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Pressing for success with lithium disilicate

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Pressing for perfection with lithium disilicate – Providence or Precision?

The importance of the all-ceramic restoration is evident in its popularity as safety becomes increasingly important. The significance of the press technique used to prepare all ceramic restorations has not been displaced by CAD/CAM processing. To the contrary - since the launch of lithium disilicate, a steady evolution in pressing technology has been observed. This growth in development can be easily explained. Processing lithium disilicate using pressing technology offers the laboratory many advantages:

- Easy efficient handling via simple, inexpensive processing
- Maximum strength and stability can be achieved using the press technique
- Highest aesthetic quality and transmission of natural optical properties
- Perfect fit
- Antagonist-friendly abrasion qualities
- Works with both, organic and conventional cementation
- Low initial investment cost, high profitability
- No update, dongle or service fees
- Custom creation value in the laboratory
- More I am sure we have not thought of…

Although advantageous, a prerequisite to success is consistency from a process with perfectly coordinated system components and equipment. This report is designed to help the laboratory not by providence or as nature allows, but as a course of consistent precision. This is achieved using process steps designed to help the technician obtain perfect results, the highest aesthetic and absolute fit when pressing lithium disilicate ceramics.

Production of lithium disilicate restorations – Process flow

1. Contouring

A clean, suitable wax that burns out ash and residue free is crucial for consistent clean pressings. We recommend all-ceramic system waxes (ASCP waxes). In addition, the wax must be free of contaminates. Impurities such as grinding residue, later show up as black spots seen in the resulting pressing.

If using CAD/CAM milling wax, ensure the wax being used is suitable for pressing. Many milling waxes contain plastic and resin reinforcements. These reinforcements in large quantities can leave residue that will cause contamination or mis-presses. Printing materials tend to be high in resins which are not suitable for pressing. These resin based materials require extremely long complex burnout processes.

Figure 1: suitable milling wax was used

Figure 1: Shows the usage of a suitable milling wax.

Figure 2: improper milling wax was used

Figure 2: Shows the results from using improper milling or printing wax.

2. Spruing

Attaching the Sprue:
When spruing, use a sprue with a diameter of 2.5 – 3mm and a length of 3 - 5mm. The overall length (Sprue + press object) must not exceed16mm. Anterior units should have sprues placed toward the incisal edge, in the axial direction of the die. This will help avoid a lateral pressure load during the press cycle and promote a smooth flow of material. Posterior units should be sprued to the thickest region of wax while paying attention to the optimal direction of ceramic flow. Inlays should have sprues attached aproximally in direction of the occlusal surface. For bridges it is important to attach sprues only to the abutment teeth and in the axial direction of the die. Do not sprue the bridge member. All transitions between the sprues must be waxed clean. Make sure there are no sharp edges, undercuts points or tapers. The ceramic must flow must flow freely into the mold and not be obstructed by investment material that could break off into fragments and contaminate the pressing.

Figure 3: Wax weight crown & inlay

Weighing:
When multiple objects are being invested, the exact wax weight must be determined, including the sprues. The wax weight determines the number or size of pellet and ring size. Do not use anything larger than a 3g pellet in a 100g ring. Overloading a 100g ring could lead to structural instability, causing crack formation.

Placement:
When pressing lithium disilicate materials, a 13mm ring base is used. All plastic parts of the ring system including the silicone ring former should be treated with a very thin coat of silicone spray or Vaseline. This ensures easy removal of the ring after bench set. Objects should be sprued on the outer edge of center cylinder of the ring base at a 45° angle. The minimum distance between the objects should be 5mm. The minimum distance between the objects and the wall of the ring should be 10mm. Using these measurements will help prevent cracking from the wall and

between the objects. The margins should be aligned vertically and facing the vertical wall of the ring. However, the angle must not allow trapping of air or bubbles during the investing process. Note: heavy use of Vaseline or silicone spray can keep investment material from setting up properly. It is important to be very sparing in its use. While light usage facilitates mold release, heavy use can cause rings to explode or crack.

Figure 4: crown and inlay

Figure 5: bridge

3. Investing

Please pay close attention to manufacturer’s instructions. Do not use a surfactant (surface tension medium). Investment powder, Special liquid and distilled water must be dosed in precise ratios for consistent results. Careful attention must be paid to the dosing device used; some commonly used measuring devices instill inaccuracy (+/- 10%) in the dosing process and become more inaccurate over time. Programmable dosing devices (like the Vario Balance) are more accurate Max 1% inaccuracy) due to their lack of medium transfer deficiencies and unmistakable measurement display not subject to angular distortion. Using these types of devices greatly decreases inconsistencies.

Figure 6: Accuracy ±10%

Figure 7: Accuracy ±1%

Important points to observe during the Investing process:

- Storage temperature of powder and liquid should be at room temperature (maximum of 21°C/70°F). Do not refrigerate powder or liquid.
- Know your mix duration and RPM, we recommend 420rpm.
- Check your mixer's vacuum level regularly.
- Embed bubbles - cavities, inner crown surfaces and chewing surfaces can be filled using a brush or a probe.
- Use silicone rings for investing (e.g. Zubler Flex Ring System).
- Use mild vibration while filling the silicone investment ring.
- Fill the silicone investment ring to the defined fill mark on the ring and insert the base former. This defines the height and positioning of the ring in the pressing oven.
- Insert the base former at and angle and pull the side of the silicone ring former to avoid bubble formation on the bottom of the ring.
- Ensure proper seating of all ring system components.
- Once the ring has been filled, provide a safe clean environment to let the ring bench set undisturbed.
- The specified bench set time and instructions must be observed. Use a timer and remove the ring from the ring former for a portion of the bench set of required.

4. Preheating the Ring (Burnout)

Removing the ring from the ring former:
At the end of the bench set time the ring should be removed from the ring former and set aside for an additional two minutes (if not already). This additional time allows for any left-over moisture to escape prior to entry into the burnout oven. Removal is usually accomplished by twisting off the base of the ring former, and pushing the ring out of the silicone ring former. Remove any access investment mass from the ring base using a plaster knife, carefully scraping the outer edge of the top of the ring.

Figure 8: Place the lid

Figure 9: Bubble if you are not careful

Placement in the burnout oven:

Placing an investment ring in a burnout oven seems simple enough, however some things should be taken into consideration; the condition of the burnout oven, the number of rings being put into or already in the oven, and the placement of the rings in the oven. Most burnout ovens have heating elements on either side with a single thermocouple positioned toward the back of the unit. When looking at the condition of a burnout oven it is important to note the heating elements condition, thermocouple condition, insulation condition and exterior component condition. While these are obviously important, placement in the oven is also crucial. The burnout oven should be pre-heated to 850°C (1562°F) for pressing lithium disilicate ceramics (rapid burnout technique). A single ring should be placed as centrally as possible. However, multiple rings must be placed in staggered positions allowing exposure of the heating elements on all sides of the ring. Ring distances should be a minimum of 2cm from heating elements and the rear wall, 5cm from the oven door and 5cm from each other (see the chart below). Burnout times should be strictly adhered to, for Zubler 144 we require 45min for 100g ring and 60min for 200g ring. If several investment rings are inserted simultaneously, the burnout time must be increased by 15 minutes for each additional ring. The speed technique is preferred for optimal pressing results.

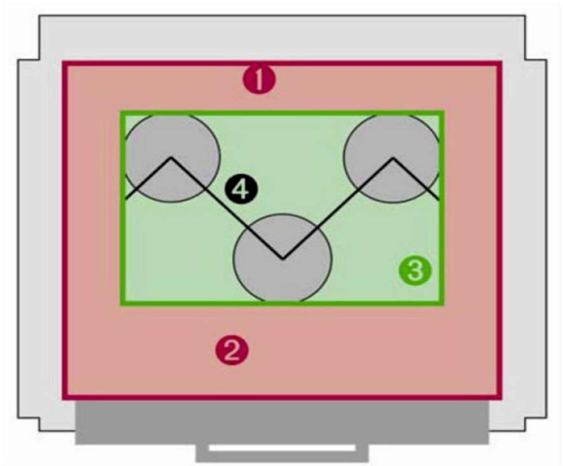


Figure 10: Burnout oven with the right ring placement

Important points to observe during the burnout process:

1. Ring distances should be a minimum of 2cm from heating elements and the rear wall, 5cm from the oven door and 5cm from each other.
2. The area in the front third of the oven must not be used since no homogeneous heat distribution is possible near the door.
3. Safe Zone is depicted in Green
4. Stagger placement of the rings to avoid shadowing of rings from heating elements.

5. Pressing

Press oven warm-up:

Before placing rings in your pressing oven, make sure the pressing oven has been warmed up. Some pressing ovens including our Vario Series include a warm-up cycle. It is also advisable to have an idle temperature of 700oC for pressing. This will help maintain the needed chamber environment and shorten program start time. If you have a lower idle temperature, let the oven set at the entry temperature 5-10 minutes before loading a ring into the oven. During consecutive pressing, make sure the oven has decreased to the start temperature before loading a ring.

Figure 11: Display VP300.e

Loading the ring:

To ensure a smooth transition of ring to press oven, place tweezers, disposable plunger (black dot face up) and ingot (print side up) next to the burnout oven. Note: do not pre-heat the plunger or ingot.

Figure 12: Concept Press ceramic, plunger and tong

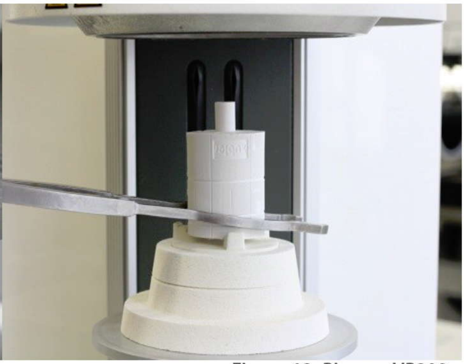


Figure 13: Ring on VP300.e

Once all processes are checked, burnout completed and the press oven ready, remove the ring from the burnout oven and quickly place the ingot (print side up) and disposable plunger (black dot up) into the ring, then quickly load the ring into the press oven making sure to place it on the platform carefully. If not placed correctly in the pressing oven, even the slightest tilt can cause displacement, cracking or internal chamber damage.

Important points to observe during the pressing process:

- Always warm up the press oven before pressing.
- The process time of loading the ring and taking it from the burnout oven to the press oven and starting the program should be under 30 seconds. Otherwise the investment ring may cool down too much and result in a faulty press.
- Do not use 100g rings when there are long distances between the burnout oven and press oven.
- Do not pre-heat (burnout) ceramic ingot or disposable plunger.
- Use press tray and fitted insert for pressing. Do not use ceramic tray.
- Insert ingot into the ring with the print facing up
- Insert the disposable plunger into the ring with the black dot facing up
- Never use a pellet larger than 3g in a 100g ring
- The ring must be placed correctly and level (not tilted) in the oven.

6. Advanced Pressing

Standard method:

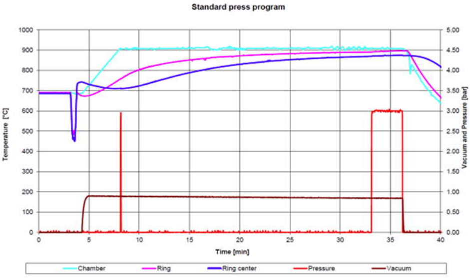


Figure 14: Standard press program

Figure 15: Result with strong reaction layer

The graph above shows temperature differentials of approximately 40oC between the temperature set in the press furnace and the inside of the ring during a standard press cycle. The high temperature difference between the ideal temperature and that of the outer regions of the ring lead to a pronounced reaction layer, especially near the outside of the ring. This pronounced reaction layer is a combination of over temperature and investment bonding, while even higher over temperature can cause surface texturing such as, “orange peel”. These effects are avoidable and the result of conventional pressing methodology. Furthermore, the requirement of solvents and special additives can be time consuming and costly.

Advanced Method:

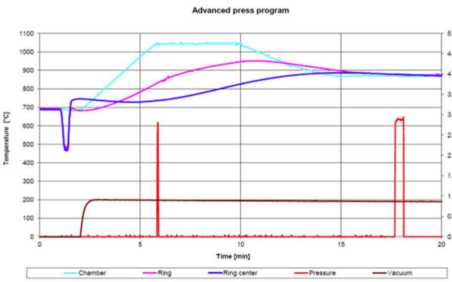


Figure 16: Advanced press program

Figure 17: Result with no reaction layer

The graph above depicts a homogenous temperature distribution during the press portion of the program, with a maximum differential of 4oC. The chamber, inside and outside of the ring are all closely matched in temperature, allowing the least possible formation of reaction layer without the use of additives. Regardless of placement, the objects in the ring will experience the ideal pressing temperature. This method also allows for a further time savings of almost 50% in overall press oven cycle time. The resulting press surface is smooth and will not require the use solvents.

7. Divesting

Before divesting, the ring must be cooled to room temperature. The investment should be removed using 50 micron glass beads and a pressure of approximately 2 bar (30PSI). Are the objects to be pressed fully divested? If not, any existing reaction layer must be carefully removed using 50 – 110 micron alumina oxide at a pressure of approximately 2 bar (30PSI). Overheating the surface of the pressed object by spot blasting must be avoided. It is recommended to place the jet nozzle at a 45° angle and a distance of about 10cm (4in.) from the pressed object while divesting. The reaction layer should be thin and very easy to remove. It is very important to pay close attention to the interior surface of the restoration, as complete removal of the reaction layer is required for a good fit. After sandblasting the pressed object should have a smooth surface and be completely free of the reaction layer. To achieve optimal results without the need for solvents, we recommend using the Advanced Press feature from Zubler.

Figure 18: Separate, ring parts

Separating the objects from the sprue and preparation for completion:

Separate the press objects from the sprue at a low speed (up to 10,000 rpm) using a diamond cutting wheel. Cool during separation with water and do not apply pressure to ensure the object does not get partially overheated. Also smooth the sprue with water cooling to avoid overheating. Take a look at the pressed object, check the margins, correct as necessary and complete as usual. Lithium disilicate can be worked with easily using suitable stones, polishers or fine diamond burs. Clean with steam prior to firing. The lithium disilicate restoration can now be completed using various techniques, such as the layering technique, illustrative technique or the combination of staining and layering technique.

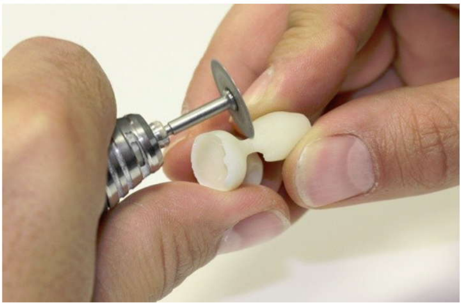


Figure 19: Separating a concept press crown

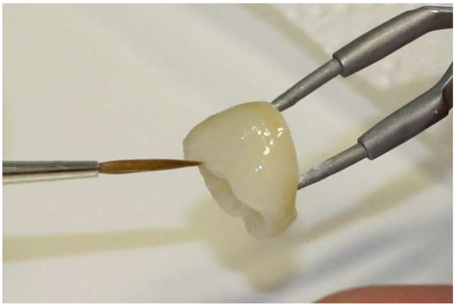
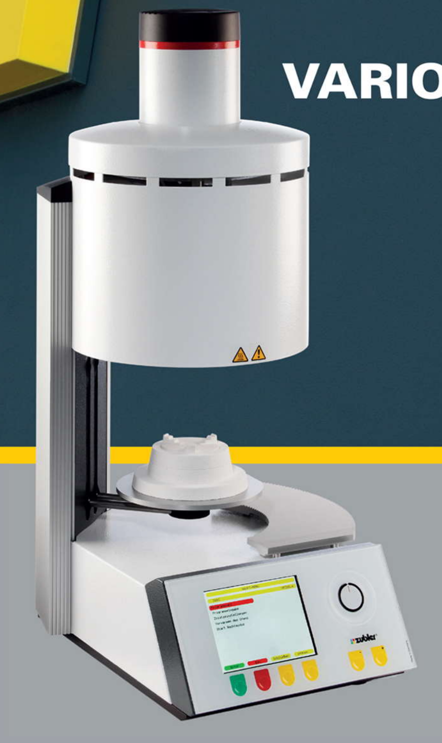


Figure 20: Glazed Concept press crown

Conclusion:

Lithium disilicate will continue to play major role in the future due to the excellent properties of this material and the continued development of sophisticated technologies used to process it. We understand that many dental laboratories struggle desperately to obtain consistently good results while working efficiently. In my opinion, this struggle is unnecessary. If we are familiar with the "rules" of correct processing, and "trained" in consistent compliance of these requirements, it is quite reasonable to expect successful and profitable handling of lithium disilicate. This report is designed to help the dental technician and motivate them to achieve this goal.

Klaus Schmidt
Translation from the original German text by Zubler USA



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