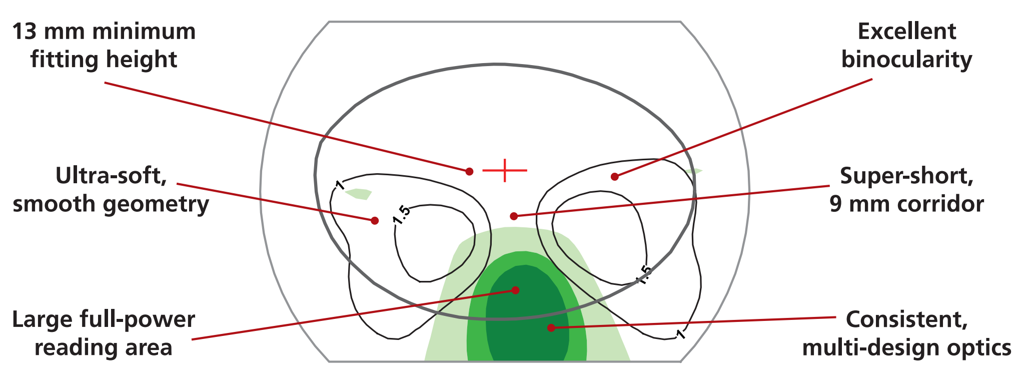
Compact ULTRA: The First Choice for Small Frames

While its revolutionary design pushes the envelope of short-corridor optics, Compact ULTRA continues original Compact's proven track-record of performance and satisfaction. In developmental wearer trials conducted globally with both expert and non-expert wearers, the vast majority of subjects preferred Compact ULTRA to their previous lens design, of whatever type. For those subjects, adaptation generally occurred in less than two days. These wearer trial results also indicate that eye care professionals can switch wearers to Compact ULTRA from other short-corridor progressive lens designs without reservation. Furthermore, previous bifocal wearers will appreciate the high reading area of Compact ULTRA, which begins at roughly the same height as the functional optical zone of a flat-top segment fitted just below the lower limbus.

Although eye care professionals are demanding progressive lens designs that work at lower and lower fitting heights, many leading progressives may fail to provide the kind of near vision utility in small frames that progressive wearers have come to expect. With a minimum fitting height of only 13 mm, Compact ULTRA offers an unsurpassed range of frame choices for progressive wearers. And, by combining patented features with intelligent design choices, Compact ULTRA delivers this performance without the compromises in optics found in many competitive progressive lens designs (Figure 7). Compact ULTRA offers lower levels of unwanted astigmatism and distortion than many leading short-corridor progressives, while delivering considerably more full-power reading area. In short, Compact ULTRA delivers unsurpassed performance in today's small fashion frames.

Figure 7. Compact ULTRA offers a variety of unique and patented features that ensure unsurpassed performance in even ultra-small frames. (Plano Rx, +2.00 Add.)



Availability

SEMI-FINISHED MATERIAL	BASE CURVES	Rx RANGE	ADD POWERS
1.67 High Index	1.00, 3.00, 5.00, 6.00, 7.00	-10.00 to +6.00 D, cyl up to -6.00	0.75 to 3.50
1.67 Transitions® V Gray	1.00, 3.00, 5.00, 6.00, 7.00	-10.00 to +6.00 D, cyl up to -6.00	0.75 to 3.50
Polycarbonate	1.50, 3.50, 5.50, 7.50	-9.00 to +5.00 D, cyl up to -6.00	1.00 to 3.00
Polycarbonate Transitions® V Gray	1.50, 3.50, 5.50, 7.50	-9.00 to +5.00 D, cyl up to -6.00	1.00 to 3.00
Hard Resin	1.50, 3.50, 5.50, 7.50	-9.00 to +5.00 D, cyl up to -6.00	0.75 to 3.50
Hard Resin Transitions® Gray	1.50, 3.50, 5.50, 7.50	-9.00 to +5.00 D, cyl up to -6.00	0.75 to 3.50

COMPACT ULTRA HD (Free-Form)		Rx RANGE	ADD POWERS
Compact ULTRA HD 1.67 High Index	Available Rx AR coated only	-12.00 to +8.00 D, cyl up to -4.00	0.75 to 3.50
Compact ULTRA HD 1.67 Transitions® V Gray	Available Rx AR coated only	-12.00 to +8.00 D, cyl up to -4.00	0.75 to 3.50

1 Bookey, S. "It's a Small (Frame) World: Short-Corridor PALs." *Vision Monday*, 2005: Vol. 19, No. 14, pp 29-32.
2 Sheedy, J., Campbell, C., King-Smith, E., and Hayes, J. "Progressive Powered Lenses: the Minkwitz Theorem." *Optometry and Vision Science*, 2005: Vol. 82, No. 10, pp 1-9.
3 Sheedy, J., Hardy, R., and Hayes, J. "Progressive addition lenses—measurements and ratings." *Optometry*, 2006: Vol. 77, No 1, pp 23-30.

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SOLA

Progressive Lenses by SOLA

SOLA **Compact ULTRA™**

By Darryl Meister, ABOM

Small frames continue to grow in market share while they shrink in size. An estimated 63% of frame styles introduced in 2005 had "B" measurements below 30 mm, compared to just 2.5% in 1999. According to one survey, 45% of eye care professionals indicated that "small frames" comprise over half of their progressive lens sales.[1] As more presbyopes have come to prefer the minimalist look of smaller and smaller frame styles, eye care professionals expect progressives to work at even lower fitting heights. This can result in significant visual compromises, even with modern short-corridor progressives. With a minimum fitting height of 13 mm, Compact ULTRA has been designed to deliver outstanding vision even in the ultra-small frame styles that many progressive wearers are choosing today. More importantly, with patented optics that include an incredibly smooth design and a revolutionary 9 mm corridor, Compact ULTRA delivers unsurpassed reading vision in small frames as well as excellent overall performance and utility.

Limitations of Today's Progressive Lenses

The 1999 launch of the original AO Compact® single-handedly defined the "small-frame" or "short-corridor" progressive lens category. Compact offered a minimum fitting height up to 7 mm lower than traditional progressives. Compact provided significantly more of the prescribed Add power at lower fitting heights compared to traditional progressives, without compromising optics, by combining a high near zone with a soft, usable periphery. In fact, Compact's exceptional performance as the first real progressive lens solution for small frames earned it the Optical Laboratory Association's prestigious *Award of Excellence in Lens Design.*

OLA AWARD OF EXCELLENCE

AO Compact®: Winner of the Award of Excellence in Lens Design

Since the introduction of original Compact, the small-frame category has continued to grow, with eye care professionals demanding shorter and shorter fitting heights. Meanwhile, other lens manufacturers have raced to introduce their own small-frame progressives. Many of these manufacturers play a "numbers game," focusing on lower minimum fitting height claims or shorter corridor length claims, with less regard for optical performance or utility. In many cases, significant optical compromises and shortcuts are made to achieve more near vision at lower fitting heights, at the expense of overall utility, comfort, and performance. Further, some of these newer, small-frame or short-corridor progressives still fail to deliver a sufficient reading area at their minimum recommended fitting height. And none of these leading progressives work especially well in *ultra-small* frames, which often require fitting heights as low as 13 mm.

It is theoretically possible to produce a progressive lens with a corridor length that approaches zero, which would allow for extremely low fitting heights. However, the overall optical performance of a progressive lens design is closely linked to its corridor length. Minkwitz demonstrated mathematically that, as the corridor length is shortened, the unwanted astigmatism in the periphery of the lens surface must increase more rapidly, resulting in higher levels of blur and distortion and/or smaller zones of usable vision. Moreover, as the corridor length becomes shorter, the intermediate zone also shrinks, reducing mid-range utility.[2]

In order to minimize the impact of the optical consequences of shorter corridors, some progressive lens designers make compromises or take shortcuts to offer more near utility in small frames. For example, some lens designers may achieve a relatively short corridor length, but offer only a narrow near zone in order to keep levels of unwanted peripheral astigmatism manageable. In some cases, the optics of a short-corridor lens design may even be similar to the optics of a traditional lens design that has simply been raised by one or two millimeters, relative to the fitting cross. While this provides more near utility in small frames, it does so by compromising distance utility (Figure 1).

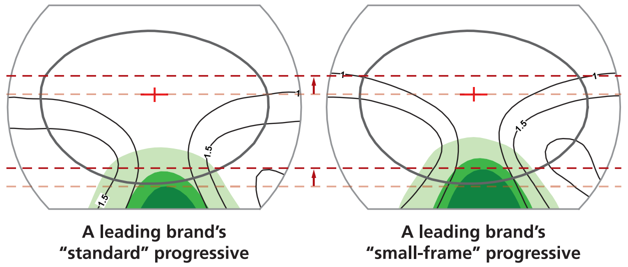

Figure 1. Some short-corridor progressives are designed using shortcuts that could compromise optical performance, such as effectively sliding the entire design up to achieve much of their reduction in corridor length.

Regardless of the shortcuts or compromises used, none of the leading short-corridor progressives offer the kind of near vision utility, in many of today's smaller fashion frames, that eye care professionals have come to expect from traditional progressive lenses at more conventional fitting heights. Many of these progressive lenses provide very little—if any—of the prescribed Add power at shorter fitting heights, since the zone of full reading power is literally edged off at these heights. In this situation, wearers may be left under-corrected for near vision, or have only a relatively small "sweet spot" of acceptable power for reading. Remedies such as "bumping the Add power" only exacerbate matters by causing the wearer to reach the prescribed addition in the comparatively narrow progressive corridor.

SOLA

Introducing Compact ULTRA™

While it is possible for any progressive lens manufacturer to offer a shorter corridor length, it takes a well-designed progressive to offer more near utility in small frames without unnecessarily compromising optical performance for the wearer. Compact ULTRA has a corridor length of less than 9 mm from the fitting cross to 85% of the specified Add power, which makes it the shortest corridor length available among leading semi-finished progressives. However, Compact ULTRA still offers a softer periphery with lower levels of unwanted astigmatism and distortion than many competing short-corridor progressives, which often have significantly longer corridor lengths and less near utility. This impressive optical performance was achieved through the application of multiple patented technologies.

Firstly, the surface power of Compact ULTRA is distributed in the smoothest possible way around a bipolar viewing zone layout by minimizing mathematical functions based on *Dirichlet's Principle*. Dirichlet's Principle, after the renowned German mathematician Johann Lejeune Dirichlet, is also known as the principle of *minimum potential energy*. Dirichlet's Principle accounts for the distribution of energy associated with certain natural phenomena, such as the distribution of electrical potential around a charged conductor and the distribution of temperature around a thermal conductor. With Compact ULTRA, Dirichlet's Principle is used to distribute the power and astigmatism in a more natural manner between the distance (D) and near (N) reference points of the surface, which serve as the two "poles." The result is exceptionally smooth progressive lens optics that represent a more natural viewing experience for the wearer (Figure 2).

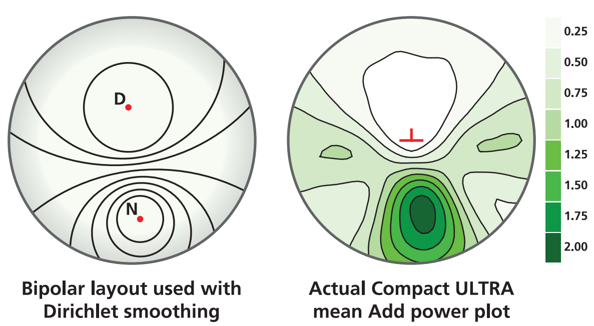

Figure 2. The surface power of Compact ULTRA is distributed in a completely natural manner using Dirichlet's principle in conjunction with a bipolar layout (US Patent 4,861,153).

Further, Compact ULTRA is also a *superposition design*. The total progressive lens geometry of a superposition design consists of the weighted mathematical average of a "hard" type progressive lens design and a "soft" type lens design. Hard progressive lens designs generally offer wider central viewing zones of clear vision, while soft progressives offer lower levels of peripheral astigmatism, image swim, and distortion. By averaging the optics of two different hard and soft lens designs that have been *superposed*, or aligned with each other, Compact ULTRA is able to combine the best features of both (Figure 3). This allows Compact ULTRA to deliver excellent viewing zone utility, even in smaller frames, while maintaining an exceptionally soft, usable periphery. Further, the combination of a remarkably short corridor length and a wide near zone translates to larger, more easily accessible fields of unobstructed near vision.

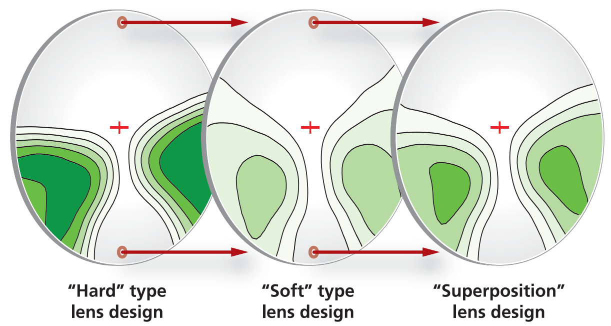

Figure 3. A superposition design represents a weighted mathematical average of a hard type lens design and a soft type lens design in order to combine generous central viewing zones with an exceptionally soft periphery (US Patent 5,726,734).

Of course, all progressives use surface astigmatism to "blend" the distance and near zones of the lens seamlessly together. However, this surface astigmatism produces unwanted cylinder power in the periphery, which—in sufficient quantities—results in sensations of blur, distortion, and *image swim* for the wearer. Moreover, the cylinder power produced by the surface astigmatism in the periphery of a progressive is generally oriented at an *oblique* (neither vertical nor horizontal) axis. As a result, the magnification produced by this unwanted cylinder power is also at an oblique orientation, which causes the edges and diagonal corners of objects to appear unusually stretched, curved, or tilted.

This optical effect is referred to as *skew distortion*. Skew distortion also contributes to image swim and the sensation of vertigo or motion sickness often experienced by progressive lens wearers, which further decreases the likelihood of successful adaptation. Fortunately, the patented bipolar design and mathematical smoothing process used for Compact ULTRA minimizes unwanted astigmatism and skew distortion compared to traditional progressive lenses (Figure 4). Because of this emphasis on the optical integrity of the periphery of the lens design, wearers will enjoy fast adaptation and effortless dynamic vision with Compact ULTRA. Moreover, the low levels of surface astigmatism to either side of the progressive corridor result in well-balanced optics, preserving binocular compatibility and performance between the right and left lenses.

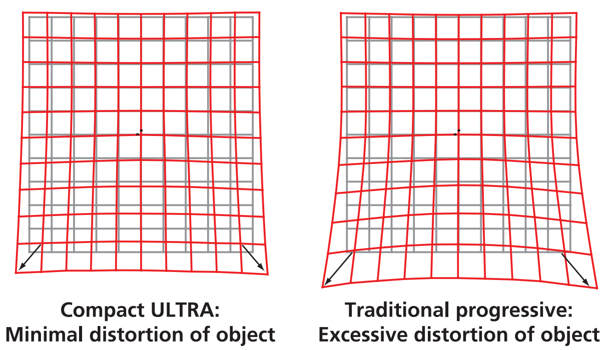

Figure 4. Compact ULTRA employs an ultra-soft periphery with considerably lower levels of unwanted astigmatism and skew distortion compared to many traditional progressives, resulting in a more natural visual experience.

Progressive Lenses by SOLA

Unsurpassed Performance

Recall that the optical performance of a progressive lens design is closely linked to the length of the progressive corridor, and that shorter corridor lengths necessitate more rapidly increasing levels of astigmatism. This can result in higher levels of peripheral astigmatism and/or narrower zones of usable vision. While Compact ULTRA employs the shortest corridor length available among leading semi-finished progressives, the geometry of the lens design has been carefully managed to minimize unwanted astigmatism and distortion in the periphery while maximizing near vision utility in small frames.

The unique superposition design of Compact ULTRA ensures unsurpassed full-power reading area, even at exceptionally low fitting heights. Moreover, Compact ULTRA's bipolar layout with Dirichlet smoothing results in a significantly softer geometry that minimizes unwanted optical effects such as blur due to unwanted astigmatism and skew distortion. Consequently, Compact ULTRA delivers this improved performance in small frames without the compromises in visual performance characteristic of other leading short-corridor progressives (Figure 5).

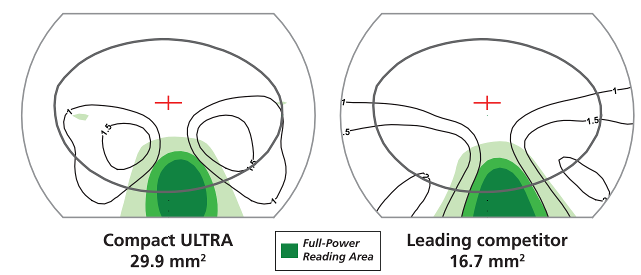

Figure 5. Compact ULTRA delivers unsurpassed full-power reading area in small frames, with lower levels of unwanted astigmatism and distortion.

	CORRIDOR LENGTH (85% ADD)	MINIMUM FITTING HEIGHT	MAXIMUM SURFACE ASTIGMATISM
Compact ULTRA™	**8.6 mm**	**13 mm**	**1.96 D**
Competitor A	9.6 mm	14 mm	2.05 D
Competitor B	11.4 mm	14 mm	2.11 D
Competitor C	11.1 mm	16 mm	2.03 D
Competitor D	10.4 mm	16 mm	2.04 D
Original Compact®	11.4 mm	15 mm	2.07 D

Measurements based upon the most statistically representative lens from a population of lens samples representing a Plano Rx, +2.00 Add. Individual results may vary. Data on file.

AVERAGE FULL-POWER READING AREA IN FRAME (mm²)					
FITTING HEIGHT:	17 mm	16 mm	15 mm	14 mm	13 mm
Compact ULTRA™	**54.1**	**46.2**	**38.0**	**29.9**	**22.1**
Competitor A	40.7	32.0	24.0	16.7	10.3
Competitor B	36.4	26.5	17.7	10.1	4.1
Competitor C	36.9	27.5	19.0	11.5	5.4
Competitor D	40.7	31.7	23.4	16.0	9.4
Original Compact®	38.9	29.0	20.1	12.5	6.2

Averages calculated from a population of lens samples representing a Plano Rx, +2.00 Add using a scaled Ovaline 7 frame shape. Individual results may vary. Data on file. Gray indicates fitting height below manufacturer's recommendation.

Of course, excellent optical performance is really only meaningful if it applies to all wearers, not just a select few. Another unfortunate consequence of Minkwitz's theorem is the fact that the unwanted astigmatism in the periphery of a progressive lens is proportional to the Add power, which causes the optics of the lens to suffer in higher additions. While many progressives may provide adequate near utility in low Add powers, as the addition increases the full-power reading area frequently becomes smaller in size. Therefore, advanced presbyopes with high Add powers may not enjoy sufficient near utility with many progressive lens designs.

However, SOLA's proprietary Design by Prescription™ technology ensures that Compact ULTRA delivers more consistent performance, regardless of the wearer's prescription or stage of presbyopia (Figure 6). The size of the near zone is increased in higher Adds in order to maintain relatively uniform near utility. The lens design is also adjusted by Base curve in order to maximize the optical performance of each prescription range, using features such as a variable near inset and precision optical asphericity.

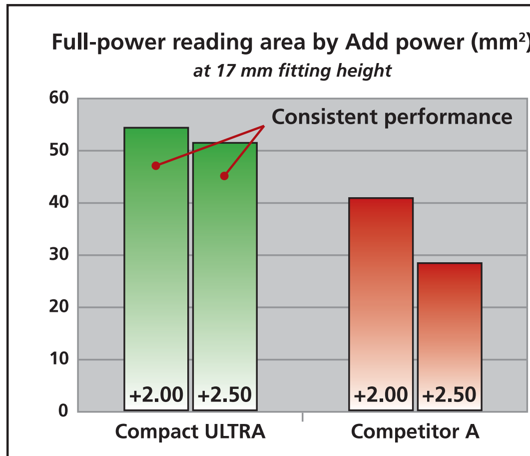

Figure 6. Many short-corridor progressives lose a significant amount of full-power reading area as the addition increases, resulting in a noticeable loss in utility as presbyopia advances.

Full-Power Reading Area

While there are many ways to measure near utility, one that is particularly relevant to performance in small frames is the area of the lens within the actual frame that provides the prescribed Add power. A difference in power of 0.25 diopters (D) represents both the customary just noticeable difference—or smallest discernible change—assumed during an eye exam and the approximate depth of focus for a typical individual. A difference of ±0.25 D from the specified addition therefore serves as a clinically meaningful threshold of visual performance as well as a functional tolerance from the prescribed Add power. Full-power reading area is defined as the region of surface power within ±0.25 D of the specified addition in a given frame, and is essentially a measure of the amount of "Add power" left in the frame.[3]