Bridge Size by Customizing the Frame The plastic frame can be customized in one of several ways. These methods are often more successful than those just described above. These customizing methods include:

Adding adjustable pad arms or a unifi t bridge. This is done by drilling and press fitting, or by using a Hot Fingers unit. (See “Retrofitting” Plastic Frames with Adjustable Nosepads, Chapter 10.)

Using build-up pads. The bridge on a plastic frame can sometimes be altered to fit an especially narrow or unusual nose by using build-up pads (Figure 9-64). Even silicone stick-on nose pads will cause a slight narrowing of the bridge. Both types of pads are attached to the area of the frame that would normally rest on the nose. For a complete explanation on how acetate or silicone build-up pads may be used to change both frontal and splay angle, and how they are applied, see the section entitled Replacing Nosepads on Plastic Frames in Chapter 10.

RECHECKING THE FRAME FIT

After completing the steps in fitting the frame as given in this chapter and as summarized in Box 9-2, recheck the following before considering the fit final.

1. Are the glasses at the correct height vertically?
2. Is one lens or one multifocal segment higher than the other, or are progressive lens fitting crosses directly in front of the pupils?
3. Is the pantoscopic tilt correct?
4. Are right and left vertex distances equal?

Figure 9-64. Silicone nose pads mounted onto plastic frames with adhesive or with small drilled holes will not only reduce slippage, but also slightly narrow the effective

width of the bridge.

Sample Questions:

1. **Discuss effects of increasing the Vertex Distance Only for Frames with Question Mark–Style Pad Arms?**

Extending the pad arms will increase the vertex distance between the lenses and the eyes. Here is the sequence of adjustments for pad bridges with question mark style pad arms:

Open the pad arm curl. Position the square-round pliers so that the square jaw is inside the pad arm

curl and the round jaw is outside. Open out the curl of the pad arm by compressing the jaws and rotating the pliers slightly (Figure 9-56, *A*). This adjustment increases the distance from the lens to the pad.

When a radical increase in vertex distance is necessary, it is possible to open the pad arm out completely (Figure 9-56, *B*). This is done by squeezing a section of it at a time, gradually moving the positions of the jaws closer to the pad while squeezing with the large part of the pliers near the pliers' throat until the pad arm is absolutely straight.

Replace the curl nearer to the pad. Flattening the curl of the pad arm, by whatever method, will turn the pad away from its proper angle so that its surface faces straight back, or nearly so. The pad arm will now require a new curl, which should be placed closer to the pad than it was previously. To put the curl in correctly, hold the square-round pliers vertically and grip the pad arm at the desired position of the curl. Position the round jaw so that it will be on the inside of the new curl (Figure 9-56, *C*). Using the round jaw as a pivotal point, rotate

the pliers until the pad reaches its proper position. Figure 9-56, *D* shows an example of how the pad arm should look when finished.

If difficulty is experienced in getting the curl to bend exactly at the desired place, it may be helpful to use a second pair of pliers as holding pliers. With these, the pad arm can be held firmly at a point approximately halfway between the pad and the point of attachment to the frame. This two-pliers technique is extremely useful for antique rimless mountings where bracing is necessary to prevent chipping the lens near the pad arm. It also allows the pad arm to be curled without inadvertently bending it at its base.

2. **Discuss effects of decreasing the Vertex Distance Only for Frames with Question Mark–Style Pad Arms**

Bringing the pads closer to the lenses will decrease the vertex distance. Here is the two-step sequence used to bring about this change for pad bridges with question mark style pad arms. (See Figure 9-57, *A* to see what the pads look like before starting the adjustment.)

3. Grasp the pad arm at its base with the round jaw toward the temporal side of the

frame (Figure 9-57,
B). Bend the pad arm towards the lens. This will throw the splay angle off (Figure 9-57, *C*).

4. Position the square-round pliers in the curl of the pad arm with the round jaw on the inside of the
curl (Figure 9-57, *D*). Tighten the curl by rotating the pliers around the round jaw. This should move the pad closer to the frame, correct the splay angle, and return the pad it to the original distance between pads.

When the adjustment is complete, the reangled pad should duplicate its original angle (Figure 9-57, *E*).

Unit 12:

Frame Repairs and Modification

Learning Objectives:
At the end of this unit students will be able to;

1. Frame repair and modification if needed by the wearer. Most necessary repairs will be minor, although occasionally a major job will be requested. Going hand in hand with repairs are modifications to frames that must be performed to make a frame fi t just right.
2. Learn methods and tips for performing these tasks as quickly and efficiently as possible while ensuring the quality of product.

This chapter provides methods and hints for performing these tasks as quickly and efficiently as possible.

SCREW REPLACEMENTS AND REPAIRS

Most major frame repairs require a lot of time. As a result, replacement of broken parts is usually more cost effective. Occasionally, however, a major repair can provide a vital service to a wearer if it enables him to continue wearing a much-needed prescription.
Minor repairs also take time but usually not more than would be expended in aligning a new pair of glasses. Perhaps, more important, is how much these repairs are appreciated.
This chapter begins with the two most common problems: screw repairs and pad replacements, followed by the third most common, temple repairs.

Correctly Using an Optical Screwdriver

When using an optical screwdriver, the screwdriver should *not* be held like a pencil (Figure 10-1). Instead, place the handle end in the palm of the hand, as shown in Figure 10-2, *A*. (Typically the end of the handle is made to rotate, making this technique work more smoothly.) Grasp the screwdriver, as shown in Figure 10-2, *B*. Now brace the frame on the edge of the work- bench (Figure 10-3) or on a bench block so that if (or rather *when*) the screwdriver slips, the sharp tip will not go halfway into your finger.

A Note on Screwdriver Types

There are many different types of optical screwdrivers available, from ones with brass shafts and no-roll handles, to others having large, round hardwood handles that fill the palm of the hand. There is also an ergonomic type shown in Figure 10-4 with a handle that can be bent to conform to the hand.
It can be tricky enough just to hold a tiny screw between thumb and forefinger. Getting it screwed into

the hole far enough to get started is even harder. Here are two options to help in this matter.

- There is a "pick-up" screwdriver with spring-loaded retractable jaws for holding small screws until they catch the threads in the barrel.
- Another option is a special screw-holding tool that grips the screw so that it can be more easily pressed into the hole (Figure 10-5).

Check to make sure that the blade of the screwdriver is in good condition. Damaged blades can damage screw heads. And regardless of what screwdriver is used, the blade size needs to match the screw. (Most optical screw- drivers have reversible blades with different widths on each end.)

Another helpful tool is a screw-lift tool. This is used after the screw is loose and ready to be removed. This tool is used to lift the screw from the hole without dropping and losing it (Figure 10-6).

Loose Screws

The constant opening and closing of temples sometimes turns the temple screw and loosens it. Although a loose temple does not necessarily affect the fit or stability of the glasses, most wearers would like to see the problem fixed. If the screw is loose and has not been fully turned, simply tighten it.

Sometimes even after tightening a temple screw, the temple may still be loose and floppy. In this case the temple barrels may need to be realigned. Realignment of temple barrels is discussed later in the Misaligned Hinge Barrels section.

Using a Sealant to Keep Screws Tight

One solution for a screw that continually loosens is to use a screw-locking adhesive sealant on the screw threads to hold it tight. A sealant does not just keep the screw from loosening. It also keeps it from corroding. A corroded screw will lock up over time, making removal difficult. Most optical suppliers carry these products.

Some prefer to use clear nail polish instead of a sealant, painting the head of the screw and the threads to prevent turning. This method is most successful on screws located in a recessed position (Figure 10-7).

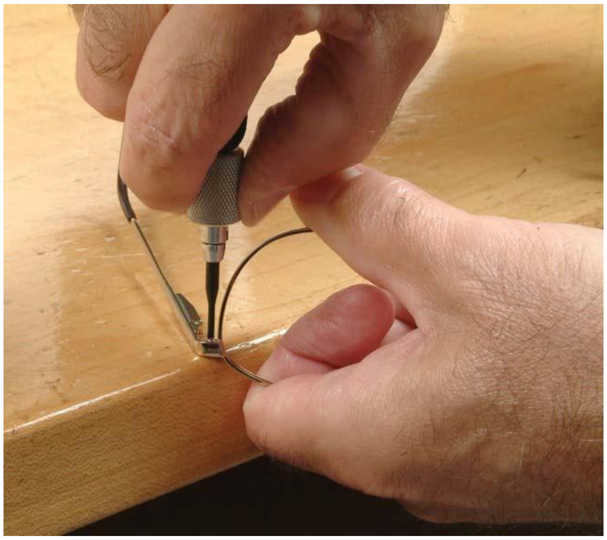
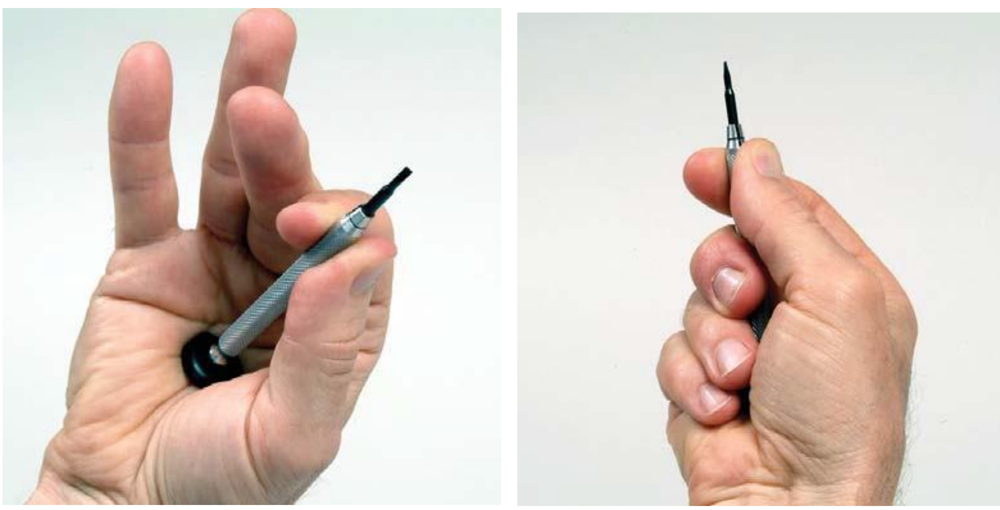


Figure 10-1. This is the wrong way to hold a screwdriver.

Figure 10-3. Safety first. Always brace the frame against something. Do not hold the frame so that when (not if, but when) the screwdriver slips, it will not penetrate your other hand.



A B

Figure 10-2. A, This photo shows how to grasp the optical screwdriver so that the rotating end of the handle is in the palm of the hand. **B,** With the handle end cradled in the center of the palm, grasp the optical screwdriver as shown.

Figure 10-4. There are a large variety of optical screwdrivers available, including this ergonometric one that bends to find the size and shape of the hand.

Figure 10-5. The screw-holding tool places the screw in hard-to-reach places where fingers cannot always go.

Figure 10-6. The screw-lift tool allows a loosened screw to be removed with less chance of being dropped.

Figure 10-7. Use clear nail polish to seal a tightened screw in place and prevent it from loosening up. This combination frame has an eyewire screw recessed under the top rim.

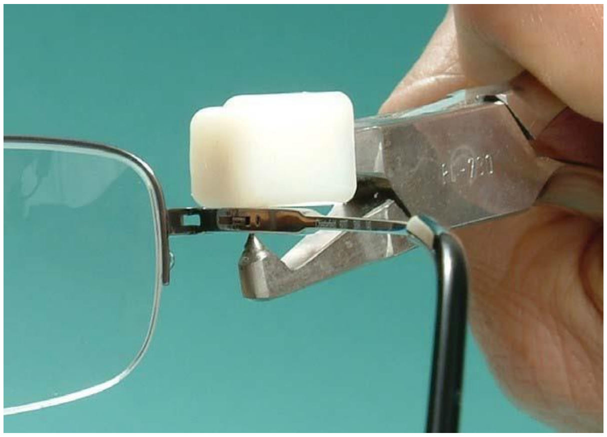


Figure 10-8. Flaring pliers will flare a rivet or screw tip to prevent it from backing out.

Peening Screw Tips to Keep Screws Tight

For temple screws whose tips protrude beyond the barrels, it is possible to put a rivetlike head on the end of the screw. This can be done in one of several ways including:

1. Tapping it firmly with the small end of an optician's hammer to keep the screw from backing out.
2. Using flaring pliers designed to flare out the ends of the screws and rivets (Figure 10-8).
3. Peening down the end using a staking set, such as the one shown later in the chapter in Figure 10-53, but with a concave-end peening tool.

Once the tip of the screw has been flared, it may later be necessary to file the tip to remove the screw.

Using Replacement Self-Locking Screws to Keep Screws Tight

Self-locking replacement screws have an epoxy type of coating on the threads that keeps the screw from backing

Figure 10-9. This type of self-locking replacement screw has an epoxy type of coating on the threads that keeps the screw from backing out. It is removable and can be used again. As would be expected, each time it is taken out and replaced, it loses some of its adhesive characteristics.

BOX 10-1

How to Keep a Loose Screw in Place

1. Use a sealant on the threads and in the barrel.
2. Use clear nail plish on the head, especially if the head is in a recessed area.
3. Flatten or peen the tip of the screw.
   a. Use an optician's hammer.
   b. Use fl aring (peening) pliers.
   c. Use a staking set with a peening tool.
4. Use self-locking replacement screws.

out (Figure 10-9). These screws can be removed and used again, as when an eyewire screw must be removed and replaced when changing prescription lenses.

The preceding methods of keeping screws tight are summarized in Box 10-1.

Other Methods Used to Keep Screws Tight

Some frames have built-in systems to keep the screws in place. These frames are designed with a small setscrew in the side of one of the barrels or with a small nut that grasps the tip of the protruding screw.

Optyl frames present a slightly different situation because many times the hinge area is protectively coated with Optyl material. To tighten, loosen, or remove a screw, the hinge area must be heated before the screw can be turned.

Replacement Screws for Spring Hinges

In many spring hinges, the screw holds the spring within the temple in tension. Because of this it is often difficult to line up the barrels on the endpiece with the barrel on the temple when replacing a temple screw. Unless some special tools or specialty screws are used, accomplishing a screw replacement may take more than two hands.

When attempting to insert a screw and turn it into place when the temple barrel is under tension, it is not uncommon to have the screw go in at an angle instead of straight up and down. If the screw is screwed in at an angle, it may cause the threads in the barrel to strip. In an effort to prevent this, Hilco makes a self-aligning spring hinge screw. This stainless steel screw is longer and has a tapered tip. The tip acts as a lead to align the hinge barrels (Figure 10-10). Once the screw is seated, the excess screw that sticks out can be snapped off with regular pliers; cutting pliers are not needed. The broken

Spring hinge screw

Figure 10-10. The spring hinge screw is tapered at the tip. This allows the screw to more easily slip into the small open area between the nonaligning temple and frame front barrel holes. (Courtesy of Hilco, Plainville, Mass.)

Figure 10-11. This picture shows that when spring hinge temples are placed on the frame front, their barrel holes do not line up. They do not line up because the spring in the temple is not stretched.end may be peened down with peening pliers or a staking tool for a neater look and more secure hold.

Once the screw is in place, flex the temple outward to see how good the action on the spring temple is. If it opens but will not spring back as it should, loosen the screw slightly. The tension of the tight screw may be holding it open. The use of lubricating oil, such as “3- in-1” may help in keeping the spring working well without sticking.

Spring Hinge Alignment Tools. Because of the diffi- culty of putting a spring hinge temple back on a frame while inserting the screw in the temple, several types of spring hinge alignment tools have been developed. Here is how to use one such tool.

Figure 10-11 shows how the barrels in the temple and frame front do not line up exactly. The spring in the temple is not stretched to allow the hole in the temple barrel to line up with the holes in the barrels on the frame front.

There are two parts to this particular spring hinge alignment tool. One part is a tiny “wrench” with a small tip on the end (Figure 10-12). The tip fits into the temple barrel hole to pull the barrel and extend the spring, as shown in Figure 10-13, *A* and *B*. (These two figures are for demonstration purposes only and are not a part of the screw replacement process.)

The second part of the tool is shown in Figure 10-14. It has a slide that will lock it in place after the tool has a grip on the temple. There is also the small “tooth” on the angled head of the tool. Here is the procedure:

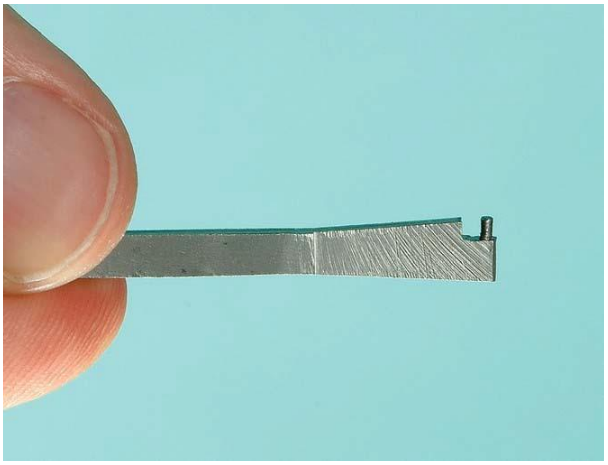
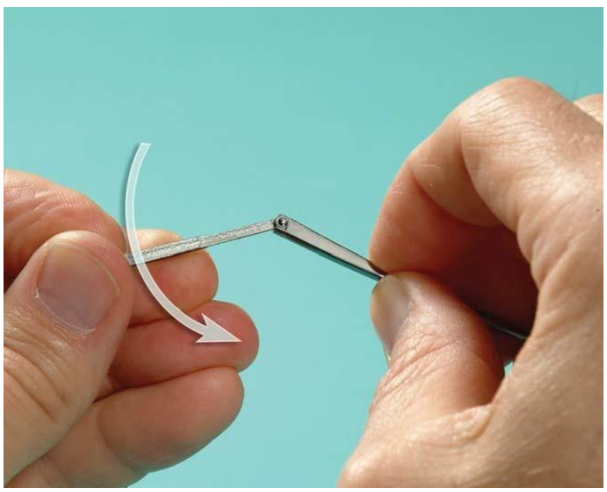


Figure 10-12. This is the "wrench" used with one type of spring hinge alignment tool. The small tip on the end slips into the spring hinge barrel.



A

Figure 10-14. This part of the spring hinge alignment tool grasps the temple. The "tooth" on the end will slip into the notch on a notched spring hinge casing and holds the spring in the extended position. For spring hinge casings without a notch (called flat front casings), the angled head of the tool holds the barrel in the extended position.

Figure 10-15. The temple is gripped with the spring hinge alignment tool, the "wrench" extends the barrel outward, and the "tooth" slips into the notch in the casing to hold the barrel in the extended position.

B

Figure 10-13. A, The "wrench" slips into the temple barrel and will extend the spring. **B,** Here the spring in a spring hinge temple has been extended. Note how far it has been pulled out compared with the previous figure.

1. Put the temple in the tool with the head of the tool behind the barrel and at

the front of the casing that surrounds the spring hinge.

2. Place the wrench in the barrel hole and extend the barrel (Figure 10-15). When the spring hinge casing is notched (as shown in the figure) the "tooth" slips into the notch. This holds the barrel in its extended position.
3. Hold the tool tightly and move the slide forward to maintain a solid grip on the temple (Figure 10-16).

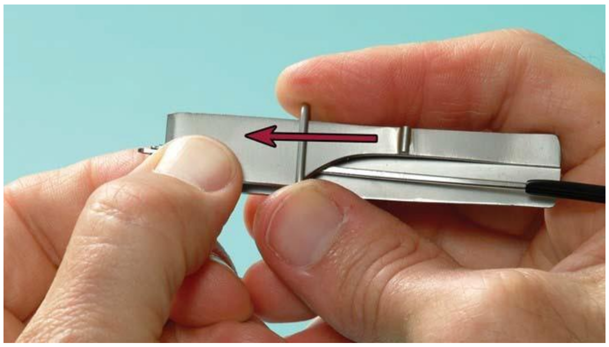


Figure 10-16. While squeezing the spring hinge alignment tool to keep the barrel extended, slip the slide forward so that the alignment tool will not open.

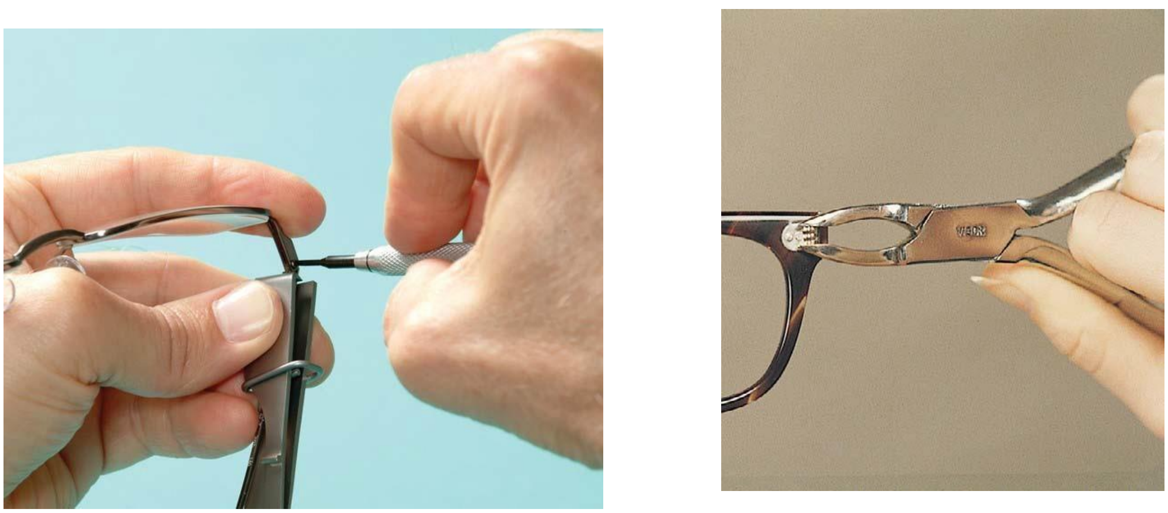


Figure 10-17. Now the temple will fit into the frame front, and all of the barrels will line up. The screw should now go in as if the frame had a normal temple barrel configuration.

4. Now the temple barrel can be slipped into the barrels on the frame front. They will line up as a regular temple would.
5. The screw may now be placed into the barrels and tightened (Figure 10-17).

(NOTE: Some casings do not have a notch. For this kind of temple, the angled head of the tool is used to grip the flat front of the casing and not the "tooth.")

Misaligned Hinge Barrels

When a temple is still loose even after tightening the screw, the problem may be that the barrels of the frame and temple hinges are mismatched. To correct this problem, remove the screw and the temple and note which hinge has the greater number of barrels (usually the front). Apply parallel-jawed pliers, such as hollow- snipe pliers, to this hinge. Compress the barrels of this front hinge to narrow the spaces into which the barrels of the other hinge fit (Figure 10-18). Take care not to compress the barrels too much; otherwise they must be

Figure 10-18. Compressing the barrels together somewhat to help tighten up a loose temple is best done with pliers whose jaws are parallel when open. In this instance, hollow snipe- nosed pliers are being used.

pried apart (sometimes breaking a barrel off) before the other part of the hinge can be returned to position.

In some instances this compression can be performed with both hinges in place, actually allowing the barrels to be fitted together while in position. This, however, is usually more difficult.

Replacing a Missing Screw

The most difficult aspect of replacing a missing screw is finding the right sized replacement. Fortunately the industry is gravitating to a common screw diameter of

1.4 mm and a length of 3.0 to 4.0 mm.

Table 10-1 shows the most common sizes of currently used replacement screws for regular spectacle frames, quality sunglasses, over-the-counter sunglasses, nose-pads, and trim.

For the more unusual sizes, Hilco makes a Fast-Find Screw and Hole Gauge Kit that includes two gauges and a booklet or chart with numerous pictures and dimen- sions of screws. These gauges allow one to easily match an existing screw or quickly find the dimensions of a missing screw using the frame.

To find the size of an existing screw, measure the diameter. This is done by putting the screw through the presized holes on the rulerlike device, as shown in Figure 10-19. Next, measure the overall length of the screw, including the head, using the slots on the same device.

To find the length of a missing screw, use the slots on the ruler-type device to measure the depth of the barrels as shown in Figure 10-20, compensating an additional amount for the screw head. To find the diameter of the missing screw, use the round, spoked tool. Each spoke has a different diameter. These spokes are inserted into the empty barrel of the frame to find the unknown diameter, as shown in Figure 10-21.

TABLE 10-1

Common Replacement Screw Diameter Sizes for Spectacle Frames

Type of Screws	Most Common Replacement Screw Size
Screws for regular spectacle frames, including both hinges and barrel-closing screws	1.4 mm
Screws for quality sunglass frames	1.6 mm
Screws for cheap, over-the-counter sunglasses	1.8 mm
Screws for nosepads	1.0 mm (If this will not fit, a 1.1-mm or 0.8-mm diameter will)
Screws for spectacle frame trim	1.2 mm, 1.4 mm (sometimes 2.0 mm) (lengths from 2.9 mm-3.6 mm)

Data obtained from Woyton R: “How can I find a replacement screw quickly when a customer comes in with a frame that needs one?” Hilco, Plainville, Mass, undated.

Figure 10-19. To find the diameter of the screw, slip the screw through each hole until a match is found. Incidentally, this 1.4 mm diameter is the most commonly used diameter for optical screws.

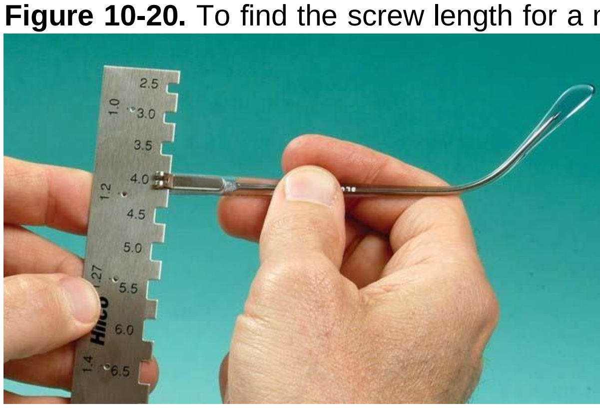


Figure 10-20. To find the screw length for a missing screw, measure the depth of the barrels and compensate an additional amount for the screw head. (Note: In other areas of industry, the head of the screw may not be included in its length.)

Finding a Screw From Inventory

One of the more frustrating aspects of screw replace- ment is just finding a matching screw. Without an orga- nized system, the dispenser is reduced to searching through a tray or jar full of extremely small screws, all of which begin to look like one another. A person with

Figure 10-21. To find the diameter of a missing screw, slide the different sized spokes of the hole gauge through the barrels until the correct fit is found.

a gift for organization can generate their own system of vials or drawers. Or one can buy a system that has the most commonly needed parts, such as the one shown in Figure 10-22, and replenish it as necessary.

Titanium Screws

Because titanium is so strong, the threads on a titanium screw do not give. So if a titanium screw enters the barrels at even a slight angle, it will bind. If this happens, do not force the screw. Just back the screw out and start over. If it continues to bind after several attempts, put a drop of cutting oil into the barrel. (In the absence of cutting oil, which works best, use household oil such 3-in-1.)[1]

Broken and Stuck Screws

Sometimes a screw will not come out or breaks off in the barrels of the frame. Suggestions on how these problems may be corrected are outlined here and summarized in Box 10-2.

Removing Stuck Screws

If the entire screw is still in place but cannot be turned with a screwdriver, either the screw may have corroded

Figure 10-22. Much searching time will be saved if an orga- nized system for storing small frame parts is in place. This is a commercially available example of a stackable system that can be added to as needed.in the barrel or the screw slot may have been destroyed.

If corrosion is the problem, the screw can be loosened by immersing the affected area in an *ultrasonic cleaner* (Figure 10-23) or by treating it with a *penetrating oil* (Figure 10-24).

Some dispensers remove frozen screws by supporting the tip of the screw on the edge of a small anvil or vise. After placing an optical screwdriver in the screw slot, the *screwdriver is gently tapped with a hammer* once or twice, breaking corrosion or adhesive. (This method may require three hands.)

One idea for removing screws that have been previously bonded in the barrels with an adhesive is to *use a soldering iron set on low*.* The iron is held on the tip of the screw for 10 to 20 seconds until the hardened adhesive melts, allowing the screw to be removed normally. (Caution: Do not use this method on plastic frames.)

The Hot Fingers unit works just as well as a soldering iron, if not better. Grasp the top and bottom of the screw with the Hot Finger tips (Figure 10-25). Heat the screw for 10 to 15 seconds. The metal expands when heated and contracts as it cools, helping to break the screw loose. The high heat also burns away any remaining adhesive. (Caution: Do not use this method on a plastic frame.)

To make both the soldering iron and Hot Fingers work even better, as soon as the screw area has been

Figure 10-23. Ultrasonic cleaners will loosen frame screws while the frame is being cleaned. This can be used to advan- tage in loosening an especially stubborn screw.

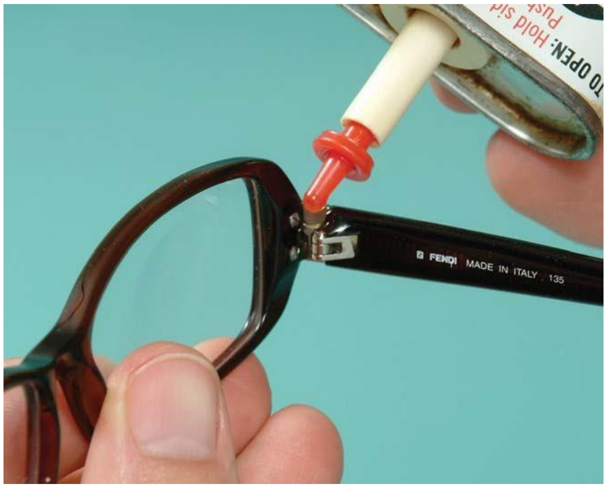


Figure 10-24. Penetrating oil, such as “Liquid Wrench” auto- motive penetrating oil, helps cut corrosion and loosen stuck screws.

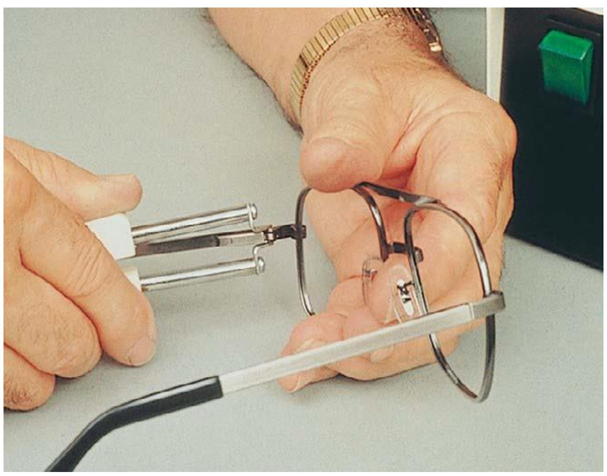


Figure 10-25. A soldering iron or Hot Fingers unit held on the tip of a previously sealed screw will often allow the screw to be removed normally. (Courtesy Hilco, Plainville, Mass.)

heated, quickly put a drop of oil on the screw. The heat thins the oil, and the oil is drawn between the threads, dissolving corrosion and lubricating the interface.[2] If neither a soldering iron nor a Hot Fingers unit are avail- able, even heating the screw area with a frame warmer and then applying oil should help.

If the slot of the screw has been worn away, use a *flat slotting file to restore and deepen the slot* so the blade of the screwdriver can again turn the screw (Figure 10-26). If the slot is widened and damaged, try filing a new slot in the screw head. The new slot should be at right angles to the original slot.

If the screw is so corroded that it cannot be loosened and removed by any of the above methods, it can be punched out. This is done with *a small hand pliers* vari- ously called “punch-out,” “knock-out,” or “shoot-out”

Figure 10-26. When the slot in the head of a screw has been destroyed, a new one can be created using a thin file known as a slotting or ribbon file. (It is sometimes possible to slot the tip of a broken screw as well. This allows a screwdriver to be used to turn the remaining part of the screw out of the bottom of the hinge.) (Courtesy Hilco, Plainville, Mass.) pliers that will punch out broken and stripped screws. (The pin in the pliers is replaceable.)
It is also possible to *drill the screw out*. This is described in the following section.

Removing Broken Screws
Occasionally a screw will break into two parts. The head can easily be removed if the slot is still usable, or it may fall out by itself. The other part of the screw remains stuck in the barrels.
The best tool for this job is a *screw extractor* (Figure 10-27). This device resembles a screwdriver, but has a barbed end that digs into the stem of the screw and turns it. The extractor comes in a variety of sizes to suit the variations in screw diameters.
To use a screw extractor, attack the screw from the bottom (Figure 10-28). Apply hard downward pressure. If the broken-off portion remaining in the barrels is long enough, turn the screw clockwise. This will drive the screw out through the top barrel. If the broken-off portion is not long enough to go back out the top, turn the screw counterclockwise to bring it on out of the bottom. Hint: The screw extractor tip can be mounted in a Dremel tool having a standard Jacob's chuck or in a hanging drill. (The Hilco Hanging Motor Drill is shown in Figure 10-29. The extractor mounted in the chuck of the drill is shown in Figure 10-30.)
There is a device called the Bull's-Eye Screw Extrac- tor (Figure 10-31), which can be very helpful and remove the screw without having to drill it out. This exerts a large amount of turning power in a controlled manner.

Figure 10-27. In a set of screw extractors, each extractor insert has two tips of different sizes. The extractor tip may be reversed in the same manner as with a two-

ended screwdriver blade.

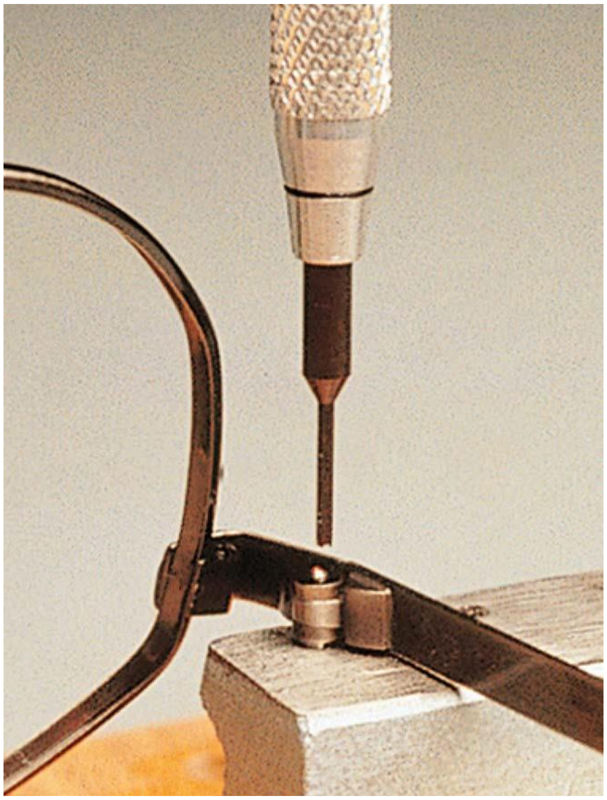


Figure 10-28. A screw extractor is used to gouge and grasp the tip of a broken-off screw so that it may be turned. (Cour- tesy Hilco, Plainville, Mass.)

Figure 10-29. A drill with a hanging motor allows for more flexibility. It can be used for purposes other than drilling. Pictured here are attachments for grinding, sanding, cutting, and polishing. (Courtesy Hilco, Plainville, Mass.)

If this tool is unavailable or cannot be used and if a portion of the screw protrudes at the end, use the *slotting or ribbon fi le* to make a slot in the tip of the screw and then turn the screw out with a screwdriver.

If none of these methods work, it may be feasible to *drive out* the remaining portion of the screw.

If all else fails, *drill out* the screw or its remaining portion (Figure 10-32). Use a drill bit slightly smaller than the diameter of the screw. Most screws in hinges and closing barrels are 1.4 mm in diameter. The drill size most commonly used for these screws is a 0.0430 (No. 57) bit.

Drill from the *bottom* of the screw. (The lower portion of the barrel is the threaded portion.) The conventional way of drilling starts by filing the screw flush with the barrel. Make a punch mark in the center of the screw to act as a guide in drilling. Center the drill carefully on the screw so as not to drill away the metal of the barrel surrounding the screw. Drill the screw out slowly, drill- ing and pausing to keep from overheating and ruining the drill bit. Always use a cutting or a household oil as a lubricant and/or coolant when drilling.

There is a drilling guide made special for the purpose of keeping the drill bit on course so that it drills just the screw and not the hinge next to the screw. This is called the *Bull's-Eye Screw Drilling Guide.* The guide is clamped to the barrels with the bottom jaw of the guide over the head of the screw (if the head is still there). After clamped in place, put a drop or two of oil into the top of the guide. Use a 0.043 (No. 57) drill bit. The drill bit fits into the top of the drill guide, as shown in Figure 10-33 and drills out the screw.

The threads are destroyed whenever a drill bit or punch pliers is used to drive out a screw. *Use a tap to*

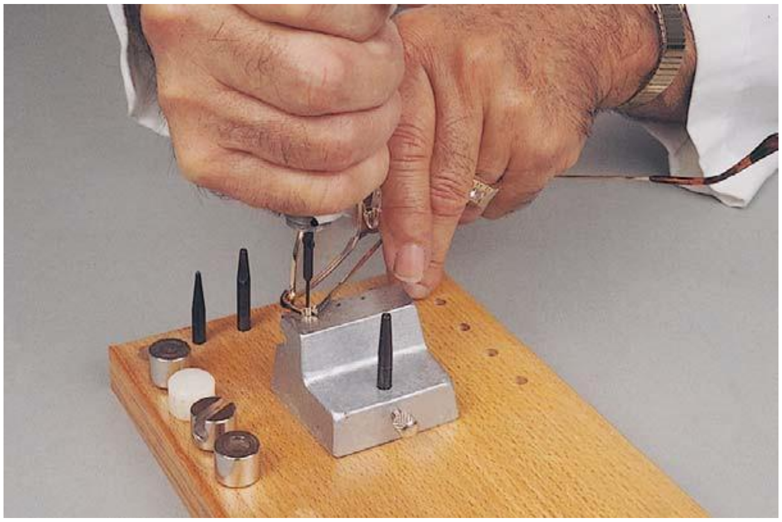


Figure 10-30. Mounting a screw extractor blade in a drill will allow extra torque to be applied when trying to remove a broken-off screw. (Courtesy Hilco, Plainville, Mass.)

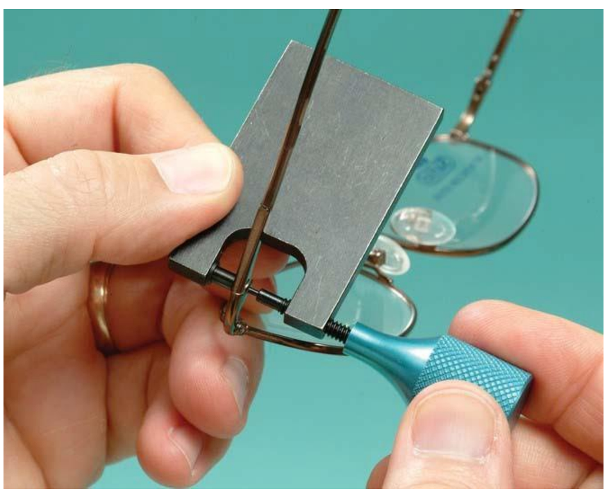


Figure 10-31. This simple device will place a lot of pressure on a broken-off screw

and accomplish the same thing that a regular screwdriver-like screw extractor may not be able to do. *restore the threads* (Figures 10-34 and 10-35). The tap can be either regular or oversized, depending on the hole drilled. A standard screw can be reapplied if a regular tap is used, but a special oversized screw must be used if an oversized tap is used.

When a tap cannot be used to restore the threads or is not desired, here are two alternatives:

1. *Use a self-tapping screw*. (This is explained in more detail in the next section.)

Figure 10-32. A hanging motor drill is used to drill out a broken screw. The frame is being braced against an optician's anvil.

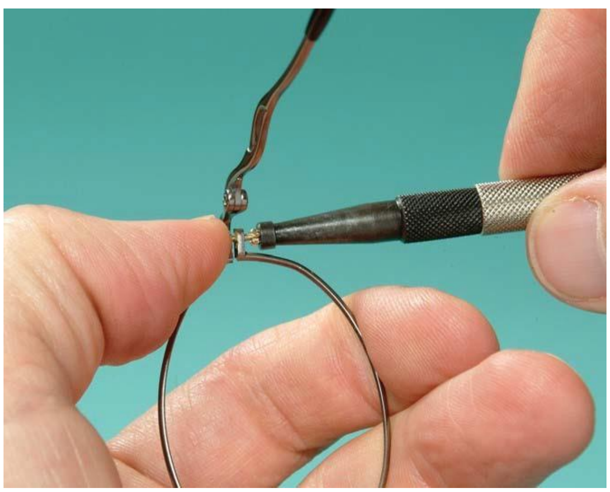


Figure 10-33. The Bull's-Eye Screw Drilling Guide is clamped to the screw. The drill is guided exactly onto the screw by going through a hole in the drilling guide.

Figure 10-34. A tap is a screw threader. It is held in a chuck with a handle. Threaders of varying size may be mounted in the chuck. The same handle can be used to mount a small drill bit for hand drilling plastic.

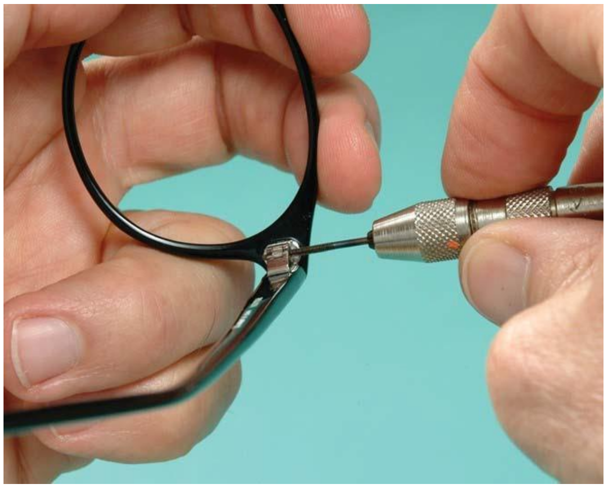


Figure 10-35. Using the tap to restore the threading involves nothing more than turning the tap clockwise into the barrels.

Figure 10-36. A "glass" screw and hex nut will serve when rethreading is no longer feasible. It is not always an attractive option. Look at the construction of the frame to see whether the nut should be at the top or bottom. The position that conceals the nut best is the preferred choice.

Figure 10-37. A self-tapping screw cuts its own threading. After the screw is fully in place, the excess is broken off with pliers. (Courtesy Hilco, Plainville, Mass.)

2. *Use a longer boltlike screw, often referred to as a glassscrew,* in combination with a hex nut* on the end to hold it tight (Figure 10-36).

Glass screws are longer than temple screws. They were made to pass through thick lenses and hold them in place in a rimless mounting. While tightening such a screw with a screwdriver, hold the hex nut with a hex wrench. Clip off the portion of the screw that protrudes beyond the hex nut and file the end of the screw smooth to the surface of the nut.

Self-Tapping Screws

Self-tapping screws offer a simple alternative to rethread- ing (Figure 10-37). In most cases they are superior to using glass screws with hex nuts.

Self-threading screws are longer than common screws. After being screwed into place, any excess length extend- ing beyond the end of the barrel should be removed. Self-tapping screws are not cut off with cutting pliers,

*Glass screws are, of course, not made of glass, but were used to mount a lens in a rimless mounting. Because the screw went through a glass lens, it is called a “glass” screw.but snapped off using regular pliers, such as flat-round or needle-nose pliers.

When replacing screws with an oversized or a large self-tapping screw, make sure the screw will freely pass through all the upper barrels that are not supposed to have threads in them. If the self-tapping screw is too

large, it can break off before it is screwed in all the way, forcing the dispenser to start the process from the begin- A

ning. If the screw is too big to pass through the upper barrel, it is possible to enlarge the hole with either a drill bit or a rattail file.

Replacing Rimless Screws

Sometimes a screw that holds the lens in place in a rimless mounting will break, loosen, or have to be replaced. There are a large variety of mounting methods for rimless eyewear, making it difficult to describe repairs on every conceivable type. However, when lenses are held in place with screws, there are three basic types of

assemblies. Each of these assemblies has more than just B

a screw with a nut. There are a combination of bushings and washers that protect the lens surfaces and remove some of the stress from the screw and nut.

Here are the basic components commonly used in the rimless assembly:

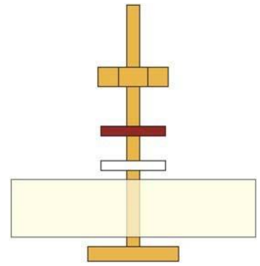
- *A screw*— The screw must be long enough to go

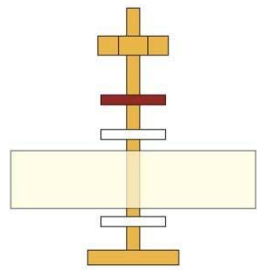
through the mounting and full thickness of the lens. The thickness of the lens varies, so after assembly the screw is cut off flush with the nut and filed smooth.

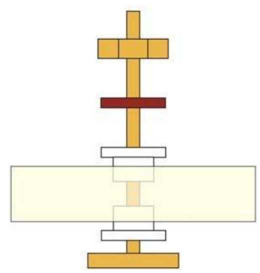
- *A nut*— The nut used can be either a hex nut or a star nut. The hex nut is screwed on to the screw with a nut driver (hex wrench); the star nut requires

a star nut driver. C

- *Washers*— There are both nylon and metal washers







Screw or other hardware used. The nylon washer goes up against the lens surface and cushions the lens. The metal washer is the last thing between the nut and the rest of the assembly. The metal washer stabilizes the stress around the holes and acts as a barrier between the nut and the softer nylon washer or bushing surface.

- *Bushings*— Bushings are small, hollow cylinders that fit into the hole in the lens. The screw passes through the bushing instead of directly through the lens and cushions the lens. “Top hat” bushings are commonly used for rimless assemblies. These have a “rim” on the bushing that both holds the bushing in place near the surface of the lens and works like a nylon washer. Top hat bushings are the type of bushings normally used for rimless mountings.

Figure 10-38 shows how three common rimless screw assemblies are put together using these components. *Note:* Even if the existing assembly on the wearer's old frame was put together with only a screw and a nut, when making a change, add a nylon washer between the lens and the nut. Better still, use a nylon bushing to protect the lens from the screw.

Figure 10-38. Here are three basic rimless assembly designs that might be used. Which is used will depend upon the frame design. Some designs use an entirely different method of securing the lens in place. **A,** A simple rimless screw assembly consists of a regular or decorative screw, a nylon washer on the back to protect the lens, a metal washer to stabilize the stress areas, and the nut. The nut may be a hex or a star nut. **B,** A common assembly cushioning both the front and back of the lens with nylon washers. **C,** Top hat bushings replace nylon washers, protect the hole in the lens, and add stability to the assembly.

NOSEPAD REPLACEMENTS

There are many different types of nosepad assemblies. The screw-on and push-on type nosepad assemblies are the most dominant. Every eyecare professional must carry both versions. The most common types are described here. Some of the more uncommon and antique styles are discussed in Appendix 10-A at the end of this chapter. These include clip-on, twist-on, Zeiss bayonet, split-clamp, stirrup, and rivet types.

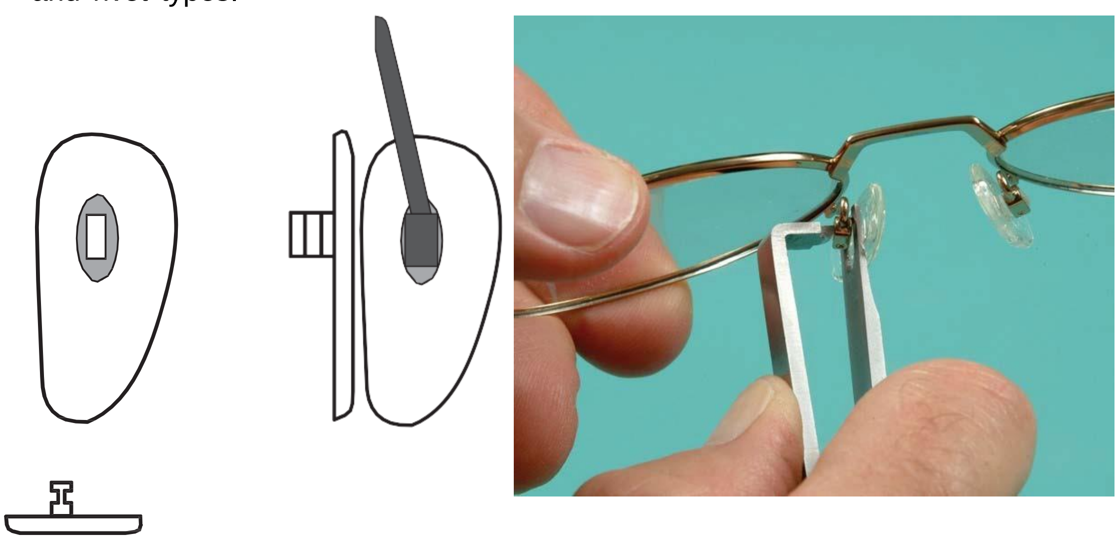


Figure 10-39. The *push-on* nosepad design slips into an indented box on the pad arm.

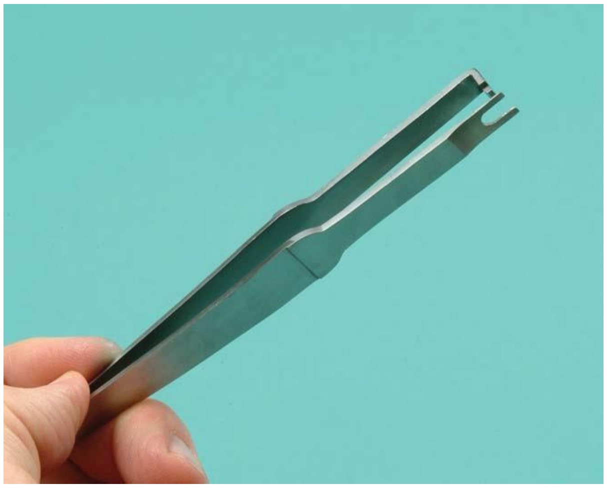


Figure 10-40. A pad popper is used to remove push-on pads without affecting the pad arm alignment.

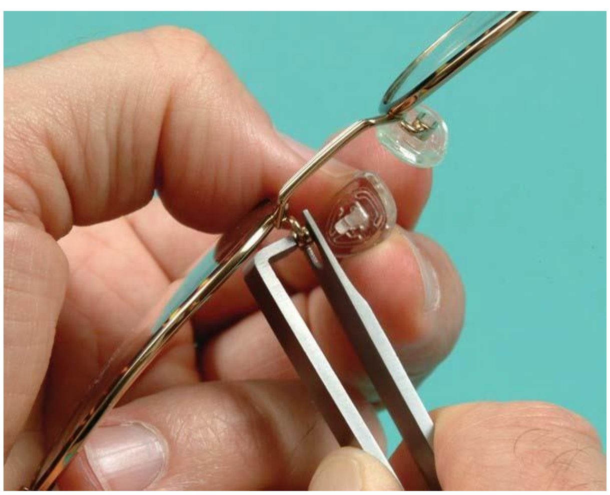
Push-On

The *push-on pad* is one of the easiest pads to remove and replace. It has a small I-beamlike shape that snaps into an indented box on the pad arm (Figure 10-39). The part of the pad that slips into the box may be either metal or hard plastic.

Although a push-on pad can be removed without the aid of tools, it is possible to use a small device called a *pad popper*. This device is slipped between the pad and the pad arm attachment, as shown in Figures 10-40 and 10-41.

There are pliers specifically designed to aid in attach- ing a push-on pad to the pad arm. Known as *Push-On Pad Pliers,* they have a curved nylon jaw on one side that cradles the pad face and a flat, metal jaw on the other side to hold the pad arm in place.

A



B

Figure 10-41. A, The thin edge is slipped between the pad and the pad arm. **B,** The back of the pad has been pressed out of the box on the pad arm.

If a push-on pad will not stay in the box securely, use a pair of pliers to squeeze and narrow the horizontal dimension of the box slightly.

Screw-On

The *screw-on type* of attachment has a small post on the back of the pad with a horizontal hole in the post. The post slips into either a boxlike assembly or a rounded piece on the pad arm (Figure 10-42). A screw is threaded from one side of the box to the other, passing through the hole in the pad post. The screw is so small that a special screwdriver is usually required.

The greatest problem with the screw-on pad design is having a properly fitting replacement screw available. If someone has the unmounted pad but not the screw, it may be difficult to find a suitable replacement screw. The most common nosepad screw diameter is 1.0 mm. If this

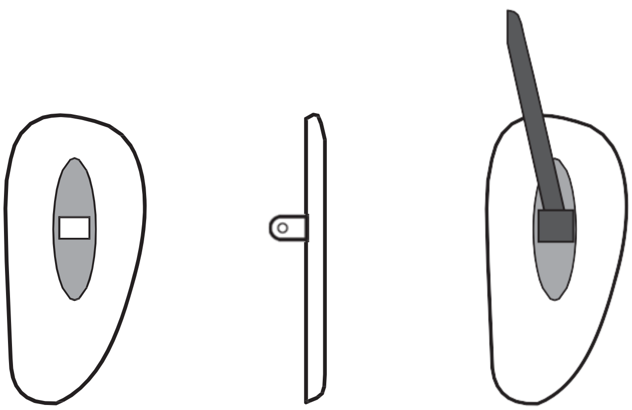


Figure 10-42. The *screw-on* pad design requires a small screw to secure it to the pad arm.

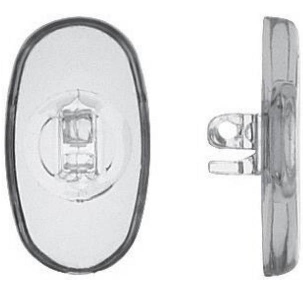


Figure 10-43. This Logic nosepad serves as a replacement for either the screw-on or the push-on type of nosepads.

screw is too small, a 1.1-mm screw should do the job. Since most companies list screw diameters, getting to know the most common sizes can really be helpful in finding replacement screws.

As a last resort, if no replacement screw is available, the nosepad can be temporarily "tied" on using the same type of nylon line as is used to "string mount" lenses. The excess line is cut off using cutting pliers or a razor blade.

Logic

There is a specialty replacement nosepad with an insert that fits both push-on and screw-on types of pad arms. This pad, called the Logic pad, comes in round or oval shapes and is symmetrical, making left and right pads interchangeable. This reduces the need to keep as many pads in inventory (Figure 10-43).

Pad Sizes

Pads are manufactured in various sizes. Sizes can be changed to match the nasal area available or to increase the bearing area when the pressure from the weight of the frame on the nose is too concentrated. Oval pads measuring 13, 15, 17, and 20 mm in their vertical axes and round pads measuring 9 and 11 mm are the most common sizes, though other sizes are available.

Types of Pad Materials

Replacement pads are available in a number of different materials, having more or less flexibility. Here are the three most common materials:

- ***Acetate pads—*** Pads made from cellulose acetate material (sometimes just called acetate) are hard and do not flex. Cellulose acetate is the same material used for a great many plastic frames.
- ***Vinyl pads—*** There are also pads made from a soft, vinyl material. Although these pads are flexible, they do not "grab" the nose, but will slide on the nose more easily than a silicone pad.
- ***Silicone pads—*** Silicone pads do not have a tendency to slide down the nose, even when perspiration or skin oil are present. This is not to say that the pads do not slide at all, but rather they slide much less. Although this is advantageous, it may irritate some people's skin because they may feel a pulling sensation on the skin. If an individual complains that the nosepads seem to pull and irritate the skin, it may be helpful to switch to an acetate or vinyl pad. (The wearer should, of course, be made aware that the glasses will slide more easily. The solution is a trade-off.) Silicone pads come in a "soft silicone,"

"firm silicone," and "flex silicone." The softness or firmness of the pad does not depend on the basic material, but rather on the mounting insert that is molded into the silicone pad. Soft silicone pads have a small metal mounting inside the pad, whereas firm silicone pads have a metal insert imbedded in a nylon core within the pad. Flex silicone pads do not have a metal insert, but rather a thin nylon core.

Hypoallergenic Nosepad Materials

There are wearers who are sensitive to standard nosepad materials, such as silicone, vinyl, and acetate. Some pads may also contain latex or other materials that cause an irritation around the nasal area. Here are some options that usually satisfy these wearers:

- *Gold-plated metal pads*— There are pads made from gold-plated nickel silver. The gold plating comes in yellow-gold (gold colored) or white-gold (silver colored) and, although nickel is problematic if directly against the skin, the gold plating becomes a barrier that prevents an allergic skin reaction.
- *Titanium pads*— Titanium is extremely well tolerated by those with skin allergies. These nosepads are made of 100% titanium.
- *Crystal pads*— There are pads made of crystal. These look more like regular nosepads and solve the problem of allergic reactions.

Replacing Adjustable Pads with Strap Bridges A *strap bridge* is like two adjustable pads whose tops are linked together with a “strap.” The strap is of the same

Figure 10-44. A *strap bridge* replaces two adjustable pads. It distributes frame weight over both the traditional nosepad areas and across the crest of the nose. The flexibility of the material allows both pads to still be adjusted separately.

material as the pads and is really an extension of them; the pads and strap are one unit (Figure 10-44). A strap bridge increases the pad bearing area to include the crest of the nose. Strap bridges are attached to the pad arms in exactly the same manner as are adjustable pads. They are also fit to the nose in the same manner. Since the whole piece is flexible, left and right halves adjust independently.

TEMPLE REPAIRS

Replacing Missing or Broken Temples

If a pair of glasses has an irreparably broken temple, it must be replaced. The first choice is to replace it with a new, identical temple. Unfortunately a new, matching temple will not always be available. The frame style may have been discontinued, and it may be impossible to obtain a matching replacement.

Replacing With an Old Temple

Most dispensaries keep a selection of old temples that can be used for temporary replacement purposes. The most difficult task is to find a temple that both looks good and has a hinge with a barrel configuration that matches the frame front. If no match is found, it may be feasible to modify the temple barrels. The end result may be less than ideal but functional.

For example, suppose one barrel is a single, thick barrel and slightly large for the other two matching barrels. In such a case, it may be possible to file either or both the top and bottom of the large, single barrel down so that it fits into the smaller space between the other two barrels.

Eyeglass frame temples come as either a right or a left. Sometimes a left temple is necessary and all that is avail- able is a right temple. For some hinges, it is possible to mount the right temple on the left side, or vice versa. If this is done, the bent-down portion will turn up instead of down. If the temple will look acceptable, heat the temple bend and bend the earpiece down.

Replacing from a Set of Replacement Temples

A variety of plastic and metal replacement temples can be purchased through an optical accessories supplier. To ensure that the temple will match the front, the butt portion of the temple is longer than necessary. This portion is cut off at the proper angle with a file or coping saw. The angle will depend on the type of endpiece or temple abutment as seen in Figure 1-16.

Replacing the Plastic Earpiece Coverson Metal Temples

Most metal temples are made so that the end of the temple is plastic covered. This allows for greater comfort. If the plastic temple cover becomes damaged, it may be replaced. Plastic replacement temple tips come in a large variety of colors and shapes. They are also available in silicone material to help decrease slippage. The most popular core diameters are 1.4 mm and 1.6 mm.

To replace a temple tip,[3] heat the plastic end of the temple, straighten it out completely, and pull the plastic cover off.

Determine the size of the metal core by measuring or using actual-size diagrams provided by the manufac- turer of the replacement tips. (One way to quickly find the diameter of the core wire is to use the same type of gauge used to measure screw diameters.) Match the shape and color of the tip as closely as possible.

Push the replacement tip onto the metal core. (If the core is round instead of rectangular, it is easier to use a back-and-forth twisting motion to get the replacement tip on the temple.) It may be necessary to heat the replacement tip.

The temple may now be rebent so that the bend is just posterior to the top of the ear as described in Chapter 9.

Adding Covers to Cable Temple Earpieces

Some people who need cable temples may be bothered because they find the cable uncomfortable or because they have an allergic reaction to the metal cable. An allergic response is usually caused by the nickel content in the frame material. Signs of this reaction are a rash behind the ear or the cable turning green.

It is possible to cover the end of a cable temple with a plastic cover. Covers for cable temples are available through optical supply houses. They come in plastic, vinyl, and silicone materials. There is also "heat-shrink" tubing sold for this purpose.

Shrink tubing is a simple solution to covering the end of a cable. The inside diameter of a heat-shrink temple cover is larger than the diameter of the cable temple. To apply this tubing, do the following:

A B C

Figure 10-45. It is possible to cover the end of a cable temple with heat-shrink cable tip covers. Find the correct diameter, cut to length, and slip over the end of the cable temple, as shown in **A**. Heat using a frame warmer on the highest setting, as shown in **B**. Heat-shrink cable tips tighten up snugly, as seen on the temple shown in **C**. (Courtesy Hilco, Plainville, Mass.)

1. Determine the diameter size of the shrink tubing needed so it will slip over the end of the cable.
2. Measure how much length is needed. (Allow 10% over the measured length to allow for shrinkage.)
3. Cut a strip to length and slide the cover over the end of the cable temple (Figure 10-45, *A*).
4. Heat both temple and cover with a hot air frame warmer at the hottest setting (Figure 10-45, *B*) until the tubing shrinks to fit the temple snugly (Figure 10-45, *C*).
5. Trim off any excess material.
6. Heat the trimmed area to smooth the edges.

Covering the Temples to Reduce AllergicReactions

If a wearer has an allergic reaction to the temple along the side of the head, the frame may be sent out to a frame repair center to be entirely coated.

A second option is to use clear, ultrathin shrink tubing that places a thin, clear barrier over the temple. This is done by sliding the tubing over the temple and then heating both tubing and temple with a hot air frame warmer.

Lengthening and Shortening of Metal Temples Metal temples usually come with bent-down portions that have a metal core, but a plastic outer portion. These types of temples are unique in that they may be short-
ened or lengthened beyond what would be expected.

To lengthen—Sometimes the desired frame is not made with temples that are long enough for the wearer. Even if the bend is moved by heating and rebending, there is insufficient length for a suitable fit. If this is the case, there are two alternatives:

1. The first alternative is to heat and straighten the temple. Then pull on the temple cover as if to remove it, but only let it slide off part of the way. For example, if the temple is 5 mm too short, pull the temple cover so that it slides 5 mm out. Now rebend the temple so that it is of the proper size.

Figure 10-46. Resizing a metal temple using plastic temple tip sizers is no harder than simply replacing the plastic ends. All three of these temple ends will interchange to fit the same temple. (Courtesy Hilco, Plainville, Mass.)

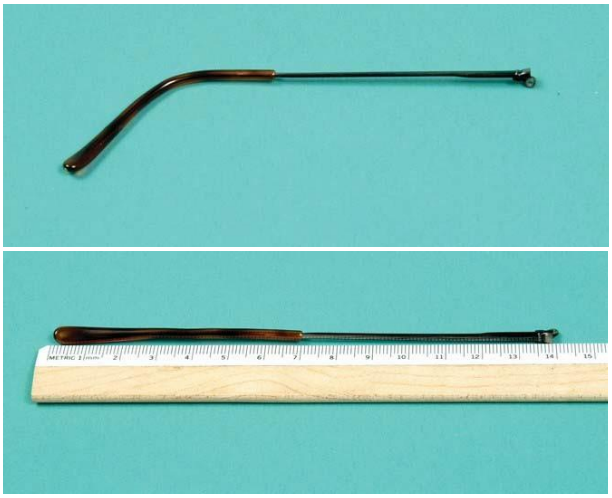
This method does not provide as much support and makes the end of the temple weaker than it would be otherwise.

2. The second alternative is to replace the plastic temple ends. Optical suppliers have temple sizer kits that will allow adding 5 to 15 mm in length to the size of a metal temple just by changing the plastic temple ends (Figure 10-46).

To shorten—If the temple is too long (Figure 10-47, *A*) and cannot be made sufficiently short by moving the temple bend, the temple must be shortened. To shorten the temple, heat the temple end, straighten it (Figure 10-47, *B*), and pull the plastic cover completely off. Clip off the end of the metal core (Figure 10-47, *C*). (The amount clipped should equal the amount the temple must be shortened.) Slip the plastic cover back on; it will now go on farther than it did before, making the temple shorter (Figure 10-47, *D*). Complete the adjustment by rebending the temple to the appropriate length.

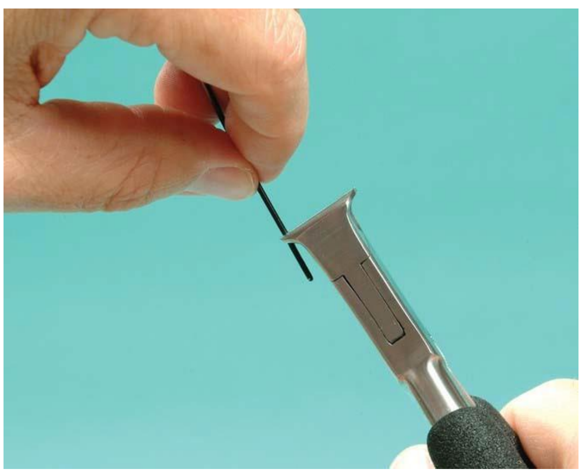
Sometimes it is necessary to file down a temple “shoul- der” if the cover will not go on past the shoulder without splitting. (That part of the metal temple that is still flat, just before the temple narrows down to a small, round diameter, is called the shoulder.) If this is the case, file either or both the top and bottom of the shoulder

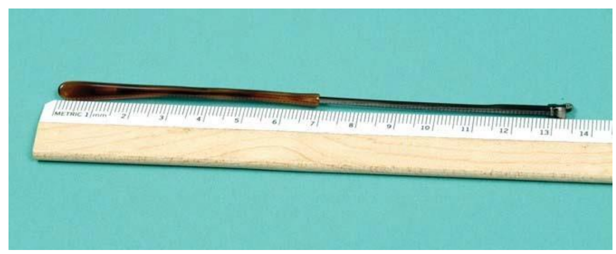
(Figure 10-48). The shoulder must be thin enough to allow the temple cover to slide all the way up without splitting.



A

B





C

Figure 10-47. Sometimes just moving the location of the bend will not make a temple short enough without leaving an excessively long and unsightly bent-down portion. **A,** Metal temples with plastic temple ends, such as the one shown, can be shortened another way. **B,** To shorten this type of temple, the bend is straightened, and the plastic cover pulled off. This temple has an overall length of 145 mm. **C,** Once the plastic cover is removed, the tip of the metal core is clipped. **D,** The temple cover is replaced and is measurably shorter.

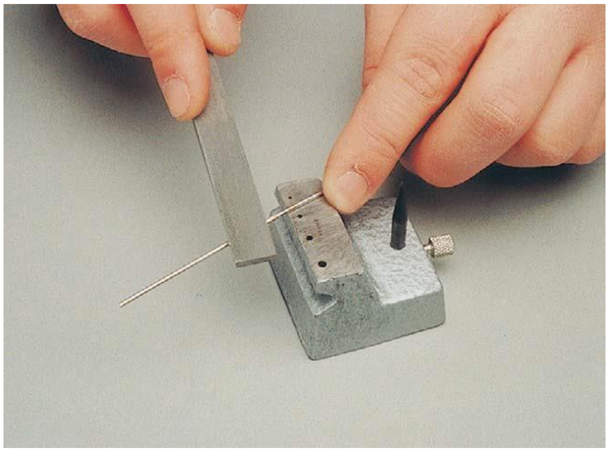


Figure 10-48. Some metal temples widen close to the location of the plastic end cover. The place where the temple widens is called the shoulder. If a temple has been clipped short and the plastic end cannot be put back on without splitting the plastic, the shoulder must be filed.When the plastic cover is slipped back on, it will now go on farther than it did before, making the temple shorter.

Help in Making Temple Tip Changes Easier

There can be some challenges when changing temple tips. Here are some hints to make the job easier[4]:

- If the old, damaged temple cover will not come off just by heating and sliding it off, use pliers to crush the old plastic until it does come off.
- File any rough places off the metal core of the temple, making certain that the end is filed smooth and rounded.
- Before trying to slide the new temple cover on, heat up the metal core. Slide the temple tip on as far as it will go, then heat the tip with the frame warmer until it will slide on the rest of the way.

Changing Cable Temple Lengths

Cable temples may be shortened by clipping, and either lengthened or shortened by replacing the curled end.

Shortening Cable Temples

If it becomes necessary to shorten a cable temple that is too long, shortening is done by simply clipping off the excess portion of the cable with cutting pliers. The rolled metal cable must be sealed so it will not unravel. To seal the cable, touch the cut end with a soldering iron, apply a small amount of solder, and allow the solder to form a small ball at the end. (It may be desirable to combine this with a heat-shrink cable tip cover.)

Lengthening, Shortening, or Replacing Cable Temple Ends with Silicone Cable

Hilco makes a silicone replacement cable end that may be used to either lengthen or shorten a cable temple. The curled silicone does not have a metal core, but rather one made of acetate. To replace the curled end, use the fol- lowing sequence of steps:

1. Determine the desired overall temple length.
2. Determine what length of curled cable is to be replaced and get the pair of replacement cable ends in the desired size and color.
3. Subtract the length of the temple to be replaced from the overall temple length.
4. Measure from the hinge center along the temple until the length determined in step 3 is reached. Mark the temple at this point.
5. Measure back an additional 8 mm and mark the temple a second time. This is the cutoff point.
6. Cut the temple off at the second mark and discard the cutoff portion.
7. Heat the replacement cable with a hot air frame warmer for 20 to 30 seconds.
8. Slide the replacement cable onto the core wire until the front of the replacement cable reaches the first mark measured.
9. Cool the whole temple in water to contract the replacement cable for a firm hold.

Converting Standard Plastic Templesto Cable-Style Temples

The same replacement cable ends that were used for the procedure just described above can also be used to convert a standard plastic temple to a cable-style temple. The procedure is very similar to that of changing the length of a cable temple and replacing it with a silicone cable.

First, determine the desired overall cable temple length and the length of the curled replacement cable end that will fit correctly. Match size of the replacement cable end to the wearer's ear and the color of the replace- ment to the original plastic temple.

Subtract the length of the replacement cable end from the desired overall cable temple length. Measure from the center of the plastic temple hinge until that length is reached. Mark the plastic temple at this point and also at a second point 8 mm farther down the temple (Figure 10-49, *A*).

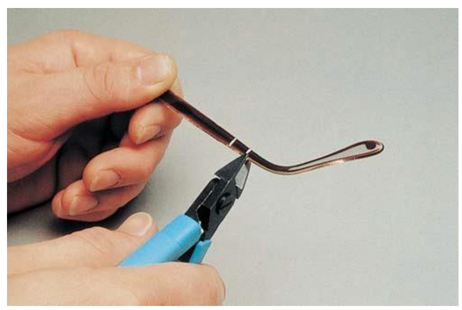
Cut the temple off at the second mark (Figure 10-49, *B*) and throw out the cutoff end (Figure 10-49, *C*). Using a razor blade or exacto knife, cut through the plastic at the first mark to the depth of the metal core all the way around the temple (Figure 10-49, *D*). Slip the 8-mm piece of plastic off (Figure 10-49, *E*). It may be necessary to file and buff the plastic around the core wire to a smooth and somewhat tapered shape so that the transi- tion between plastic temple and replacement cable appears natural.

The replacement cable should be heated with a hot air frame warmer for 20 to 30 seconds and slipped onto the exposed 8-mm temple core wire (Figure 10-49, *F*). When the replacement cable completely covers the core wire, the whole temple should be cooled in water to contract the replacement cable firmly around the core wire. Assuming the appropriate color match has been made, the finished product should look as if it were originally intended to be a cable-style temple (Figure 10-49, *G*).

Shortening Plastic Temples

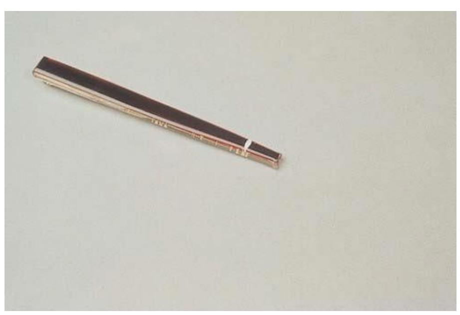
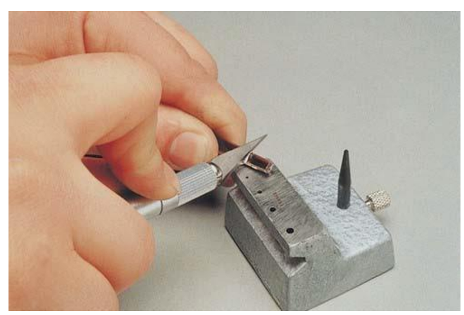
It may be possible to special order a shorter pair oftemples from the manufacturer if the current pair for a plastic frame is unacceptably long. This option should not be overlooked. Another option is to check for a suit- able replacement pair. (See section "Replacing from a Set of Replacement Temples" earlier in this chapter.)
Should neither option be viable, there is a method that can be used to shorten the length of plastic temples.* It requires care, or the results may reveal the modification. This technique is used when no other satisfactory frame is available and is done with the full knowledge and consent of the wearer. The procedure parallels that used to shorten the length of a metal temple having a plastic cover.

*Contributed by Dr. Jerry Bizer, Jeffersonville, Ind.

A

B

C

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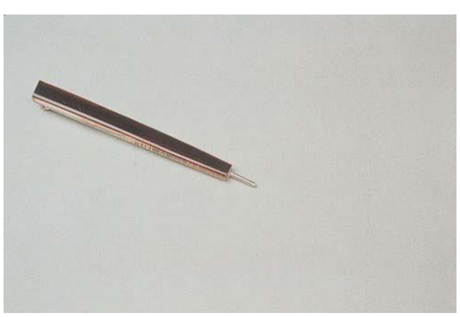



E

F

G

Figure 10-49. A, Converting a plastic skull temple to a cable-style temple begins by making two marks on the temple. The position of the first mark in millimeters equals the desired cable temple length minus the length of the replacement cable end. The position of the second mark equals first mark location plus 8 mm. **B,** The plastic temple is cut off at the location of the second mark. **C,** The temple has been cut at the second mark. **D,** The plastic between the first mark and the cut end is cut then stripped from the core wire. **E,** This shows the exposed core wire as it appears before adding the replacement cable end. **F,** After tapering and polishing the cut area of the plastic temple, the replacement cable end is slipped over the exposed 8 mm of core wire and heated. **G,** The skull-to-cable conversion is complete.

Rivets

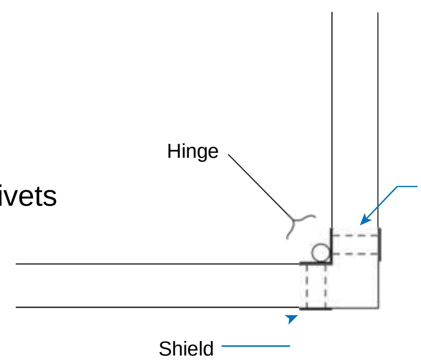


Figure 10-50. Top view of a riveted hinge construction.

To begin, heat and straighten the plastic temple. With a sharp knife or razor blade, cut around the metal core of the temple about ½ inch in front of where the temple bend should be positioned. If the cut is made to the depth of the metal reinforcing wire, the end of the temple may be pulled off the wire. If it does not pull off easily, heat the temple again.

Next, cut off a section of plastic from the loose temple end adjacent to the first cut. The amount removed should equal the amount that the temple needs to be shortened. Now cut off the end of the metal reinforcing wire. (The amount of wire cut away should be

slightly longer than the amount that the temple needs to be shortened.)
Slip the plastic end of the temple back on the wire. Reseal the two pieces with acetone. After the area has dried and hardened, it may be filed and buffed.

REPAIRING THE HINGES

The hinge area of a frame is especially susceptible to damage. A blow or other impact to the side of the head can break the hinge area by forcing the joint between the temple and the front to open farther than it was designed to.

Riveted Hinges

The structure that usually gives way in a plastic frame with riveted hinges is not the hinge, but the rivets that hold the hinge to the frame. A riveted hinge is identifi- able by a visible shield on the outside of the endpiece. Since the rivets are attached to the shield, a new shield is required when the rivets break (Figure 10-50). When the barrels of the hinge break, both hinge and shield must be replaced. Before any repairs are made to riveted hinges, the temple must be removed.

Removing the Rivets and Shield

First file the rivets on the inside of the hinge (Figure 10-51) until they are almost flush with the metal, leaving only a small amount of the rivets visible to act as a guide for pushing out the rivet. Then remove them, using one of the following methods:

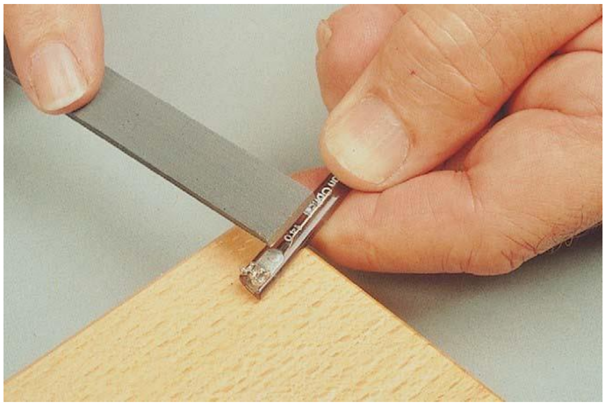


Figure 10-51. To remove a riveted hinge, it is necessary to file the rivets almost flush with the inside of the hinge, leaving only enough rivet visible to act as a guide when pressing them out. (Courtesy Hilco, Plainville, Mass.)

- *Punch pliers*— Punch pliers have a fine, rounded, rodlike projection that is placed against the filed end of the rivet. The pliers are squeezed to push the rivet out of the plastic.
- *Anvil and punch*— To use the anvil and punch method, brace the endpiece or temple (filed rivet ends up) on an optician's anvil or on the base of a hinge punch set. If no anvil or punch base is available, brace the temple on some

other flat surface in such a way that the movement of the rivet out of the plastic is not obstructed. Next, place a punch on the filed end of the rivet. Tap the end of the punch with a small hammer until the rivet moves out of the endpiece (Figure 10-52).

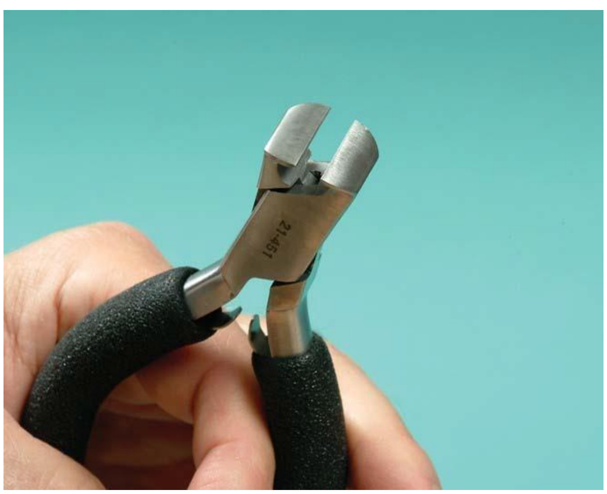
- *Staking tool*— A staking tool may also be used to punch out old rivets (Figure 10-53). Most staking tools come with both a single and a double punch. The single punch is safer to use; the double punch may put too much pressure on the part all at once and damage it. To remove the rivets with a single punch, first push a little on one rivet, then a little on the other. Alternate back and forth between the two, working them free gradually.

Once the rivets are free from the hinge, the hinge comes off the temple or front. The rivets are attached to the shield and are still in the plastic.

- *Cutting pliers*— Cutting pliers serve well for pulling out the shield because the jaws are narrow and can get behind the shield (Figure 10-54, *A* and *B*). They must be held without squeezing and used only for pulling. Inadvertently squeezing the pliers will cut

the shield from the rivets.

(As an aside, it should be noted that some cutting pliers are not able to cut especially hard materials, such as stainless steel or titanium. Using the wrong pliers on these materials can ruin the pliers.)



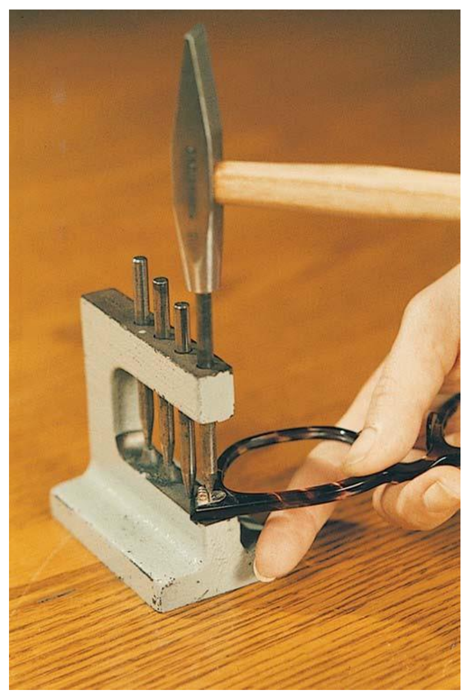


Figure 10-52. One method for removing rivets is tapping the old rivet out with a hammer and punch.

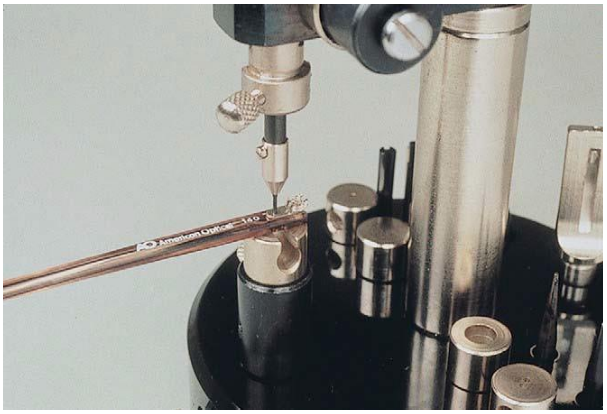


Figure 10-53. A staking tool with interchangeable attach- ments may be used to press the old rivets out. (Courtesy Hilco, Plainville, Mass.)

Replacing the Shield

Use a shield that matches the old shield that has been removed as nearly as possible. Since an exact duplicate may not always be available, it may be necessary to use a shield that fits but does not look exactly the same. In these cases it is best to have the wearer approve the sub- stitute shield before proceeding with the repair.

For the new shield to fit, the spacing between the rivets of the new shield must be identical to the spacing in the old shield. When the hinges themselves need replacing, the number of barrels and the spacing and type of rivet holes must match the original hinge. Most

A

B

Figure 10-54. The most common type of cutting pliers is shown in **A**. There are other designs that cut from the side of the pliers' jaw area, rather than the top, as shown in **B**.

hinges are made for either the left or the right side, but check to be sure that this is the case.

Place the new shield on the outside of the endpiece or temple so the rivets pass through the plastic or metal. Affix the hinge to these protruding rivets and reduce the excess rivet length to about 1 mm using cutting pliers (Figure 10-55).

Round these excess rivet ends into firmly holding “heads,” using either peening pliers or a staking set with a peening tool. (The peening tool has a concave, cupped end.) When using peening pliers, one jaw rests on the shield while the other presses and rounds the rivet head. This operation can also be accomplished by placing the shield firmly on a flat surface or anvil, with the exposed rivet ends up, and tapping the ends into a rounded “head” with a hammer (Figure 10-56).

For a summary of how to repair riveted hinges, see Box 10-3.

Rivets can loosen over a period of time, allowing the temple to wobble even when the screw is tight. The rivets can be retightened by hammering or repeening them.

Hidden Hinges

Most plastic frames have a hinge anchored directly in the plastic instead of being fastened with rivets and a

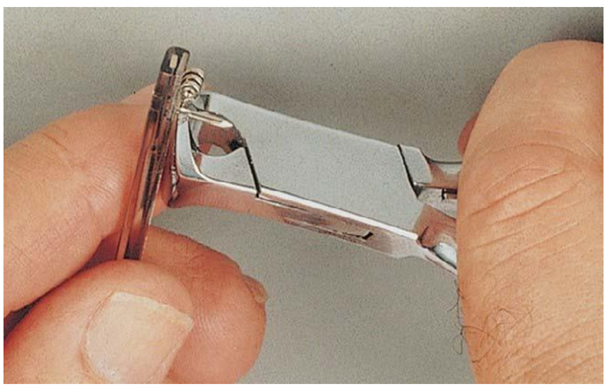


Figure 10-55. Reducing rivet length too much will not allow for a sufficient hold, whereas cutting rivets too long causes them to bend over when compressed rather than form a head.

Figure 10-56. When cut to the proper length, rivets are easily hammered to form a rounded head. If the lens is in the frame, the thumb should be placed over the lens near the hinge so that the lens is protected from the hammer.

shield. Such a construction is referred to as a “hidden hinge” since no shield is visible from the front.

To repair a damaged hidden hinge, it is necessary to have a soldering iron, or better still, a unit made especially for this purpose, such as a *hidden hinge repair kit* (several types are available from a number of optical suppliers) or Hilco’s Hot Fingers. A moderately priced hidden hinge repair kit is considerably easier to use than a soldering iron because it has tips included to allow better contact between the hinge and the hot metal. The

Figure 10-57. The probe of the Hot Fingers unit allows the object being heated to be grasped easily. The Hot Fingers unit may be used to replace or repair hidden hinges, do repairs on plastic frame breaks, and to add adjustable nosepads to plastic frames.

BOX 10-3

Repairing Riveted Hinges

1. Remove the temple.
2. File the rivets.
3. Press the rivets out.
4. Pull the shield off.
5. Put a new shield on.
6. Put the hinge back on.
7. Clip off the rivets.
8. Peen the rivets down.

Hot Fingers unit is more expensive, but offers conve- nience, including the ability to pick up small parts with the tip of the probe (Figure 10-57) and a foot switch for instant heat when necessary.

Repairing a Loose Hidden Hinge

To repair a loose hidden hinge, begin by removing the temple. Hold the tip of the heating unit to the loose hinge until the hinge becomes hot enough to begin to melt the surrounding plastic. Make certain that the hinge is not crooked and plunge the hot area into cold water (Box 10-4).

Repairing a Hidden Hinge That is Completely Torn Out of the Frame

If a hinge has torn completely out of the frame, it may be repaired using the sequence given here and summa- rized in Box 10-5:

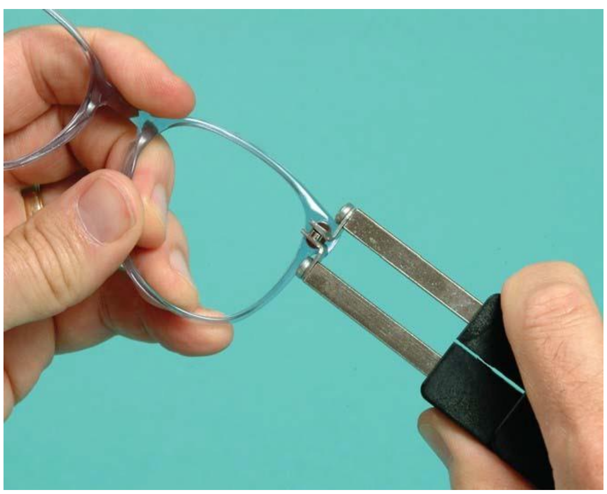


Figure 10-58. The Hot Fingers is used to grasp a torn out hidden hinge, put it back in the frame front, and heat it so that the plastic will be remolded around it.

BOX 10-4

How to Repair a Loose Hidden Hinge

1. Remove the temple.
2. Hold the tip of a hot instrument on the hinge until surrounding plastic softens.
3. Check for hinge straightness.
4. Plunge hinge area in cold water.

BOX 10-5

How to Repair a Torn-Out Hidden Hinge

1. Cut off tiny pieces of a junk frame, make filings from a junk frame, or use virgin plastic pellets.
2. Put a few junk plastic pieces, a plastic pellet, or plastic filings in the hinge hole.
3. Place the hinge squarely in the hole.
4. Hold the tip of a hot instrument on the hinge until surrounding plastic softens.
5. Recheck the hinge for straightness.
6. Plunge hinge area in cold water.
7. Trim away excess plastic.

1. First cut off very small pieces, or using a coarse file, produce a quantity of loose plastic filings from an old junk frame made of the same type of plastic as the one being repaired. Alternatively, use virgin plastic pellets available from an optical supplier.
2. Put a few small pieces or filings into the hole where the hinge belongs. Replace the hinge in the hole, making absolutely certain that it is straight. Hold it
3. Plunge the whole area into cold water to set the plastic.
4. Trim any excess plastic off using a razor blade.

Repairing a Hidden Hinge That is Damaged or Broken Off*

If the barrels of the hidden hinge are split or broken, the old hinge must be removed and replaced with a new hinge. This is most easily done using the Hot Fingers unit because it allows a protruding hinge part to be grasped with the pincerlike end of the heated tool or, if the hinge is broken off flush with the frame, to be pried out with the picklike edge of the tool.

To make the repair, place the Hot Finger tips on the top of the hinge base and depress the foot pedal to heat the hinge. Once the surrounding plastic begins to soften, the hinge will start to rise out of the plastic. When this happens, take one point of the Hot Fingers and pry the hinge out. Use the pincers of the tool to grasp a new hinge by the barrel. The new hinge will have an “anchor” or wider area at the bottom to help hold the hinge in the frame. Heat the new hinge. Then take a pellet of new acetate or a piece of plastic from the scrap frame. Since the hinge is hot, the plastic should stick to the hinge (Figure 10-59). Place the hinge base with the scrap plastic into the hole in the frame. Heat the hinge. As it is heated, it will begin to sink into the plastic. Continue heating until the base of the hinge is flush with the surface (Figure 10-60). Remove your foot from the foot switch to turn off the heat, but do not let go of the hinge. Hold it steady for about 10 seconds to let the frame and hinge cool without moving. This will help set the hinge more securely in the frame. Last, plunge the frame in cold water.

After repairing a hidden hinge, the temple is put back on the frame front. Check that the temple spread is correct. *If the temple is spread too far,* the hinge has not been sunk deeply enough into the plastic. Remove the temple and reheat the hinge until it sinks a little deeper. *If the temple will not open far enough,* the hinge is sunk too deep. Instead of trying to pull the hinge out to some degree, simply file the butt portion of the temple as during standard alignment of a frame.
A note on frame materials—This method works for frames made from cellulose acetate, propionate, polyam- ide, nylon, and carbon fiber. It will not work on Optyl. The filler material used to secure the hinge must be the same material as the frame being repaired. In other words, if the frame is made of nylon, use only nylon scrap for filler, acetate for acetate, and so forth.

Repairing an Optyl Hidden Hinge

At the time of this writing, it is almost impossible to repair a hidden hinge on an Optyl frame without a Hot

in place with the Hot Fingers tool (Figure 10-58) or touch it with a soldering iron until the metal becomes hot enough to cause the plastic around it to remold itself to the hinge.

*Special thanks to Robert Woyton and Ted Rzemien of Hilco, A Division of the Hilsinger Corp., Plainville, Mass., for information contained in this and the Optyl hinge repair section.

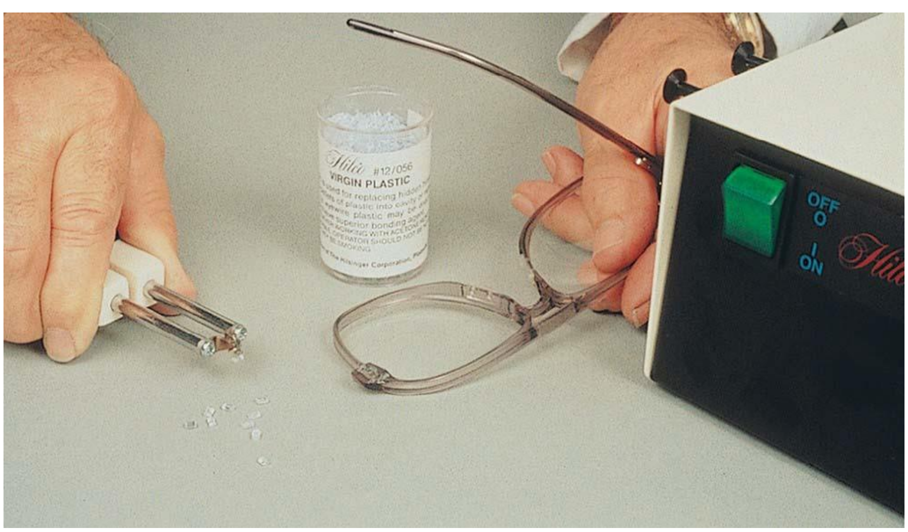


Figure 10-59. Instead of using plastic filings or cut-up pieces from an old frame, it may be helpful to purchase virgin plastic pellets to fill in the extra space when replacing or repairing a hidden hinge. (Courtesy Hilco, Plainville, Mass.)

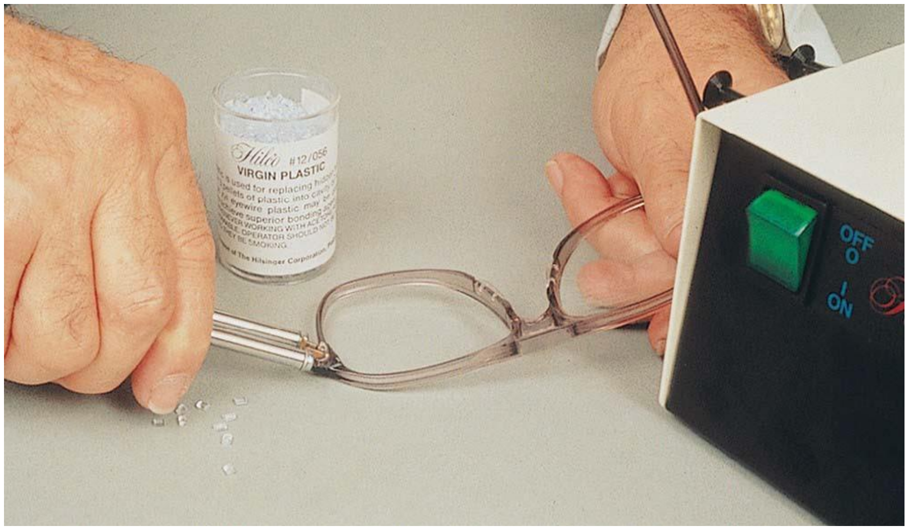


Figure 10-60. The hinge is placed back into the hole and heated until the base of the hinge sinks into the plastic and is flush with the surface. (Courtesy Hilco, Plainville, Mass.)

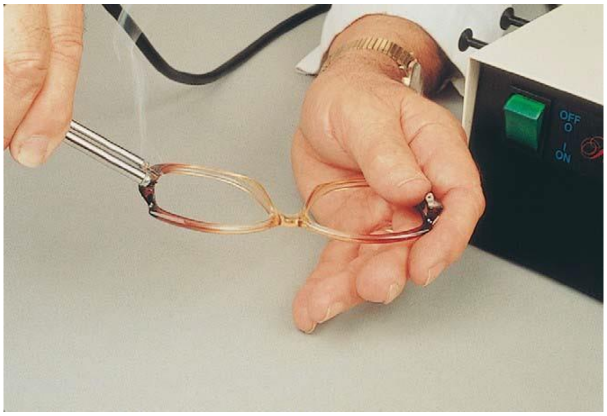
Fingers unit. This unit is the only piece of equipment that appears to be capable of getting the hinge hot enough to melt Optyl.

To make the repair, grasp the broken hinge with the Hot Fingers and suspend the frame in midair. Use the other hand to lightly hold the other side of the frame so the frame will not fall when the hinge comes out. Begin heating the hinge.

After about 20 seconds, the material around the hinge will start to smoke (Figure 10-61, *A*). Let the frame drop away from the hinge without applying pressure. Trying to pry a hinge out of an Optyl material frame will cause the material to shatter. It should be burned out instead of pried out. Once the hinge is out, cool the cavity in cold water.

Next, clean out the cavity (Figure 10-61, *B*). This is done with a small burr using a Dremel hand tool (available in hobby shops or hardware stores) or a hanging motor tool (available from optical suppliers). Be sure all burnt material is removed and the hole is deep enough for the new replace- ment hinge. (Try putting the new hinge in the hole ahead of time to make sure the hole is deep enough.)

When the hole is deep enough, put two or three drops of strong adhesive or epoxy in the hole. Place the new hinge in the hole so that it is seated properly and at the correct angle. Allow the adhesive to dry overnight.



A

B

Figure 10-61. A, When removing a hidden hinge from an Optyl frame, the hinge must get hot enough to burn its way out. It is already possible to see smoke leaving the hinge area. **B,** After the hinge has been burned out of an Optyl frame, the hole that remains should be cleaned out with a small burr so that the hinge will bond well when glued in place. (Courtesy Hilco, Plainville, Mass.)

BRIDGE REPAIRS

Ordinarily, if a frame has a broken bridge, it takes less effort and looks better to replace the entire frame front than to repair the bridge. On occasion a different frame can be used, if perhaps only temporarily, until a proper replacement is secured. Sometimes, however, either by the wearer's choice or because no other expedient solu- tion is possible, it is necessary to attempt to attach the broken halves of the bridge to each other.

Broken Plastic Bridges

Broken plastic bridges can be repaired using a variety of glues, several forms of wire braces, or several pos- sible combinations of materials and methods. Unfortu- nately, none of these methods guarantees an attractive repair.

Glues

There are several types of glue that can be used to cement the broken parts of bridges back together. Some of these can also be used in conjunction with wire braces; these applications will be discussed in the following sections.

Epoxy. The use of epoxy glue will result in a strong repair. There are a number of different types of epoxy on the market. Using a type especially designed for plastic will help. One such epoxy is a superadhesive called Plastic Welder and dries to 80% strength in 15 minutes and full bond strength in 1 to 2 hours. Plastic Welder is made by Devcon Corp., Danvers, Mass.

Although different types of epoxy glues require varying amounts of time to dry, the major problem is holding the two parts together properly until the epoxy is set. A special dual-spring vise, used by jewelers, is especially effective for this task. If this vise is not avail- able, make a holding apparatus from modeling clay by simply surrounding the parts with enough clay to hold them in alignment.

Acetone. An old-fashioned method for repairing cellulose acetate frames uses acetone to melt or soften the plastic so that the two separated portions unite and adhere when the plastic hardens.

Since some of the plastic is melted during this process, a slightly narrower distance between lenses may result. To prevent this, melt some excess plastic from an old frame chassis (or other part made of clear plastic) in acetone and apply a bit to each end of the broken bridge before uniting the two parts.

Because acetone is absorbed through the skin, use a cotton-tipped applicator or other tool so that direct contact with the skin is avoided. There are other reasons for caution when using acetone. Acetone is an extremely flammable liquid and there are strict regulations for use and storage. This is especially true when storing larger quantities.

"Instant" Cements. There are a number of quick- drying cements suitable for eyeglass frames that are sold in hardware and other stores. Cements marketed specifi- cally for the purpose of repairing eyeglass frames are sold through optical supply houses.

Vigor Super Glue is a quick-drying glue that is sold specifically for ophthalmic frames and is available pro- fessionally from Vigor, Austell, Ga. Other super glues are widely available in hardware stores and are also used extensively to repair frames. Only a small amount of glue is required and will repair almost any break as long as the surfaces are clean, dry, and fit absolutely flush. The glue dries in seconds, so no special holding device is necessary. Once bonded, it holds extremely well, although the permanency of the bond over a long period of time is unpredictable.

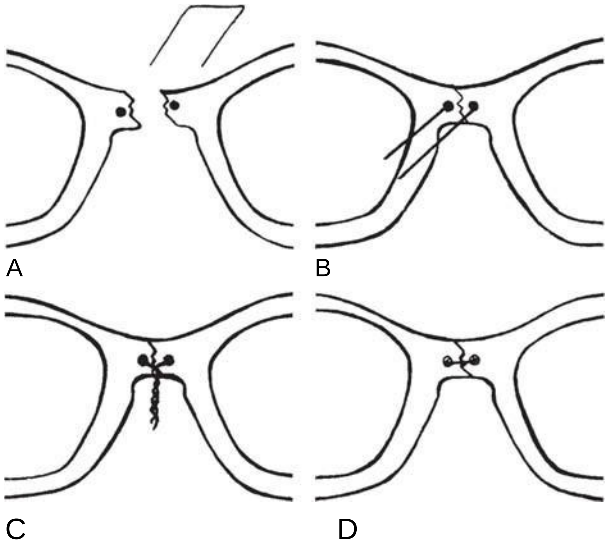
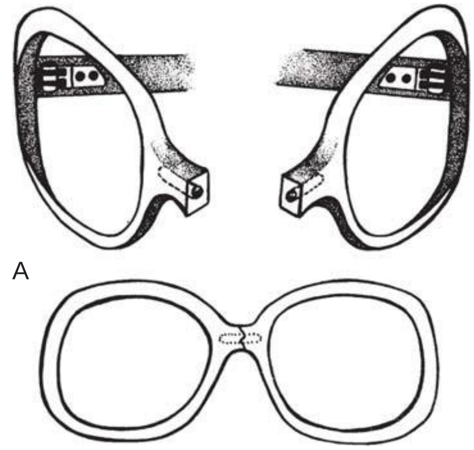


Figure 10-62. A-D, One functional (but unsightly) method of repairing a broken bridge with a wire brace.



Extreme caution is required to prevent contact with the eyes and to guard against inadvertently gluing the fingers together because these glues bond skin instantly on contact. If this occurs, no attempt should be made to pull the skin apart. There is a debonder made for super glue (also available from Vigor) that is useful. It will clean a broken surface before an application of instant cement, “unglue” a previous repair, clean up excess glue, or unglue fingers. If no debonder is available, glued fingers may be soaked in acetone or nail polish remover.

Note: Individuals with broken frames may order a new pair of glasses, but request that their old frame be repaired temporarily. It may be prudent to require a deposit for the new glasses. With the repaired frame they are no longer in crisis and may not pick up and pay for the new pair.

Wire Braces

Several methods of repairing a broken bridge use wires as braces. The most common method entails drilling holes in each portion of the broken bridge and inserting a thin wire through the holes to hold the two parts together, either using the wire alone or in conjunction with a glue or cement material. An alternate method pushes the wire brace directly into the plastic.

The plastic is best drilled by using a small drill bit in either a hand or variable-speed drill; a high-speed elec- tric drill tends to melt the plastic.

Twisted Wire. Drill a hole *perpendicular* to the frame front in each broken half of the bridge. Cut a U-shaped piece of a wire brace or paper clip and insert one end

B

Figure 10-63. A, To repair the bridge, holes are drilled into the broken parts of the bridge parallel to the frame front. **B,** Glue is applied to both halves, and a thin wire (such as a piece of the stiff wire reinforcement used in frame temples) is inserted into the broken parts. The parts are pressed together.

(Figure 10-62, *C*). Clip away the excess wire and file the sharp edges smooth (Figure 10-62, *D*).

This method works best when used in combination with glue, acetone, or epoxy resin.

Imbedded Core Wire. A hole is drilled into the center of each half of the broken surface *parallel* to the frame front (Figure 10-63, *A*). The two halves of the bridge are pushed together over a small, thin, stiff piece of wire reinforcement, such as is used in frame temples. The holes should have the same diameter as the wire (Figure 10-63, *B*).

This method works best when used in combination with glue or epoxy resin.

Stainless Steel Screws and Super Glue.* An improved version of the imbedded core wire that was shown in Figure 10-63 is accomplished with stainless steel screws and super glue.

Using a 0.0430 (No. 57) drill bit, drill two holes into one broken end of the bridge. Next, screw a 1.4-mm diameter stainless steel screw into each hole, but not all the way in. Leave enough of the screw sticking out so that the screw head can be clipped off and still have 3 to 4 mm of threaded screw sticking out. With the screws securely in the drilled half of the bridge, clip the end off so that 3 to 4 mm of the screws are left protruding. through each hole (Figure 10-62, *A* and *B*). Twist the

protruding portions of the clip about each other with small pliers until the bridge is held securely together *Thanks to Robert Woyton of Hilco, A Division of the Hilsinger Corp., Plainville, Mass., for suggesting this method.

In the other broken half of the bridge, drill two holes in as close to the same location as possible, using a slightly larger drill bit. Try to put the two pieces together to see if they will fit correctly. It may be necessary to open up the holes slightly larger to ensure a flush, even fit.

When everything fits properly, put a couple of drops of super glue on the screw threads and press the two halves together. The bridge should be allowed to dry overnight before the frame is used.

Figure 10-64. The Hot Fingers repair unit can be used to fix a broken bridge with a commercial grade ¼-inch staple. The staple is grasped securely with the staple adapter. (Courtesy Hilco, Plainville, Mass.)

Imbedding Staples Using the Hot Fingers Unit. One effective method uses the Hilco Hot Fingers unit to repair a broken bridge. (For more information on Hot Fingers, see the section on how to repair hidden hinges earlier in this chapter.)

To repair a bridge using the Hot Fingers unit, first repair the break using glue. The Hot Fingers unit has a staple adapter that allows for easy insertion of a ¼-inch industrial staple. Place the staple ends into the adapter holes (Figure 10-64). Depress the foot pedal to heat the staple. Because the staple is thin, it will heat quickly. Slowly and firmly press the staple into the back of the frame bridge so that one staple leg is on either side of the break (Figure 10-65). Do not stop pressing the staple into the frame when the staple top is flush with the surface of the frame bridge. Instead, keep pressing the staple into the bridge. The staple should be imbedded approximately halfway through the thickness of the bridge. This will give extra stability to the broken area and hide the staple somewhat better.

Once the correct depth is achieved, take your foot off the foot pedal and hold the staple in place approximately 10 seconds. Next, cool the bridge area in water and clip off the protruding ends of the staple. The ends should be filed smooth. If the design of the bridge allows, a second staple can be inserted through the top of the bridge for added stability (Figure 10-66).

Replacing Nosepads on Plastic Frames

Replacing Broken-Off Plastic Pads

Though less common, some plastic frames have distinct, plastic nosepads that are attached to the frame. (An example may be seen in Chapter 1, Figure 1-

14.) If a

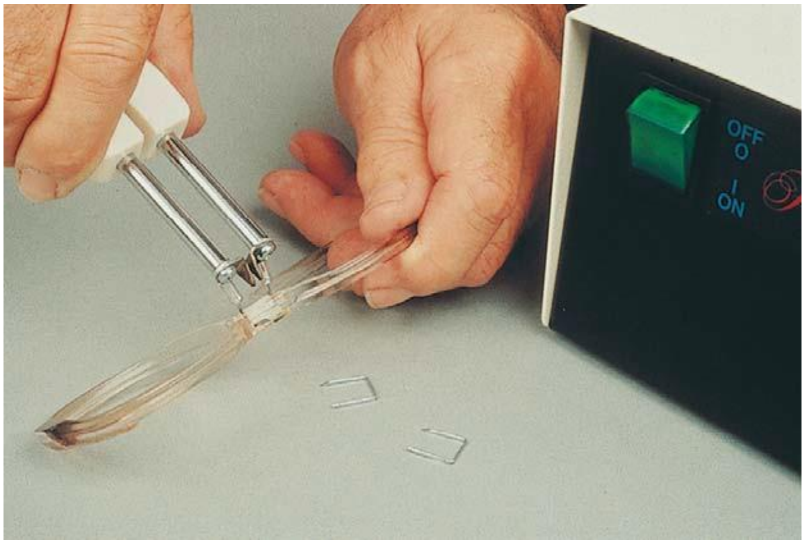


Figure 10-65. Placing the staple on the intended spot, the heat is turned on and the staple pressed into position. (Courtesy Hilco, Plainville, Mass.)

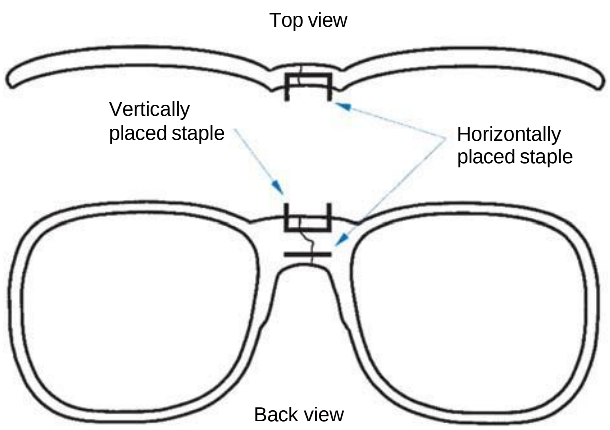


Figure 10-66. Recommended staple positions for repairing a plastic bridge. It is possible to repair a plastic bridge with only one staple. However, whenever possible a second stable should be imbedded into the plastic. Afterwards the ends are clipped off using cutting pliers and then filed smooth.plastic nosepad of this type breaks off the bridge, it can readily be replaced by simply cementing a replacement pad to the area that held the original pad. Either plastic cement or acetone is used.

To begin the replacement, file the residue of the origi- nal nosepad off the frame and smooth the area with fine sandpaper. File a clear plastic replacement nosepad of the proper size at its contact edge. File the edge to the angle that will allow the pad surface to fit the nose correctly. When properly filed, the replacement pad should display the proper splay angle when attached to the frame.

Apply plastic cement or acetone to the area of the frame that will receive the pad and also to the contact edge of the pad until that edge softens. Press the two edges together at the proper splay angle.

After the joint dries, acetone is applied to smooth the nasal surface. For the best results, apply the acetone in combination with a drop of household oil using a cotton swab. The application should be done using small, quick strokes, all in the same direction. Strokes made in varying directions may ball the plastic or imprint the surface.

Adding Cement or Stick-On Pads to a Plastic Bridge It is possible to modify the shape and "width" of a plastic frame bridge to fit an especially narrow or unusual nose by using cement, stick-on, or otherwise mounted pads (see Chapter 9, Figure 9-64). They can be used to narrow the fit of the bridge or change the frontal and splay angles.

These pads are attached to the area of the frame that would normally rest on the nose and are secured in place with acetone or an adhesive. (Pads being added to Optyl frames are fastened in place with an epoxy resin.)

Such pads come in varying thickness. Some are uni- formly thick and others are thicker at the "top" than the

Desired Effect	**Recommended Action**
Increase frontal angle	Orient pad with thick part up
Decrease frontal angle	Orient pad with thick part down
Increase splay angle	Orient pad with thick edge forward
Decrease splay angle	Orient pad with thick edge toward back of frame
Narrow bridge without changing angles	Use uniform thickness stick-on or press-on pads

Note: Adding pads directly to a plastic bridge will always have the effect of narrowing the bridge.

"bottom" and at the "front" than at the "back." Such wedge-shaped pads can be used to change both frontal and splay angles. Therefore how the pads are applied will determine how well the finished product fits. (See Table 10-2 for how to apply such pads.)

If the fit of the bridge needs to be further modified with the new build-up pads in place, acetate pads can be filed to the right shape after they are dry.

Applying Silicone or Acetate Press-On Pads Directly to a Plastic Frame Bridge

If a frame slips or is uncomfortable on the nose, it may be advisable to apply silicone nosepads directly to the frame bridge area. Acetate or silicone pads can be used to build up the frame bridge area to narrow the bridge or change the way the bridge fits. It is possible to pur- chase a whole kit (Figure 10-67) or pads only. To put these pads on the frame, use the marking template that comes with the kit. Mark the bridge area where the pads will rest (Figure 10-68, *A*). Next, drill holes where the bridge is marked (Figure 10-68, *B*). The pad comes with two protrusions. These protrusions are pressed into the drilled holes (Figure 10-68, *C*). When finished the pad sits flush with the frame bridge.

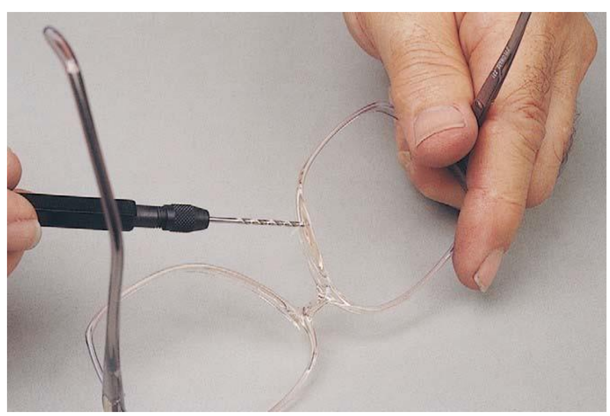
Remember, since these added pads have thickness they will cause an effective narrowing of the bridge. How much the bridge is narrowed depends upon the thickness of the pad chosen. Decreasing the distance between pads will raise the frame on the face and increase the vertex distance slightly.

"Retrofi tting" Plastic Frames With Adjustable Nosepads

It is possible to put a pair of adjustable nosepads on a plastic frame if there is a sufficient thickness of plastic in the nasal area of the frame. The pad arms come indi- vidually or linked together as a pair. Both kinds are shown in Figure 10-69. The single pad arms are available in either low- or high-mount designs. The design chosen depends upon the thickness of the bridge of the plastic

Figure 10-67. Here are the necessary items for mounting press-on build-up pads to a plastic frame. All items are available as a kit. Pads are available in either acetate (regular hard plastic) or silicone (pliable, slip-resistant material). (Courtesy Hilco, Plainville, Mass.)

B



A

C

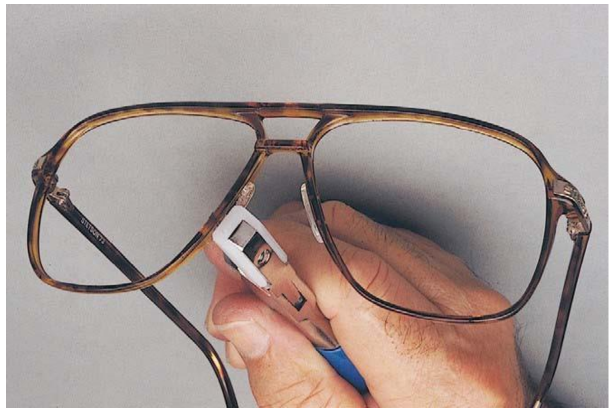


Figure 10-68. A, Either a measuring gauge or clear templates can be used to determine where the bridge area should be drilled. Here the template allows for exact premarking. **B,** A drill bit mounted in a chuck handle is used to bore out the needed holes for a replacement press-on pad. **C,** The protrusions on the backs of the press-on pads are squeezed into the drilled holes, mounting them firmly to the bridge. (Courtesy Hilco, Plainville, Mass.)

Figure 10-69. Adjustable pads may be added to a plastic frame if the frame has sufficient thickness in the area where the pad arms are to be mounted. Because of design variety in pad arms, chances of finding a suitable match are good. Here are some of the pad arms and pads available, along with tools that are used in mounting. (Courtesy Hilco, Plainville, Mass.)

frame. There must be a sufficient depth of plastic so that the prongs on the pad arms will not hit the lens bevel or go all the way through the plastic. If the frame does not have enough thickness on the rim, then a one-piece bridge can be mounted on the cross portion of the frame bridge. Here is the sequence for mounting the pad arms:

1. First, decide which pad arms are most appropriate.
2. Next, file the existing plastic pads off the frame and smooth the filed area (Figure 10-70, *A*). Even though this area of the frame may not be visible when worn, it may be advisable to buff the area with a buffing wheel and polishing compound to restore the finish.
3. To be certain of getting both pad arms symmetrically placed (or a one-piece bridge properly centered, if this is being done), mark the proposed location of the prongs (Figure 10-70, *B*). Use a template, if provided.

4. Mount the pad arms by either drilling holes in the frame or heating the pad arm and pressing it in place using the Hot Fingers unit. (If the Hot Fingers unit is not available, it is possible to purchase a “Pad Arm Conversion Kit” that contains a small hand drill from Hilco, Plainville, Mass.) Drill the holes and press the pad arm into place.
   a. If the Hot Fingers unit is used, grasp the bridge or individual pad arm using the Hot Fingers tool with the prongs positioned at the previously marked location (Figure 10-70, *C*).
   b. Turn the heat on with the foot switch.
   c. Press the pad arm slowly into the plastic until it is fully seated.
   d. Release the foot switch first, then the pad arm.
   e. Immerse the frame in cold water and check for tightness.
   f. It may be necessary to use a razor blade or small surgical knife to cut away excess plastic from around the point of attachment (Figure 10-70, *D*).
5. Last, attach the pads to the pad arms.

NOTE: All of these services are available through Hilco’s repair center and through many local laborato- ries if the dispenser is uncomfortable with attempting them alone.

THE EYEWIRE AND LENS

Attempts to repair a broken plastic eyewire are often unsuccessful since the strain of the lens on such a small area tends to rebreak the repair when the frame is repeatedly taken off and put back on. Some forms of eyewire repair can be attempted in emergencies when it would be extremely difficult for the wearer to do without the glasses.

Repairs to the eyewire that do not relate to an actual break in the eyewire are generally more successful. These procedures concern the fit of the lens in the eyewire of the frame.

Broken Eyewires

The simplest approach is to attempt to repair the eyewire using the methods described for repairing the bridge of a plastic frame—with epoxy and fast-drying glues being the most successful.

The most difficult part of repairing an eyewire is reinserting the lens without rebreaking the frame. Only that portion of the eyewire that is still intact should be heated.

If the repair is to be temporary, it is best to attempt doing the repair with the lens in place.

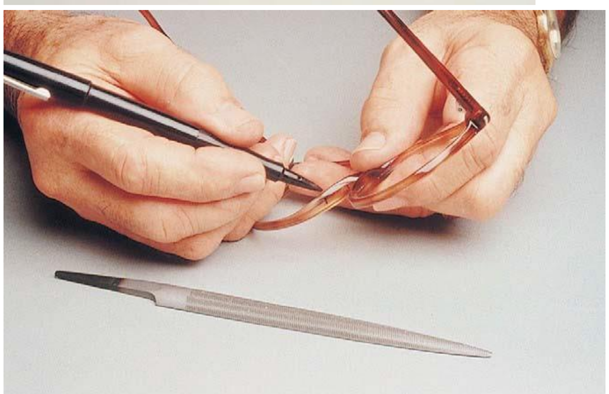
If all else fails, encircling the lens itself with glue and cementing the frame to the lens provides a temporary means of holding the lens in the frame. This avoids both the necessity of reinserting the lens and of attempting to stretch the frame to encircle the lens.

Epoxy or other glues of that type should not be used; if it will eventually be necessary to remove the lens, scrape off the glue and reinsert the lens in a new frame. Acetone should not be used because it will not adhere to lenses and will damage a polycarbonate lens. An inex- pensive model airplane type of glue works best.

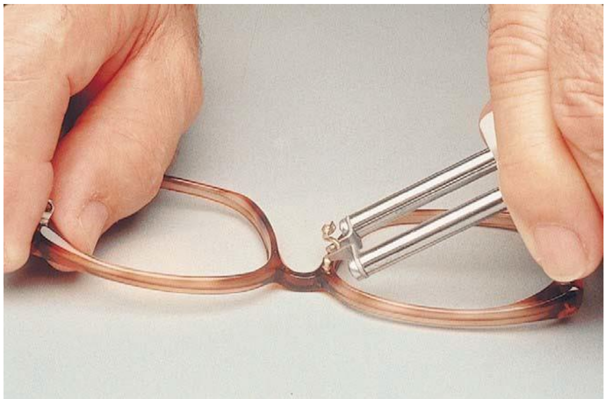
Lower Edge Appears Out of the Frame

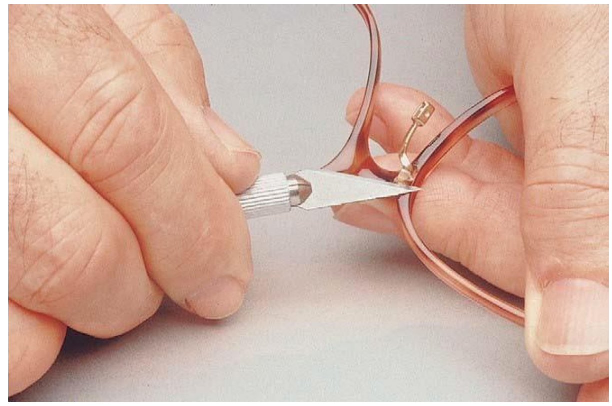
If the lenses have been inserted unsatisfactorily, particu- larly in a plastic frame, either the lower or upper portion of the lens may not fit properly in the eyewire and may give the impression that the lens is about to fall out of the frame.

If the lower eyewire of a *plastic frame* has been “rolled” during lens insertion, the lower edge of the lens will appear to be out of the frame. This condition can readily be noted by observing the frame from the side (Figure 10-71).



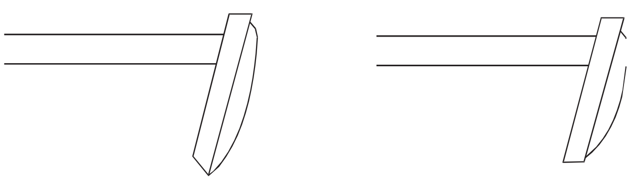
A B





C D

Figure 10-70. A, To mount single pad arms or one-piece pad-arm bridges to plastic frames, begin by filing off any existing plastic pads and file or buff the area clean. **B,** The next step in mounting pad arms to a plastic frame is to mark the proper position for the insertion. **C,** To mount the adjustable arm in the plastic frame, pick up the pad arm with the Hot Fingers tool. Carefully place the pad-arm anchor on the position marks. Firmly, but slowly, let the heated pad arm seat itself in the frame. Release the foot pedal, then the pad arm. Cool the frame in water and check the implant. **D,** After the pad arm has been securely mounted in the plastic frame, trim away any excess plastic with a razor blade or knife. (Courtesy Hilco, Plainville, Mass.)



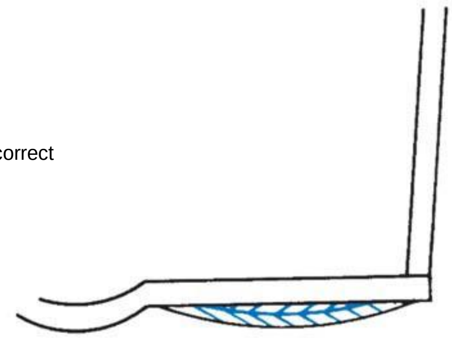
Incorrect Correct

Figure 10-71. Observing the frame from the side for a lower eyewire that has been "rolled" during lens insertion.

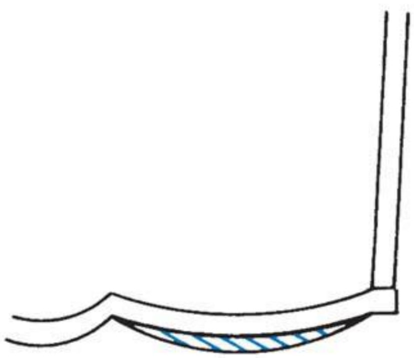
To remedy this situation, remove the lens and reheat the lower portion of the frame. Grasp the eyewire between thumb and forefinger and rotate it back until the bevel again faces directly upward. Shield the fingers, if necessary, with a towel or other protective padding. The eyewire may have to be reheated and turned severaltimes until it is completely aligned. When the eyewire is straight and the bevel directly vertical, the lens is reinserted, taking care not to roll the eyewire again. It might be helpful to insert the lens from the back of the frame if the eyewire was rolled forward if an attempt to put the lens in from the front continues to result in a rolled eyewire.

If the lower edge of a lens in a *metal frame* appears to be out of the frame, the eyewire has not been properly shaped to follow the curvature of the lens edge. To correct this problem, remove the screw holding the eyewire. Hold the eyewire around the lens so that the bevel of the lens completely fits the groove of the eyewire. Then reinsert the screw. It may be necessary to prebend the eyewire to match the lower curve of the lens edge while the lens is out. This may be done with the fingers or with eyewire shaping pliers. (See Chapter 7.)

Incorrect



Correct



Overall looseness is corrected in cellulose acetate and propionate plastic frames by removing the lenses and shrinking the eyewire size by heating and chilling as described in Chapter 7. The process is repeated several times, if necessary. When the eyewire reaches a size that is slightly too small to accept the lens, the frame is again reheated, and the lens is inserted. After the lens has been inserted, immediate chilling of both lens and frame should secure the lens. (For how to “shrink” frames made from other materials, see Chapter 7.)

Occasionally the lens appears secure, but a small gap or space is visible between the lens and the frame. The area standing away from the lens is heated and compressed against the lens bevel. Holding the plastic against the lens while immersing the frame and the lens into very cold water will further shrink the frame around the lens and secure the corrected position of the rim.

Sometimes a lens interliner is used with plastic frames, even though it is intended primarily for metal frames. This is explained in the section below under metal frames.

Figure 10-72. An exposed upper bevel gives an unsightly appearance, but is readily correctable.

Upper Edge Appears Out of the Frame

If the bevel of the lens is excessively visible from the top, the frame probably does not conform to the curvature of the top of the lens (Figure 10-72). This situation is more likely to appear at the top than at the bottom of the eyewire because most lens shapes have a longer, straighter top. The curved front of the lens is more evident at the top, and the frame may not follow the curve as well. This is especially evident with high plus- powered lenses.

With a *plastic frame,* it is sometimes possible to heat the plastic without removing the lens. Pull the eyewire over the bevel, and *while holding it there,* dip the lens and frame into cold water to fix the position.

If this cannot be done, the lens should be removed, the eyewire heated and reshaped to match the lens cur- vature, and the lens then reinserted.

When the upper bevel of a lens in a *metal frame* sticks out, the lens must be removed, and the eyewire reshaped. The methodology is the same as described in the previ- ous section on reshaping the lower eyewire.

When the Lens Is Too Small for a Plastic Frame If a lens which fits too loosely has been inserted into a plastic frame, it may rattle or rotate within the frame. When the frame appears to be too large for the lens, the lens must be remounted so it is secure.

When the Lens Is Too Small for a Metal Frame When a lens is loose in a metal frame, the most probable cause is that the screw holding the eyewire together has loosened. As an automatic first measure, check the screw and, if loose, tighten it.

If tightening the screw does not accomplish the desired result, it is probable that the lens has been cut and finished with a circumference slightly too small to firmly fit the eyewire. For a new prescription, this is a quality control issue. The glasses should be returned to the laboratory to be redone. However, if the problem is with an old prescription, there are ways to make the lenses fit better.

Acetate Lens Interliner (Lens Washer)

One method of correcting the problem is to loosen the screw and insert a plastic (acetate) lens liner, commonly referred to as a *lens washer,* in the bevel between the lens and the eyewire. This more common, nonadhesive form of lens liner comes in different thicknesses, is bevel shaped on the outside to fit the eyewire, and contains a bevel on the inside to hold the lens. It is sold in a roll and may be cut to any desired length.

When using acetate liner, it is best to use the 0.010 mm interliner size. It is far less obtrusive than the 0.020 mm interliner. Here are three ways to keep the liner in place while inserting the lens. The first is the currently recom- mended method:

1. Use a very small amount of super glue to hold the acetate interliner in place.

To apply the glue, place a drop on some scrap paper and slide the back side of the interliner through the glue (Figure 10-73). Hold the interliner in the eyewire groove for 20 seconds, and it should stick.

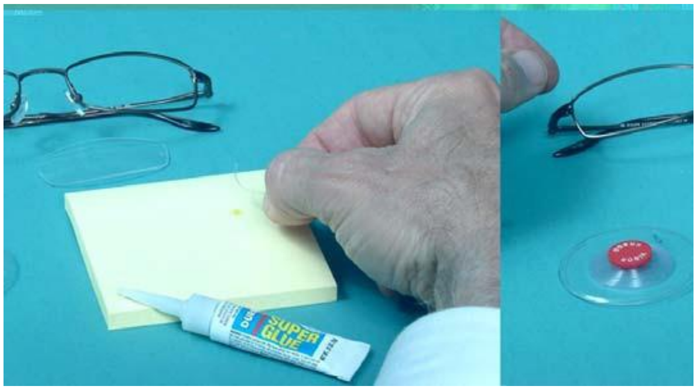


Figure 10-73. To hold acetate interliner in place in the groove while reinserting the lens, drag the outside of the interliner through a drop of super glue.

2. Soak the liner in acetone. When the liner is soft and sticky; place it directly in the bevel of the frame. It will stick in the groove, and the lens can easily be inserted.
3. Tape the liner to the lens with transparent tape and insert the lens in the frame with the tape still in place. When the lens is securely positioned, cut the tape away using a razor or exacto-type knife.

Double-Sided Adhesive

Another form of liner is a double-sided, clear plastic tape. This tape is thin and hence inappropriate when the amount of looseness is considerable. It is much easier to use than the beveled liner, however, because it can be stuck directly to the lens bevel.

If the lens is extremely small for the eyewire and a sufficient amount of room is present, first apply the double-sided adhesive liner to the lens bevel, then fasten the thicker, beveled liner to the double-sided liner. This arrangement provides added bulk and simplifies the task by holding the thicker liner in position.

Latex Liquid Interliner

Instead of using conventional lens liner, there is a liquid liner that can be applied (Figure 10-74). It is dispensed right from the bottle into the “V groove” in the frames’ eyewire and can be applied to the entire inside portion of the eyewear, if necessary. Liquid liner dries in about 1 minute and can be used in almost any situation where acetate liner would is used. It may be necessary to use more than one application, depending upon how loose the lens is.

There is one word of caution. Some people are aller- gic to latex. It should not be used for such individuals.

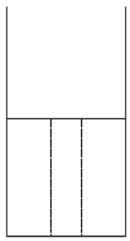
Figure 10-74. Soft Latex Lens Interliner is a liquid latex material that can be applied directly from the bottle to the groove of the frame. It dries is about a minute and, when done properly, is not visible when the glasses are being worn.

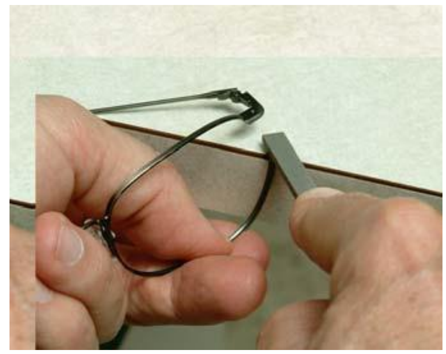
Gap or Air Space

If a gap or air space appears in a metal frame between the lens and the eyewire, place a strip of liner between the lens and the eyewire directly *opposite* the gap to force the lens into the gap (Figure 10-75).

A gap is totally unsatisfactory for a new lens. Such repairs should only be used if the glasses were not ini- tially supplied by you. Inform the wearer that although the repair is less than satisfactory, it is the best that can be done without replacing the lenses.

Because of the shape of most lenses, any sizable amount of liner will be far more obvious when placed along the upper bevel of the lens than when used to fill





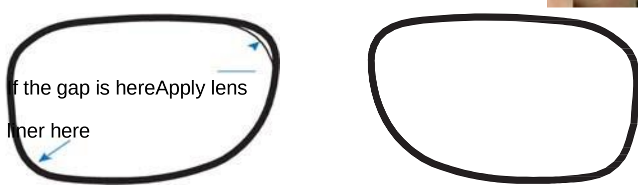


Figure 10-75. To fill an “air hole” between the lens edge and the frame, lens liner is applied in the area *opposite* the position of the gap.

Figure 10-76. Care is taken to file evenly so the barrel section will continue to fit flush as before.

the lower bevel. Consequently, from a cosmetic stand- point, it is less noticeable to place the liner in the lower bevel when only a short strip is necessary.

Any of the previously listed procedures may be used as a temporary measure while a new lens of proper dimensions is made.

Lens Slightly Loose

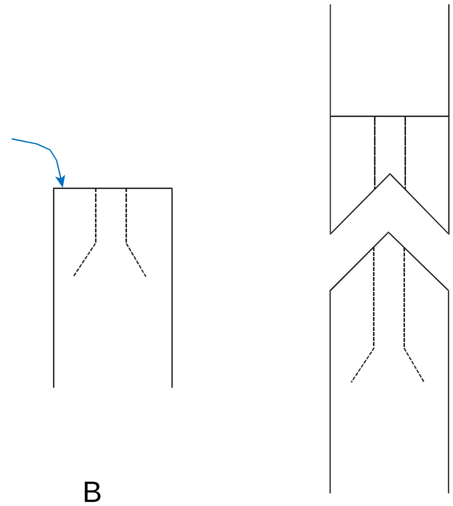
If the lens is only slightly loose in the frame, reduce the circumference of the metal eyewire itself by removing the eyewire screw and filing the barrel surface. The filing must be done evenly so the barrel sections con- tinue to fit flush (Figure 10-76). This is only possible on barrels that come together flat and not on barrels that have a wedge-shaped abutment (Figure 10-77).

(It is preferable to file the nonthreaded portion of the barrel rather than the side that accepts the tip of the screw.)

The disadvantage of filing is that if the lenses are later changed and the same frame used, the new lenses could appear to be slightly too large for the eyewire, even if actually ground to the original size.

FRAME TRIM

Trim on frames goes in and out of style. Not all trim is attached in just the same way. This section addresses some of the methods for replacing or repairing trim.



A B

Figure 10-77. Reducing the circumference of the metal eyewire in the case of a loose lens by filing the barrel is only feasible on type **A**. The surface indicated by the arrow has been filed. Type **B** does not lend itself as readily to filing.

Trim On Plastic Frames

When a plastic frame adorned with metal trim breaks, the plastic chassis can be replaced and the original trim reapplied to the new chassis. The trim is usually attached by screws through holes in the chassis. These screws may have fancy heads that hold the trim or may be part of the trim itself. The screws are fastened in back of the chassis with hex nuts.

To reapply trim, begin by removing the hex nuts and forcing the trim off the old frame by inserting a screw- driver blade between the trim and frame near the screws by pushing on the protruding screws, or both.

Align the trim with the holes in the new chassis and push new screws (where separate) through the trim and the frame with the thumb. Tighten new hex nuts with their rounded surface inside the barrel of the hex wrench onto the ends of the screws (Figure 10-78). The nuts must fit precisely into the wrench and can sometimes be picked up and held in place more easily if the tip of the wrench is moistened as with saliva.

Cut off the excess screw flush with the surface of the nut (Figure 10-79) and file the end smooth with a small, curved, spoon-shaped riffler file (Figure 10-80). If the end is not filed smooth, the rough edges may catch in the patient's brows or prove otherwise irritating.

After the trim has been attached, heat the eyewire and the lens. Apply most of the heat to the portion of the eyewire not covered by trim (usually the lower portion) since heating and stretching the covered portion may raise it above the trim and result in an unsightly appear- ance. A metal plaque may need to be shielded while heating the frame since it usually becomes too hot to touch.

Figure 10-78. Attaching the hex nut to the screw that secures the metal trim to the plastic chassis.

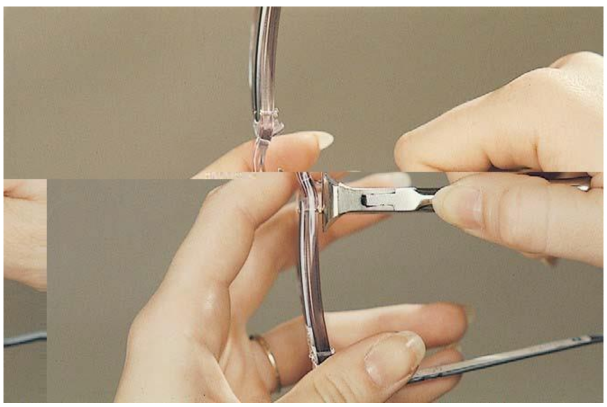


Figure 10-79. The screw is clipped off close since any portion left protruding must be filed.

Figure 10-80. The rough end of the clipped-off screw is filed smooth with a riffler file. Although it may appear easier, inserting the lens before attaching the plaques may stretch the upper part of the eyewire. As a result, the predrilled holes in the chassis separate slightly so that the screws that pass through the plaque no longer pass through the holes in the chassis. In this event, drill one or more new holes to reattach the plaque.

Figure 10-81. This hex wrench has a knock-out pin that ejects a stuck hex nut from the end of a hex wrench.

It is possible that the plastic of the chassis will stretch and become too thin to allow the drilling of such holes. It is also conceivable that the original hole could be moved so far by the stretching process that it would no longer be fully covered by the trim. Even if neither of these situations occurs, the cosmetic effect may be out of balance since one eyewire may stretch somewhat differently from the other.

A Note on Hex Wrenches

Those who have worked with small hex nuts and the optical hex wrench will know that sooner or later a removed hex nut will become lodged in the socket of the wrench and momentarily defy removal. Using a hex wrench with a Teflon-coated socket will help. It should also be noted that there is an optical hex wrench available with a knock-out pin. The pin easily ejects the hex nut from the wrench tip (Figure 10-81).

Metal Plaques on a Metal Chassis

One type of metal frame consists of a metal chassis with a narrow eyewire. Broad plaques are joined to the chassis at the brow area, much like a combination frame. These plaques also contain the endpiece hinges for the temple. They fit over and enclose the upper eyewire of the metal chassis by means of a small, specially-designed screw and a slot attachment.

Frequently, these screws become loose or fall out, causing the frame to disassemble. The size and thread of these screws are of special dimensions. When the screw has simply turned until it has fallen out and the threads in the eyewire are intact, the screw can simply be replaced.

Sometimes this proves difficult to do with the lenses in since the plaques fit at one end in a slot in the chassis with the screw at the other end. If the hole in the plaque does not line up exactly over the hole in the eyewire when the eyewire slot is fitted into the catch in the plaque, there is no alternative but to remove the lens and force the eyewire to line up with the plaque.

It is possible that a new screw will not hold because the threads in the eyewire have been ruined by constant retightening of the screw. In such cases, the plaque must be removed and a larger hole threaded with a tap that is equivalent in diameter to a glass screw. The plaque is replaced (without the lens if necessary, as above) and fastened securely with a glass screw clipped to the length necessary to fit the eyewire thickness.

CLEANING THE FRAME

From time to time, because of repair work or just because of normal wear, frames need to be cleaned. Also, on occasion the action of chemicals in perspiration, the use of tools on the plastic, or the circumstances of overheat- ing a plastic frame, may result in discoloration, blem- ishes, or marks in or on the plastic. In these instances, the defects need to be removed if the frames are in excel- lent operational order otherwise.

Cleaning Technique

Frames may be cleaned with ordinary soap and water so long as the soap contains no abrasive pumice material. An old toothbrush serves best for scrubbing hard- to-reach areas, such as the pad arms or trim.

An ultrasonic cleaning unit is a most useful cleaning instrument. Leaving the frame (lens side up) in the small tank loosens dirt that might not otherwise be dislodged. After cleaning a frame in such a unit, be sure to check all screws for tightness since the vibrations tend to loosen them.

The following two types of spectacles should not be cleaned in an ultrasonic unit:

1. Glasses whose lenses are held in place by screws passing through the lenses, such as rimless or semirimless. The intense vibrations of the ultrasonic unit may cause lens breakage.
2. Frames with glued-in rhinestones or other small jewels should not be cleaned ultrasonically because the stones may be dislodged.

It is not advisable to clean antireflection (AR) coated lenses in an ultrasonic unit.

Discoloration

Discoloration usually occurs on the inside of the temples of plastic frames where they contact the hair and the skin and most often appears as a whitish film. With age, cel- lulose acetate and propionate frames may exhibit a film, which is caused by plasticizers within the material migrating to the surface.[5] In either case, a buffing wheel used with polishing compound will remove the discol- oration and will also repolish the plastic.

When a buffing wheel is not available, apply acetone and oil with a cotton-tipped applicator and rub over the entire length of the temple. Dip the applicator in the mixture and run the length of the temple in one direc- tion. Each time the temple is brushed it should be with fresh acetone and oil and in the same direction. Repeat this process as often as necessary until the color is restored. If acetone without oil is used, the brushing action must be rapid to avoid leaving prints in the soft- ened surface. If the wet surface is blown on or exposed to moving air, condensation may again whiten the temple.

Surface Marked by Pliers

If the plastic has been marked by the jaws of pliers, an attempt to restore the surface can be made. Heating the frame at the area of the mark will hopefully cause the compressed portion to expand back to its original dimen- sions. The area can be reheated repeatedly as long as the plastic is not overheated until it bubbles because this would compound the problem. When it appears that the frame has reexpanded as far as is likely, the area is buffed with buffing compound on a rag wheel.

Restoring Finish on Optyl Frames

The finish of an Optyl frame can be damaged if the frame is inadvertently rubbed against a rough surface. If the frame surface has been marred, remove the defect by buffing the area.

To restore the sheen after buffing, coat the area with polyurethane finish, such as is used in furniture refinish- ing. Either satin or glossy polyurethane will prove satisfactory.

Bubbles

Bubbles result from overheating the plastic and cannot actually be removed because they ordinarily extend well into the plastic.

An attempt to salvage the aesthetic appearance of the frame can be made, however, by filing the bubbled area smooth and then buffing it to restore the luster.

If the frame looks asymmetric as a result of the one area having obviously been thinned, the mirror portion of the frame is also filed and buffed to match.

SOLDERING

Soldering is the only possible way to repair a broken metal portion of a frame unless the entire front or temple is replaced. The techniques used for soldering spectacles are similar to those used for soldering jewelry and are sometimes performed by jewelers.

Most people hesitate to solder in the office because of the amount of time involved, but since the time involved is still less than would be required to send the frame back

Figure 10-82. Solder comes in a variety of forms and must be used in conjunction with *soldering fl ux*. Flux is shown in the upper left-hand container. There is a *silver solder paste* that combines both solder and flux. This is seen in the upper right- hand container. Solder is available in *rod form,* as pictured in the plastic envelope in the center of the photo. The *chip form* of solder, at the bottom of the photo, is particularly useful for electric soldering. (Courtesy Hilco, Plainville, Mass.) to the laboratory or elsewhere for repairs, soldering sometimes provides a definite service to the wearer. It also sets the office apart from others and provides another unique service.

It is a poor risk to solder frames of inferior quality since they tend to come apart at their points of assembly when the frames are heated during the soldering process. It is also difficult to solder metal eyewires because the solder tends to fill the bevel groove into which the lens must fit.

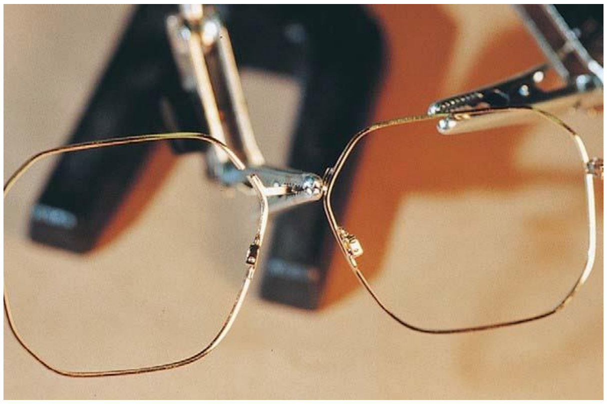
Special solder must be used because of the metals and alloys used to make frames. Only a high quality solder of the type designed for jewelry or frames can be used; normal electrical solder will not work.

Hard solder is available in chip form (to be mixed with liquid or paste flux), paste form (with the flux already mixed in), or rod form (Figure 10-82). Hilco offers a rod form solder called “Pallarium.” It melts at a temperature of 1060° F. This temperature may seem high, but com- pared with other solder melting temperatures is consid- ered very low. Pallarium is a hollow rod with flux running through the center for ease of application. Because it melts at such a low temperature, when used properly it minimizes discoloration of frame components.

It should be noted that titanium frame materials cannot be soldered through conventional frame repair techniques. It is possible to solder the top plating together, but such a repair is usually not strong enough to withstand much use.

Titanium can only be repaired by laser or induction welding machines. It is a very sophisticated process that is dependent on the grade of titanium being welded. The welding process must also be performed in an inert

A



B

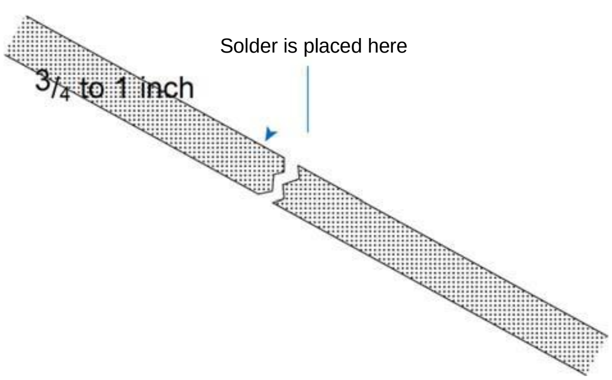
Figure 10-83. A, Here is a jig or “third hand” is used to hold the frame in place while soldering. **B,** The jig holds the frame in place during soldering. atmosphere, usually an enclosed chamber, to success- fully bond the material.

Flame Soldering

Some flame soldering units use one gas, butane. Others use two independently regulated gases, either oxygen and acetylene or oxygen and butane. The oxygen will be used up at twice the rate of either the acetylene or the butane. The single gas unit is less cumbersome to operate. It is recommended when soldering is done in small quan- tities or only irregularly.

To flame solder, remove the lenses from the frame; if the soldering is to be done near the bridge, remove the nosepads too. If the frame is bent, readjust it before attempting to solder it.

One of the most important aspects of soldering is the proper positioning of the parts. Use a special jig, or “third hand,” that consists of adjustable clips mounted on a base to hold the frame in place while soldering (Figure 10-83).



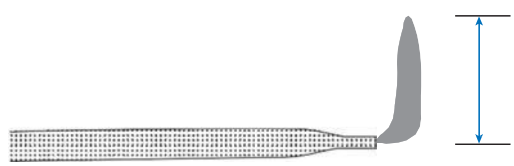


Figure 10-86. When ame soldering with a two-gas system, befo re the oxygen is turned on, the butane or acetylene ame is regulated to its proper length.

1 inch

Figure 10-84. The part to be soldered is aligned at somewhatof a slant so that solder will ow over the broken part.

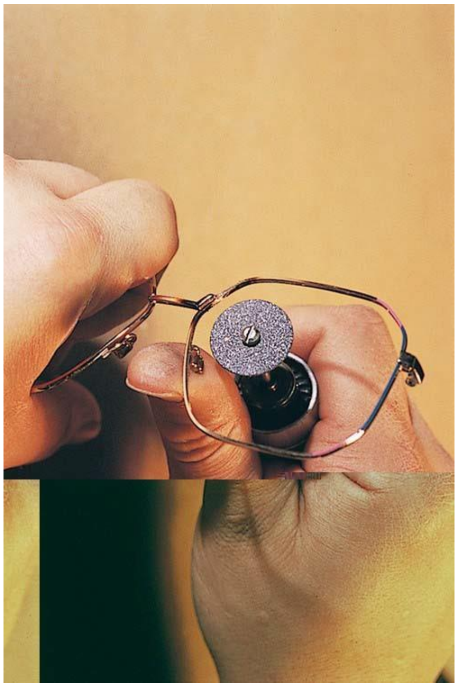


Figure 10-85. If solder gets into the groove of the frame,it must be removed with a grinding disk. (Courtesy Hilco, Plainville, Mass.)

Position the well-cleaned part to be soldered at some- what of a slant so that the solder, placed slightly above the broken area, will ow downward over the broken part (Figure 10-84). To solder an eyewire, mount the frame so that the broken section is held vertically. This permits the solder, placed on the outside of the bend, to
ow down over the break. Place solder *only on the outside of an eyewire. If solder should get on the inside of the eyewire, it must be removed. This can be done by mount- ing a separating diskor cutting wheel to a hanging motortool or hand Demel to grind away any excess solder (Figure 10-85).*
Attach a metal alligator clip to the frame between thesolder joint and the next adjacent joint in the frame to

Figure 10-87. For two-gas ame soldering, the oxygen is turned on after the butane or acetylene has been regulated.Oxygen is modi ed until the total ame is 1 inch long and hasa darkblue center.

act as a heat sinkand to help absorb the heat. If a great quantity of heat is conducted along the metal to an adja- cent joint of the frame, it may loosen the solder of that joint and dismember the frame. The heat sink absorbs the heat before it reaches the area of concern. A com- mercially available foam to coat the adjacent areas may be used instead.

Place ux on the area to be soldered before applying heat to prevent oxidation and to aid the ow of the solder.

Start the soldering ame by turning on the butane and lighting the torch. If the unit uses two gases, adjust the butane ame to a length of 0. 5to 1.0inch (Figure 10-86). Then turn on the oxygen and regulate it until the total ame is 1 inch long and reveals a dark blue center (Figure 10-8).

The hottest part of the ame is the tip of the blue center portion, which is applied to the area to be soldered until that area is red hot. Apply solder to the break or slightly above it and remove the heat as soon as the solder ows over the break. If the ame is applied for too long, the solder will melt and nally oxidize away, negating the repair. If the solder does not ow but balls up at the end of the soldering wire, the frame is not hot enough.

Turn off the unit immediately after use. To be sure it is off, since the gases are invisible, immerse the tip of the torch in water so that any escaping gas can be detected.

Electric Soldering

An electric soldering technique to repair frames is pre- ferred by some. Either ame or electricity can produce excellent results, with personal preference and experi-ence the basis for choice.

As with ame soldering, a strong bond requires that the area be brushed clean. After cleaning adjust the

Figure 10-88. Frames are buffed after soldering to remove foreign matter and discoloration. The tiny rag wheel is mounted on a Dremel tool or a hanging motor drill.

(Courtesy Hilco, Plainville, Mass.)

frame so that it is bent like it should be during normal wear. Then remove the lenses. Once again, hold the parts in contact by means of a soldering jig

Instead of applying solder after the area is hot, place a small clip of solder on the position of the break while the frame is still cold. The area must be pre uxed as when ame soldering

Clip a wire from the electric soldering unit to the jig. This will allow an electric current to ow a complete circuit through the frame during the actual soldering

To do the soldering touch a carbon rod attached to the soldering unit by a second wire to the solder clip. Depress the foot switch to feed an electric current through the system, bonding the break within 1 or 2 seconds. The strength of the current and karat rating of the solder necessary depends on frame thickness.

Discoloration

Gold- and silver-colored frames can be cleaned quite well after soldering by buf ng with a rag wheel and polishing compound. The rag wheel can be a large, bench-mounted wheel or a tiny rag wheel mounted on a hand drill, as shown in Figure 10-88. It is possible, however, that some discoloration may still remain. The wearer should be warned of this consequence ahead of time.

Bronze, pewter, and other colored frames will not buff out.

It the wearer wants the frame soldered with no sign of discoloration, the frame can be completely replated with an electroplating unit and the appropriate solu- tions. This alternative is seldom used, but is available if needed. An electroplating unit can be used to change a silver frame to a gold or a copper color and vice versa.

Figure 10-89. It is possible to do touch-up replating after soldering. Plating is applied by rst attaching the alligator clip as close to the area to be plated as possible. Plating solution is brushed back and forth across the plating area as shown. Then the unit is turned on. (Courtesy Hilco, Plainville, Mass.)

Touch-Up Plating

Rather than completely replate an entire frame, it is pos-sible to obtain a unit used for touch-up plating to certain areas of a frame. To plate the part of a frame that has been soldered, polish the discolored area. Then place the frame in an ultrasonic unit to remove all polishing com- pounds and oils that may be present. (If an ultrasonic unit is not available, clean with warm water and a soft cloth.)

Some plating units come with disposable plating pens. Others come with bottles of plating solutions that are applied with a felt tip. There is a variety of plating colors available, including gold, silver, copper, gunmetal, and nickel or palladium.

To apply the plating, attach the alligator clip as close to the area to be plated as possible. Brush the solution back and forth across the plating area, as shown in Figure 10-89. The color obtained in plating depends on the amount of plating material applied. The more the area is brushed with solution, the deeper the color that will result.

If after plating is initiated no color appears, the alliga-tor clip may not have suf cient contact with the metal of the frame. This can be caused by a clear coating thathas been applied to the frame during the manufacturing process. To overcome the problem, move the clip onto apolished area so that the plating will take to the frame.

CLIP-ON

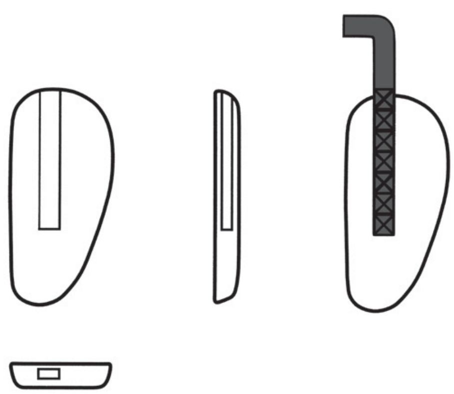
The *clip-on design, also known as B & L clamp style, con- sists of two curled hooks on the pad, which t about anindented waist in the bearing area of the pad arm (AppendixFigure 10-1). The hooks are passed about this waist and then clamped tight with pliers.*

If a broken or corroded pad is to be removed, a special bifurcated tool can be used to separate the hooks to remove them. If this tool is not available, an ordinary optical screwdriver may be used to pry up the hooks by forcing the blade under them. This latter procedure is sometimes dif cult to perform, depending on the extent to which the hooks have been compressed and the posi- tion of the pad arms in relation to the frame front. It may be more expedient to alter the position of the pad arms so that the hooks can be approached more easily. Care should be taken not to clamp the hooks too tightly.

Too tight a clamp totally eliminates the play of the pads at their juncture with the pad arms.

TWIST-ON

Appendix Figure 10-2. The *twist-on pad de sign is sometimes called the A.O. twist system .*



A**ppendix Figure 10-3. The** *Zeiss bayonet pad de sign is extremely easy to change and adds the possibility of changing vertex distance and pad separation without moving the basic position of the pad arms.*

ears are worn away, the shaft may come out of the slot even though the pads are vertical, in which case an entirely new pad is needed.

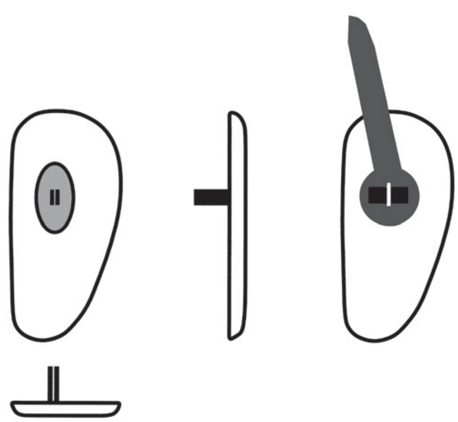
ZEISS BAYONET

The Zeiss bayonet style pad slips onto a ridged pad arm (Appendix Figure 10-3). It is simple to remove and One system that twists into place has employed a vertical replace. Some, but not all, types of Zeiss bayonet pads metal stud that is attached to the pad. This twist-on method is sometimes referred to as the A.O. twist system. The shaft of the stud itself is indented with two slots that permit it to be inserted, with its long axis horizontal, into a horizontal slot in the pad arm.

When the pad is rotated to a vertical position, the ears on the stud overlap the sides of the slot in the pad arm, preventing the pad from falling off the pad arm (Appen- dix Figure 10-2). Occasionally, it is necessary to com- press the sides of the slots slightly with pliers so that the pad shafts cannot rotate backto a horizontal position.

If a pad is broken, it may be necessary to cut or le away the ears of the stud to remove the old shaft. If the are made so that they will turn around 180 degrees so that they go on either frontward or backward. When the hole for the pa d arm is not exactly centered in refer- ence to the edges of the pad, putting both pads on back- ward will increase the vertex distance. With some types of Zeiss pads, this is said to change the vertex distance up to 4 mm.

When the hole for the pad arm is not cent ered in reference to the front and back surfaces of the pad, switching the pads left-for-right and right-for-left will increase the distance between pad surfaces, either making the frame more suitable for a wider nose or causing the frame to sit lower on the face.



Appendix Figure 10-4. The *split-clamp pad de sign is also referred to as the A.O. split-type of attachment.*

SPLIT-CLAMP

There is a pad with a back that consists of two clasp like pieces of metal, much like the fastener on a large mailing envelope. These two pieces t through the vertically elongated hole in the pad arm and are spread to hold the frame in place (Appendix Figure 10-4). It is sometimes called the *A.O. split-type of attachment.*

STIRRUP

The stirrup type of mechanism consists of a miniature cylinder attached to the back of the pad. (It is similar to the post of the screw-on type pad.) Occasionally the cylinder may have a square or oval cross section rather than a round one.

The pad arm ends in a stirrup like structure that has the footrest divided in two. The stirrup is spread apart, using a special tool, a screwdriver blade, or pliers. When half of each stirrup is astride the cylinder, with the ends of the footrest facing the holes, the footrest is then compressed so that each ends into the corresponding hole.

It is difficult to remove such pads since a special tool is required to spread the stirrup footrest once it has been compressed about a pad. It is possible to remove them using a screwdriver blade, but with more difficulty.

RIVET TYPE

Some older types of pads are attached by means of a loosely tting rivetlike system that allows rocking of the pads. It is a semipermanent arrangement and cannot be removed unless clipped off. If it becomes necessary to replace this type of pad, the replacement is a split-clamp design and works like the fastener on a large mailing envelope. The replacement pad clips are inserted through this rivet hole in the pad arm and then spread.

Sample Questions:

1. A cable temple is too short. It is 160 mm long and needs to be 170 mm in length. Replacement cable ends come in a variety of sizes. The appropriate length is the length that will allow a proper fit around the back of the ear (shown earlier in Figure 9-27, *A*) and end at a logical point of attachment to the straight portion of the temple. In this case we will say that our replacement cable end length is 90 mm. To what length should the cable temple be cut to achieve the new length?

If the overall desired length is 170 mm, we subtract 90 from 170, which equals 80 mm (170 mm − 90 mm D 80 mm). This 80-mm length is measured back from the center of the hinge barrel and marked. Then an additional 8 mm is measured (at 88 mm) and also marked. The temple is cut at the second mark, and the 90-mm replacement part attached.

2. **Write a Note on Screwdriver Types**

There are many different types of optical screwdrivers available, from ones with brass shafts and no-roll handles, to others having large, round hardwood handles that fill the palm of the hand. There is also an ergonomic type shown in Figure 10-4 with a handle that can be bent to conform to the hand.

It can be tricky enough just to hold a tiny screw between thumb and forefinger. Getting it screwed into the hole far enough to get started is even harder. Here are two options to help in this matter.

- There is a “pick-up” screwdriver with spring-loaded retractable jaws for holding small screws until they catch the threads in the barrel.
- Another option is a special screw-holding tool that grips the screw so that it can be more easily pressed into the hole (Figure 10-5).

Check to make sure that the blade of the screwdriver is in good condition. Damaged blades can damage screw heads. And regardless of what screwdriver is used, the blade size needs to match the screw. (Most optical screw- drivers have reversible blades with different widths on each end.)

Another helpful tool is a screw-lift tool. This is used after the screw is loose and ready to be removed.

UNIT 13

RECORD KEEPING

Learning Objective:

At the end of this course, students will be able to;

- Learn and practice record keeping.
- Understand the purpose and methods of record keeping for quality documentation.

INTRODUCTION:

An appropriate record-keeping system can determine the survival or failure of a new business. For those already in business, good record-keeping systems can increase the chances of staying in business and the opportunity to earn larger profits. Complete records will keep you in touch with your business's operations and obligations and help you see problems before they occur.

This unit explains the characteristics of and procedure for establishing a goodrecord-keeping system.

THE NEED FOR GOOD RECORDS

Accounting records furnish substantial information about your volume of business, such as howpresent and prior volumes compare, the amount of cash versus credit sales and the level and status of accounts receivable. In addition, good accounting records help to accomplish the following tasks.

Monitor Inventory

While a large inventory allows goods to be delivered when they are ordered, too large an inventory represents an excess investment. If your inventory does not turn over quickly, your business may lose profits due to obsolescence, deterioration or excess investment.

Any items removed from inventory for personal use should be set aside in a special account for two reasons: first, they need to be recognized separately for tax purposes and, second, includingthese items in business gross profit calculations can be misleading.

Control Expenses

Accounting records detail the amounts owed to suppliers and other creditors so that you can planthe availability of cash to meet your obligations. Such records also provide information regarding expenditures and allow you to establish controls over them. At all times, you must be aware of your individual expense requirements and how they relate to the overall picture.

Fulfill Payroll Requirements

Payroll is one of the largest expenses in a small business. Adequate payroll records should meet the requirements of the

D Internal Revenue Service.

D State department of revenue.

D Local department of revenue.

D Workers' compensation laws.

D Wage and hour laws.

D Social security requirements.

D Unemployment insurance requirements.

For each of these categories you are required to provide annual reports and summaries. In addition, you must provide employees with the W-2 forms needed to file federal and otherincome tax returns. In order to provide this detailed information, it is essential for you to maintain good accounting records.

Determine Profit Margin

Good accounting records will indicate a business's level of profit, and provide specific information on the profitability of certain departments or lines of goods within your business.Such analysis is important to avoid continuing product lines far beyond their profitability. In most cases, you can avoid losses if you maintain current records and analyze the information from your records on an ongoing basis.

Improve Cash Flow

Good accounting records provide detailed reports of cash availability, both on hand and in thebank, and of cash shortages or the diversion of cash. Since cash is your most liquid asset,you must carefully account for it.

Use Supplier Discounts

A cash budget will provide the business owner with a projection of the availability of cash that may be used to pay invoices as they become due. Discounts from suppliers for prompt payment can amount to substantial savings. A 2 percent discount is common if you pay the bill in full within 10 days; if not, full payment is due within 30 days. In business, this is commonly referredto as "2/10, n/30" where n = the net sum due. It means you pay 2 percent less if you pay within 10 days or you pay full price within 30 days. Take into account that this discount is cumulative. If you make timely payments for each month of the year you will gain a 24 percent benefit (2 percent 12 months).

Measure Performance

Finally, good business records help you measure your business's performance by comparing youractual results with the figures in your budget and those of other similar businesses.

REQUIREMENTS OF A GOOD SYSTEM

The following criteria are essential to a good record-keeping system:

D Simplicity

D Accuracy

D Timeliness

D Consistency

D Understandability

D Reliability and completeness

There are several copyrighted accounting systems that can be purchased and adapted to the individual business, or you may find it is better to use a system specifically designed for yourbusiness and one that meets the above-mentioned criteria.

Commercial Record-Keeping Systems

Record-keeping systems are currently available from various sources in the marketplace: stationery stores, publishers and business advisory services. These systems either are specificallydesigned for a certain type of business or are general enough to be used by many different types of businesses. Systems are available for cash basis recording, accrual basis recording and for both single and double entry.

Computerized Record Keeping

Consider using a computer for your business operations. Compare different software systems andmake sure that the system you choose provides accurate and timely information and offers more than adequate presentation of accounting information for small businesses.

Low-cost computer programs are available that can handle many of the book entries that are necessary in a system that is maintained by hand. Appropriate hardware and a good general ledger software program can offer you substantial assistance in recording business transactionsand summarizing the information into appropriate accounting presentations.

Currently available software allows you to enter transactions individually; these transactions are posted directly to the general ledger. A printout at the end of a given period shows the individualaccount activity, and also includes a balance and total of the accounts and provides a trial balance presentation. If the software is designed properly, it will provide appropriately prepared financial statements (balance sheet, income statements).

METHODS OF ACCOUNTING

There are two basic methods of accounting: cash basis and accrual basis. The method you choosewill depend on your type of business. Cash basis is the simpler method. It is mainly used by service businesses that do not maintain inventory or startup businesses that do not offer credit.

The accrual method is used by businesses that provide for credit sales or maintain an inventory.

Cash Basis Method

In cash basis accounting, you record sales when cash is received and expenses when they are actually paid. Using the cash basis method is like maintaining a checkbook. Under this method,accounts receivable are not recorded as sales until they are collected. Accounts payable are not recorded as expenses until the account is paid. Bad debt, accruals and deferrals are not appropriately recorded under cash basis because they are examples of outstanding credit

(business notes). The cash basis method is not appropriate for businesses that extend credit.

Accrual Basis Method

In accrual basis accounting, you report income or expenses as they are earned or incurred rather than when they are collected or paid. Record credit sales as accounts receivable that have not yetbeen collected.

The accrual basis also provides a method for recording expenditures paid in a single installmentbut covering more than one period. For example, interest may be paid semiannually or annually,but it is recorded on a monthly basis.

The accrual method satisfies the matching concept, i.e., matching income with related expenditures. Consequently, it can provide a clear and accurate view of business operations for agiven period.

THE ACCOUNTING CYCLE

The accounting cycle can be described as follows:

1. A business transaction occurs, giving rise to an original document that is recordedin a book of original entries called a *journal*.

2. The totals from the journal are summarized and reported in a book of accounts,known as a *general ledger*.

3. The general ledger contains the *individual accounts* maintained by the business.

4. The individual accounts are listed in the form of debits and credits, known as the

trial balance of the general ledger.

5. From this trial balance, after making certain adjustments, you prepare thebusiness's *financial statements*.

Journals

You derive the information for each journal entry from original source documents, such as, salesslips, cash register tapes, check stubs, purchase invoices and other items that record your business transactions. You may need to create subsidiary journals for specific, frequently occurring types of transactions, such as sales and expenses.

General Ledgers

The summary and totals from all journals are entered into the general ledger. A general ledger is a summary book that records transactions and balances of individual accounts, and is organized into five classes of individual accounts, as follows:

1. Assets -- A record of all items that the business owns.

2. Liabilities -- A record of all debts the business owes.

3. Capital -- A record of all ownership or equity.

4. Sales -- A record of all income earned for a specific period.

5. Expenses -- A record of all expenditures incurred during a given period.

When the trial balance is prepared, these classifications are easily recognized.

Trial Balance

At the end of the fiscal year or accounting period, the individual accounts in the general ledgerare totaled and closed. The balances of the individual accounts are summarized in the financialstatements.

HOW TO ANALYZE YOUR RECORDS

To chart the progress of your business, you should become familiar with various forms offinancial statements analysis and measurement.

Financial statements indicate which items need more attention. For example, profits may be too low or rent unnecessarily high. Perhaps there is a way to use the business vehicles more efficiently, to increase inventory turnover or to reduce long distance telephone bills.

In analyzing financial statements, carefully examine all items that do not seem realistic. Answerthe following questions:

D Why are certain expenses at a particular level?

D Are there any ways to reduce or avoid certain expenses?

D Should you incur all of your expenses?

D Does the level of profit justify your investment, time and effort?

Financially significant items should be analyzed regularly. For example, examine payroll as a percentage of total administrative expenses. Keep in mind that, if your business is a proprietorship, your salary is not a payroll expense; however, if your business is a corporation,your salary should be a payroll expense.

Analyzing Payroll Expenses

In justifying payroll and other expenses, answer the following questions:

D Are accurate records maintained for time spent on various jobs and functions?

D Is the eight-hour day of each employee accounted for appropriately?

D When employees are paid overtime, is the additional expense reflected in chargesto the customer?

D Is the level of payroll expense appropriate for your type of business?

D Are you billing on a guaranteed price basis or on an hourly basis?

D When using guaranteed price basis for billing, does actual time spent exceed timeestimated for the job?

D Do employees work with a minimum of wasted effort and time?

D Are you operating at maximum efficiency? What strategies can be implementedto maximize efficiency?

Ratios

Accountants use various ratios to evaluate financial statements, such as ratios that assessliquidity, solvency and profitability.

Liquidity

These ratios indicate the availability of cash and the firm'sability to pay liabilities.

Current ratio: Current assets divided byCurrent liabilities

Acid test (liquidity ratio): Cash, cash equivalents and Receivables divided byCurrent liabilities

Day's sales in receivables: Accounts receivable divided by Credit sales divided by 360

Inventory turnover: Cost of sales divided byAverage inventory

Capital and Long-term Solvency

These ratios indicate the firm's ability to meet debts when due. Equity/debt ratio: Total equity divided by Total debt

Total equity to Total equity divided byfixed assets: Net fixed assets

Profitability

These ratios indicate your firm's performance.

Gross profit margin: Gross profit divided bySales

Net income to sales: Net income divided bySales

Operating income to sales: Income before income taxesdivided by Total assets

Return on total assets: Net income and interest expensesdivided by Total assets

Return on total assets: Net income divided byTotal equity

OTHER IMPORTANT RECORDS

In addition to accounting records, you will need to keep separate records for accounts receivable,payroll and taxes, petty cash, insurance, business equipment and perhaps other items.

Accounts Receivable

A good record-keeping system should provide you with a detailed report of accounts receivable, including current information on customers and a running balance of their accounts. To maintaina good accounts receivable system, record credit charges on a regular basis. It is essential that you follow up on all late paying and delinquent customers.

Accounts receivable should be aged at the end of each month. This means organizing the accounts into those that are current; 30-, 60-, and 90-days old and older. This arrangement helpsyou to take appropriate, timely actions.

One example of a timely action is to transfer delinquent accounts to a notes receivable account.Notes receivable are loans the business makes to others, either inside or outside the business.

Each note receivable should contain specific terms of credit and interest and should be signed bythe customer. An additional timely action to decrease the number of bad accounts and avoid the effort of collecting payments from slow-paying customers is to issue a formal complaint with your local credit bureau.

Payroll and Taxes

Current Internal Revenue Service (IRS) regulations require that you withhold federal income tax and social security (FICA) from each employee. You must remit the amount for taxes to the IRSon a quarterly, monthly or more frequent basis. A detailed reporting system for payroll will help you make timely tax payments.

Gather specific information about each employee on individual employee record cards. All employees should fill out federal Form W-4, which indicates their filing status and the number ofexemptions they claim. Use this information to compute the federal withholding and social security (FICA) deductions for each payroll check.

Prepare Employees Quarterly Federal Tax Return (Form 941) by totaling each employee'swithholding for federal taxes and social security. File Form 941 with the IRS.

Each payroll period, total the accumulated withholdings of both federal taxes and social securityfor all employees. If this total exceeds $500 for any month, you must deposit this amount by the15th day of the following month in a depository bank (an authorized financial institution or a federal reserve bank). Generally, when the total exceeds $3,000, you must deposit this amount within three business days. Any overpayment in taxes is paid back to you quarterly.

At the year's end, you are required to prepare not only the information normally required for thatquarter, but also summaries of each employee's total earnings and withholdings for the year (Form W-2). Provide this form to each employee and the IRS.

A Word of Caution

It is very easy to fall behind in making tax payments. If you find yourself short of cash, do not betempted to delay payment of taxes. The IRS will not bill your business for taxes due nor will it notify you of late payments. Delayed payments can easily add up to a large sum; the debt may impede the growth of your business and may even force you to close your business, to say nothing of the federal penalties incurred for late payments.

With a good record-keeping system, you can simplify the process of filing taxes to the point where the information needed to complete the forms is automatically generated. Setting up sucha system is a rather technical task and you may need to seek guidance.

Petty Cash

Sometimes a petty cash fund is needed to purchase small items required on a day-to-day basis. Ifthis is necessary, draw a check to petty cash for a nominal amount.

Problems often arise when cash is easily available; therefore, if possible, avoid a petty cash fund.However, very often the convenience of having a small amount of cash available will facilitate the smooth operation of your business. Be sure to balance this fund monthly, based on the cash balance plus receipts for all expenditures.

Insurance

Most businesses have several types of insurance. For each policy, you should have the followinginformation:

D Clear statement of the type of coverage.

D Names of individuals covered.

D Effective dates and expiration date.

D Annual premium.

Review your insurance policies on a regular basis. In addition, annually consult an insurance specialist, who will review the total insurance package to determine what coverage is appropriateand ensure that premiums remain in line with prior quotations.

Business Equipment

Keep an accurate list of permanent business equipment used on both a regular and stand-by basis. The list should describe the equipment and provide serial numbers, date of purchase andoriginal cost. Keep the list available for insurance or other purposes. You will also need this information to prepare accurate depreciation schedules.

ACCOUNTING SERVICES

You have several choices in who should maintain your accounting system. You can

D Maintain the books yourself.

D Hire a bookkeeper on a full-time or part-time basis.

D Hire the accountant who set up your books.

D Set up a hybrid system in which you maintain the day-to-day reports, while an accountant does the period-end record preparation, summaries and renconiliationsand the returns for sales tax, excise tax and payroll taxes.

In making the choice, you must decide whether you have the ability and time to set up and maintain good records or if you should engage an outside accounting service. It is usually suggested that you hire an accountant to do the final year-end preparations and to advise you. No matter what you choose, you should remain familiar with your books and participate in the record-keeping process. This will maximize the services provided by the accountant and allow you to keep track of your business.

Selecting the Accounting Service

If you decide to hire an outside service, find an accounting firm that will work closely with yourbusiness and provide you with the information necessary to develop a successful operation.

Interview several accounting professionals and compare their level of accounting knowledge,computer literacy, knowledge of and experience with small business accounting and any specialized knowledge required in your business.

There are many types of professionals you may consider, such as a certified public accountant,an enrolled agent or an accredited accountant.

D *Certified Public Accountant (CPA)* -- A person who has passed the AmericanInstitute of CPAs' national examination, which tests an individual's ability in accounting, auditing, law and related areas.

D *Enrolled Agent (EA)* -- An individual who has passed a two-day exam preparedby the IRS, covering many areas of federal taxation. This person is generally considered a tax specialist.

D *Accredited Accountant* -- An individual who has passed a rigorous examinationprepared by the Accreditation Council of Accountancy and Taxation, a nationalaccounting accreditation board affiliated with the National Society of Public Accountants and the College for Financial Planning in Denver, Colorado. Accredited accountants specialize in small business accounting.

Other accountants in public practice perform various levels of accounting and write-up services.

When selecting an accountant, the cost of the accountant's fees must be weighed against the benefits received. Frequently, the accountant's professional advice can increase profits to more than cover the expense. Monthly services by an accounting firm will provide you with completeand timely information and also will allow the accountant to develop knowledge of your business and be in a more comfortable position to render professional advice as the business grows.

Advice and Assistance

In addition to bookkeeping, an accountant can advise you on financial management. He or she can assist with cash flow requirements and budget forecasts, business borrowing, choosing a legal structure for your business and preparation and advice on tax matters.

Cash Flow Requirements

An accountant can help you work out the amount of cash needed to operate the business during acertain period for example, a three-month, six-month or one-year projection. The accountant considers how much cash you will need to carry your accounts receivable, to increase inventory, to cover current invoices, to acquire needed equipment and to retire outstanding debts.

Additionally, the accountant can determine how much cash will come from collection of accounts receivable and how much will have to be borrowed or provided from other sources.

In determining cash requirements, the accountant may notice and call attention to danger spots,such as accounts that are in arrears or delinquent areas or areas of excess expenditure.

Business Borrowing

An accountant can assist you in compiling the information necessary to secure a loan: the assetsthe business will offer for collateral, the present debt obligations, a summary of how the moneywill be used and repayment schedules. Such data show the lender the financial condition of the business and your ability to repay the loan. Remember, lenders have two very definite requirements: (1) that the business have adequate collateral to secure the loan and (2) that the business will be able to repay the loan. An accountant can advise on whether you need a short- or long-term loan. In addition, your accountant may introduce you to a banker who knows and respects his or her financial judgment.

Legal Structure

It is wise to discuss the type of business organization that best fits your needs with an accountant and an attorney. They can point out the advantages and disadvantages of the various forms of business organization, such as a

D *Proprietorship* -- An extension of individual ownership.

D *Partnership* -- Multiple proprietors.

D *Corporation* -- A completely separate legal entity.

In addition, they can advise you on immediate plans regarding management, financing,
long-range plans to bring others into the business and estate planning, all of which affect the typeof business you choose.

Tax Considerations

This is an area in which an accountant can provide much advice and assistance. Your accountantcan suggest methods to record and document the various types of information necessary for taxes.

APPENDIX A: FINANCIAL STATUS CHECKLIST

What You Should Know

Daily

1. The balance of cash on hand.
2. The bank balance.
3. Daily summaries of sales and cash receipts.
4. Any errors or problems that have occurred in collections.
5. A record of monies paid out, both by cash and by check.

Weekly

1. Accounts receivable (particularly those accounts that appear to be slow paying).
2. Accounts payable (be aware of the discount period mentioned above).
3. Payroll (be aware of the accumulation of hours and the development of thepayroll liability).
4. Taxes (be aware of any tax items that are due and reports that might

be requiredby government agencies).

Monthly

1. If you engage an outside accounting service, provide records of receipts, disbursements, bank accounts and journals to the accounting firm. This will allow

the firm to maintain good records and present them to you for review, consideration and support in decision making.

2. Make sure that income statements are available on a monthly basis, and certainlywithin 15 days of the close of the month.

3. Review a balance sheet that indicates the balance of business assets and the totalcurrent liability.

4. Reconcile your bank account each month so that any variations are recognizedand necessary adjustments made.

5. Balance the petty cash account on a monthly basis. If you allow this account to extend for a longer period, it may create substantial problems.

6. Review federal tax requirements and make deposits.

7. Review and age accounts receivable so that slow and bad accounts are recognizedand handled.

Sample Questions:

1. **Describe How would you analyze your records?**

HOW TO ANALYZE YOUR RECORDS

To chart the progress of your business, you should become familiar with various forms offinancial statements analysis and measurement.

Financial statements indicate which items need more attention. For example, profits may be too low or rent unnecessarily high. Perhaps there is a way to use the business vehicles more efficiently, to increase inventory turnover or to reduce long distance telephone bills.

In analyzing financial statements, carefully examine all items that do not seem realistic. Answerthe following questions:

D Why are certain expenses at a particular level?

D Are there any ways to reduce or avoid certain expenses?

D Should you incur all of your expenses?

D Does the level of profit justify your investment, time and effort?

Financially significant items should be analyzed regularly. For example, examine payroll as a percentage of total administrative expenses. Keep in mind that, if your business is a proprietorship, your salary is not a payroll expense; however, if your business is a corporation,your salary should be a payroll expens**e.**

2. Describe the process of analyzing payroll expenses?

Analyzing Payroll Expenses

In justifying payroll and other expenses, answer the following questions:

D Are accurate records maintained for time spent on various jobs and functions?

D Is the eight-hour day of each employee accounted for appropriately?

D When employees are paid overtime, is the additional expense reflected in chargesto the customer?

D Is the level of payroll expense appropriate for your type of business?

D Are you billing on a guaranteed price basis or on an hourly basis?

D When using guaranteed price basis for billing, does actual time spent exceed timeestimated for the job?

D Do employees work with a minimum of wasted effort and time?

D Are you operating at maximum efficiency? What strategies can be implementedto maximize efficiency?

Unit 14

ABNORMAL OCULAR CONDITIONS AND STANDARD OF PRACTICE:

Learning Objectives:

1. At the end of this course, students will be able to learn abnormal ocular conditions.

2. Students will be able to learn standards of practice and referral guidelines.

Ocular abnormalities are the basis of core subjects 6 for optometrists and subject 8 for dispensing opticians

Optometrists are required to have a comprehensive knowledge of the causes, indication, assessment, diagnosis and management of common conditions.

Dispensing opticians need to recognise symptoms requiring emergency action and understand the implications of these diseases.

It is important to remember that dispensing opticians have a duty of care regarding ocular conditions and failure to identify, record and act upon appropriately presenting symptoms in a practice may constitute negligence on their behalf.

The breakdown of the two core subjects for each of the professions is as follows.

Optometrists

Core Subject 6: Ocular abnormalities

- The ability to identify and manage ocular abnormalitiesThe ability to interpret and investigate the presenting symptoms of the patient
- The ability to develop a management plan for the investigation of the patient
- The ability to identify external pathology and offer appropriate advice to patients not needing referral
- An understanding of risk factors for common ocular conditions
- The ability to recognise common ocular abnormalities and to refer when appropriate
- The ability to manage a patient presenting with a red eye

- The ability to manage a patient presenting with reduced vision
- The ability to identify abnormal colour vision and to appreciate its significance
- The ability to manage a patient presenting with cataract
- The ability to evaluate glaucoma risk factors, to detect glaucoma and refer accordingly
- The ability to manage a patient presenting with macular degeneration
- The ability to recognise, evaluate and manage diabetic eye disease and refer accordingly
- The ability to evaluate and manage a patient presenting with symptoms suggestive of retinal detachment
- An understanding of the treatment of a range of common ocular diseases
- The ability to recognise ocular manifestations of systemic disease
- An understanding of the role of optometrists in shared care schemes
- The ability to assess symptoms and signs of neurological significance
- The ability to manage patients presenting with sight-threatening eye disease
- An ability to recognise adverse ocular reactions to medication.

Dispensing Opticians

Core Subject 8: Ocular abnormalities

An understanding of the relevance of ocular disease.

Critical competencies

- The ability to recognise conditions and symptoms requiring referral and/or emergency referral and the demonstration of the ability to take appropriate action.

Applied knowledge and skills

- The ability to identify common diseases of the external eye and adnexa
- An understanding of symptoms associated with internal eye disease
- An understanding of the clinical treatment of a range of significant ocular diseases/disorders and conditions
- An understanding of the clinical treatment of a range of systemic diseases with ocular manifestations and adverse ocular reactions to medication
- An understanding of the implications of the manifestations of eye disease

- The ability to recognise and deal with ocular emergencies.

Ocular Emergency

Referral and management is always best considered on a case-by-case basis. However, in general terms it is useful to think of emergency conditions in terms of the following:

- Pain - if severe pain is present, there is usually no difficulty in persuading a patient to seek immediate medical assistance. Although pain is obviously subjective, there are a number of conditions known to cause severe ocular and peri-ocular pain, such as acute angle-closure glaucoma, acute anterior uveitis, scleritis, orbital cellulitis, many infective and traumatic corneal conditions, all of which benefit from prompt medical intervention.

- Loss of vision - it is worth asking whether the suspected condition is one which presents an increasing threat to vision the longer it is left before medical intervention. A classic example here is retinal detachment (characteristic symptoms being a sudden onset of floaters, flashing lights, possibly an increasing reduction in vision).

- Threat to health - thankfully, it is rare for any ocular condition to reflect a life-threatening situation. However, whenever a patient is feeling generally unwell, advice to seek medical attention is sensible. There are a number of conditions which certainly require prompt attention. Papilloedema is interesting in that bilateral disc swelling is linked with raised intracranial pressure and, though more often associated with cerebrospinal fluid build-up, may result from a space occupying lesion such as an intracranial aneurysm. Visual symptoms are often absent or vague and this makes an interesting challenge when the potential urgency of the situation needs to be made clear to the patient. Vascular incidents are common causes of sudden loss of vision, particularly in the elderly. A complete, sudden and painless loss of vision may be due to an arterial occlusion and this is another example of where urgency is required. The embolus that blocks flow in a high-pressure artery is typically calcific. The fact that such an embolus exists is an important warning that further occlusion, either in the other eye, the brain, lung or heart, is a distinct possibility and therefore prompt attention is warranted. Some older texts imply that if the symptoms are longstanding then little can be done to restore sight, so urgency is no longer appropriate. Arterial occlusion is a useful example of where the general medical implications should be borne in mind alongside the ocular implications.

Sample Questions:

1. Describe Referral mechanism of different ocular conditions?

Pain - if severe pain is present, there is usually no difficulty in persuading a patient to seek immediate medical assistance. Although pain is obviously subjective, there are a number of conditions known to cause severe ocular and peri-ocular pain, such as acute angle-closure glaucoma, acute anterior uveitis, scleritis, orbital cellulitis, many infective and traumatic corneal conditions, all of which benefit from prompt medical intervention.

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UNIT 15:

Comprehensive Guideline: Business Organizational Structure & Management Functions

Learning Objectives:

At the end of this course, students will be able to learn the;

1. Multidisciplinary approach of business organization.
2. Integrating managerial skills including leadership, planning, budgeting, innovation and diversity and strategic management.
3. Different tools and softwares.

Introduction

Opticianry plays a crucial role in providing essential eye care services, from routine examinations to diagnosing and managing various eye conditions. Optimizing the business structure and incorporating effective management functions are vital for opticians to thrive in this competitive landscape. This comprehensive guideline delves into these crucial aspects, equipping you with valuable insights and best practices to navigate your optometry practice towards success.

Part 1: Navigating the Organizational Landscape

1. Hierarchical Model:

This traditional setup features a clear chain of command, with the owner/manager at the helm, followed by optometrists, technicians, support staff, and administrative personnel. Advantages include well-defined roles and responsibilities, efficient decision-making, and a structured workflow. However, potential drawbacks include rigidity, limited communication flow, and a potentially demotivating environment for lower-level staff.

2. Team-Based Model:

This approach prioritizes collaboration and interdisciplinary teams. Teams, each focusing on specific areas like patient care, administration, or marketing, function as cohesive units with shared goals. Benefits include improved communication, increased job satisfaction, and greater adaptability to changing needs. However, potential challenges include role overlaps and the need for strong team leadership to ensure cohesion and accountability.

3. Hybrid Model:

Combining elements of both hierarchical and team-based structures, this model offers flexibility and adaptability. Teams, led by supervisors, operate under the guidance of a central manager. This structure optimizes communication flow, leverages individual strengths, and fosters collaboration while maintaining a degree of control. However, creating a clear delineation of roles and responsibilities is crucial to avoid confusion and friction.

Choosing the Right Model:
The ideal organizational structure depends on various factors like practice size, budget, target market, and overall management style. Consider these factors along with your long-term vision to determine the model that best aligns with your goals and fosters a thriving practice environment.

Part 2: The Pillars of Success: Key Management Roles

1. The Visionary: The Optometrist
At the heart of the practice lies the optometrist, responsible for examining patients, diagnosing eye conditions, prescribing corrective lenses, and managing various ocular diseases. Beyond clinical expertise, leadership, effective communication skills, and patient empathy are critical for building trust and ensuring exceptional patient care.

2. The Orchestrator: The Practice Manager
The practice manager plays the pivotal role of overseeing daily operations. From budgeting and human resources to marketing and inventory management, their skill set encompasses a broad range of responsibilities. Strong organizational, communication, and financial management skills are essential for navigating the complexities of running a successful practice.

3. The Technical Backbone: The Optometrist Technician
Assisting the optometrist in examinations, preparing eyewear, and maintaining equipment, the optometrist technician occupies a critical role in ensuring smooth patient flow and efficient operations. Technical proficiency, patient interaction skills, and attention to detail are key qualities for this vital position.

4. The Supporting Cast: Additional Staff
From front desk staff and receptionists who provide the first point of contact for patients to billing personnel who ensure financial stability, all supporting staff contribute to the overall success of the practice. Their dedication to customer service, administrative efficiency, and creating a welcoming environment for patients is paramount.

Part 3: Building a Foundation for Excellence: Essential Management Functions

1. Charting the Course: Strategic Planning
Defining a clear vision, mission, and long-term goals is crucial for guiding the practice towards sustained success. Conduct market research, perform a SWOT analysis, and develop a comprehensive strategic plan outlining objectives, timelines, and resource allocation. Regularly reviewing and adapting this plan ensures your practice remains flexible and responsive to changing market dynamics.

2. Securing the Future: Financial Management

Sound financial management is the cornerstone of long-term viability. Establish and monitor key financial metrics like revenue streams, operational costs, and profitability. Implement budgeting practices, track expenses diligently, and explore cost-saving strategies to optimize financial health.

3. Putting Patients First: Patient Care Management

Delivering high-quality, patient-centered care is at the core of every successful optometry practice. Prioritize clear communication, active listening, and building trust with patients. Implement scheduling protocols, optimize patient flow, and ensure efficient examination procedures to deliver a positive and seamless experience.

4. Cultivating a Thriving Team: Human Resource Management

Recruiting, training, and motivating staff are essential for building a strong and dedicated team. Foster a positive work environment through effective communication, performance management, and team-building activities. Empower staff, recognize their contributions, and invest in their professional development to foster loyalty and enhance engagement.

5. Expanding Your Reach: Marketing and Sales (Continued)

- Utilize diverse channels like targeted advertising, social media campaigns, community outreach programs, and patient referral incentives to effectively reach your target audience.
- Develop persuasive messaging that highlights the unique value proposition of your practice and resonates with your ideal patients.
- Track the effectiveness of your marketing campaigns and adapt your strategies based on data and market trends.
- Train staff on upselling and cross-selling techniques to maximize revenue opportunities while ensuring ethical product recommendations and patient needs remain the priority.

6. Inventory Optimization: A Balancing Act

Maintaining sufficient inventory of eyewear, equipment, and consumables is crucial to avoid disruptions and delays. However, overstocking can lead to financial constraints and outdated products. Implement efficient inventory management practices like cycle counting, forecasting demand, and setting reorder points to optimize stock levels. Analyze sales data and patient preferences to ensure you offer the most popular and in-demand products.

7. Embracing Technology: A Driver of Progress

Integrating technology can significantly enhance practice efficiency, patient experience, and communication. Utilize appointment booking software, electronic medical records, telehealth platforms, and marketing automation tools to streamline operations, improve accessibility, and personalize patient interactions. Ensure data security and comply with relevant regulations when introducing new technologies.

8. Continuous Improvement: A Journey, Not a Destination

Regularly assess your practice performance, analyze financial data, and gather patient feedback to identify areas for improvement. Conduct staff training programs, encourage innovation, and embrace a culture of continuous learning to adapt to evolving trends and patient needs.

9. Building Partnerships: Strategic Collaboration

Forge strategic partnerships with other healthcare providers, insurance companies, and relevant industry organizations to expand your referral network, gain access to new patient populations, and leverage expertise.

10. Measuring Success: Defining Key Performance Indicators (KPIs)

Establish clear KPIs to track progress and measure the effectiveness of your management efforts. Examples include patient satisfaction scores, appointment no-show rates, average revenue per patient, and employee retention rates. Regularly monitor and analyze these KPIs to identify areas for improvement and celebrate successes.

Navigating the business landscape of optometry requires a multifaceted approach. By establishing a well-defined organizational structure, fostering a dedicated team, and implementing effective management functions, you can create a thriving practice that delivers exceptional patient care, secures financial stability, and adapts to the ever-evolving world of healthcare. Remember, continuous learning, innovation, and a commitment to excellence are key ingredients for long-term success in the competitive field of optometry.

Specific Examples of Successful Organizational Structures within Optometry Practices:

1. Team-Based Model:
    - Example: "Family Eye Care Center" in California implemented a team-based approach with cross-functional teams responsible for specific tasks like pre-screening patients, managing appointments, and handling billing. This resulted in a 20% increase in patient satisfaction and a 15% reduction in operational costs. (Image of a team of optometrists and technicians working together in a patient-centered environment)
2. Hybrid Model:
    - Example: "Bright Eyes Optometry" in New York adopted a hybrid model with optometrists leading teams of technicians and support staff while reporting to a central practice manager. This structure allowed for improved staff communication and collaboration while maintaining

clear lines of authority. (Image of an optometrist leading a team meeting with technicians and support staff)

3. Virtual Care Integration:
   - Example: "Vision Direct" in Texas established a hybrid model with traditional in-person care supplemented by virtual consultations for routine exams and follow-up appointments. This increased patient access to care, particularly in rural areas, and boosted practice efficiency. (Image of a patient having a virtual eye exam with an optometrist)

Remember: The best structure for your practice depends on factors like size, budget, and target market.

Detailed Strategies for Implementing Different Marketing and Sales Tactics:

1. Content Marketing:
   - Create informative blog posts, articles, and social media content on eye health, common eye conditions, and benefits of preventative care.
   - Example: "The Eye Care Blog" by Dr. Smith provides valuable tips on choosing the right eyewear and maintaining healthy vision. (Image of an optometrist writing a blog post about eye health)
2. Targeted Advertising:
   - Utilize online platforms like Google Ads and Facebook Ads to reach specific demographics in your local area.
   - Example: Target ads to people searching for "eyeglasses near me" or those interested in specific eye care services.
3. Patient Referral Programs:
   - Encourage existing patients to refer friends and family by offering discounts or rewards.
   - Example: Offer a free eye exam discount for every successful referral.
4. Community Outreach:
   - Partner with local businesses, schools, or senior centers to offer free eye screenings or educational workshops.
   - Example: Sponsor a "Healthy Vision Day" at a local community center.
5. Patient Relationship Management (PRM):
   - Use a PRM system to track patient interactions, personalize communication, and send targeted email campaigns.
   - Example: Send automated appointment reminders or birthday greetings to patients.

Remember: Track the effectiveness of your marketing efforts and adjust your strategies as needed.

Guidance on Choosing and Integrating the Right Technology Solutions:

1. Electronic Medical Records (EMR):
   - Streamline patient recordkeeping, improve data accuracy, and facilitate communication with other healthcare providers.

    - Example: Choose an EMR system that integrates with your billing software and insurance verification tools.
2. Appointment Scheduling Software:
    - Allow patients to book appointments online 24/7, reduce phone calls, and manage your schedule efficiently.
    - Example: Choose software that integrates with your EMR and sends automated appointment reminders.
3. Telehealth Platforms:
    - Offer virtual consultations for convenient access to care, especially for patients with limited mobility or in remote areas.
    - Example: Choose a platform that meets HIPAA compliance standards and ensures secure video conferencing.
4. Practice Management Software:
    - Manage billing, inventory, marketing campaigns, and staff scheduling from one central platform.
    - Example: Choose software that scales with your practice growth and offers robust reporting capabilities.
5. Patient Engagement Tools:
    - Utilize online portals or mobile apps for patients to access test results, refill prescriptions, and communicate with their doctor.
    - Example: Offer a patient portal that allows patients to view their medical history and ask questions through secure messaging.

Remember: Prioritize user-friendliness, data security, and integration with existing software when choosing technology solutions.

Best Practices for Building Strong Relationships with Healthcare Partners and Patient Insurance Providers:

1. Regular Communication:
    - Maintain open communication with referring physicians, clinics, and insurance companies.
    - Example: Attend networking events and participate in professional organizations to connect with potential partners.
2. Collaborative Care:
    - Develop referral protocols and clinical pathways for seamless patient transitions between providers.
    - Example: Establish agreements with ophthalmologists for co-managing complex cases.
3. Insurance Billing Expertise:
    - Ensure staff are trained on accurate coding and billing practices to avoid claim denials and delays.
    - Example: Partner with

Building Strong Relationships with Insurance Providers:

Here's how you can delve deeper into building strong relationships with patient insurance providers:

1. Become a Preferred Provider:
   - Negotiate contracts with major insurance companies to become a preferred provider, increasing patient referrals and maximizing reimbursements.
   - Example: Highlight your excellent patient satisfaction scores and advanced technology to demonstrate your value as a preferred provider.
2. Offer In-Network Coverage:
   - Work with insurance companies to offer in-network coverage for your services, making them more affordable for patients and increasing your patient pool.
   - Example: Offer competitive pricing and demonstrate your cost-effectiveness to insurance companies.
3. Streamline the Claims Process:
   - Implement efficient billing and coding practices to minimize errors and denials, ensuring prompt payment from insurance companies.
   - Example: Invest in robust practice management software with automated claim submission features.
4. Stay Updated on Changes:
   - Regularly monitor changes in insurance policies, coverage options, and coding requirements to avoid compliance issues.
   - Example: Subscribe to industry publications or attend seminars to stay informed about insurance updates.
5. Develop Communication Channels:
   - Establish clear communication channels with insurance companies to resolve billing issues, clarify coverage questions, and foster positive relationships.
   - Example: Assign a dedicated staff member to handle insurance inquiries and maintain regular communication with insurance representatives.

Remember: Building strong relationships with insurance providers requires proactive effort, consistent communication, and a commitment to efficient claims processing.

Insights on Data Analysis and Using KPIs to Drive Continuous Improvement:

1. Identify Relevant KPIs:
   - Choose key performance indicators (KPIs) specific to your practice goals, such as patient satisfaction scores, appointment adherence rates, revenue per patient, and staff retention.
   - Example: Track "percentage of patients who rate their experience as excellent" to measure patient satisfaction.
2. Collect and Analyze Data:
   - Utilize practice management software, surveys, and patient feedback to gather data on your chosen KPIs.

- Example: Use your EMR system to track appointment no-show rates and analyze reasons for cancellations.

3. Visualize and Interpret Data:
    - Create charts, graphs, and dashboards to visualize your KPI data and identify trends or areas for improvement.
    - Example: Track "average revenue per patient" over time to monitor financial performance.
4. Take Action Based on Insights:
    - Use data analysis to inform your decision-making, implement improvement strategies, and track their effectiveness.
    - Example: If you see a high no-show rate, implement appointment reminder protocols or offer flexible scheduling options.
5. Continuous Monitoring and Adaptation:
    - Regularly monitor your KPIs and adapt your strategies based on evolving data and patient needs.
    - Example: Adjust marketing campaigns based on audience demographics and preferences.

Additional Challenges and Opportunities Unique to the Optometry Industry:

Challenges:

- Competition from Large Retail Chains:
    - Independent optometrists may face competition from large retail chains offering eyeglasses and eye care services at lower prices.
    - Opportunity: Emphasize personalized care, advanced technology, and superior patient experience to differentiate your practice.
- Increasing Healthcare Costs:
    - Rising healthcare costs may limit patient access to eye care services.
    - Opportunity: Offer flexible payment plans, partner with community organizations, and explore telehealth options to make care more affordable.
- Technological Advancements:
    - Rapid advancements in eye care technology can be challenging to keep up with.
    - Opportunity: Invest in innovative technology, offer unique services like specialized testing or telemedicine, and embrace technology as a tool to enhance patient care.
- Evolving Patient Expectations:
    - Patients are increasingly tech-savvy and demand convenient, accessible care options.
    - Opportunity: Offer online appointment booking, telehealth consultations, patient portals, and personalized communication channels to meet evolving patient expectations.

By proactively addressing these challenges and leveraging the exciting opportunities in the optometry industry, you can position your practice for long-term success and deliver exceptional patient care.

Tips for Successful Partnerships and Collaborations in Optometry Practice Management

Developing strong partnerships and collaborations can be a game-changer for your optometry practice. By tapping into the expertise and resources of others, you can expand your reach, enhance patient care, and achieve your business goals. Here are some tips to help you build successful partnerships and collaborations:

Identifying Potential Partners:

- Healthcare professionals: Look for partnerships with physicians, dentists, ophthalmologists, and other healthcare providers who treat patients with conditions linked to vision.
- Community organizations: Collaborate with schools, senior centers, libraries, and health advocacy groups to offer eye screenings, educational workshops, and access to care for underserved populations.
- Optical industry players: Partner with eyewear brands, labs, lens manufacturers, and equipment suppliers to leverage their expertise and resources.
- Professional organizations: Actively participate in optometry associations and attend conferences to connect with potential partners and stay updated on industry trends.

Building and Nurturing Relationships:

- Focus on mutual benefit: Clearly communicate how each partner will benefit from the collaboration.
- Establish clear agreements: Define roles, responsibilities, communication protocols, and financial arrangements in a written agreement.
- Maintain open communication: Regularly communicate with your partners to share updates, address challenges, and celebrate successes.
- Invest in relationship building: Schedule regular meetings, participate in joint events, and foster personal connections with your partners.

Examples of Successful Partnerships:

- Co-managing patients with ophthalmologists for complex cases.
- Offering vision screenings at schools and health fairs in partnership with community organizations.
- Partnering with an eyewear brand to offer exclusive lens packages or discounts to your patients.
- Collaborating with a professional association to provide continuing education courses for optometrists in your area.

Beyond the Basics:

- Leverage technology for collaboration: Utilize video conferencing, cloud platforms, and shared documentation tools to facilitate efficient communication and project management.
- Measure the impact of your partnerships: Track key metrics like patient referrals, revenue growth, and community outreach impact to evaluate the success of your collaborations.
- Be open to new opportunities: Stay informed about emerging trends and potential partnerships that could further enhance your practice and benefit your patients.

Remember, building successful partnerships takes time, effort, and commitment. By focusing on mutual benefit, open communication, and a collaborative spirit, you can forge partnerships that will propel your optometry practice towards a thriving future.

Sample questions:

1. Describe Key management roles in the opticianry business.?

The Visionary: The Optometrist
At the heart of the practice lies the optometrist, responsible for examining patients, diagnosing eye conditions, prescribing corrective lenses, and managing various ocular diseases. Beyond clinical expertise, leadership, effective communication skills, and patient empathy are critical for building trust and ensuring exceptional patient care.

The Orchestrator: The Practice Manager
The practice manager plays the pivotal role of overseeing daily operations. From budgeting and human resources to marketing and inventory management, their skill set encompasses a broad range of responsibilities. Strong organizational, communication, and financial management skills are essential for navigating the complexities of running a successful practice.

The Technical Backbone: The Optometrist Technician
Assisting the optometrist in examinations, preparing eyewear, and maintaining equipment, the optometrist technician occupies a critical role in ensuring smooth patient flow and efficient operations. Technical proficiency, patient interaction skills, and attention to detail are key qualities for this vital position.

The Supporting Cast: Additional Staff
From front desk staff and receptionists who provide the first point of contact for patients to billing personnel who ensure financial stability, all supporting staff contribute to the overall success of the practice. Their dedication to customer service, administrative efficiency, and creating a welcoming environment for patients is paramount.

2. Discuss Key performance indicators?

Key Performance Indicators (KPIs)
Establish clear KPIs to track progress and measure the effectiveness of your management efforts. Examples include patient satisfaction scores, appointment no-show rates, average revenue per patient, and employee retention rates. Regularly monitor and analyze these KPIs to identify areas for improvement and celebrate successes.

Navigating the business landscape of optometry requires a multifaceted approach. By establishing a well-defined organizational structure, fostering a dedicated team, and implementing effective management functions, you can create a thriving practice that delivers exceptional patient care, secures financial stability, and adapts to the ever-evolving world of healthcare. Remember, continuous learning, innovation, and a commitment to excellence are key ingredients for long-term success in the competitive field of optometry.

Specific Examples of Successful Organizational Structures within Optometry Practices:

1. Team-Based Model:
    - Example: "Family Eye Care Center" in California implemented a team-based approach with cross-functional teams responsible for specific tasks like pre-screening patients, managing appointments, and handling billing. This resulted in a 20% increase in patient satisfaction and a 15% reduction in operational costs. (Image of a team of optometrists and technicians working together in a patient-centered environment)
2. Hybrid Model:
    - Example: "Bright Eyes Optometry" in New York adopted a hybrid model with optometrists leading teams of technicians and support staff while reporting to a central practice manager. This structure allowed for improved staff communication and collaboration while maintaining clear lines of authority. (Image of an optometrist leading a team meeting with technicians and support staff)
3. Virtual Care Integration:
    - Example: "Vision Direct" in Texas established a hybrid model with traditional in-person care supplemented by virtual consultations for routine exams and follow-up appointments. This increased patient access to care, particularly in rural areas, and boosted practice efficiency. (Image of a patient having a virtual eye exam with an optometrist)

Remember: The best structure for your practice depends on factors like size, budget, and target market.

Unit 16:

Going from Good to Great

Learning Objectives:

At the end of this unit, students will be able to learn faith, harmony and discipline with leadership.

There are many Moments of Truth you can come up with. Each office layout may create a new supply of these encounter points and ways to make them patient-centered. How many points did you come up with for which you, as an optician, are not even present? These are tougher to think of but can be the most important. There are two major Moments of Truth encounter points we must prepare extra hard for since we will not be present to steer the outcome we want. We must therefore lay the groundwork during the sale. These two moments are when:

The patient sees an ad on TV for what appears to be a better deal than what he got from you.

When the patient's friend, neighbor, or family member talks about her own eyeglass-buying experience and new glasses.

Let's talk about No. 1 first. There is a common phenomenon in marketing called *post-purchase dissonance*. In a nutshell, this is the post-purchase behavior of Going from Good to Great consumers that drives them to seek out advertisements from your competitors to reassure themselves that they did the right thing by buying from you and that they got the best value. Keep in mind, all this happens *after* they have already bought from you! In order to get these patients' business again next year, we must be aware of this behavior and lay the groundwork during the sale to minimize the patients' post-purchase dissonance. There are a number of ways to do this.

As we discussed previously, talk to the patients about the benefits of all the lens and frame options they have included in their eyeglasses. This will have the patient leaving your office feeling good about their purchase and understanding the value of their purchase.

Give the patients itemized lists of all their lens and frame specifications. This way, when they see that ad for two pairs of glasses for $99, they will have a physical reminder that their own glasses (although they may have cost $400) were a much better value. Speak with your optical manager to see if your office has such a list for every patient. If not, suggest one be started and you will look like a genius!

The second Moment of Truth for which you will not be present is the most commonly feared marketing moment of any sales person: word-of-mouth advertising among friends and family. As an optician, the last thing you want is to have your patient's friend talk about how he got some great new "featherweight" lenses and have your patient wonder why you did not offer the same lenses to him! Don't have your patient learn something from a neighbor. Remember, *you* are the expert; that is *your* job!

To prevent this from happening, you must:

Educate your patients in multiple ways (verbal, with demos, and in writing after the sale) of all the benefits their eyeglasses provide. Your patient needs to become the community educator on eyeglass advancements and the one with bragging rights to owning the most advanced eyeglasses on the block! You do not want your patient learning anything from his neighbor; this will not be a positive Moment of Truth and will likely lead the patient to his neighbor's optician the next time he needs glasses.

Never prejudge your patient. By jumping to conclusions about your patient's ability to pay for an upgrade, you neglect to discuss lens options that may be important to the patient and that he learns about from a neighbor.

Address the important concerns of every patient about their wants and needs connected to their new eyeglasses.

Opening Communication Channels

Many things in the life of an optician inhibit productive communication with the patient, the optician's single most important job. There is an old adage that "people don't care how much you know until they know how much you care." You must show each patient that he or she is the most important one of the day. The challenge is in doing this twenty or more times per day!

Additionally, communication done properly can be the best advertising for an optical center. Let us say that you sell a patient the best pair of glasses money can buy. The frames are made of titanium to help with the patient's allergies to other types of frame materials, the lenses are high-index and aspheric to help reduce the weight of the heavy prescription, and an antireflection coating was ordered to help the patient with symptoms of nighttime glare. Now suppose the patient is not made fully aware of the benefits of the purchase. The patient goes home with a large bill and feels resentment when he sees the next advertisement on TV touting two pairs of glasses for $99. He will think, “Wow, did I get taken!”

Now imagine the same patient encounter, but with extra time taken to ensure that the patient fully understood the *benefits* of what he purchased. Instead of paying $80 for an antireflective coat, he purchased “the state-of-the-art lens treatment to cut my nighttime glare problems!” Instead of paying for a high-index aspheric lens, he purchased “the most thin and lightweight lens available so my nose won’t hurt anymore!” Speaking to the patient in terms of *benefits,* not optical lingo, will create a lifelong patient, one with armor to deflect any ads promoting cheaper glasses, and one who will speak to his neighbors about you.

The following are the most common obstacles to effective communication and how to overcome them.

Obstacle: Tech-talk. This is speaking in our language, not the patient’s. It’s also speaking in terms of features, not benefits. A feature of an antireflective coating is its ten layers of silica precisely applied to create a reflection-free surface. Your patient typically will not care about this. A patient is concerned only about the benefit it provides: reducing his nighttime driving glare problem.

Solutions:

Realize that we live in a different world from our patients. We must discuss benefits, not just features. In our patient’s world, “Antireflective coating” means nothing. “High index” or “aspheric” mean nothing. “PD, base curve, OC” mean nothing. When we speak *their* language, “antireflective coating” becomes the “less glare at night” coating. The “high index aspheric lens” becomes the “less weight on your nose” lens option.

Studies show that the best way to communicate a new term is to use the term first, then define it in terms of benefit. For example, “This problem you are having at night with glare, Mrs. Smith, I have just the solution. It is called an antireflective coating. It is specifically designed for people such as yourself who experience problems with glare from headlights. It makes nighttime driving much more comfortable."

Obstacle: Limited time. We have a limited amount of time to make the patient we are with feel like the most important patient of the day.

Solution:

Use of demos can explain a hundred words in a moment. Your office will likely have many wonderful demos of antireflective coatings and other lens options. Use them frequently!

Use the patient's name three times during ordering and pick-ups. There is no sound as sweet to your patient.

Obstacle: Waiting for the patient to make a complaint before offering a solution. Sometimes we feel as if telling patients about lens options makes us pushy salespeople. This feeling shortchanges the patients from very beneficial options that can completely change the way they feel about their glasses.

Solution:

Understand that *you* are the expert. This patient has come to you and trusted his eye care to you for a reason. He feels *you* will

provide the best care. So provide it—let him know all of the latest and greatest in lens options.

Do not wait for the patient to ask about a "better lens" before explaining AR coats, high index, or photochromatics. The last thing we want is for the patient's neighbor to be the first to tell *our* patient of a lens option he would have benefited from.

Ask lifestyle questions to introduce lens options. Ask the patient if his high prescriptions seem heavy. If so, discuss high-index and aspheric lenses. Ask the patient if he ever notices glare at nighttime or on the computer. If so, discuss antireflective coatings. The patients will appreciate the interest you take in their well- being!

Obstacle: Prejudging a patient's ability to afford a given lens option. It is human nature to want to pigeonhole your patients into financial categories based on their insurance, appearance, or a host of other factors. This obstacle will shortchange the patients from receiving the best pair of glasses to meet their needs.

Solution:

Remember, everyone deserves the best, or at least the *opportunity* to receive the best. Never assume someone cannot or will not pay for a lens option that is truly the best for the patient. Let the

patients be the ones to inform you what they can or cannot afford.

Obstacle: Filtered listening. Filtered listening is anytime either you or the patient listen with a preconceived notion about what is being said. For example, you may say, “I see the doctor has you starting in bifocals for the first time,” and the patient may reply with, “What! You think I’m old now, too!” This is because patients often associate the word “bifocal” with “old.” In another example, the patient says, “I am on a budget, so

I only want what I really need.” And you may hear, “I want the cheapest pair of glasses you have.” This is because you associate the word “budget” with “tight-wad”. One person’s budget is not another person’s budget.

This person deserves the same attention to lifestyle prescribing as anyone. Besides, he may consider lens option upgrades as something that falls in the category of “something he really needs,” especially if he has lived a life complaining of heavy glasses or glare.

Solution:

Clean the filter. Really listen to what is being said as well as what you are saying, and try to avoid making assumptions.

Ask patients if they have any questions. This will open the lines of communication and help declog any wrong perceptions trapped in the filter.

Have the patient repeat back to you what you have said. This will ensure the patient fully understands why they would benefit from a given lens option.

Obstacle: Body language. Yes, your body itself can become an obstacle to efficient communication.

Solution:

See yourself from an out-of-body experience. Are you writing in the chart while talking to the patient? Are you making eye contact or watching other patients during your discussion? Are you chewing gum or playing with your hair? None of these will exactly open up the lines of communication.

Lean in slightly toward the patient.

Make eye contact.

Open your posture. Avoid crossed arms or legs.

So here you are, thrown to the wolves, and you see a patient walking toward the door. Your heartbeat quickens, your palms become sweaty, and you forget your own name or how you even landed yourself in this position. Hopefully, you are a new optician and not a seasoned one experiencing this!

Sweat not; the following map will help give you the confidence to navigate through your first patient encounter. The following is only a general outline. As you gain confidence, you will likely discover your own additions to include on the map and make it your own. But for now, you need to know where you are, where you are going, and how you are going to get there.

Let's return to the plight of our new optician seeing his first patient walking toward him. Our optician remembers his map and proceeds as follows.

Greet the patient! This sounds simplistic, but it is often forgotten. Welcome the patient to your optical center and introduce yourself *by name*. For example, "Welcome! My name is Susan and I will be your optician today." Many great optical consultants will recommend not using the word *optician* since many patients are not clear on what it is. They often confuse that job title with optometrist, ophthalmologist, or even the lab technician. Other titles you can use in its place are "frame stylist," "fashion consultant," or "eyewear specialist". Speak with your manager about what the proper usage of your job title should be.

Ask "What can I help you with today?" Asking an open-ended question such as this will get the conversation and eyeglass selection process headed in the right direction on our map. Follow up by asking patients to be as specific as they can about the problems they are having or the goal they are hoping to achieve.

Show a demonstration of solutions to their problems. Your optical department will likely have demonstrations of everything from antireflective lenses to the difference in thickness between high-index lenses and conventional plastic lenses.

Recommend. This is the step in which you show your true professional knowledge. The worst thing you can say is, "Do you want … ?" You are the professional. Say, "I recommend … on your glasses to solve your complaint of …" For example, for a person who told you he wanted lighter-weight lenses, this recommendation step would sound like this: "Mrs. Smith, you stated that you wanted to have lighter-weight lenses in your glasses. I would recommend you get a high-index aspheric lens.

This lens is made up of the thinnest and lightest material available. If we pair this lens with a titanium frame, we will truly have the lightest pair of glasses possible."

Present price. Presenting the final price to a patient is often the most difficult stage for a new optician. You add everything up and arrive at a total of six hundred dollars, and your first thought is, "Oh my! I would never spend this much on glasses. How can I ask this patient to?" The difference is two-fold. 1) You are not your patient. Maybe your patient just spent $2,000 on a new wardrobe and $200 on a haircut. Investing $600

on a new pair of glasses may seem like a bargain. 2) You may be a very healthy individual with a light prescription. Without knowing what it is like to have to wear a very thick prescription or have to put up with glare from your cataracts, it is difficult to place a value on a premium pair of glasses with high index lenses and an antireflective coating. Remember, the patients always deserve the best. As long as you are meeting their needs, you have no reason to feel guilty about the price. If the patient says that the glasses cost too much, ask the patient which benefit he is willing to give up in order to bring the price down. Your job is to offer a product to meet the patient's needs; it is up to the patient to decide what he can and cannot afford and what benefits he can live without. Present the price with confidence and without prejudice as to what you think the patient can afford to pay.

Collect. Every office will have different collection policies, but in general it is best to collect the entire purchase price before the patient leaves the office. There will always be the patients who ask if they can simply make a deposit. Speak with your office manager about these cases. When collecting the money, it is best to simply state the total price of the purchase and ask if the patient will be paying by cash, check, or credit card; then be quiet and let the patient respond.

It is at this collection step that many opticians feel guilty over the price, which prompts them to ask the patient if he would rather just put a deposit down. *Avoid this temptation.* What other business do you know that allows you to place an order for a customized product but not pay for it in full? Yet somehow, this has become a standard practice in the optical world and seriously

affects the offices' cash flow. Just because you do not make the patient pay up-front does not mean your office will not have to pay for the materials up-front. So do your office a favor and expect full payment when glasses are ordered.

Defusing a Dissatisfied Patient

A recent study showed that premium car buyers who had to take their new car back to the dealer for repair work and were treated respectfully during the process had a greater overall satisfaction with their car than owners of the same type of car who never had to take the car back to the dealer for repairs. This shows us that when patients returns to us with a problem with their new glasses, we should see this as an opportunity, a Moment of Truth, in which we can make the patient more loyal to us than if they had never had a problem in the first place.

The following is designed to help you communicate more efficiently with patients who may not, let's say, be in the happiest of moods. In any retail setting, you are bound to run across patients who, either rightly or wrongly, have a grudge to bear against you, your company, or life in general. You are the one they are intent on taking it out on.

The primary reason dissatisfied patients seem to be on the offensive from the beginning is that they fear we will trivialize their complaint. Turn the tables and be *more* gracious than the day you sold them the glasses. Here are steps to quickly turn a dissatisfied patient encounter into a pleasant exchange. Do not be afraid to apologize during any of these steps if you discover you or a coworker made a mistake in the fabrication of the patient's eyeglasses. An apology can go a long way in building rapport.

Introduce yourself and state that *you* will be the one to solve the problem. This is not to say you may not need to rely on others for guidance, but you are the patient's point person and will see that a resolution to the problem occurs.

Thank the patient for coming back to let us solve his problem. This will help the patient drop his guard. He is expecting a fight, or at least a trivialization of his complaint. A simple "Thank you for bringing this to my attention" will smooth the road to finding a solution for both you and the patient.

Listen. Let the patient vent, then ask detailed questions using FOLDAR to get a clearer understanding of the problem. FOLDAR is an acronym for the questions you need to ask to get to the root of the problem.

FOLDAR stands for:

F: Frequency. How often does the problem occur? All day or just at certain times of the day?

O: Onset. When did the problem first occur? When you first put on the glasses, or has it started more recently?

L: Location. Where is the problem? One eye or both eyes?

D: Duration. How long does the problem last?

A: Associated symptoms. Are there any other symptoms accompanying the one you are describing?

R: Relief. Does doing anything help the symptoms? Such as closing one eye or taking the glasses off?

The venting is for the patient's benefit; FOLDAR is for yours.

Show you understand how the patient feels. Say "You feel because " For example, say to the patient "You feel

frustrated because that right eye of yours just isn't seeing up to either of our expectations." This may seem corny, but it works wonders. It also works when a patient unloads his life's troubles on you. It shows the

patient you are not an adversary and that you understand why the patient is back in your office.

Solve the problem.

Thank the patient. Yes, thank the patient again for coming back so we could solve his problems. He is doing us a favor; he is not an annoyance in our day. By coming back to vent with us and allow us to solve his problem, he is not venting with a neighbor!

Get Off Our Buts!

Patients are interested in solutions to their problems, not excuses. It is common to reply to a patient's request with "I would, but …" or "I wish I could, but …." Excuses contain "but …"; solutions contain "what I can do is …." Remember, *patients do not enter our offices with problems, only solutions waiting to be discovered!*

Are we doing all we can to create solutions and not excuses?

For each of the following situations, think about an excuse, something that contains the word "but." Then think of a solution. *Solve the problem! Make it happen!* There are no single correct answers. Discuss them with your optical manager to make sure that your solution is actually possible. The goal here is to make you feel empowered in your job and to think with a patient-centered mindset.

Situations:

Patient calls one week after ordering to see if glasses are ready. Glasses are not ready yet.

Excuse:

Solution:

Patient is upset with us that insurance authorization is not in yet. We have been calling for a week to get the authorization, but the insurance company is dragging its feet.

Excuse:

Solution:

During a busy day, we forget to call a cab for a patient. Patient has been waiting for an hour and is obviously upset.

Excuse:

Solution:

Patient wants to replace a broken frame that is now discontinued.

Excuse: Solution:

Features vs. Benefits

Patients do not buy *features*, they buy *benefits.* What is the difference? Features are inherent properties of a material or product. For example, features of polycarbonate lenses are its light weight, UV protection, and thinness. Do patients actually care about any of these things? Actually, no! So why would they pay extra for polycarbonate lenses? Because of the *benefits* these things provide. What benefit does a lightweight lens give? More comfort. What benefit does UV protection provide? Better eye health. What benefit does a thin lens provide? A more cosmetically appealing pair of glasses.

When selling glasses, it is essential to describe the benefits of lens options, not just the features. For each of the following examples, list the features and the benefits of each feature. Discuss this with your team leader or manager for ideas on how to present each lens option through demonstrations your office may have.

Antireflective coating

Features Benefits

Titanium frame

Features Benefits

Sunglasses

Features Benefits

High Index lenses

Features Benefits

Aspheric lenses

Features Benefits

Dispensing Checklist

The time of dispensing glasses should be considered one of our Moments of Truth. This is one of those make-or-break moments when a patient will form a lasting impression of the service you provide. There are two parts of dispensing eyeglasses that must be kept in mind. One is the *Nuts and Bolts* and the other is the *Warm and Fuzzies.* The *Nuts and Bolts* deal with insuring the proper power and fit of the glasses on the patient. The *Warm and Fuzzies* deal with making the patient feel as if he is receiving the most important pair of glasses you have ever handled. Recall the phrase we learned earlier: *The patient doesn't care how much you know* (the nuts and bolts) *until they know how much you care* (the warm and fuzzies). This means you can create the most accurate pair of glasses known to man, but if you just give them to the patient with no regard for the patient's emotional interest in the glasses, the patient will likely find fault with them. We will now discuss the *Nuts and Bolts* and *Warm and Fuzzies* to make you look like a genius optician.

The Nuts and Bolts

The following checks *must* be made on all glasses *just before they are given to the patient*. There is nothing more embarrassing than having a patient return unhappy with her glasses when one of these basic checks have not been made. These checks, when performed in the order listed below, will help you ensure the proper fit and function of the glasses *before* the patient notices a problem. It may be a good idea to make a copy of these checks and have them posted in your dispensing area as a reminder.

Power check

Prism check

Tint check

Lens inspection for defects

Frame inspection for defects

Optical centers marked in lensometer

Adjust frame

Ensure optical center marks align with patient's PD (if dispensing PAL, must be checked on patient with template on lenses)

Ensure bifocal line is appropriate height.

Clean glasses

The Warm and Fuzzies

Now that we have a pair of glasses that will knock the socks off the patient, how do we present them in a way that will make the patient feel it is the most important pair of glasses you have ever dispensed? Simple; just remember the following.

Proper eyeglass packaging.

How do you package the eyeglasses when you deliver them to the patient? Are they in a dirty plastic tray or are they on a nice presentation mat with a quality eyeglass case?

Exceed Expectations.

Do you provide anything not otherwise expected by the patient? Every patient expects a clean pair of glasses, so simply having them spotless isn't enough. If it's OK with your optical manager, include a cleaning spray bottle, cleaning cloth, or any other product or service that will make the patient feel as if she is getting more than she paid for.

Provide clean and new-looking reading material for the patient's first look through the new glasses.

When dispensing glasses, you will likely want to have the patient try to read something so you can ensure the prescription is correct. Is your reading material dog-eared and worn, or does it look crisp, new, and bright?

Handle glasses like jewelry.

Whether you are dispensing a $900 pair of glasses or a $100 pair, the patient has a lot invested in the glasses, and receiving them is a major moment for the patient. Treat the glasses like the jewelry that they are. Hold them gingerly and speak of them fondly.

Review all benefits of the glasses and premium upgrades.

By the time the patient picks up her glasses, she may have forgotten many of the benefits of the premium upgrades she purchased, such as an antireflective coating or a titanium frame. It is important to review these with her so when she goes home and hears a commercial for two pairs of glasses for $99, she does not feel buyer's remorse for the amount she spent in your office. Additionally, a well-informed patient becomes a spokesperson for you to all of her friends and neighbors. We always want our patients to educate their friends about the best lens options, not to have our patients *be educated* by a friend about a lens option they should have received. Patients *do* talk about their glasses; make sure your patient is fully aware of all the premium benefits of her glasses.

Adjust the glasses, even if no adjustment is necessary.

Patients want to feel as if their glasses are custom fit; part of this includes your making adjustments. Even if the frame fits perfectly on the patient, do some slight fiddling with the frame to make the patient feel she is getting that customized fit.

Compliment the patient on her new glasses.

Have you ever bought a nice piece of jewelry and the salesperson did

not tell you how nice you looked in it? Probably not. Do the same with your patients after you give them their glasses, and the patients will think fondly of you when they think fondly of their new glasses.

Instruct patients on proper eyeglass care and handling.

Just as you would never buy jewelry without being taught how to care for it, you should never have patients leave your office without teaching them how to care for their glasses:

Always store them in their case.

Never clean them with a paper product (Kleenex, paper towels, etc.), which can scratch the lenses. Use only a lint-free cleaning cloth.

Always put them on and remove them by holding both temples to avoid getting them out of adjustment.

Show proper cleaning with an eyeglass cleaner and silk cloth and recommend stores that sell them.

Cover Your Bases for Accurate Ordering

Have you ever had that nagging feeling that something just has not been done that you really needed to do? Well, hopefully if you remember the steps for ordering a pair of glasses, this feeling will never again happen to you (at least not at work!) The following are the steps that must occur, in order, to get you from the batter's box, across all the bases, and back to home plate for each glasses order. There is no jumping from first base to third base in baseball or in preparing your order.

First Base: To get to first, make sure you have a current copy of the patient's prescription, recognize if it is in (+) or (–) cylinder form, and record this on the order form. It is amazing how often an optician will spend a half hour with a patient selecting a frame only to find out the patient expected the optician to be psychic and know what their prescription is. Get a copy in your hands before the selection process begins. This also will help you make better recommendations on the type of frame and lens that would work best for the patient's prescription.

Make sure to double-check the prescription you record for accuracy.

Second Base: To get to second base, properly adjust the selected frame. This must occur prior to any measurements. If, for example, the frame is not adjusted until after a seg height is measured, your adjustment would change the final location of the seg height to something other than what you intended. Congratulations, you are now in scoring position!

Third Base: Getting to third requires measuring the patient's PD. No pair of glasses can accurately be fabricated by the laboratory without this.

Home Plate: To get across home plate, measure for the seg height, if one is needed.

There are several additional things to keep in mind that can minimize errors in completing your order.

Always use three decimal places when writing prescriptions. For example, a power of +2.50 should not be abbreviated to +2.5, nor should a power of -3.00 be abbreviated to -3. The same rule applies to the axis. A two-digit axis, such as an axis of 10, should be recorded as 010.

Do not use a degree sign (°) after the axis when placing your order. This can sometimes be mistaken for a zero (0), and the lab might fabricate the lens with an incorrect axis.

If only one lens in the patient's glasses is being replaced, be sure to measure the base curve of the fellow lens and specify that the new lens be made with the same base curve. Having both lenses with the same base curve will help ease the patients' adaptation to their new glasses.

If the prescription calls for only a spherical lens with no cylinder component, always write DS (for diopter sphere) or just Sphere after the spherical power. This lets the reader know that you did not simply forget to complete writing the prescription's cylinder component.

Recommend, and the Selling Part is Done for You (Increasing your second pair and average dollar sales)

"Do you want …" is a phrase used by novice salespeople. There is no expertise or knowledge of the patient reflected in such a statement.

"I recommend, based on what you've been telling me, that we go with … " shows expertise, professionalism, and a true knowledge of the patient's wants and needs. It is not based on preconceived notions of a person's ability to pay, but rather respects the patients enough to recommend the best solutions to their problems.

The only way you can get to the point of making recommendations is to ask open-ended questions to get to know the patient's wants and needs. The difference between an open-ended question and a closed-ended question is the amount of information gleaned from the answer. For example, a common closed- ended question for a novice optician to start a conversation is, "Are you looking for a pair of glasses similar to what you have now?" Aside from the fact that the whole reason the patient came in to see us is that they have an unmet need, an even bigger issue is, what are you going to do with the answer? What if the patient says no? You haven't gotten any information about what it is they want to change about their glasses. What if the patient says yes? You may then assume that they are talking about the shape, when in fact they are talking about the weight!

A better question would be an open-ended one that allows the patient to elaborate on the topic. In this case, the question may be worded, "What about your glasses do you like?" or, "What about your current glasses don't you like?" This will enable you to gather much more useful information that you can then package as a recommendation.

Examples of opened-ended questions:

What do you like about your current glasses?

What don't you like about your current glasses?

Where do you find your vision most troublesome? (to glean interest in add-ons)

What do you do for a living? (to glean interest in second pairs, add-ons)

How may I help you? (After telling the patient your name!)

What do you currently use for sunglasses? (increase second pairs)

What kind of leisure activities are you involved in? (increase second pairs)

Are you looking for any particular type of frame?

What do you want your frames to say about you? (increase second pairs)

What type of activities are you involved in outside work? (increase second pairs)

When making your recommendations, make sure to reference what the patient has told you when you arrive at your recommendations, and be sure to start with the phrase "Based upon what you have told me, I would recommend

." The patient is there to get your expert opinion, so give it!

There is another benefit of this recommend-based philosophy to patient interaction; it improves your average dollar sale without you having to feel like a pushy salesperson, and the patient feels better served. This is because you are starting with a top-down approach, as opposed to a bottom-up approach, at creating a pair of glasses. For example, let's say a patient walks up to you with a prescription for his new glasses. Instead of getting to know the patient through open-ended questions, you simply say, "Do you want a titanium frame to make them lighter weight?" Your next question is, "Do you want a high index lens?" followed by "Do you want an aspheric lens?" and "Do you want an AR coat to help with the glare?" This is a bottom-up approach. You are starting with nothing, and bit by bit piecing together a pair of glasses for your patient. This is excruciatingly painful for the patient, as he sees the bill getting higher and higher, and painful for you as well as you wait for his answers. When you are done, the patient is looking a huge bill and not understanding how it all happened.

By contrast, let us say that through your open-ended questions that you find the patient's chief goal for getting new glasses is to make the -5.00 prescription more comfortable to wear and look cosmetically better. You then say, "Based upon what you have been telling me, I recommend we go with a titanium frame matched with a high-index aspheric lens. This will provide you with the ultimate in a thin and lightweight pair of glasses. Additionally, I recommend we put an antireflective treatment on the lenses, since this coating will not only provide additional visual comfort by allowing greater light transmission through your higher prescription and reducing glare, but will also make your lenses seem invisible to anyone looking at you, which you said was important to you as well."

This is an example of a top-down approach. You are presenting the patient with a package that meets his needs. No more and no less. The patient also understands why you are making the recommendations, since they are completely based on his own answers to your questions. Let's say the bill now comes to $500, and the patient flinches. This is fine, because we have started with what the patient needs based on his own goals. There has been no hard selling, so the patient has no hard feelings toward you about the price. The patient knows he is the one who brought the two of you to this point and why. Let him now be the one to prioritize his goals to get a pair of glasses within his budget. How do we do this? Simply by asking, *"Based upon your goals of a thin and lightweight pair of glasses that are also cosmetically appealing, which goals are most important to you, and which ones can you do without?"*

More often than not, if the patient can afford it, he will follow your recommendations. You have educated him, and he sees the value of the premium package in meeting his goals. Sometimes, however, the patient can afford only a basic frame with a basic plastic lens. At least the patient knows that you, unlike any other optician, took the time to get to know his needs, and so next year he will come back to you for those lightweight glare-free lenses the two of you discussed.

For each of the following patients, provide an example of a novice sales job and an example showcasing your true expertise and professionalism.

A child (who always needs polycarbonate) who plays soccer.

A person whose prescription is a +4.00 DS OU and wants thinner, lighter lenses.

A person in sales who makes presentations in front of large audiences and wants to look her best.

An elderly person who has red marks on his nose from the weight of his frame.

A middle-aged person with a deep tan.

A contact-lens wearer.

A person who complains of nighttime glare interfering with his driving.

Troubleshooting

What do you do when a patient comes into your office saying she does not see well with her new glasses? This will be a frequent part of your job, occurring often, so this is not a topic to be taken lightly. Your job is to do all you can to find the source of the problem before sending the patient back to the doctor for an Rx re-check. This scenario is embarrassing for the patient and time-consuming for the doctor. There are times when it is necessary, but the better goalie you can be in preventing unnecessary doctor visits for Rx checks, the happier both the doctor and the patient will be.

Patients' complaints that they are not seeing well through their new glasses may arise from one or several sources:

Prescription error: The doctor arrived at an incorrect prescription for the patient.

Lab error: The lab made an error in lens fabrication that was not caught.

Optician error: The ordering optician made incorrect measurements, incorrect assumptions, or made transposing errors from the doctor's prescription.

Patient perception error: The patients either have an incorrect perception about their visual potential or about how long it may take to become adjusted to their new glasses prescription.

A visual/perceptual problem: New prescriptions may not always permit adaptation, regardless of the amount of time given to wearing the new glasses, if there is too large of a change from the patient's previous glasses.

Let us discuss each one in more detail.

Prescription error

Do doctors make errors? Sometimes. The doctor uses many sources of information when arriving at a prescription for a patient. The primary source is from the *subjective refraction*. This is the infamous “What is better, 1 or 2” test. What is maddening for doctors about this test is the very *subjective* nature of it; the doctor cannot see what the patients are

seeing and tell them which choice to make. The patients must decide for themselves. Doctors much prefer cut-and-dry, *objective*, decision making.

Doctor: “Where does it hurt?” Patient: “My toe.”

Doctor: “This one?” Patient: “Ouch!”

Doctor: “OK then, let’s do an X-ray of it.”

Doctor: “Hey, look here! It’s broken; see the crack in your bone? This is proof it’s broken and explains your pain. Let me wrap it and get you a prescription for a pain killer.”

This is the type of conversation doctors like to have. It is very *objective*, meaning evidence-based. In comparison, here is a typical conversation that leads a doctor to write a prescription for glasses:

Doctor: I am going to show you a series of two lenses; you tell me which one makes the letters *more* clear. OK?

Patient: OK.

Doctor: This is lens number one … or lens number two? Patient: They are both kinda blurry.

Doctor: Again, just tell me which one is *more* clear. Lens number one … or two?

Patient: Two. I guess.

Doctor: Please don’t guess. If they both look the same, it is OK to say they look the same. Let’s look at the next two lenses now. This is number three

… or four?

Patient: That number two was better than either of these!

Doctor: We have moved beyond those. Again, which lens is *more* clear? Patient: Well, number four is, if I have to guess!

This illustrates the *subjective* nature of arriving at a glasses prescription. Accurate patient feedback is essential at arriving at a good endpoint.

Fortunately for the doctor, he or she is able to rely on additional sources of information. These other sources include:

The patient's current prescription.

Any complaints the patient is having about his current glasses.

Any medical conditions that may adversely alter the patient's responses.

The confidence the doctor has in the patient's responses.

For example, if a patient has no complaints with his current glasses, but the doctor finds a large change in their prescription, the doctor is not likely to prescribe the entire change even if it significantly improves the patient's vision. Another example of a scenario that happens frequently is in a patient with cataracts. Cataracts will cause a patient to enter the doctor's office with a complaint of decreased vision. During the subjective refraction, the patient will usually like additional minus-power added to their prescription. Often this can lead to a significant improvement in their tested visual acuity in the exam room. Unfortunately for the patient, if the doctor prescribes this cataract-induced minus-power shift, the patient will complain of eyestrain. It is therefore up to the doctor to realize that the power change is caused by the cataracts and know that, for whatever the reason, cataract patients do not respond well to new glasses with this change.

Lab error

Do labs make errors? Sometimes. Labs are busy places where lenses are made quickly by a machine. However, wherever there are machines, there is always the human element. Lab technicians must input data into the equipment and check the work that is completed. Data can be missed and flawed lenses can be passed.

Optician error

Do opticians make errors? Despite the best efforts of this book, sometimes. Optician errors can arise from any number of situations: erroneous PD measurements; incorrectly assuming the patient wanted a trifocal when they wanted a bifocal; transposition errors when copying the doctor's prescription; or not matching the best progressive lens design for the patient's lifestyle.

Patient perception error

Do patients make mistakes? Sometimes, but we can never let them know it. What we can do, though, is make them aware of what may be causing their erroneous perceptions. For a new prescription that has had anything but a very mild change, reassure patients that it may take a week to get completely used to their new glasses. Always review the patients' chart to be sure there aren't cataracts or macular degeneration that the patients have forgotten about, which may explain the patients feeling

as if their glasses still don't help them see well. Patients often have an erroneous perception of their visual potential.

Visual-perception problem

Do the glasses themselves, even if the prescription is correct, cause problems? Sometimes. These are called visual-perception problems. These are the problems created by a different image size or shape projected onto the retina than was projected by the previous glasses, even if the new image is clearer. A large change in the prescription's sphere power will cause a change in image size and a large change in a prescription's cylinder correction will change the image shape. Examples of visual-perception problems include the following:

The tilted table problem: Patients may complain that a flat surface, like a table, looks tilted. What does this mean? If the flat surface is tilted right/left, then this is likely an astigmatism change. Recall that with

astigmatism, one axis has a different power than the axis 90 degrees away. This creates varying magnifications around the lens from 1–180°. If this magnification is different from the previous glasses, the brain will take a step back and wonder what is wrong. As long as there has not been too large of a change, the brain will usually adapt over time.

What if the table is perceived as tilted toward or away from the patient? This is usually a result of a change in the vertex distance, base curve, or pantoscopic tilt from their previous glasses. This is harder for the brain to adapt to since it is not the actual prescription causing the magnification difference, but rather a lens (external factor)-induced magnification difference. Finding a difference in one of these parameters from their previous glasses is likely the only way to solve the patients' symptoms.

Fortunately, at the end of this chapter is a Troubleshooting Analysis Form that will help you do just that.

Wow, that's big! (Or small): Patients may complain that images appear bigger or smaller through their new glasses. Prescription changes that add plus power will likely yield images appearing larger than they should be. The additional plus power projects a more magnified image onto the retina than their previous glasses did. This is usually solved simply by

having the patient continue wearing the lenses for a week. An easy way to help the patient adapt is to say, "Through your previous glasses, images were perceived as being smaller than they really were; now with the

new glasses, images are the correct size, but the brain is seeing them as relatively larger. It may take a week, but the brain will adapt." It is best to place the adaptation blame onto some third party, like the brain, so the patient does not feel we are placing the blame directly on them!

A change in prescription that adds more minus-power will cause the opposite effect; images may seem slightly smaller than with the patient's old glasses. Like before, as long as the prescription is correct, the patient will adapt within about a week.

As you can see, most of these errors are just from people being people. People make mistakes. Taking care in checking your work will help, but people still make mistakes. This book cannot keep those from happening, but it can help you navigate the waters when you find the source of the patient's problems. How? The next page is the Troubleshooting Analysis Worksheet. Use it on all of your patients who have any complaints about their new glasses before sending them back to the doctor for an Rx re-check. Tear it out and make copies for yourself and your coworkers.

Not all fabrication errors require a remake of the glasses. *ANSI standards* specify how much off-prescription a lens can be and still be acceptable. ANSI standards are developed by a private, nonprofit organization that develops norms and guidelines for a wide range of industry-grade products, including prescription glasses. You will want to obtain a copy of these standards and post it where you perform your glasses analysis. A copy of these standards can be obtained at www. ansi.org. ANSI standards typically allow less than a 0.25D difference for low powers and less than a 2-percent difference in high powers. So these standards pretty much require the glasses to be spot-on to the prescription.

Here is a key for a few of the abbreviations on the Troubleshooting Worksheet:

Pano: The pantoscopic tilt. Recall that this is the angle the lenses make with the face. This should be about 10 degrees.

OC: The optical centers. This should be directly over the pupils. Recall the way to find the optical centers is to place the lens in a lensometer, center the mires, and use the ink marker in the lensometer to identify the location.

Seg Ht: This is the seg height—how high the bifocal is on the frame. DBOC: The distance between the optical centers.

DBS: The distance between the bifocal segments.

Patient's PD. The distance between the patient's pupils, as measured with a pupilometer or PD ruler. Recall that this should be the same as the distance between optical centers in most cases.

Patient Name: Date:

Chief complaint:

Wearing time:

Prior glasses

OS______

Vert OD______OS

Check if OK

Pano [ ] OC [ ]

Vertex dist [ ]

Lens Style:____________

Sphere Cyl Axis Prism

Rx OD____Seg Ht _______

Add +

DBOC_______ DBS _______

Prescribed Rx

Sphere Cyl Axis Prism Rx OD

OS

Add + Patient's PD

New Glasses

OS______ Check if OK

Vert OD______OS Pano [ ] OC [ ]

Lens Style:_____________ Vertex dist [ ]

Sphere Cyl Axis Prism

Rx OD____Seg Ht ________

Add + DBOC ________ DBS ________

Suggested action Keeping Track of Your Patients

Have you ever placed an order for a product and felt as if the salesperson suddenly gave up caring about you or tracking your order as soon as you walked out the door. Of course you have. You realize the salesperson does not have as much vested interest in the order as you do, but still you wish he would at least act like he does. As an optician, we need to keep patients from thinking this of you.

Your patients will be spending hundreds of dollars on a product you sell them and will hear every word you tell them regarding when they can expect to receive their glasses. Your patients will be sitting by the phone the day you promised the glasses would be ready and fuming if the phone is not ringing.

Your goal: Call the patient BEFORE the patient calls you.

Keeping your patients regularly updated on the status of their order will go a long way in taking you from being a good optician to a truly great optician in the mind of the patient. Remember from our previous discussion; Patients do not care how much you know until they know how much you care. Keeping them updated on their glasses is showing how much you care.

There is a constant battle between two forces after the patient makes the purchase. That of you proving yourself as a caring patient advocate versus the patient expectation that you are going to be just another average order taker. If a patient calls you to check on the status of their glasses, you have just lost the battle. You are no longer the caring optician. If, however, you can preempt this phone call by the patient with a call from you to the patient, the victory belongs to you!

The problem in most optical boutiques is that there is no system in place to make sure these phone calls get made. Typically, an optician will only call a patient when the glasses are ready to be picked up. If there is any communication with the patient about delayed orders it is up to the patient to call the optician. Well, you are not "most" opticians. You are a great one. Therefore, you do have a system in place to insure you call patients about their orders before the patient calls you. "I do have a system for this?" you ask. Yes, on a following page. Tear this out, make copies, and use it for every patient you see. Here's how:

In the first column, record the date the order is made. This will be the basis for all of your follow up calls. It is the day you and the patient sit down together and create their new pair of glasses. In the next column, the patients name to help you track the order followed by the date the order is placed. The "Order Placed" column is the day you send the information to the lab for fabrication. This helps you remember not to forget such an important task.

The columns for "Follow-up Call #1" and "Follow-up Call #2" are used to record when your preemptive call is made to the patient to either let them know the order is on track to be delivered as promised or has been delayed for some reason. The time separation between the "Order Date" and Follow-up Call #1" and between the two follow-up calls can be made to be anything you feel is appropriate for your office, however do not make these calls be more than 5 days apart. Anything more than five days and the patient's finger is going to start itching to call you. You need to make your preemptive call before this happens!

The "Dispense Date" column is for the day you give the finished glasses to the patient.

The "Satisfaction Call" is the nail securing you in the patient's mind as a *great* optician. This call is much underused in the industry and is likely the only time your patient has ever received such a call. It is a phone call made to the patient one week after they pick up their glasses to ask how they are adapting. This call is a win-win for everyone for several reasons.

It gives the patient the impression that your optical boutique is not like any other they have been to. Even if they are happy with their glasses, it differentiates you from your competition.

If they *are* having any difficulties, it allows you to invite them back to the office for a check of the glasses or adjustment before they revert back to their old glasses, complain to their neighbor, and go someplace else next year.

3) Most importantly, it allows you to remind the patient of the benefits gained by using your optical boutique. Emphasize the benefits of any premium options purchased, warranties, and ability to return to your boutique for free cleanings or adjustments as needed. This will keep the patient loyal to you even when being bombarded by ads from competitors. The patient will remember why they made the right choice to go to you.

My Patient Tracking Sheet

Optician

Order Date	Patient Name	Order Placed	Follow-Up Call #1	Follow-Up Call #2	Dispense Date	Satisfaction Call

Goal Setting Your Way to Greatness

Goal setting will be your single greatest work before all others in ascending from a good optician to a great one. A well designed goal is a paved road ahead of you guiding you to your destination. Earl Nightingale, the noted personal achievement coach, stated it well when he said "People with goals succeed because they know where they are going. It's as simple as that." It actually *is* as simple as that. You are going to end your day, your week, and your year somewhere. Wouldn't you want to be in control of where that somewhere is? Every road leads somewhere, this section is designed to help you pick the road that's right for you and see that you not only stay on course, but reach the end on schedule.

Do goals work? A recent study completed on Yale graduates answers this question. During school, only 3% of the study participants had kept a list of well defined goals for their school years and beyond. Twenty years later, the study was followed up with an assessment of their net worth. The 3% who had kept goals had a greater total net worth than the entire 97% of the graduates who had not. Granted, accumulating net worth is not the only way to measure success, however, this study does illustrate that for a given measure of performance, having a goal is invaluable.

Reading this book shows that at least you have some goal in mind to become a better optician. Is reading this book going to help you achieve that goal? Maybe, but only if you have the right motivation. Becoming the President, a doctor, an astronaut, a billionaire, or a great optician are all lofty goals, but they are not the right goal for everyone. In order for any goal to be achievable it must first be meaningful to you, not imposed upon you by someone else. This, however, does not imply that you can disregard the wishes of your managers. If it is meaningful to you for you to keep your job, and your boss gives you a deadline for a project, then that project deadline becomes a meaningful goal since you want to keep your job! The point here is whatever your goals may be, make sure you can verbalize the meaningful motivation behind them; otherwise it likely will not be achieved and will just waste your time in its pursuit.

Often, goal setting for someone is just having a vague idea in their head that, for example, “I want to be a better optician this year than last year”. As we will learn, there is a science behind setting a good goal. We will discuss the four steps of creating a good goal and the four steps in making it happen. Don’t worry if you don’t memorize these steps, a *Goal Setting Worksheet* is provided at the end of this section to help you on your way to setting and achieving your goals, no matter how big or small.

The four parts of a goal

Make it Meaningful

If being a better optician is something you wish to attain (as reading this book would suggest) and you wish to set a goal to help you attain that, then the first question you must ask is why? Why do you want to attain this goal? The more personal the reason you have the more motivating the goal will be. There is no right answer, but make sure you know what “lights your fire” in your pursuit of the goal. Is it to make more money to support your family or take a long awaited vacation? Is it to be named Optician of the Year to make your family proud? If you have to think too hard about this there probably is not sufficient motivation behind your goal. Try a different goal.

Make it Specific

A goal of “wanting to be a better optician” or “make more money” isn’t a specific enough goal to make it a reality. How do you define “better” Is it in selling more second pairs or in increasing your average dollar sales, therefore a reflection of getting to know your patients better? Is it reducing your avoidable remakes, such as incorrect PD measurements or matching the wrong prescription with frame style? If your goal is to make more money, how do you define more? How much more? $100 more than last year? 10% more than last year? How you define it does not matter, it will be different for everyone, just make sure you know the measure by which your goal will be evaluated and that it is appropriately linked with your meaningful motivation. For example, if your motivation for making more money this year is to buy your dream car, your specific goal had better make you enough money to be able to finance the payments!

Make it Measurable

For a goal to be attainable, you need to be able to measure its success. A goal of, for example, “increasing the number of referrals I get from previous patients by 10% this year” is a very specific goal, but is it measurable? It may be, but only if two conditions apply. 1) You know what you accomplished in this area last year and 2) you can continue to track referrals in the coming year. For such a goal, you would have to have had a good referral log from the previous year to know exactly how many patient referrals you had. Additionally, you would want to make sure to continue such a referral log into this year.

What if, using this goal, you do not have adequate referral records from the previous year to measure a 10% increase? It may be best then to revise your goal to read "I will increase my patient referral base by 10% each month this year using a patient referral log to track my referral sources." Such a goal is measurable even without any previous records because you are using the first month of your record keeping as the basis from which you grow 10% per month.

Goals often fall short of what they could achieve simply because the goal setter either does not make it measurable or sets the measurement bar too low. Remember to set your goal realistically, but do not short change yourself.

Make it Timely

Goals are not to be set for an indefinite period of time. There must be a time frame in which you hope to accomplish your goal. "Work will expand to fill the time allowed for its completion" is a quote that describes what will happen when working towards a goal with no deadline. Your goal needs to include a date on which you measure your success in achieving your goal.

Here are a few example of well written goals:

I will increase my 2nd pairs (specific) by 10% (measurable) for the year ending 2009 compared to 2008 (timely) so that I can qualify for the year end bonus and make a down payment on that new car.

I will have my bonus (specific) increase 7% (measurable) this quarter compared to this quarter last year (timely) so that I can take that trip to Las Vegas (motivation)

I will increase my average dollar sale (specific) 25% each month (measurable) going forward compared to last year (timely) so that I can justify to my boss allowing me to take Fridays off to spend time with my ailing mother (motivation).

While having an attainable goal with all above attributes does not by itself make it happen, it certainly helps. Now that we have a well conceived goal, how do we make it happen and turn this goal into a reality?

The four steps to make your goal a reality

Write it down

Simple yes. And absolutely necessary. A written goal is significantly more likely to be accomplished than one that is not written down.

Post it in a spot where you will see it daily

Tape it to the front of your computer screen. A refrigerator works well, too. Seeing it in print every day will rejuvenate, energize, and organize your thoughts around making the goal a reality. See, we are already through the first two steps and it has only taken you about 5 minutes.

Study what will be required

This is where the rubber meets the road. Prepare to meet your goal the same way you would prepare for a presentation, your retirement, or a job interview. Luck is never involved in achieving a goal. “Good luck” is commonly heard coming from acquaintances when you tell them of a goal. “Good Prepare” should be the mantra instead. This stage is the bulk of the work in meeting your goal. To take your performance to the next level in achieving your goal you will have to do something different than you have been. You cannot keep doing the same thing, using the same techniques, and expect a different outcome.

If your goal is to increase your second pairs by 10% over last year, you are going to have to learn some sales techniques (hopefully you already learned some from this book) which are different than the ones you are currently using. Ask your manager for help in sales techniques and use any number of available resources to help improve sales techniques. Don’t think just within the optical world when looking for resources. There are many great books on helping you improve your general sales techniques no matter what field you are in. Just check your local bookstore. The bigger your goal, the more new techniques you are likely to have to learn. To increase your sales 5% you may need only one new technique, to increase it 20% you will need three or more new techniques.

A second aspect of this stage is in creating a flowsheet to help you identify the mini-steps needed to meet your goal. The bigger the goal, the more of these mini- steps there will be in your flowsheet. For example, if your goal is to become ABO certified, you will need to acquire study materials, apply for the test by the deadline, make time to study, and so forth. Making a list of these events will insure that you do not to miss a deadline and help to identify where bottlenecks may occur in your progress.

Measure progress

In order to achieve a goal, you must make an effort to measure your steps toward the goal. If a goal is set to be completed a year away, is can be hard to judge whether you are on track to complete it on time or not. Breaking it down into smaller monthly chunks so that you know if you are on track or need to speed up your work can be helpful.

On the next pages, you will find the *Goal Setting Worksheet.* Tear it our and make copies for each of your goals and enough for all your future goals. It is strongly recommended that you get yourself a goal setting book from your bookstore or library to learn more about the power of goal setting and other techniques to make them a reality.

Set goals for your professional life *and* personal life. Too often people wrap their identity around what they do for a living and fail to set goals for personal fulfillment. A person happy and fulfilled in their personal life will be a happy and fulfilled optician. Remember, despite the fact that it may feel like you spend most of your life at work, you are not your work. You are greater than your work. You need to cultivate relationships, achievements, and dreams outside work or risk never realizing your own personal greatness.

Goal Setting Worksheet

Writing your goal

What (SPECIFICALLY) do you want to accomplish?

How am I going to measure success (MEASUREMENT)

In what time frame will I complete this? (TIMELY)

Why do I want to accomplish this? (MOTIVATION)

Preparing your goal

What steps need to be undertaken in order to reach your goal?

Achieving your goal

Professional Goal: Deadline:

Step 1: Deadline:

Step 2: Deadline:

Step 3: Deadline:

Step 4: Deadline:

Step 5: Deadline:

Completion:

Personal Goal Deadline:

Step 1: Deadline:

Step 2: Deadline:

Step 3: Deadline:

Step 4: Deadline:

Step 5: Deadline:

Completion:

Sample Questions:

Discuss different obsacles an optician can face in a business?

Obstacle: Tech-talk. This is speaking in our language, not the patient's. It's also speaking in terms of features, not benefits. A feature of an antireflective coating is its ten layers of silica precisely applied to create a reflection-free surface. Your patient typically will not care about this. A patient is concerned only about the benefit it provides: reducing his nighttime driving glare problem.

Solutions:

Realize that we live in a different world from our patients. We must discuss benefits, not just features. In our patient'sworld, "Antireflective coating" means nothing. "High index" or "aspheric" mean nothing. "PD, base curve, OC" mean nothing. When we speak *their* language, "antireflective coating" becomes the "less glare at night" coating. The "high index aspheric lens" becomes the "less weight on your nose" lens option.

Studies show that the best way to communicate a new term is to use the term first, then define it in terms of benefit. For example, "This problem you are having at night with glare, Mrs. Smith, I have just the solution. It is called an antireflective coating. It is specifically designed for people such as yourself who experience problems with glare from headlights. It makes nighttime driving much more comfortable."

Obstacle: Limited time. We have a limited amount of time to make the patient we are with feel like the most important patient of the day.

Solution:

Use of demos can explain a hundred words in a moment. Your office will likely have many wonderful demos of antireflective coatings and other lens options. Use them frequently!

Use the patient's name three times during ordering and pick-ups. There is no sound as sweet to your patient.

Obstacle: Waiting for the patient to make a complaint before offering a solution. Sometimes we feel as if telling patients about lens options makes us pushy salespeople. This feeling shortchanges the patients from very beneficial options that can completely change the way they feel about their glasses.

Solution:

Understand that *you* are the expert. This patient has come to you and trusted his eye care to you for a reason. He feels *you* will

provide the best care. So provide it—let him know all of the latest and greatest in lens options.

Do not wait for the patient to ask about a "better lens" before explaining AR coats, high index, or photochromatics. The last thing we want is for the patient's neighbor to be the first to tell *our* patient of a lens option he would have benefited from.

Ask lifestyle questions to introduce lens options. Ask the patient if his high prescriptions seem heavy. If so, discuss high-index and aspheric lenses. Ask the patient if he ever notices glare at nighttime or on the computer. If so, discuss antireflective coatings. The patients will appreciate the interest you take in their well- being!

Obstacle: Prejudging a patient's ability to afford a given lens option. It is human nature to want to pigeonhole your patients into financial categories based on their insurance, appearance, or a host of other factors. This obstacle will shortchange the patients from receiving the best pair of glasses to meet their needs.

Solution:

Remember, everyone deserves the best, or at least the *opportunity* to receive the best. Never assume someone cannot or will not pay for a lens option that is truly the best for the patient. Let the patients be the ones to inform you what they can or cannot afford.

Obstacle: Filtered listening. Filtered listening is anytime either you or the patient listen with a preconceived notion about what is being said. For example, you may say, "I see the doctor has you starting in bifocals for the first time," and the patient may reply with, "What! You think I'm old now, too!" This is because patients often associate the word "bifocal" with "old." In another example, the patient says, "I am on a budget, so

I only want what I really need." And you may hear, "I want the cheapest pair of glasses you have." This is because you associate the word "budget" with "tight-wad". One person's budget is not another person's budget.

This person deserves the same attention to lifestyle prescribing as anyone. Besides, he may consider lens option upgrades as something that falls in the category of "something he really needs," especially if he has lived a life complaining of heavy glasses or glare.

Solution:

Clean the filter. Really listen to what is being said as well as what you are saying, and try to avoid making assumptions.

Ask patients if they have any questions. This will open the lines of communication and help declog any wrong perceptions trapped in the filter.

Have the patient repeat back to you what you have said. This will ensure the patient fully understands why they would benefit from a given lens option.

Obstacle: Body language. Yes, your body itself can become an obstacle to efficient communication.

Solution:

See yourself from an out-of-body experience. Are you writing in the chart while talking to the patient? Are you making eye contact or watching other patients during your discussion? Are you chewing gum or playing with your hair? None of these will exactly open up the lines of communication.

Lean in slightly toward the patient.

Make eye contact.

Open your posture. Avoid crossed arms or legs.

Discuss how will you develop a patient tracking sheet?

Sample given in chapter.

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