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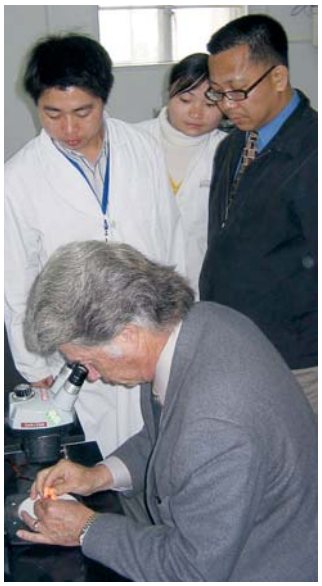
Contents

- Tips for Using Water-soluble Compound in GP Manufacturing 1
- Comparison of Lens Manufacturing Techniques 2
- Two Case Options for Scleral and Semi-Scleral Lenses 5
- Lathe Calibration Standards 5

Tips for Using Water-soluble Compound In GP Manufacturing

By Jim Lunkley, Technical Field Representative, Bausch + Lomb



Jim Lunkley at the Hangzhou lab.

Many labs have changed their manufacturing process to include water-soluble blocking compound. Most have seen the benefits of this change, including fewer complaints about nonwetting and a cleaner, safer lab environment. The old blocking compounds left residue on equipment and lenses, requiring regular cleaning with solvents. Solvents can produce toxic fumes and can be irritating to the skin.

During my visits to customers, I find many still have some difficulty getting optimal performance from water-soluble blocking compounds. The following tips should help resolve some of the issues labs are encountering:

- Store unused wax in an area with desiccant or in a "dry box." This is especially important where humidity is high.
- Control the wax thickness. A thin, controlled wax layer allows the blocking arbor to add support to the lens during processing.



Store unused wax with desiccant or in a "dry box."

- Make sure the crowns (top) of all blocking arbors are smooth and free from dents and other damage. The dents and damage can transfer to the lens and appear as aberrations and/or distortions in the finished lens.
- Reduce the separation of the lens from the wax during cutting by doing the following:
  - > Keep the depth of the rough cut at 0.70 mm or less.
  - > Use a pyramid-stepped-type cut for the rough cut, if the lathe software permits.
  - > Reduce the rough cut feed rate.
- Do not overheat brass blocking arbors. They should only be warm to the touch. A better alternative is to use blocking arbors tipped with Delrin or solid plastic arbors that do not require heating.
- When using Delrin-tipped blocking arbors, lightly sand the surface of the Delrin with fine sandpaper or emery cloth. The wax will adhere to the arbor, and the lenses will deblock cleaner.
- Deblocking is best done with an ultrasonic unit containing water at a temperature of approximately 40°F. Be sure the ultrasonic action is strong enough to remove the lens from the arbor in a few seconds.



Deblock with an ultrasonic unit containing water at 40°F.

- Air cool the base curve blank after blocking. Minimizing exposure to elevated temperatures helps prevent potential lens stability problems. Be sure the cooling occurs evenly around the part being blocked, because uneven cooling can cause the part to become distorted, resulting in poor lens quality.
- When cutting lens designs with extremely flat or extremely steep base curves, it can be helpful to cut arbors with a crown radius more closely aligned to the base curve. Extremely thin or extremely thick wax may cause aberrations and/or distortions in the finished lens.
- The temperature of the blocking wax should be no more than 140°F or 60°C. When using an auto-blocker, monitor the temperature at the nozzle tip. Be sure to consult the wax distributor to determine the best working temperature for the wax being used. Always monitor the wax temperature during production. Overheating the wax can destroy its working properties.
- Do not stir Misupco wax. This can leave small bubbles in the wax that can create air spaces under the lens. Air spaces will allow the lens to flex during processing and cause aberrations and/or poor optics.
- When using an automatic wax dispenser, be sure enough blocking compound is in the wax pot so that air does not get sucked into the blocking compound during the dispensing action. If this happens, bubbles will get mixed into the blocking compound.

Water-soluble blocking compound has many advantages over the old blocking compounds. As you gain experience and start using some of these tips, you should see the benefits in your lab.

A Comparison of Lens Manufacturing Techniques

By Erik Larsen, President, Larsen Equipment Design, Seattle, Wash.



I have followed contact lens manufacturing techniques since I entered the industry in 1974. In this article, I discuss the changes I have seen and even some things that have come full circle. I will cover the basic steps of polishing and blocking, comparing the traditional process with what is considered current.

In referring to traditional and current manufacturing methods, I am not implying that one is in common use while the other is fading out. It is important to look at the reasons why particular methods are in use. This is especially true when process or tooling changes are being considered, because when something is changed, other parts of the process are usually affected.

POLISHING: Traditional method

Probably the most important step in making contact lenses using the traditional method was "polishing in" the optics with pitch. This allowed the lathe set-up to be "close" and the lathe finish to be "pretty good." I still hear these terms rather than "10 microns of runout," for example. The blank was held in a collet to turn the base curve. Depending on the size of the blank and if it was round, the lathe collet would force it to the collet size and shape. This resulted in a distorted base curve, which the pitch would grind to a sphere.

The test of a good polish was a suction of the lap and the lens after polishing. This meant there was a good match of the curves (spheres). Crisp optics and a predictable radius were expected. Typically, the lathe was adjusted a few hundredths of a millimeter to yield a particular radius after polishing. If the lathe lateral and tool height were set up properly, this compensation was fairly accurate over the range of radii being produced. Turning base curves and front curves on the same lathe usually didn't work, however, so it was common to have a lathe for each side.

This process yielded the two sides of the lens. Peripheral curves and CN bevels were done by hand by a skilled technician. For specialty lenses, basic spherical lathe-turning was employed, and the lenses were modified at the finishing station. Toric lenses were generally crimped (some labs used fly cutters) and polished in the spherical shape. Again, the peripheral curves were done by a skilled technician.

POLISHING: Current method

The advent of the CNC air-bearing spindle lathe changed polishing methods. Along with superior precision and finish from the lathe, the CNC control makes it possible to produce a wide variety of lens designs. Various "soft" tools are used to polish the nonspherical surfaces of these designs. Since it is no longer necessary to "polish in" the optics, pitch has given way to the soft tool.



A well-calibrated CNC lathe in combination with the proper software can make manual edging and beveling obsolete.

Finishes are so good with this lathe that the optics can be read in the radiuscope. Poor optics on the lathe-cut surface usually indicates collet crimp, which, ironically, can be corrected by polishing with pitch. Many labs continue to polish the spherical base curves with pitch with good results and shorter polishing times.

An alternative is to block the blank and turn the base curve. This eliminates collet crimp



Polishing the back surface.

distortion and provides subsequent tooling and blocking advantages, such as transfer blocking and blank truing.

With the improved surface on fronts, cloth-covered drum tools filled with sponge are the preferred polishing tooling. The main difference is that the surface from the lathe has to be the one that you want on the finished lens. So, the lathe set-up is critical and the soft tooling buffs it out.

A later lathe development was the oscillating or fast tool servo. This feature coordinates the movement of the diamond tool with the spindle rotation to offer almost unlimited lens design capabilities. This requires complicated polishing because pitch doesn't work on nonspherical (free-form) surfaces. Solid soft tools molded in increments work on small (0.2 mm radius) departures from a sphere. For toric base curves of many diopters, the molded solid tools don't conform well enough to polish the flat meridian. This is because of the stiffness of the solid tool and the unequal contact pressure. The bladder tool polisher system was developed to address this problem. In particular, the bladder works like a tire, in that the contact pressure is uniform. The use of a single bladder tool for all lens designs, including peripheral curves, simplifies and shortens the polishing process.

BLOCKING: Traditional method

The next major procedure was to block the base curve. Usually, this was done on a jeweler's lathe or on a few special machines made for the industry. These were spindle-type machines, usually with tapers (some had collets) to mount the blocking tool (arbor). With this combination of lathe collet, base curve, arbor and blocking machine, making a prism-free lens was a challenge. Every component in the process had to be high quality and well maintained. Alignment adjustments were not done, and repair meant sending the machine for reconditioning or replacing collets and/or arbors. The condition of these components is still an important part of lens manufacturing. One blocking method that had merit was to block directly on the front cutting lathe. This method eliminates how the lathe spindle/taper or collet and the arbor affect the runout of the base curve. This is because the base curve can be trued to the lens diameter shoulder while mounted on the lathe spindle.

A feature of blocking arbors offered by G. Nissel and Co. was incremental sizing of the radius and back surface. From my background (USA), I didn't understand why it was important to match the radius of the base curve to the arbor. In the UK and Europe, they used soft wax to block lenses. The arbor was heated with the wax, and the base curve was pressed on and trued on a spindle while the arbor and wax cooled. The thin layer of wax gained support from the arbor. Also, the radius was concentric with the internal taper and the 12.7 mm (0.5000") shank. This concentric radius was useful in providing alignment to the base curve. I imagine some of my customers were concerned when I questioned the need for individually radiused arbors because I wasn't aware they used soft wax. Toric lenses were generally fly-cut, so the lenses were not crimped, and the soft wax worked fine.

My introduction to blocking was with Kerr Impression Compound, a heavy-bodied material that is very stiff at room temperature. It was common to see 1 mm of this compound between the base curve and the arbor and 10 times more along the side of the arbor. This is when I realized the condition of the top of an arbor wasn't important. Any imperfections would be absorbed by the Kerr compound. It has excellent adhesion properties, especially to hold crimped base curves to arbors for front toric lenses.

The spin blockers dominated the industry because they provided an easy way to test the prism (runout). Countless times, I saw a technician put a fingernail against the side of a blank to test the runout. This method was better than nothing, even though it was time-consuming and not verifiable. I haven't seen data showing how this test affected the prism reject rate. I often see the fingernail test being used today. If there is runout, rather than look for the cause, the operator re-chucks the arbor a few times to try to minimize the runout.

BLOCKING: Current method

There is no inherent need to spin-block to attach a base curve to an arbor. Two well-aligned collets will block a base curve with consistently good results. Alignment should be checked periodically. Regularly monitoring the condition of all lens-holding devices and recording the results will keep the lab operating smoothly. These records will help identify where problems that cause prism may be occurring, making it easier to correct them. This data is very important when considering automation.

Static blockers were introduced in the early 1990s. Some were variations on the spin-blocker frame and could be adjusted to radially align the two collets (no face-tilt adjustment). This usually involved a gauge pin inserted in the collets, then securing the collet positions. While this sounds like a good approach, the proof of "no" prism is taking the blocked button to the lathe and checking the radial and face runout. The problem is that there are no gauges on these blockers to indicate what the adjustment is. When we use

a gauge pin to align the blocker, it is for roughing only and results in about 50-100 microns of prism. After roughing in the blocker with the gauge pin, we calibrate the blocker to a lathe spindle/collet that has less than 1 micron runout. In our lab, it is a Hardinge HSL 59. This involves taking runout readings on the side and face of the blank relative to 0 degrees on the blocker, and then making the indicated adjustments on the blocker. In the lab, the usual procedure is to block some blanks and record the runout on a few arbor/blanks. If the results are random, then clean the lathe and blocker collets and inspect the arbors. This usually fixes the runout problem. If the runout is consistent in amount and location, the blocker needs to be adjusted. This should be checked every week.

Two other developments in the past few years are being adopted throughout the industry: solid arbors and water-soluble blocking compound (WSBC).

Solid arbors were introduced to standardize tooling, similar to how fasteners and pipe fittings are standardized in more mature industries. This standardization reduces the cost and fits in with automation. Reducing variation, such as keeping the arbors the same height, is a cornerstone of manufacturing.

The other less apparent benefit is that plastic arbors are more durable than brass or stainless steel arbors. Plastic arbors also are easier to modify for different lens styles (sclerals) and/or job tracking devices.

Water-soluble blocking compound (WSBC) has changed the industry and even the patient's comfort. Labs have documented cleaner lenses being shipped and fewer returns. My introduction to WSBC was a bit of a challenge and reminded me of the European practice of using a thin layer of wax. The first WSBCs were very thin and would not work on a spin blocker. At that time, our autoblocker was working with Kerr or Perfectblock (Polychem), the heavy-bodied compounds. As the top chuck of the blocking machine came down, the compound dispensed in the base curve was thick enough to support it. This allowed for a free operating system where arbor length or center thickness variations were cancelled out.

This changed with WSBC. A thin layer of WSBC was needed because of its softness. This meant the blocker had to position the base curve and arbor to within 0.1 mm while allowing for center thickness and arbor length variations and not touching the base curve. This needed to be compensated for on each lens/arbor combination.

This challenge led to the development of a wax thickness control (WTC) on the autoblocker that measures each base curve/arbor and yields a 0.2 mm compound thickness. So, the Nissel method of blocking with the thin wax layer has returned. It was also determined that, unlike the Nissel matched radius arbor, for 90% of base curves, a 7.0 mm arbor radius works well.

The overall result of the WTC is better support of the base curve, yielding better optics and cleaner lenses. Although this has not been an easy transition, many labs have made the effort to use WSBC. With the number of WSBC suppliers, there is a lot of support for the labs. An off-shoot of the WTC was that the arbor had to be fully inserted into the upper collet. An arbor sensor was added to the autoblocker to ensure full insertion in the collet. This greatly reduces prism caused by the arbor not being fully engaged in the collet.

The introduction of WSBC required several accommodations in tooling and machinery, which is a good example of the effects of process changes.



Final inspection.

FINISHING/INSPECTION: Traditional method

I am not a contact lens fitter, but I have the highest respect for the technicians who bevel lenses and roll the edges. My understanding is that the edge determines the comfort of the lens. My impression of hand-beveling lenses is that many adjustments were made to the lenses at this point in the process. So while the lathe work was done and production had a certain yield, the finisher "saved" many lenses that would have been rejected otherwise. The result was a high yield rate with a high reliance on the finishing technician.

FINISHING/INSPECTION: Current method

The CNC lathe can generate almost any lens design and make that lens over and over again. For many labs, inspection of the base curve has become automated, with the results given on paper or directly downloaded to the front lathe. So, theoretically, the lens should be finished when it is deblocked and the edge polished. If all the tooling and machinery is set up and calibrated properly, then the last step would be final inspection without modification. In reality, some power adjustment may be needed.

Conclusion

The contact lens manufacturing industry continues to evolve, with some labs just getting their first CNC lathe and peripheral equipment, while a few are automating the process to a high level. At both extremes, there is an ongoing need to monitor the processes with good housekeeping and to invest in key personnel. The manufacturing process is changing, yielding repeatable results and lower costs. This is possible while improving quality. This is the prescription for success.

Two Case Options for Scleral and Semi-Scleral Lenses

The Boston Products Group of Bausch + Lomb offers two contact lens cases for shipping large-diameter lenses.



Scleral Lens Case, part #CP0704.

Part #CP0704 is a vented barrel-type case designed for very large diameter scleral lenses. The basket in the center is similar to those used in some soft lens cases and can accommodate two scleral lenses up to 25 mm in diameter. The outer barrel is designed to have the minimum possible volume to enclose the basket structure, requiring only 10 mL of solution to fill.



Large Diameter Case, part #CP0692.

For mini-scleral and semi-scleral lenses, we offer part #CP0692. This is a simple clip-type case, similar to our existing blue-capped plasma treatment vials (CP0688). We have tested these vials with our recommended plasma treatment process and have found them to be compatible.

Lathe Calibration Standards

In response to customers' requests, we are now producing inexpensive buttons for calibrating lathes. These calibration standards are made of PMMA with an index of refraction of 1.491. They are strictly for use in production to calibrate your laboratory's lathes and are not for on-eye use.

Calibration standards (product #3300V) are listed under "Laboratory Support Products" on our price list dated May 4, 2009. They are packaged in bags of 100 and can be ordered from Wilmington Customer Service (800) 999-2678.



Calibration Standards, product #3300V.

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