Digital Surfacing

2007 A YEAR OF CHANGE... WHERE DO WE GO FROM HERE? PART 6

Digital surfacing has changed the U.S. optical market in 2007. By all estimates, digital surfacing has changed the market and will become some part of all labs, doctors' and dispensers' offerings as we move through 2008. The change has meant new manufacturing processes as well as new opportunities for lens designs, precision and a means to increase the customization and personalization of progressive lenses in the market.

By Mark Mattison-Shupnick

Remember, digital surfacing is a manufacturing process and by itself does not guarantee a better lens design. It does, however, provide for delivering new designs and customization for improved vision by creating lenses that achieve increased contrast and sharpness, wider, clearer viewing zones as well as lenses tuned to the personal needs of each patient.

By using this new processing technology, each lab and practice improves his or her knowledge about the ways that we can further customize eyewear. For the lab, it has meant a large capital investment in new machinery, training and digital sophistication. For the ECP, learning the benefits of each lens design and the methods used to describe and dispense them increases professional capabilities. It has also meant financial growth for the industry that will fuel additional R&D, marketing programs and newer visual benefits for each patient.

It is estimated that between 1.2 and 1.5 million pairs of lenses, the result of digital surfacing, will be dispensed this year or about 7 percent of all sold. That covers all the forms of digitally surfaced lenses i.e., lenses created from digitally surfaced molds, SF progressives digitally enhanced, dual surface and/or concave surface progressives.

According to Dr. Wenko Süptitz of Schneider Optical Machines, these highly sophisticated and automated equipment free-form systems drive two other developments in the market. First, digital surfacing has become so fast and robust that this technology now successfully competes with traditional prescription laboratories' surfacing equipment. Its advantages include simplified logistics and processing, increased flexibility and the option to make optimized aspheric and atoric lenses—a technology that does not require special free-form design software. Secondly, digital surfacing equipment lines are now available in reduced scale for smaller production demands and made more affordable. As a result, the technology of the large machines like HSC Master generator and CCP 102 polisher are now possible for smaller labs. This new economical line consists of the blocker CB bond, generator HSC smart, polisher CCP swift and laser marker CCL C*mark.

As a result, new lens designs, processing software and equipment availability will fuel better patient's options throughout 2008. It's been a process of evolution and revolution.

A Review of the Differences

Let's review the differences between digital surfacing and/or digitally surfaced lenses. In the two columns below, digital surfacing as the manufacturing method is described on the left and the resulting lenses are reviewed on the right. It is critically important to understand that merely producing an existing progressive design by digital surfacing does not improve the design. New vision science and an optimization program are required to drive digital surfacing equipment to produce lenses with improved vision and personalized characteristics.

Manufacturing – Digital Surfacing

Blocking - Increased accuracy is required when blocking lenses for digital surfacing. Therefore, the tolerances that the lab would have previously accepted are no longer acceptable.

The Schneider CB Bond (manual) and CCU 100 (automated blocker) combine high-resolution optical detection systems with variable lens clamping both in pressure and position. In this way, lens markings can be easily identified and numerically controlled (NC) prism and axes adjustment ensure that the required blocking precision for corridor, OC and prescription axis location.

Generating (Milling & Turning) - Generating creates the complex surfaces that incorporate Rx, add power, corridor position, aspher- or ator-icity and base curve optimization. A milling tool is used to increase throughput, reduce diameter, bevel and create the initial contour of the surface.

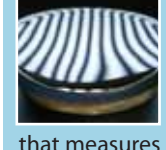
High-speed natural diamond cutting tools in a turning process are used to create a very fine surface that only requires light buffing. A PCD tool is also available on some machines when that generator is used for traditional Rx work along with digital surfacing.

Polishing – The polishing tool must conform to the complex changing lens surface. As a result, the tools must be adaptive. The Schneider polisher analyzes pad pressure, changing surface shape and tool speed required. The result is the machine's calculation of time and position at various positions on the lens surface. And intelligent process management of path, dwell time and swivel profile are individually configured to polish a pair of lenses simultaneously.

Laser Marking - All progressives require lens markings. If created from a single-vision blank, a variety of different methods from in generator to after polishing are available to mark lenses.

On board CO2 laser marking

Verification – For the lab, design replication and consistency verification will require surface measurement either directly or by reflection. Schneider offers either a floor (PMD 100) or tabletop (PMD 100-T) unit that measures surfaces by Phase Deflectometry. For the ECP, some Rxs may have been compensated for position of wear so the lab will return a verification Rx as well as the prescribed Rx.



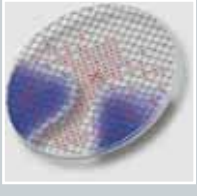
Best of AR – The best digital designs are best delivered when AR is added. Order only the best of the highly durable, easy to clean and keep clean finishes. Consider lenses with Crizal Alize with Clearguard, Zeiss Carat Advantage or SOLA Teflon.

Lenses – The Results

New Vision Science – Lens design drives the performance characteristics of the lens. New science has refined the design to be adapted to the visual needs of the wearer.

Optimization Software – An initial "lens" model is analyzed using optical ray tracing for an assumed wearing position. The software then minimizes optical blur, distortion and other factors using additional fitting, lifestyle, biometric and/or frame data. A final lens can be described mathematically representing the best result. Digital surfacing now makes it possible to deliver the lenses with a variety of degrees of customization. Consider Zeiss Individual, which also uses vertex and tilt data to optimize the prescription.

New Molds for SF Progressives - Using Wavefront Advanced Vision Enhancement (W.A.V.E.), a wavefront adapted technology, Essilor produces lenses with reduced distortion, improved contrast and clearer vision. Consider Varilux Physio where better control of higher order aberrations delivers unsurpassed visual sharpness.



Zeiss GT2 uses ZOOM technology to dramatically reduce lower and higher order wavefront aberrations, control the point-by-point design of the lens surface for excellent binocularity, clarity above the 180º and a wearer preferred near viewing angle.

Further Improve SF Progressives – Digitally surfacing the back of Varilux progressives provides a second opportunity to further customize the design to the patient's prescription. This reduces the front surface effects of unwanted astigmatism considering the patient's cylinder and axis. Consider Varilux Physio 360° to increase the clear field of view. Varilux Ellipse 360º for small frames and Varilux Comfort 360º for the proven ease of adaptation and fitting.

Automatically optimize corridor length for frame size and fitting height using Accolade Freedom. This maximizes the horizontal visual space whatever the frame while the vertical visual space is maximized for frame size by reducing the progressive length as needed to enhance near vision.

Concave Surface Progressives – Using complex software, a progressive and prescription can be transferred to the back of the lens and be made in the lab. Some manufacturers can further customize the lens using the prescription, base curve chosen, fitting characteristics and biometric data to create a cutting file for a personalized progressive. Using a spherical SV lens blank, all lens characteristics are created on the concave

surface of the lens. Magnification differences between visual areas are reduced, all zones are located closer to the eye increasing the clear field size and control of off-center astigmatism and power error remove the traditional limitations of base curves. Consider new SOLA HDv, Varilux Ipseo, SOLA One HD, SOLA Compact ULTRA HD and AO Easy HD for prescription-optimized progressives.

Dual Surface Progressives - Divides the progressive onto both sides of the lens or, creates two distinct non-progressive surfaces that, when combined, are progressive. The benefit is that the sum of the astigmatism (blur) of the parts is less than the astigmatism. Digitally surfaced, Definity and Definity short deliver wider intermediates and a clearer periphery than traditional progressives. Another manufacturer controls one surface for field width, corridor length is controlled on the opposite surface.

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Automatically optimizing designs for fitting and frame choice

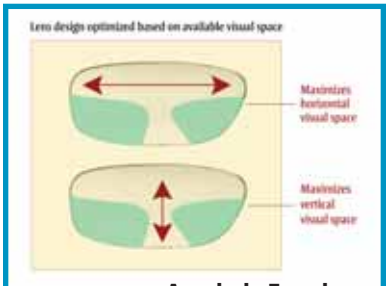
Delivering multiple corridor-length designs or designs with continuously variable corridor lengths is possible using digital surfacing. From this month's CE on lens customization (by D. Meister), "By providing a wide range of potential corridor length options, progressive lens wearers will always get sufficient near vision utility in small frames, without compromising optical performance any more than necessary."

SOLA HDv

New SOLA HDv from Carl Zeiss Vision morphs the design of a concave surface progressive creating a continuously variable corridor length to accommodate any small frame and required fitting height from 35 to 13mm.

Accolade Freedom by Essilor incorporates FrameOptimization and Harmonix Technology to create a digitally surfaced progressive optimizing vision (design based on the ametropia) while improving frame choice adjusting horizontal and vertical visual space).

Lens design, corridor length, inset, fitting height and prescription can now be automatically optimized for frames chosen.



Accolade Freedom

The Future is in Digital Surfacing

Just as progressives can be enhanced by digital surfacing, ordering an aspheric or atoric back on SF single vision or lined multifocal blanks are also expected to be available during 2008. In this way, improvements to a patient's vision are possible for all prescriptions and lens preferences. Optimizing the prescription with digital surfacing can remove the limitations of traditional base curves and can better adapt the lens to a patient's needs.

If base curve limitations can be removed, then the prescription can also be more easily improved for special frames like wrap sunwear where the requirement of 8 base lenses and lens wrap (tilt) require a compensated and optimized prescription centrally and peripherally.

Lastly, unique options like slab off, special prisms, localized add segments and lenticulation can help make special or high-powered lenses conjured by doctors and opticians possible on a per patient basis. Have a special lens need? Contact your lab and see how digital surfacing can make that lens real.

Converting to digital surfacing?

Andrew Karp, lenses and technology editor, Jobson Optical Group, initiated a lab usage survey regarding this new technology and reported on it at the Optical Laboratories Association meeting. Of the 79 percent of respondents that said that they currently didn't own digital surfacing equipment, 61% intended to invest in it over the next 24 months.

When asked the reasons for such an investment, 80-90 percent agreed or strongly agreed with the statements that digital surfacing technology allowed them "to do their own work in-house, keep up with the competition, eliminate hard laps and use the system for their standard prescription work also". Of the remaining 39 percent that did not intend on investing, 90 percent agreed or strongly agreed with the statements "the initial investment is still too high and the market is too small". However, they also agreed that if the costs were reduced and that there was significant training available they would reconsider. I think that they will be more interested in the new systems reduced in scale and cost. Clearly, digital technology is changing the market and many will invest in 2008.

Seen at OLA

Reduction in scale without reducing technical ability – Schneider Optical Machines introduced the new CCP swift, a smaller manually operated version of the automated polisher CCP 102. The CCP swift uses the same polishing technology and polishing pads as the CCP 102. The result is a proven technology scaled for reduced production requirements without a compromise in quality. The CCP swift uses the same soft-tool polishing as the automated machines and results in very competitive tooling costs.


CCP swift

Operators are taught which tooling to choose dependent on curve radius, usage cycle, etc. Tool usage is also monitored and will tell operators when tool replacement is necessary.

This meets the lab's request for a choice of machine size, cost and production capability. It also creates an opportunity to work with companies that may be licensing a technology transfer of designs between machines and locations. Add a CB bond Blocker and expanded business unit Tool Systems for a complete small production system.

- New for reduced production - Generator HSC smart, Polisher CCP swift
- For high production - HSC master Generator, CCP 102 Polisher
- Also new for lens marking - CCL C*mark, CO2 Laser marking unit.

Design morphed to match frames - New SOLA HDv, customized high-definition vision uses the patient's prescription, fitting height and frame size to morph the corridor length to deliver full reading performance while maximizing the clear area of the other viewing zones.


CCL C*mark

New machine entries – Gerber Coburn introduced a modular approach to traditional cut-to-polish and digital lens processing. They introduced the DTL200A generator and MAAT100 sub-aperture polisher. Optotech showed another approach to diamond turning; use of a sintered diamond tool. They also introduced the ASP 80 CNC DT polisher that has four FEM tools for the polishing of two lenses simultaneously.

Customized Progressives	Source	Front	Back
Digitally Enhanced			
Varilux Physio 360°	Essilor	Progressive	Digitally Surfaced
Varilux Ellipse 360°	Essilor	Progressive	Digitally Surfaced
Varilux Comfort 360°	Essilor	Progressive	Digitally Surfaced
Accolade Freedom	Essilor	Progressive	Digitally Surfaced
Concave Surface			
Varilux Ipseo	Essilor	Spherical SV	Digitally Surfaced
Zeiss Gradal Individual	Carl Zeiss Vision	Spherical SV	Digitally Surfaced
SOLA HDv	Carl Zeiss Vision	Spherical SV	Digitally Surfaced
SOLAOne HD	Carl Zeiss Vision	Spherical SV	Digitally Surfaced
Compact ULTRA HD	Carl Zeiss Vision	Spherical SV	Digitally Surfaced
AO Easy HD	Carl Zeiss Vision	Spherical SV	Digitally Surfaced
Kodak Unique	Signet Armorlite	Spherical SV	Digitally Surfaced
EyeMade	INDO, Signet Armorlite	Spherical SV	Digitally Surfaced
Succeed	SEIKO Pentax	Spherical SV	Digitally Surfaced
Autograph	Shamir	Spherical SV	Digitally Surfaced
Mulitgressiv MyView	Rodenstock	Spherical SV	Digitally Surfaced
Dual Surface			
Definity	Essilor	Progressive	Digitally Surfaced
Definity short	Essilor	Progressive	Digitally Surfaced
HOYALUX iD	HOYA	Digitally Surfaced	Digitally Surfaced
HOYALUX iD Lifestyle	HOYA	Vertical Progressive*	Digitally Surfaced

* Complex vertical surface

Measuring instruments - Satisloh showed its new measurement tool for advanced surface analysis, the Surface-Analyzer (SA) is based on an all optical high-precision reflectometry technique. It is ideally suited for process development and process control in ophthalmic lens surfacing.

My View

Demystifying Digital Surfacing, By Andrew Karp, group editor, lenses & technology, Jobson Optical Group

Since digital surfacing has emerged in the U.S. in the past few years, the technology has already begun to profoundly affect the way ophthalmic lenses are designed, manufactured, distributed and dispensed. As we learn to take full advantage of digital surfacing's potential, let's consider how it is impacting various levels of our industry.

For lens manufacturers, digital surfacing provides an opportunity to offer advanced technology in the form of high-value premium products. This will be done by selling actual lenses or "virtual" lenses in the form of data files containing proprietary lens designs which are then uploaded by optical laboratories that pay a "click fee" to produce the lens.

Optical labs are using the technology to increase efficiency and reduce their lens inventories, such as when they convert single-vision lens blanks into digitally surfaced progressives. This creates the capability to produce any variety of branded lenses as well as various types of specialty lenses that cannot be made with conventional surfacing techniques.

Eyecare professionals benefit by being able to offer their patients the most technologically advanced lenses available. Offering these products reinforces the ECP's role as lens experts.

Finally, consumers benefit from the improved or optimized optical performance available with digitally surfaced lenses. In some cases, these lenses can deliver a more personalized experience that factors in the wearer's viewing habits, visual activities and frame selection and fit.

Despite these advantages, there are some obstacles that will continue to be smoothed out during 2008. The cost of the lenses is relatively high, due to research and development and production costs. The technology for producing the lenses is complex. Labs need to integrate each supplier's lens design software with their lab management software and lens processing equipment. Perhaps most important is the question of how to best market these lenses to consumers in a way that will persuade them the lenses are perceptibly better than conventional lenses, and that such a difference is worth paying more for. With that said, 2008 will be an exciting year.