Progressive lenses Part 2

The new generation

The first patent for a progressive power lens, and a method of producing it, appears to have been granted to a British optometrist, Owen Aves, in 1907 (British Patent No. 15 735, *Improvements in and relating to multifocal lenses and the like, and the method of grinding same*).

The Aves lens employed an inverted conical section on one side and an eccentric section of an oblate ellipsoid on the other, combined so that each surface contributed an equal cylindrical effect with axes at right angles to one another. The result, which is depicted in **Figure 1**, is a sphere of ever-increasing power from top to bottom. Although described and a few samples made, Owen Aves' design appears not to have been put into production, not least because the problem of adding a prescription cylinder for the correction of astigmatism could not be solved.

Progressive lens developments

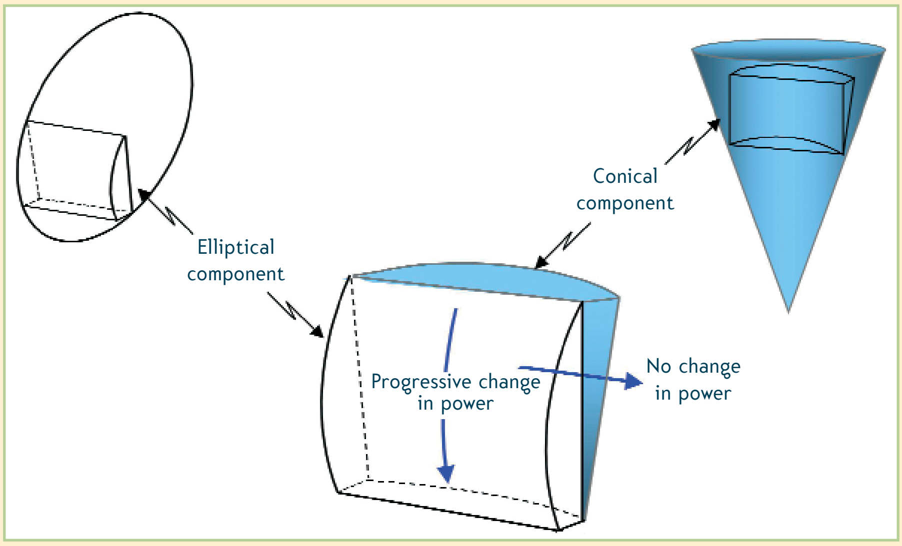
The first commercially successful lens was introduced by Essel (one of the founding members of Essilor International) under the name of *Varilux* (1959). The design consisted of large spherical distance and near zones, linked by a series of circles of ever-decreasing radii between the distance vision sphere and the near vision sphere. Today, such a design would be described as very hard, more attention having been paid to ensuring large distance and near zones than to the quality of peripheral vision on either side of the progression corridor.

The second generation of progressive lenses, *Varilux 2*, was introduced in 1973. It too provided large distance, intermediate and near fields of vision, but the designers had also paid a great deal of attention to the quality of vision in the lateral regions of the progression zone. Conic sections of changing eccentricities, from one section of the lens to another, replaced the circular sections employed in the *Varilux 1* design. The effect of which was to reduce the power in the peripheries of the progression zone, the result being termed 'horizontal optical moduation'. Binocular vision was optimised as a result of an asymmetric design.

During the decade following the introduction of *Varilux 2*, other manufacturers introduced progressive lens designs, focusing on specific optical characteristics. Some emphasised large distance and near vision zones, concentrating the inevitable astigmatism in the lens periphery (American Optical *Ultravue*, Rodenstock *Progressiv R*, BBGR *Zoom*, Sola *Graduate*, etc). Other manufacturers took a different approach, reducing the amount of unwanted astigmatism in the periphery by spreading it more widely in the lens (American Optical *Truvision Omni*). Others placed special emphasis on the concept of lens asymmetry and comfortable binocular vision (Zeiss *Gradal HS*).

A further step in the enhancement of progressive lens performance was made with the third generation, multi-design

Figure 1
Owen Aves' progressive power lens



Module 2 Part 6
Lens Dispensing Today

About the author
Mo Jalie is Visiting Professor at the University of Ulster.

concept with the *Varilux Multi-Design* lens (1988). This lens used distinct designs to match the wearer's changing needs with advancing presbyopia. The multi-design concept aimed at optimising visual comfort for each stage of presbyopia, making adaptation to changes in near addition easier for the wearer.

Essentially, the multi-design concept relates to the change of power progression profile with near addition, generally resulting in a longer progression length and a soft design for low additions – the corridor length becoming shorter and the design harder as the addition increases. Similar design philosophies were introduced by American Optical *AO M3*, BBGR *Selective/Natural*, HOYA *Hoyalux*, etc. Some manufacturers offered designs which combined flatter aspheric base curves with a progressive surface – the first being the Rodenstock *Progressiv S* design.

The fourth generation of progressive lenses (introduced by Essilor under the name of *Varilux Comfort* in 1993), offered wearers more natural vision than any previous progressive lens design. The near vision area for *Varilux Comfort* is located high in the lens so that the wearer can reach it easily and naturally when lowering their gaze. To explore the near and intermediate vision fields, fewer head and eye movements are required and the wearer enjoys more comfortable posture. These advantages arise from the specific power profile in the progression zone adopted for *Varilux Comfort*. For example, in the case of a +2.00D addition, 85% of the full addition is reached just 12mm below the fitting point compared to a minimum of 14mm or 15mm for previous progressive designs.

Larger fields of clear vision were offered by *Varilux Comfort*, as well as additional comfort in peripheral and dynamic vision. Due to the softness of the lens periphery, the necessary horizontal head movement required to explore the full width of the field was greatly reduced. Furthermore, this was accompanied by a dramatic reduction in swimming effects, thus improving wearer comfort in dynamic vision. Thanks to its asymmetry, *Varilux Comfort* also offered balanced binocular vision, whilst at the same time, integrating the multi-design concept of previous *Varilux* generations. Several competitive designs from other manufacturers appeared during the 1990s.

In 2000, the fifth generation progressive design, *Varilux Panamic*, was introduced. This new design was based on the success achieved by *Varilux Comfort* in providing a large field of vision, which resulted from the softness and regularity of the lens periphery. The *Varilux Comfort* design showed that vision was a global process and wearers would perceive their field as large if they had the ability to see

Table 1
Availability of lens designs described

	Material	Photochromic	Polarising
American Optical *AO b'Active* *AO PRO Easy*	 CR39 CR39 Polycarbonate 1.60 mid index	 Green & Brown Brown NG & Grey NG	 Grey 15%
BBGR *Evolis*	CR39 Polycarbonate 1.67 high index	Brown NG & Grey NG Brown & Grey	
Essilor *Varilux Panamic* *Varilux Ipseo* *Varilux Ellipse*	Glass 1.60 Glass 1.80 CR39 Polycarbonate 1.60 mid index 1.67 high index 1.74 very high index 1.67 high index CR39 Polycarbonate High index 1.67	Photobrown Extra Brown & Grey Brown V & Grey V Brown V Brown & Grey Brown V & Grey V Brown V	 Brown & Grey 15%
Hoya *Hoyalux iD*	1.60 mid index 1.67 Eynoa 1.70 Eyry	Eyas 1.60 Suntech	
Nikon *Presio-Ci* *Presio-Ei* *Presio-Fi* *Presio-Gi* *Presio W*	CR39 1.60 mid index 1.67 high index 1.74 very high index 1.60 mid index 1.67 high index	Brown & Grey	
Pentax *AF 1.60* *Mini AF 1.60* *AF 1.67* *Mini AF 1.67* *PF 1.74* *Super Atoric 'F' 1.60* *Super Atoric 'F' 1.67*	1.60 mid index 1.60 mid index 1.67 high index 1.67 high index 1.74 very high index 1.60 mid index 1.67 high index		
Rodenstock *Impression*[ILT] *& Impression XS*[ILT] *Impression Hyperop*[ILT] *&* *Impression Hyperop XS*[ILT] *Nexyma 40 & Nexyma 80*	CR39 1.60 mid index 1.67 high index 1.74 very high index 1.67 high index CR39	Colormatic™	
Rupp + Hubrach *Ysis*	1.60 mid index		
Seiko *P-1W* *P-1W* *P-1SY* *P-1SY*	1.56 mid index 1.67 high index 1.67 high index 1.74 very high index	 Brown V & Grey V	
Shamir *Genesis* *Autograph*	CR39 Trivex 1.60 mid index 1.67 high index Glass 1.60 index Glass 1.70 index Glass 1.80 index CR39 1.60 mid index	NG Brown V & Grey V Photobrown Extra Brown V & Grey V	Brown & Grey 15%
Signet Armorlite *Navigator*	CR39 1.56 1.59 polycarbonate 1.60 mid index	Brown & Grey SunSensors Brown & Grey	

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	Material	Photochromic	Polarising
Kodak Concise & Precise	CR39 1.56 Polycarbonate 1.60 mid index 1.67 high index Glass 1.60 index	Brown & Grey SunSensors Brown & Grey InstaShades Grey & Brown Photobrown Extra	
SOLA *Percepta* *SOLAOne* *SOLAOne Ego*	CR39 Spectralite Polycarbonate Glass 1.60 index CR39 Spectralite 1.60 mid index 1.67 high index	Brown NG & Grey NG Brown NG & Grey NG Photobrown Brown NG & Grey NG Brown NG & Grey NG	Grey
Younger *Image*	CR 39 Trivex Polycarbonate	Brown & Grey Grey V Brown V & Grey V	Brown & Grey Brown & Grey
Zeiss *Gradal Individual*	Glass 1.60 mid index Clarlet 1.60 Clarlet 1.67	Umbramatic Brown & Grey	

Unless otherwise stated, the plastics photochromic versions refer to Transitions availability.
NG = Next generation V = Transitions V

Table 1
Availability of lens designs described (continued)

comfortably through the lens periphery.

In the *Varilux Panamic* design, the balance between the central zone and the periphery was shifted towards the peripheral zones of the lens, so that peripheral effects were less dramatic than in previous progressive designs. This change in emphasis also brought the advantages of reducing the swimming effects obtained by rotation of the head and eyes around the field, and improving binocular fusion in the lens periphery. Clinical trials were to prove that wearers felt that the key improvement found with *Varilux Panamic* was an enlargement of the near vision field, providing a wider field of vision in all zones of the lens. The wearer tests showed that distortion was reduced by 20% in peripheral vision, enabling objects to be detected quicker. There was also a significant reduction of swimming effects in binocular vision, ensuring a wider binocular field – and the intermediate and near fields appeared wider.

Over the last five years, rapid strides have taken place in ophthalmic lens production technology. In particular, computer numerically controlled (CNC) grinding technology has been developed to the stage that a lens can be transferred directly from a CNC generator to CNC polishing without fear that the form of the surface may be altered by the polishing process. This freedom from the restrictions, which go hand in hand with the older lapping process and its need for smoothing and polishing tools of equal curvature to the surface being processed, has led to the term ‘free-form surfaces’, which can be of virtually any form as dictated by the computer controlling the cutting process.

Through a combination of better software, faster computer processing and free-form surfacing, it has become possible to modify some aspects of a progressive design to take into account the individual characteristics of the frame in which the lenses are to be mounted. For example, variations in fitting details for an individual wearer, such as the vertex distance and pantoscopic tilt, can be allowed for in the design when this information is given to the manufacturer, along with the required prescription of the lens (Rodenstock *Impression*ILT, Rupp + Hubrach *Ysis*, Shamir *Autograph*, Zeiss *Individual*).

New generation designs from other manufacturers include the BBGR *Evolis*, the Nikon *Presio W*, the Pentax *Super Atoric ‘F’*, the Seiko *P-1SY*, the first of the new designs to have the progression on the concave surface, and the SOLA *MAX One*. The still awaited (in the UK) Johnson & Johnson *Definity* lens shares the progression between the front and back surfaces, as does Hoya’s *Hoyalux iD* design, which is a double-sided progressive.

Also available from most of the major manufacturers are vocational progressive lenses designed for intermediate and near vision use. Because the addition for these lenses is less than the full near addition required by the wearer, and the progressive corridors are extended into the upper portion of the lens, the aberrations in the lens periphery remain small and wider fields of clear, useful vision are achieved. Such designs are usually advocated for use at the desk, particularly at a computer workstation (*AO Technica*, BBGR *Extenso*, Essilor *New Interview*, Hoya *Tact*, etc). Typically, these lenses are made to the near vision prescription but incorporate a power degression from near to intermediate of some -1.00D to -1.50D.

A fuller description of the manufacturer’s latest designs follows, with each lens’s availability summarised in **Table 1**.

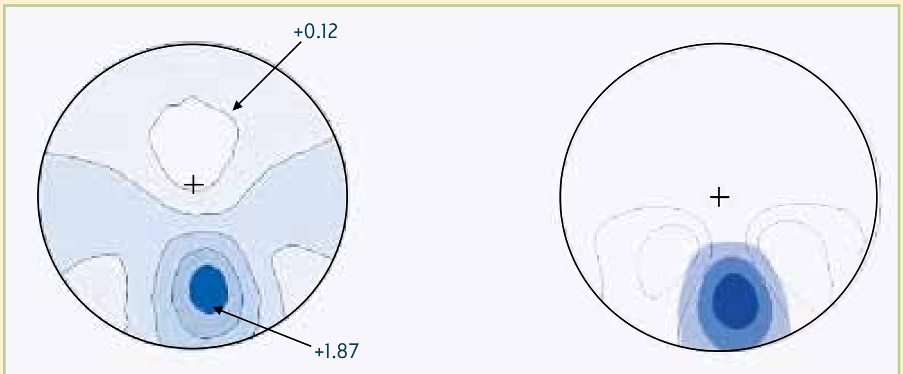
Manufacturers’ latest designs

American Optical

AO PRO Easy is a general-purpose progressive lens that incorporates newer design techniques and technologies used in other American Optical progressives, such as *AO Compact* and *AO b’Active*. These techniques and technologies have provided *AO PRO Easy* with an optimised corridor length of 15mm and improved peripheral performance, whilst maintaining proven reliability and ease of wear.

This new design from Dr John Winthrop, the originator of the *AO Truvision OMNI* lens, is of bipolar construction with the power increasing smoothly between the distance and near reference points (**Figure 2**). *AO PRO Easy* offers excellent performance in the distance, near and intermediate viewing zones, whilst providing good quality of vision in the peripheral viewing area. **Figure 2a** shows the variation in mean surface power for a lens of power plano add +2.00, and **Figure 2b** the surface astigmatism for the same power. The

Figure 2
AO PRO Easy progressive power lens



a) Mean surface power b) Surface astigmatism

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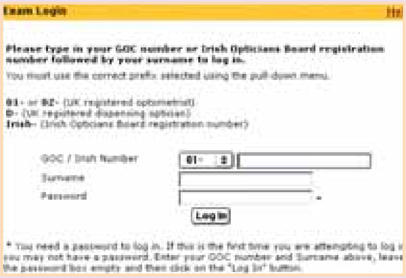

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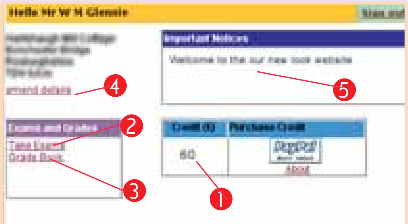

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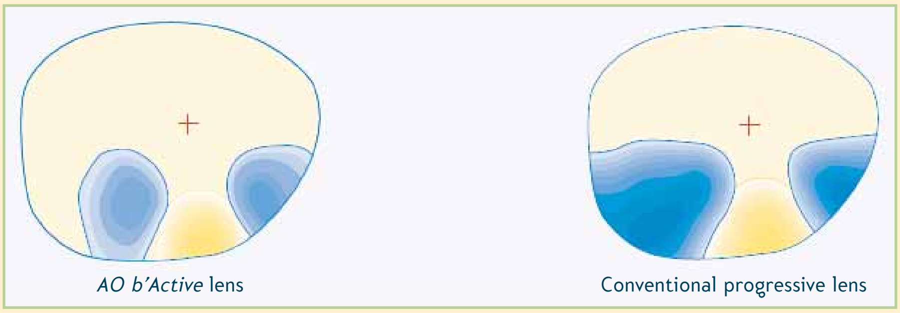


Figure 3
Active viewing zones for *AO b'Active* progressive power lens

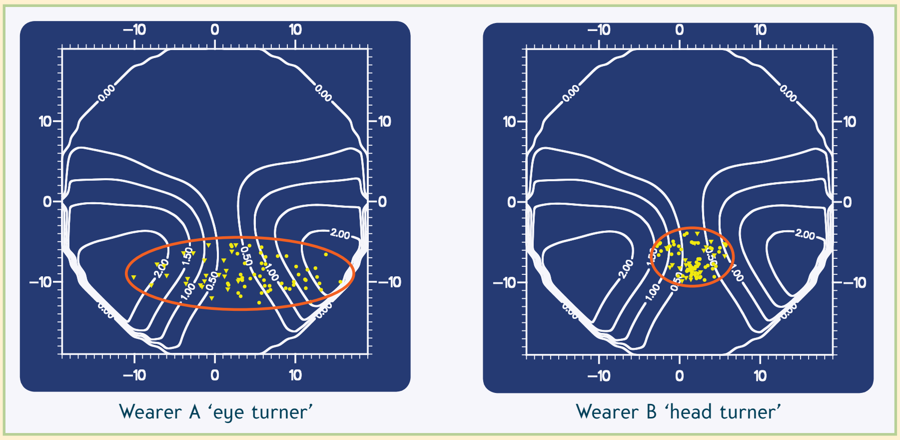


Figure 4
Visual point positions for a patient who A) mainly turns their eyes, and B) mainly turns their head

minimum recommended fitting height to provide an adequate near vision area is 18mm.

The *AO b'Active* lens, designed for wearers who require wide horizontal fields of aberration-free distance vision (active viewing zone), provides an area of very low astigmatism on the temporal side of the progressive zone. This is illustrated in **Figure 3**, which compares the surface astigmatism of the design with that of a conventional progressive lens. The minimum recommended fitting height to provide an adequate near vision area is 20mm.

BBGR

BBGR is the third largest supplier of progressive lenses in Europe. Its *Evolis* progressive lens won the Silmo d'Or Award for Innovation in 2002 as a new concept in progressive lens design. Within the *Evolis* design, BBGR developed three designs – one dedicated to each type of ametropia. Each design is charachterised by a specific meridian, so has a specific power profile and progession length. *Evolis* is a soft, multi-design in terms of both the degree of ametropia and the near addition, with a corridor length of 17mm. However, 85% of the addition is obtained, in the case of minus lenses, 10.4mm below the distance reference point, in the case of low ametropes, 11.5mm below the distance reference point and, in the case of hypermetropes, 12.2mm below the distance reference point. The recommended minimum fitting height is 16mm for a myope and 18mm for a hypermetrope and, subject to these minima, is suitable for fitting in compact frames.

Essilor

Essilor's *Varilux Comfort* design has to date outsold every other progressive lens on the market. The company's policy of striving to perfect the *Varilux* lens led, in 2000, to the new design, *Varilux Panamic*, which retained all the benefits of the *Comfort* lens and achieved an even smoother surface topography in the periphery of the lens. This enabled the design to address the comfort of the overall field of vision and provide a significant improvement in the overall effect of the lens in wear. *Varilux Panamic* was positioned as the premier *Varilux* product alongside *Varilux Comfort* and *Varilux Liberty*, which continue to be offered.

The latest design from Essilor takes into account the actual degree of head and eye rotation, which the wearer employs when viewing through the intermediate and near zones of the lens. Research[1] has shown that each individual has specific head and eye behaviour, which can be measured and the progressive surface then designed to incorporate the wearer behaviour. This principle has been incorporated into a personalised progressive design from Essilor – the *Varilux Ipseo*.

Figure 4 illustrates the visual point positions on the lens for two successful progressive lens wearers (A and B). The positions of the visual points were measured when the wearers were asked to

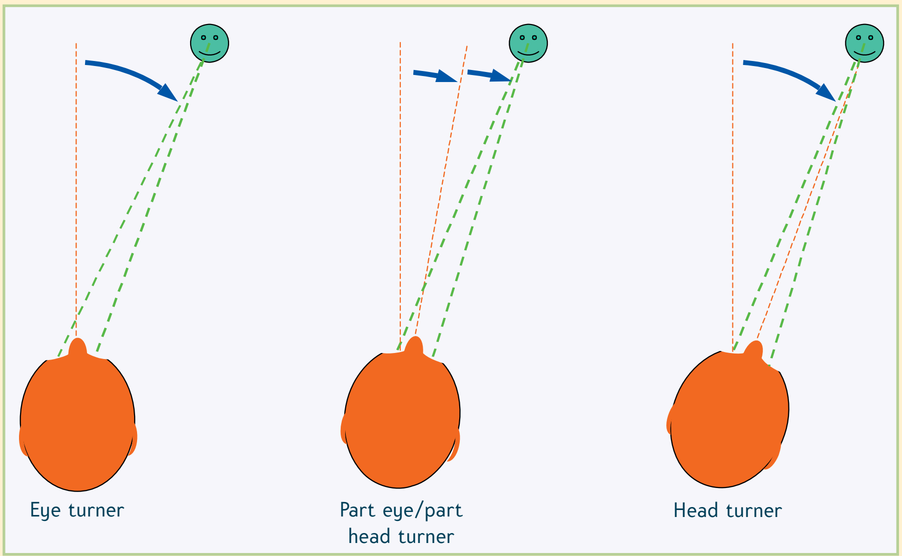


Figure 5
Eye turners and head turners

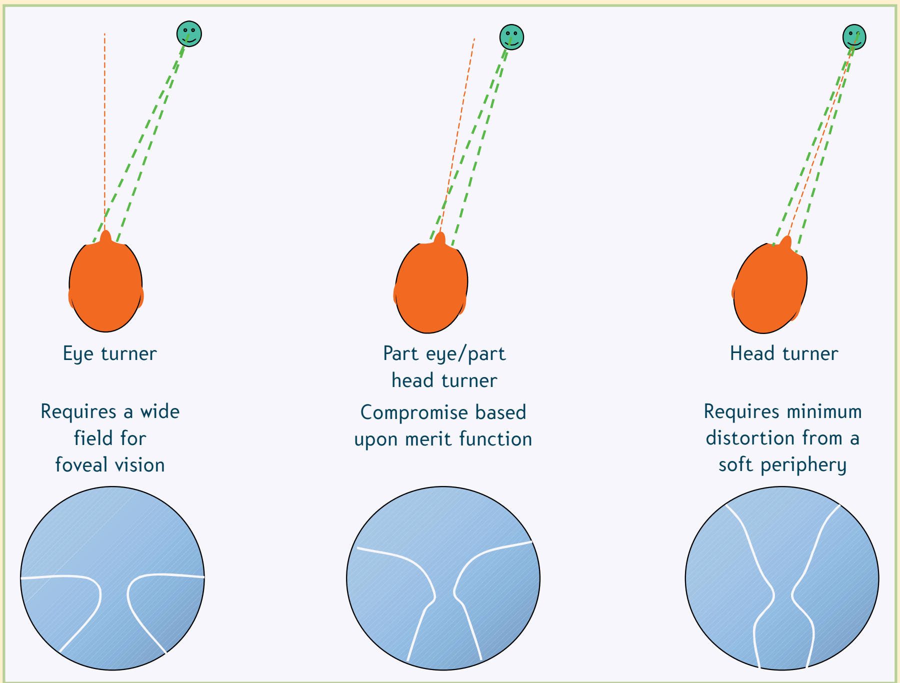
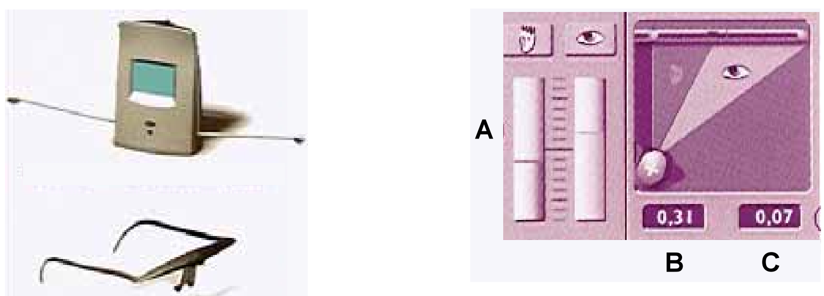


Figure 6
Progressive designs for eye turners and head turners



a) VisionPrint system

A – Indicators for head/eye proportions
B – Head/eye ratio
C – Stability coefficient

b) The information displayed on the screen

Figure 7
The VisionPrint System from Essilor

identify targets, which appeared at random in the intermediate field of view. Wearer A is quite clearly an 'eye turner', who perceives objects quite clearly over a wide zone of the lens. Such a wearer would claim that the width of their intermediate field was as wide as the lens itself. Wearer B, on the other hand, tends to 'point the nose' at objects in the intermediate field and, for whatever reason, prefers not to view through peripheral parts of the lens.

The experimental set-up is shown in **Figure 5**; the relative movement of the head is detected by sensors attached to the head when the patient is asked to view an object in the temporal portion of the field. Knowledge of this characteristic can help the practitioner to choose the best progressive design for an individual wearer (**Figure 6**).

A new instrument, the VisionPrint System (**Figure 7**), has been produced to determine eye/head movement for a specific individual, the results of which can be incorporated into the progressive surface. Essentially, the VisionPrint System consists of three lamps; the central lamp is viewed at 40cm from the centre of the patient's forehead, with two separate lamps, 40cm on either side of the central lamp. The patient is directed to look at the lamp, which is illuminated, and their head movement recorded by an ultrasonic signal which is emitted by the system and reflected by a transponder attached to the special trial frame the patient is wearing. As far as the patient is concerned, the lamps are illuminated at random and following a short 15-second cycle to familiarise the patient, the test sequence continues over a 90-second cycle which enables the system to calculate and display the eye/head ratio, along with a consistency factor referred to as the 'stability coefficient'.

In order to quantify the relative eye/head movement, a variable is used called the Gain, and is equal to the ratio of the angular movement of the head to the total angle of the target:

$$\text{Gain} = \frac{\text{head angle}}{\text{target angle}}$$

Thus, if the target angle is 45˚ and the head rotates 15˚ to view the target, the Gain is 0.33. Clearly a Gain of zero would indicate that the patient was an eye turner, whereas a Gain of 1.0 would indicate that the patient was a head turner.

People who tend to turn mainly their heads when viewing lateral objects will benefit from a design which provides optimum central acuity, i.e. a softer design, whereas people who tend to turn mainly their eyes, will benefit from a design which provides good acuity over a wider field, i.e. a harder design. The VisionPrint system enables the practitioner to determine the wearer profile of the individual quickly and accurately and provides a method for communicating the information to the laboratory for incorporation in the design of the surface. Thus, each *Varilux Ipseo* lens is designed for the individual wearer, manufactured by free-form technology and, in recognition of its individual nature, micro-engraved with the patient's initials.

Essilor normally recommends a minimum fitting height of 18mm for the *Varilux* designs but a recent addition to the range, the *Varilux Ellipse*, is specifically designed for the fashionable shallow frame. With this lens, 85% of the near addition is reached only 9.2mm below the distance reference point, allowing it to be mounted with a minimum recommended fitting height of just 14mm.

Hoya Lens UK

Described as an integrated double surface design, the *Hoyalux iD* lens was the first of a new generation to be released in the UK, which incorporated some of the progressive power on the convex surface and some on the concave surface. In the design of the lens, Hoya incorporated the progressive component that gives rise to a vertical change in power on the convex surface of the lens, and the progressive component that gives rise to the horizontal change in power on the concave surface of the lens. A simple simulation of how this results in a spherical increase in power in the near portion is obtained by considering the magnification effects of two plano cylinders that have been combined at right angles to one another.

Figure 8 illustrates a target in the form of graph paper, which is viewed through a plano convex cylinder with its axis vertical. Since the cylinder has power only at right angles to its axis, the squares are magnified in the horizontal meridian only, and when viewed through the cylinder, appear as horizontal rectangles.

In **Figure 9a**, the target is shown with a plano convex cylinder placed with its axis horizontal over the progression area to represent the vertical progression components. In **Figure 9b**, the plano convex cylinder has been placed with its axis vertical over the progression area to represent the horizontal progression components. The result is shown in **Figure 9c**; the magnifications combine to produce images which are the same shape as the object over most of the central field.

If the magnification produced by the lens in the peripheral field is irregular, due to rapid changes in the shape of the surface, peripheral objects will appear to change direction. This is often referred to as the 'swimming' effect by the new wearer, as images viewed through peripheral portions of the right and left lenses apparently move at different speeds.

The swimming effect is a combination of distortion produced by the increasing power between the distance and near portions, and changes which take place in surface topography as the result of trying to achieve the correct blend between the various zones of the lens. The effect is particularly troublesome to the new progressive lens wearer, especially when looking at the floor, or walking down stairs, when the visual system is attempting to process information which is arriving from oblique sight directions.

Hoya has considered this problem in some detail and derived a method whereby it can control the deformation using the concept of a point deformation index. It represents each point in object space as a small circle and calculates, by ray tracing through the lens, the spectacle magnification throughout the progression zone and near portion of the lens. If the spectacle magnification is the same in every direction, then the object circles will be imaged as circles and, apart from the magnification itself, there will be no deformation by the lens of that point.

Spectacle magnification (the ratio of the retinal image size in the corrected eye to that in the uncorrected eye) can be expressed in terms of the two angles, ω' and ω (**Figure 10**). The object point, Q, is

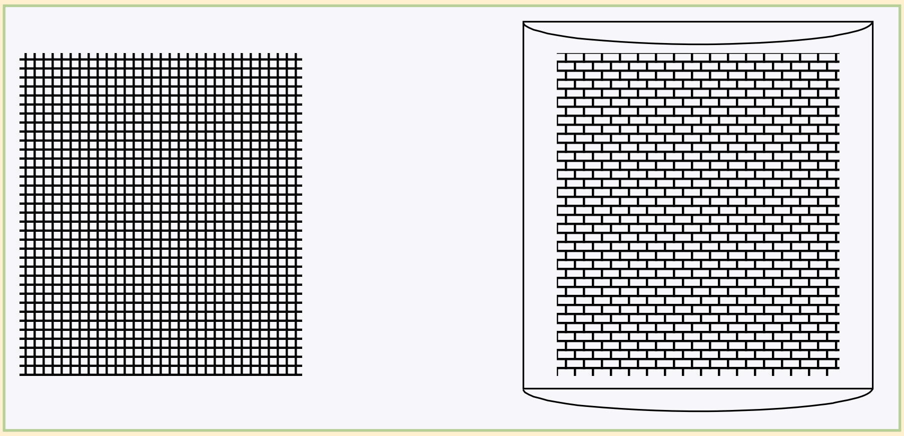
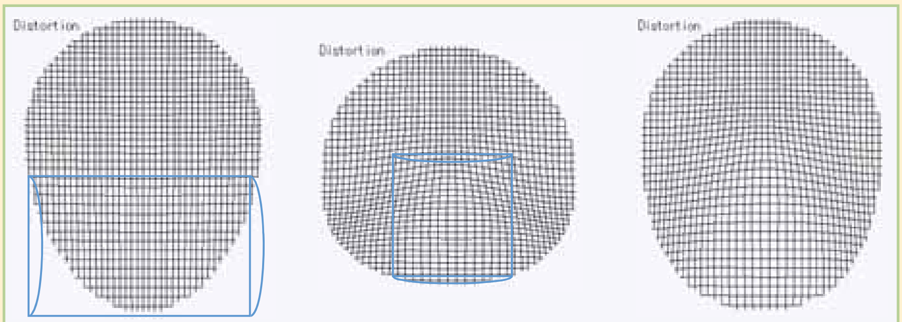


Figure 8
Meridional magnification by a plano-cylinder



a) Vertical progressive component on convex side | b) Horizontal progressive component on concave side | c) Combined progressive components

Figure 9
The vertical and horizontal progressive components of the *Hoyalux iD* progressive lens

Figure 10
Spectacle magnification

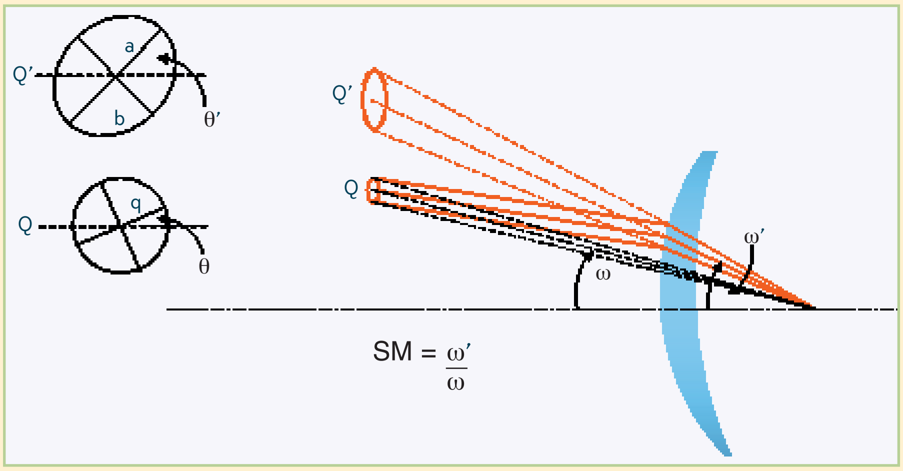


Figure 11
Effect of different orientations of the spectacle magnification ellipse

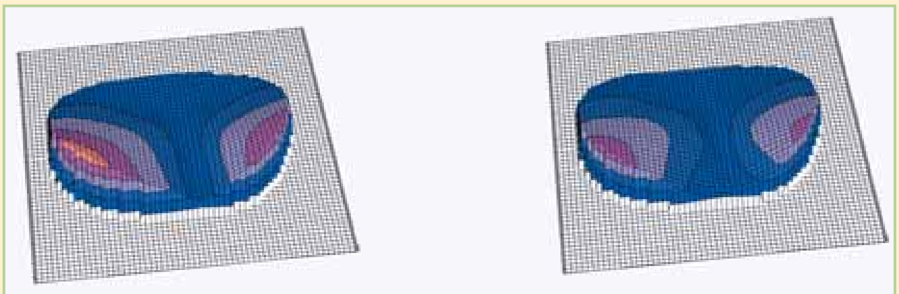


Figure 12
Distribution of deformation indices, *P* and P_S

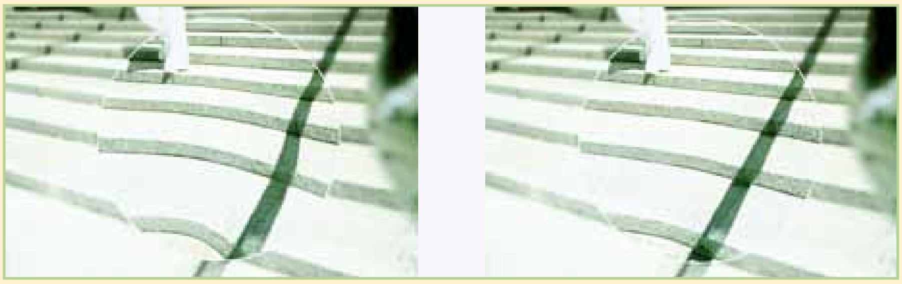


Figure 13
Hoyalux iD balanced view control

represented by the circle of radius *q* and the image formed by the lens is seen to be drawn out into an ellipse of semi major axis, *a*, and semi-minor axis, *b*. The spectacle magnification for each of the meridians a and b is expressed as:

$$SM_a = a/q \quad \text{and} \quad SM_b = b/q$$

Figure 10 illustrates a severe case of deformation where it can be seen that not only are the two spectacle magnifications different, but the aximuth of *a* differs from the azimuth of *q* (θ′ is greater than θ).

The point deformation index, *P*, is defined as:

$$P = \frac{a - b}{b}$$

and depends only upon the shape of the spectacle magnification ellipse. It does not describe its orientation. It is immediately apparent from **Figure 11** that when the spectacle magnification ellipse has its major axis vertical or horizontal, it does not trouble the wearer as much as when the major axis lies obliquely. The ellipses drawn alongside each view show the orientation of the major axis of the ellipse.

The normal point deformation index, P_N, is at a maximum when $\theta_b = 0°$ or when $\theta_b = 90°$, and represents the deformation component along the horizontal and the vertical meridians respectively.

The skew point deformation index, P_S, is at a maximum when $\theta_b = 45°$ or when $\theta_b = 135°$, and represents the deformation component along the 45 and 135 meridians respectively. It is the skew deformation index, P_S, which gives rise to the most objectionable feeling of deformation and the swimming effect.

The total point deformation index, *P*, and the skew point deformation index, P_S, are evaluated for a large number of points in object space, and plotted as shown in **Figure 12**, to provide the designer with an indication of the areas of the lens where the wearer is not likely to experience spatial distortion. As a result, the apparent curvature of objects is reduced to levels where it is barely perceptible (**Figure 13**).

The double aspheric *Hoyalux iD* lens is currently available in Eyas 1.60 index plastics material with two different progressive lengths, 14mm and 11mm, the shorter length being designed for shallow-eye frames. Hoya recommends that the 14mm design should be fitted in a frame, which provides a minimum height of 18mm from the bottom rim of the frame to the pupil centre, and a minimum distance of 10mm from the pupil centre to the upper edge of the lens, or to the bottom edge of the upper frame rim. The compact 11mm design should be fitted in a frame which provides a minimum height of 14mm from the bottom rim of the frame to the pupil centre, and a minimum distance of 10mm from the pupil centre to the upper edge of the lens, or to the bottom edge of the upper frame rim. The fitting point is designed to be mounted in front of the centre of the pupil.

Hoyalux iD lenses are supplied with HiVision ViewProtect coating, which combines a 99% transmission multi-layer AR coating with a scratch resistant hard coating and a hydrophobic top coat.

Nikon

The *Presio X* series of progressive lenses has been available in the UK for several years. The codes *FX*, *DX* and *CX*, relate to 1.67, 1.56 and 1.498 index materials respectively. They are available with either 14mm or 16mm length progression lengths.

The more recent *Presio-i* progressive design from Nikon is available in four different materials, ranging from 1.50 to 1.74. It is available in all materials with either 13mm or 15mm progression lengths, with the *Presio i-13* having the widest near vision area in the range. Nikon terms the *Presio-i* design an 'interfaced' shallow-base aspheric, resulting in significantly reduced aberration and easy adaptation for both new and existing progressive lens wearers. The recommended minimum fitting heights are 18mm for the *Presio i-13* and 21mm for the *Presio i-15*. In each case, there should be a minimum distance of 9mm from the distance reference point to the upper rim of the frame.

The latest design from Nikon, the *Presio W*, is a double surface design available in either 1.60 or 1.67 index materials. The concave surface is calculated not only to complete the prescription of the lens, but also to minimise the aberrations produced by the progressive surface – and if the lens incorporates a cylindrical correction, it is a atoroidal in nature.

Presio-i and *Presio W* are supplied with the Nikon HCC hard, multipurpose coating.

Pentax

Like Nikon, Pentax (Seiko Optical UK) offers its aspheric progressive design in a range of materials and corridor lengths. The *AF* is termed a 'retina forward' design which signifies that in order to optimise the lens performance the designers have traced rays from the retina forward through the eye and the lens to the stipulated object position. The corridor length is 16mm and Pentax recommends a minimum fitting height of 23mm for this design.

A shorter corridor version, the *Mini AF* is also available with a corridor length of 14mm and a recommended minimum fitting height of just 18mm. The *AF* design is available in 1.60, 1.67 and 1.74 index (PF) materials, the latter with a choice of either 12mm or 14mm length corridors. The newest Pentax progressive lens is the *Super Atoric 'F'* progressive lens, the design of which commences when the company receives the prescription order. The prescriber is offered the facility to select a preferred base curve and the most apposite asphericity is then built into the design according to the choice of bending. Thus, a pair of lenses of quite different powers can be made free from aberrational astigmatism, even if they have the same base curve or incorporate prismatic corrections. The working distance can also be specified to ensure that the optimum inset is provided. Four different corridor lengths can be specified – 10mm, 12mm, 14mm or 16mm – with minimum fitting heights of 15mm, 16mm, 18mm or 23mm respectively.

Rodenstock

Rodenstock introduced its original *Multigressiv* design in 1995. With *Multigressiv 2* came online optimisation of the concave surface with an aspherical surface being applied to spherical prescriptions and an atoroidal surface being used when the prescription calls for a cylindrical correction.

In 2000, a new design, *Multigressiv*ILT, was launched which applied Individual Lens Technology (ILT) to the design, enabling the optimum progressive power surface to be computed from a knowledge of the prescription data and base curve of the lens. With this new design, the progressive surface was switched from the front to the back surface of the lens and, in the case of astigmatic prescriptions, the surface also incorporated the cylindrical correction. The front surface of the lens is a simple spherical surface, with the near addition and necessary aspheric correction for the form, being built into the concave surface.

With astigmatic prescriptions, the concave surface is an atoroidal progressive surface. One advantage of this method of construction is that the geometrical inset is no longer dependent on the convex surface geometry when the inset is fixed by the progressive surface geometry, but can now be calculated individually for the lens prescription. Correct positioning of the meridian line results in larger clear vision zones for distance and near, and a wider progressive zone with smoother transition to the lens periphery.

The *Impression*ILT lens is Rodenstock's flagship progressive power lens design. Just like the *Multigressiv*ILT, it has a concave progressive power surface, which is combined with the cylinder in the case of astigmatic lenses, but it can also incorporate the precise positioning of the lens in its design. In addition to the individual CDs and progression heights, practitioners can submit the vertex distance, pantoscopic angle and the dihedral (face form) angle of the front. The dihedral angle takes into account the bow of the front of the frame and may be defined as the angle between a vertical tangent plane to the front surface of the frame, and the vertical plane tangential to the front surface of the lens. The computer software allows input of all the different fitting parameters as variables in deciding the optimum form of the concave surface, so the resulting lens is custom designed for the individual fitting of the frame to the face.

Rodenstock's newest lens is specifically designed for medium and high hypermetropes. The *Impression Hyperop* is produced in 1.67 high index material and designed for powers in the range from +6.00D to +13.00D, with cylinders up to +6.00D. The design is available in four different forms. *Impression*S *Hyperop* and *Impression*S *XS Hyperop* are the normal and short corridor versions designed for standard fitting parameters, whereas *Impression*ILT *Hyperop* and *Impression*ILT *XS Hyperop* enable the practitioner to supply lenses with the surfaces individually calculated for the patient's measured vertex distance, pantoscopic and dihedral angles. Each lens is individually calculated to be of minimum thickness using Rodenstock's Shape-to-ShapeTM surfacing technology.

Rodenstock has introduced another new type of near vision lens providing intermediate and near vision. *Nexyma 80* and *Nexyma 40*. The figures 80 and 40 relate to the main viewing distance, expressed in centimetres, for which the lens is prescribed (**Figure 14**). *Nexyma 80* provides a wide clear zone for a main viewing distance of 80cm, and would be found particularly helpful for use at a computer workstation. *Nexyma 40* provides a wide viewing area at 40cm and, compared with a single vision lens for near, would provide an extended range of vision from the near point out to beyond arms length.

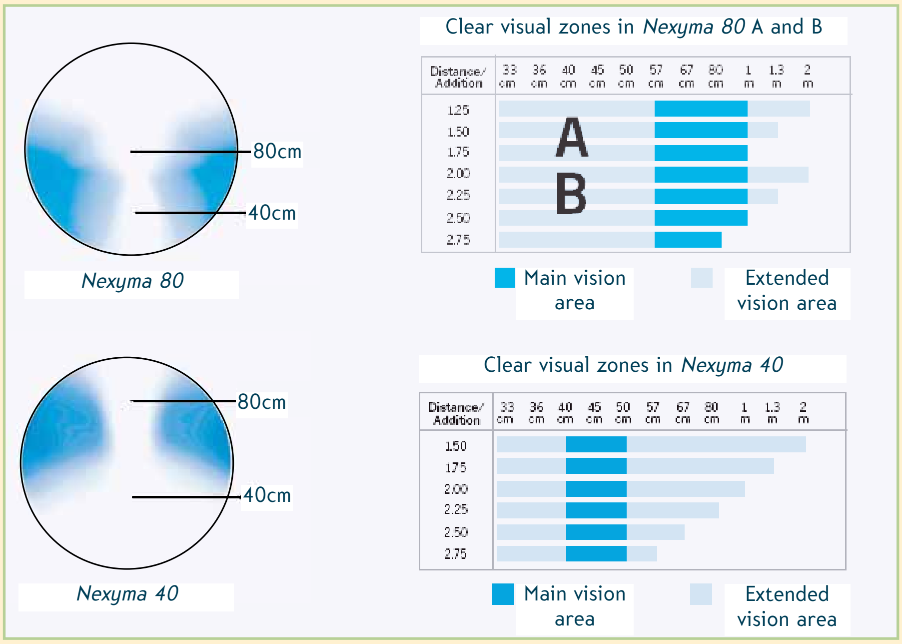


Figure 14
Rodenstock *Nexyma* reading lenses

Rupp + Hubrach

Rupp + Hubrach (R+H) offers three different progressive designs, *Sentoris*, *Selectal* and the new *Ysis* tailor-made design which takes into account such factors as the patient's posture, frame position, amount of head tilt used for near vision tasks and which area of the lens is likely to be used most frequently.

The amount of head tilt which the patient uses for near vision tasks is measured with the help of a special head tilt measuring gauge. This involves a sensor attached to the frame and a receiver, which displays the vertical angle between the visual axes when the head is held in the primary position and the visual axes in the patient's normal reading posture. The device is simple to use. The patient is first asked to stand in a relaxed position looking straight ahead viewing a distant object. They are then seated and asked to look at a book whilst in their normal, comfortable posture for near. The difference between the two readings on the scale is the head tilt. This value is then incorporated as part of the data used to determine the optimum progression length and other parameters of the progression surface. The specially designed order form enables this and other features of the frame fit to be taken into consideration in the design of the free-form concave surface.

R+H has developed an integrated consumer marketing package to reinforce the message that *Ysis* is a special luxury lens design personalised for individual clients. The spectacles are supplied in an '*Ysis safe*', which also contains a crystal and a 'vision map' profiling the wearer priorities, which were taken into account in the design of the lenses. R+H products are now available in the UK from BBGR Ltd.

Seiko

The Seiko range of lenses is now distributed in the UK by Seiko Optical UK. It currently offers both front and back surface progressive designs, the front surface design is called the *P-1W*, available in both white and Transitions V®, Brown or Grey. The white version is available with a choice of either 14mm or 16mm corridor lengths, with minimum recommended fitting heights of 18mm and 21mm respectively.

The Seiko *P-1SY*, the first design to take advantage of free-form technology and combine the cylinder with the progression on the concave surface of the lens, is available in 1.60, 1.67 and 1.74 index materials with a choice of three corridor lengths – 10mm, 12mm or 14mm. The minimum recommended fitting heights for these are 15mm, 16mm and 18mm respectively.

Since the progression is located on the back surface of the lens, when supplied with a 10mm progressive corridor (with a minimum fitting height of 15mm) the *P-1SY* can be fitted into shallow eye frames without compromising the near field. Seiko also recommends that in the case of distance powers greater than 3.00D, if a patient is changing from a convex surface progressive design to one with a concave progressive surface, then the addition should be increased by 0.25D. All Seiko lenses are automatically supplied with multipurpose hard, MAR coatings. The 1.67 index version is available in both white and Transitions V material (brown or grey).

Seiko's latest offer is the *Super P-1*, which was awarded the Good Design Award 2003/04 by the Japan Industrial Design Promotion Organisation.

Shamir Optical

Shamir Optical Industries has set up a UK subsidiary in Cambridge, under the name of Altra Optics UK, to ensure rapid distribution of its range of lenses. Well known as the supplier of progressive moulds to several lens manufacturers, Shamir has been producing its own range of progressive lenses for several years. The best known in the UK are the *Genesis* and the short-corridor *Piccolo* designs.

Shamir has developed a unique computer design facility known as Eye-Point Technology™, at the heart of which is a dedicated ray tracing program written by Shamir scientists. The program enables the designers to trace rays from the eye through the lens to the object and quantify the lens performance point-by-point over the lens. The progressive surface can then be optimised for any given set of circumstances, including personalising the lens according to variations in vertex distance and pantoscopic angle.

Genesis is an aspheric progressive design, which is available in both glass and plastics materials. The minimum recommended fitting height for *Genesis* is 19mm.

The new flagship design is the Shamir *Autograph* design with a concave, free-form progressive surface. It can be tailored individually according to the prescription and fitting data which is entered for each lens. The minimum recommended fitting height for *Autograph* is 19mm.

Signet Armorlite

Signet Armorlite offers the *Navigator* progressive lens in several different materials, together with the Kodak range which includes *Kodak Progressive*, *Kodak Precise* and the short corridor *Kodak Concise*.

The company's ranges include the Corning plastics 1.56 index photochromic Sunsensors material in both Brown and Grey, and *Kodak InstaShades*™ Grey and Brown in 1.60 index material. *InstaShades* was developed by Signet Armorlite to provide a very fast acting 1.60 index photochromic material, where the photochromic molecules are sandwiched between the RLX coating and the monomer in the mould during the casting operation. Upon polymerisation, the photochromic matrix lies just beneath the front surface of the lens.

Signet publishes minimum recommended fitting heights for all its progressive designs and includes a minimum depth of lens below the top rim of the frame to ensure that the patient obtains an adequate distance portion on the lens (**Figure 15**).

SOLA Optical

The SOLA range of progressive lenses includes the *Graduate*, the *XL*, the *Percepta* and the SOLAOne – all available in different materials. The newest design is *SOLAOne Ego*, which is a personalised progressive design individually customised to take into account the wearer's lifestyle. Profiling the patient's lifestyle and vision needs is undertaken at the dispensing table with the aid of *iPilot*, a computer based dispensing system designed to run on a PDA (such as a Palm Pilot). *iPilot* prompts the dispensing optician through a series of questions in order to assess visual activities most frequently undertaken by the wearer. Sophisticated algorithms derived from SOLA's extensive database are used to analyse a number of lifestyle factors. From this data, a customisation code is computed, which is then used to order a customised *SOLAOne Ego* lens.

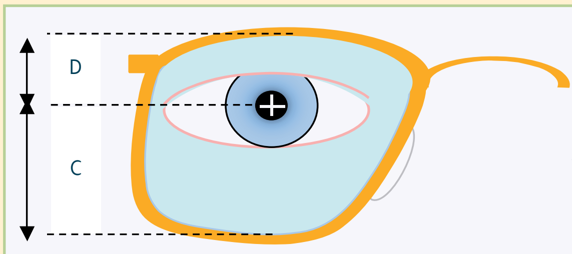
SOLA refers to its free-form lens processing as High Definition (HD) Technology, stating that it can deliver the ideal lens design surface for each wearer's prescription and fitting parameters.

Younger Optics

The *Image* progressive lens from Younger Optics (California) is available in the UK from the Norville Group in several different materials, including the two strongest plastics media, Trivex® and polycarbonate. Younger recently updated its polarising NuPolar technology and most of its designs are available in NuPolar form.

Figure 15

Minimum recommended fitting parameters for Signet Armorlite progressive lenses



	Measurement C	Measurement D
SA Navigator	22	15
Kodak Precise	20	12
Kodak Progressive	22	15
Kodak Concise	17	12

Zeiss

The current flagship progressive lenses from Carl Zeiss are based upon the company's successful *Gradal* design, for which a convex progressive surface is employed and the lens completed by incorporating an aspherical or atoroidal concave surface as the prescription demands. The *Gradal Individual* design enables the precise positioning of the lens to be incorporated in the design. In addition to the monocular CDs and progression heights, practitioners can submit the vertex distance, and pantoscopic angle relating to the frame fitting, which are taken into account in the design of the progressive power surface.

Effectively, the design process first determines the parameters of the concave surface, assuming a given progressive surface design, and then re-computes the progressive surface to take into account the individual fitting values supplied by the practitioner. New algorithms have been developed which allow the progressive surface to be designed in about 20 seconds instead of the former two to three hours of interactive work with the computer.

For small frames, Zeiss offers *Gradal Brevis* and the individually tailored *Gradal Short I* and, as vocational lenses for intermediate and near vision use, the *Clarlet Business* and the *Gradal RD*.

Reference

1. Simonet P *et al* (2003) Eye-head coordination in presbyopes. *Points de vue* No 49 17-21.

MCQs

Module 2 Part 6 of Lens Dispensing Today

Progressive lenses Part 2 – The new generation

Please note there is only ONE correct answer

1. What power would be found 12mm below the distance reference point of a *Varilux Comfort* design of power +1.00 Add +2.50?
a. +2.12
b. +2.62
c. +3.12
d. +3.62

2. What is the minimum recommended vertical dimension of a mounted lens, measured through the pupil centre for a *Hoyalux iD* design with a 14mm corridor?
a. 35mm
b. 28mm
c. 18mm
d. 14mm

3. The results from the VisionPrint system at the time of dispensing are: Gain 0.8, Stability Coefficient 0.1. Which one of the following most aptly describes the subject?
a. Eye turner – low confidence in result
b. Eye turner – high confidence in result
c. Head turner – low confidence in result
d. Head turner – high confidence in result

4. Which one of the following lenses is the odd one out?
a. Hoya *Hoyalux iD*
b. R + H *Ysis*
c. Shamir *Autograph*
d. Zeiss *Gradal Individual*

5. Near vision with a progressive lens is usually possible when 85% of the full near addition has been obtained along the progressive corridor. How does the distance of this point, in relation to the distance reference point, vary with modern multi-design progressive lenses?
a. It gets longer as the add increases
b. It remains the same for all reading additions
c. It gets longer as the lens power becomes more negative
d. It gets longer as the lens power becomes more positive

6. Which one of the following lenses is the odd one out?
a. Rupp + Hubrach *Ysis*
b. Rodenstock *Impression*[ILT]
c. Essilor *Varilux Panamic*
d. Seiko *P-1SY*

7. The first progressive lens to be marketed with the progression on the concave surface was the *Variplas* design from Essel during the 1960s. Which was the second?
a. Essilor *Varilux Comfort*
b. Seiko *P-1SY*
c. Pentax *AF 1.50*
d. BBGR *Evolis*

8. Which one of the following is NOT a short-corridor, progressive design?
a. Shamir *Piccolo*
b. Essilor *Varilux Ellipse*
c. Rodenstock *Nexyma 40*
d. Zeiss *Brevis*

9. Which one of the following developments has NOT contributed to the recent ability to custom design progressive lenses, which can take into account fitting parameters such as vertex distance and pantoscopic angle?
a. Sophisticated software
b. Arrival of free-form surfacing
c. More powerful computing facilities
d. Arrival of CNC generators

10. Which one of the following lenses is NOT designed solely for intermediate and near vision use?
a. Essilor *New Interview*
b. Rodenstock *Nexyma 40*
c. SOLA *SOLAOne*
d. Zeiss *Clarlet Business*

11. What is the recommended minimum vertical depth of a spectacle frame measured through the pupil centre, for the *Kodak Precise* progressive lens?
a. 37mm
b. 32mm
c. 30mm
d. 29mm

12. Which one of the following lenses is the odd one out?
a. Hoya *Hoyalux iD*
b. Nikon *Presio-Gi*
c. Pentax *PF*
d. Seiko *P-1SY*

An answer return form is included in this issue. Paper entries ONLY should be completed and returned by July 13 to: CET initiatives (c-145), *OT*, Victoria House, 178-180 Fleet Road, Fleet, Hampshire, GU51 4DA.

Please note that model answers for this *Pay-As-You-Learn* series will not be available until July 15, 2005. This is so that readers submitting answers online can join at any time from now until July 12, 2005 and take part in any or all of the six articles as they are published. Paper entries will be marked on the normal monthly basis.