CERA-FUSION®

Introduction:

- The **Cera-Fusion Coating Procedure** outlines the step-by-step process for applying **Cera-Fusion Prime and Armor** to wax models used in ceramic shell lost-wax casting. This document provides essential safety guidelines, required equipment, coating application instructions, burnout procedures, and shell preparation for metal pouring.

- This SOP is intended for foundry workers, artists, and metal casters who require a durable, high-fidelity shell for investment casting applications. The procedure includes best practices for handling materials, monitoring temperature profiles, and troubleshooting common issues encountered during the ceramic shell process.

- For full safety data, consult the **SDS sheets** available at castables.co.nz/cera-fusion

Castables

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Instructional videos can be found on our website and our YouTube channel demonstrating how we use the Cera-Fusion ceramic shell system. These videos are intended as supplementary information to this document.

- **YouTube:** https://www.youtube.com/@castables
- **Cera-Fusion product Page:** castables.co.nz/cera-fusion

Contents

PPE (Personal Protection Equipment)

Your safety is a priority. Always wear the appropriate PPE when handling Cera-Fusion Prime and Armor.

For full safety information, view our SDS sheets at castables.co.nz/cera-fusion

Eye / Face protection: • Wear **safety goggles** and/or **face shield** to prevent splashes and accidental exposure. • Cera-Fusion Armor has a high pH and is abrasive. Contact with **eyes** may cause **permanent damage or blindness**.	
Skin protection: • Wear gloves when handling Cera-Fusion products. • Use overalls, long sleeves, and trousers to protect against splashes. • If the product contacts your skin, wash off immediately with soap and water. • Wear appropriate footwear to prevent injuries.	
Respiratory protection: • In its wet state, Cera-Fusion Prime and Armor pose minimal airborne risks. • Once dried and crushed, fine silica dust can become airborne. Use a respirator compliant with AS/NZS 1715 and AS/NZS 1716.	

Equipment:

Drying cabinet:

- Ensures consistent shell quality by drying each coat within 3–6 hours.
- The drying environment significantly impacts shell strength; prolonged drying reduces durability.
- Maintain a temperature between 30–36°C with gentle airflow to ensure even drying.
- **Note:** Commercial food warming drawers can be modified for this purpose.

Stirring stick / Paint mixer:

- A drill-mounted paint mixer is recommended for proper slurry mixing.
- Alternatively, a stirring stick may be used.

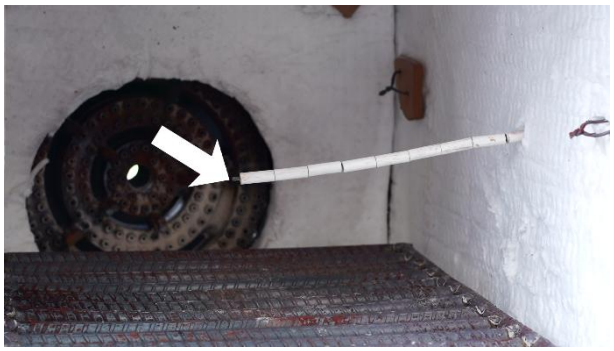
Furnace / De-waxing station:

- Essential for burnout and pre-heating ceramic shells before metal pouring.

- **Recommended Features:**
  - **Insulation:** Enhances temperature control and reduces cold spots.
  - **Multiple Burners:** Ensures even heating; single-burner systems may cause shell cracking.
  - **Temperature Probe:** Monitors internal furnace temperature, crucial for de-waxing and burnout processes.

(our LPG burner furnace)

(multiple burners)



(temperature probe)

Moisture meter:

• Use a contact moisture meter (e.g., MESTEK WM710A) to confirm dryness before applying additional coats. • Apply the next coat when the meter reads below 30.	

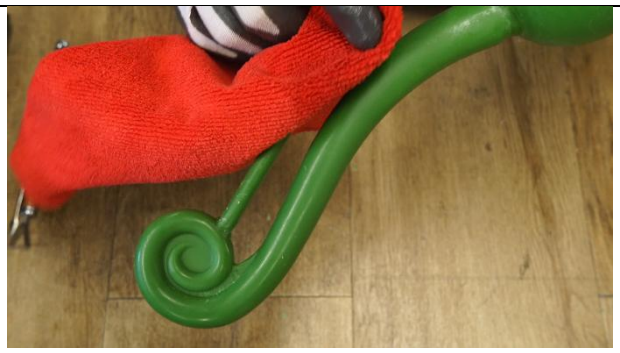
Other hardware/tools:

- **Hot air gun:** Used to melt wax cups before furnace burnout.
- **Fine bristle brush:** Buffs the initial Prime coat into the wax model.
- **Spoon/Jug:** Scoops and pours slurry for large models.
- **Sealed plastic container:** Prevents silica sand contamination.
- **Microfiber towel:** Cleans wax models before applying Cera-Fusion Prime.

How to apply Prime and Armor to a wax model:

Step 1: Cleaning the wax model

- Wipe the model using a **microfiber towel** dampened with **wax & grease remover**, isopropyl alcohol, or methylated spirits.
- Removes dust, dirt, and contaminants for optimal adhesion.



Step 2: Mixing ***Prime***

- **Stir** the ***Cera-Fusion Prime*** slurry thoroughly before application.
- **Avoid** excessive mixing, which can trap air bubbles.
- If bubbles form, allow them to dissipate before proceeding.

Step 3: Applying the initial ***Prime*** coat

- Use a **soft bristle brush** to apply a **thin** layer of Prime.
- **Buff** the coat into the surface to capture fine details.

Info: *The purpose of this initial thin coat is to capture the finest details by buffing the product into all surface features which produces a smooth surface finish for high-quality casting.*

(applying the initial thin coat with a brush)

(completed initial thin coat)

Step 4: Drying initial coat

- Allow to dry in a **30–36°C drying cabinet** for approximately **30 minutes**.
- The thin coat will dry **very quickly** (normally within **30mins**) to a powder-like finish.

Do not dry:

- In direct sunlight
- Using strong airflow
- In cold or high humidity conditions

Step 5: Applying Additional ***Prime*** Coats

- **Mix *Cera-Fusion Prime*** again before each application.
- Dip or pour the slurry **over** the wax model.
- Allow excess slurry to **drip off** (30–60 seconds) **before** dusting with silica sand.
- Repeat drying process for **3 hours** before proceeding.

Info: *Do not soak/leave the model in the slurry. Doing so may cause the initial thin coat to rehydrate and fall off the model. Ideally the entire coat should be applied within 1~2mins*

(Pour-over method)

(Dip method)

Step 6: Allow the excess to drip off

- Allow excess slurry to **drip off** (30–60 seconds) **before** dusting with silica sand.

Info: *Once the drips have slowed to roughly 1 drip per second, the coat is ready for sand application in the next step*

Step 7: Apply sand to wet ***Prime*** coat

- **Immediately** cover the wet ***Prime*** coat by dusting pure silica sand over the model.
- **Do not** force or throw sand into the slurry.
- Scoop up a handful of sand. Position your hand about 200mm above the model and let the sand run between your fingers to coat the wet slurry.
- Apply enough sand **until** the surface loses its **wet appearance** and no more sand adheres to the coat.

(dusting sand over wet slurry coat)

(apply enough sand until the coat has lost its wet glossy appearance)

Step 8: Drying the ***Prime*** Coat

- Place the coated model into a drying cabinet between **30~36°c** for approximately **3hrs or until dry**.

Info: *We recommend using a contact moisture meter to check each coat is sufficiently dry before applying the next coat.*

Step 9: Mixing *Armor*

- **Mix** the *Cera-Fusion Armor* slurry thoroughly **before** application.
- **Avoid** excessive mixing, which can trap air bubbles.
- If bubbles form, allow them to dissipate before proceeding.

Info: *Over time there will be a small amount of clear liquid rise to the surface. This must be thoroughly mixed prior to application.*

Step 10: Applying *Armor*

- **Dip** the wax model into *Cera-Fusion Armor* (or if the wax model is larger than the container, pour the slurry over the wax model).

- Allow the **excess** slurry to **run off** until there is no more dripping (normally about **20~40secs**)

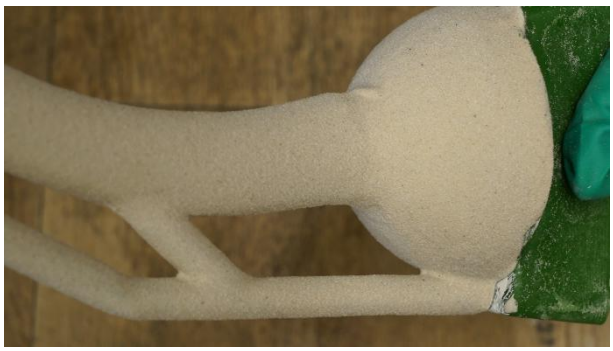
Info: *Once the drips have slowed to roughly 1 drip per second, the coat is ready for sand application in the next step.*

Do not *soak/leave the model in the slurry. Doing so may cause the previous coat to absorb excess liquid and weaken the previous coat. Ideally the entire coat should be applied within 1~2mins*

Step 11: Apply sand to the wet *Armor* coat

- **Immediately** cover the wet slurry coat by dusting pure silica sand over the model.
- **Do not** force or throw sand into the slurry.
- Instead, scoop up a handful of sand. Position your hand about 200mm above the model and let the sand run between your fingers to coat the wet slurry.
- Apply enough sand until the surface loses its wet appearance and no more sand adheres to the coat.

(applying sand to wet coat)



(apply enough sand until the coat has lost its wet glossy appearance)

Step 12: Drying the *Armor* Coat

- **Place** the coated model into a drying cabinet between **30~36°c** for approximately **3~6hrs or until dry**.

Do not dry:

- In direct sunlight
- Using strong airflow
- In cold or high humidity conditions

(placing the model inside the drying cabinet)

(checking if the shell is dry using a moisture meter before applying subsequent coats)

Step 13: Repeat to apply additional *Armor* coats

- Repeat **steps 9~12** for each coat.
- Apply a total of **8 coats** (up to **11 coats** for larger models).
- Final shell thickness should be **6–7mm**.

Info: *For large or heavy wax models, a total of 11 coats of* ***Armor*** *maybe applied to add additional strength. However, this may prolong the burnout time during dewaxing due to the increase wall thickness of the shell.*

Summary of the coating application:

1. Fine coat of ***Cera-Fusion Prime*** buffed into surface with a brush
2. Dip/Pour model with ***Cera-Fusion Prime*** with sand application
3. Dip/Pour model with ***Cera-Fusion Armor*** with sand application
4. Dip/Pour model with ***Cera-Fusion Armor*** with sand application
5. Dip/Pour model with ***Cera-Fusion Armor*** with sand application
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7. Dip/Pour model with ***Cera-Fusion Armor*** with sand application
8. Dip/Pour model with ***Cera-Fusion Armor*** with sand application
9. Dip/Pour model with ***Cera-Fusion Armor*** with sand application
10. Dip/Pour model with ***Cera-Fusion Armor*** with sand application

Temperature monitoring during burnout:

Use a **K-type temperature probe** rated for **at least 1000°C** *(we prefer to use a k-type probe rated for up to 1300°c)*. The location of the probe is important. Place the probe near the ceramic shell inside the furnace.	 (probe placed near the shell)  (temperature monitored during burnout)

Burnout *(Dewaxing the ceramic shell)**:***

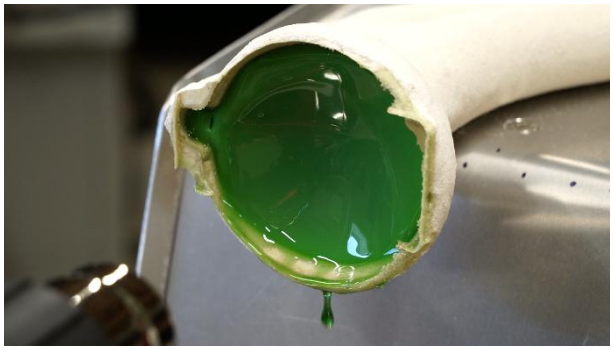
Step 1: Remove wax cup

- When using a solid wax cup, ideally the cup should be melted out of the shell using a hot air gun before de-waxing in a furnace.

- This is because a solid wax cup is a large body of wax which may take longer to melt relative to the wax above the cup. If the wax above the cup melts first, it will expand with enough force to sometimes crack the shell.

Info: ***Do not*** *use LPG/Gas burners for this step. This is because they are too hot and may thermally shock and result in cracking the shell.*

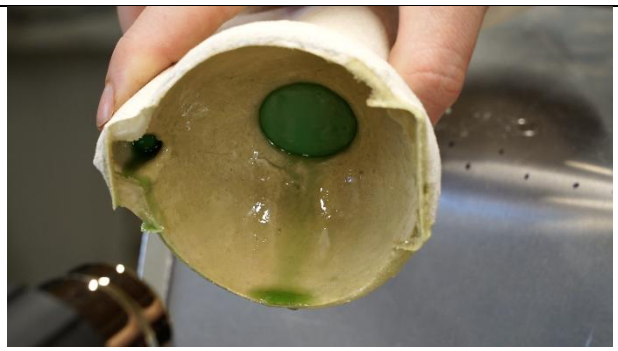
(getting ready to melt wax cup using a hot air gun)



(melting wax cup)

Step 2: Shell ready for the furnace

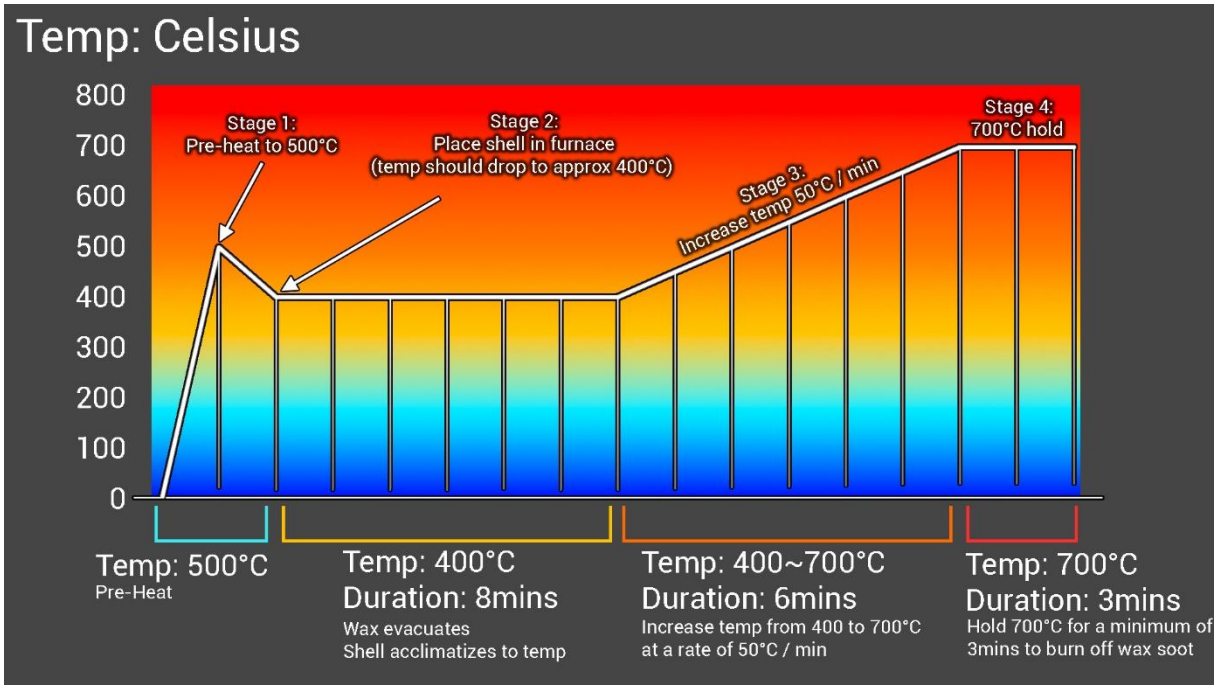
After melting the cup from the ceramic shell, the ceramic shell is ready for the de-waxing in a furnace.



(wax cup completely melted out)

Burnout temperature profile:

Burning the remaining wax out of the shell requires following a temperature profile provided below. There are 4 stages of the wax burn-out process. Each stage has temperatures to target over time.



Stage 1: Pre-Heat

- Pre-heat the furnace to **500°C** before inserting the shell.

Info: *Pre-heating the furnace ensures that the outer layer of wax begins melting sooner. If the entire body of wax is slowly heated, the wax can stay as a solid and expand resulting in a cracked shell before the wax has melted into a liquid.*

Stage 2: Wax evacuation

- Insert the shell and hold **400°C** for **8 minutes** to allow wax drainage.

- If the wax model is particularly large, the duration of this stage maybe extended as necessary.

Info: *During this stage, the wax evacuates the shell (typically within the first 2~4mins) then the remaining time allows the shell to acclimate to the furnace temperature.*

Stage 3: Temperature increase

- Raise the temperature at **+50°C per minute** to reach **700°C**

Info: *700°c is an important target to achieve for 2 primary benefits. The first benefit is the shell becomes harder and stronger at this temperature. The second benefit is at this temperature, the carbon soot left behind from the wax will burn off.*
Carbon deposits left inside the shell can act as a fuel source when hot molten metal is pored into the shell. This can cause porosity in the metal. Or in a worst-case scenario, can explode the shell and eject hot metal.

Stage 4: Peak hold

- Maintain **700°C for 3 minutes** to burn off carbon residues - (thicker or larger shells may require a longer time to ensure the carbon deposits are burned off).

Info: *This stage allows time for the temperature to soak through the shell and burn off the carbon on the inside of the shell.*

Post-Burnout procedure:

• After completing the burnout and shutting off the burners, it is recommended to leave the furnace doors/vents closed to allow the shell time to gradually cool down to ambient temperature (typically 1~2hrs). Once the shell is below 100°c, it is safe to remove it from the furnace. **Info:** *We know you must be excited to see your finished ceramic shell, however, opening the door of your furnace too soon can cause a rapid drop in temperature and may cause thermal shock to the shell.*	

Inspecting the shell post-burnout:

- The shell should be inspected for defects or cracks.

Info: *Minor cracks can be reinforced using a small amount of Armor to repair the affected area (follow the same principal of applying slurry, then sand, and drying as before).*

(inspecting shell post-burnout)

Preparing the shell for metal pouring:

Choosing a suitable container:

- To support the shell during metal pouring, place the shell inside a stainless or mild steel container.

Info: *Ideally, the container should be slightly larger than the shell. If the container is much larger than the shell, pre-heating the shell may take much longer in the next steps. Try to limit the amount of sand between the container and shell to no more than 50mm.*

(shell being inserted into a stainless container)

Supporting the shell in the container:

- Sand is carefully poured around the shell.

- Avoid contaminating the interior of the shell with sand while pouring. If necessary, use a cover to prevent sand/debris from entering the shell.

Info: *General purpose sand is okay to use. However, the sand should be dry (using moist sand will slow pre-heating and may also weaken the shell). If your sand requires drying, place the sand in an oven tray in the furnace for 30mins or until dry*

- Leave a small gap between the top of the cup and the sand. This reduces the chances of sand/debris falling inside the shell and contaminating the metal during pouring.

- Place a lid over the shell to prevent debris from contaminating the shell.

- At this stage the shell is prepared and ready for pre-heating.

Pre-heating before metal pouring:

- Pre-heating the shell prior to receiving metal is **vital** to ensure the metal completely fills the shell. Pre-heating also prevents the shell from thermal shock when receiving hot molten metal.

- The container with the shell can be placed inside the furnace (no need to pre-heat the furnace this time) and the burners turned on.

- The sand used to pack the shell inside the container is a poor heat conductor. We recommend pre-heating at 700°c for at least 30minutes to allow enough time for the heat to make its way through the container, sand, and ultimately heat the ceramic shell inside.

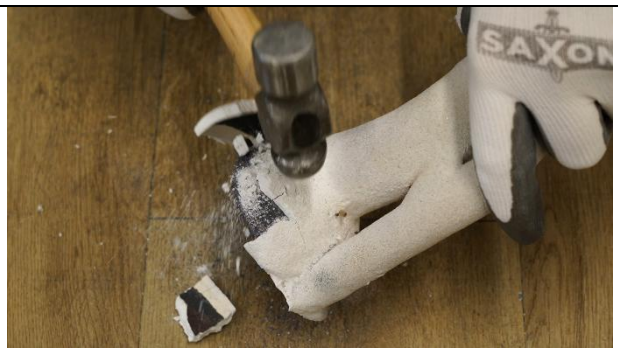
(placing the container with the shell inside the furnace for pre-heating prior to metal pouring)

Metal Pour and shell removal:

- Once the shell is pre-heated, it is ready to receive metal.

- After cooling for several hours, the shell is removed from the container.

- Provided the shell was adequately pre-heated, the shell should be in good condition. Minor cracks may appear after cooling; however, these often occur long after the metal has solidified.

• Break the shell by using a hammer. Care should be used to avoid striking the metal underneath. • Alternatively, a pneumatic air chisel is very effective at removing the shell. **Tip:** *To keep dust to a minimum, the shell can be soaked in a bucket of water for 20mins and then broken*.	

• Any residue of shell or metal oxide can be removed using a wire brush. • Alternatively, a sandblaster makes quick work of cleaning the surface of the casting.	 (wire brushing)  (cleaned metal casting)

FAQ's:

General Questions:

1. What is Cera-Fusion, and how is it used?

Cera-Fusion is a ceramic slurry system designed for lost-wax casting. It consists of Cera-Fusion Prime (for initial coats) and Cera-Fusion Armor (for structural coats). These are applied in layers to a wax model to create a durable ceramic shell that can withstand the casting process.

2. What metal types can be cast using Cera-Fusion shells?

Cera-Fusion shells can be used for casting various metals, including bronze, aluminum, zinc, brass, cast iron, and other alloys with a similar melting point.

3. How many layers of coating should be applied?

A minimum of 10 layers is required for standard wax models, while larger or heavier models may need up to 13 layers for additional strength.

4. What is the purpose of using silica sand in the coating process?

Silica sand is applied to each wet slurry coat to enhance mechanical strength and heat resistance. This prevents cracking during burnout and ensures the shell can handle molten metal.

Application & Drying:

5. How long should each coat dry before applying the next?

Each coat should be dried for approximately 3-6 hours at 30-36°C in a drying cabinet. Use a moisture meter to confirm dryness (reading below 30) before applying the next coat.

6. Can I use alternative drying methods if I don't have a drying cabinet?

While a drying cabinet ensures consistent quality, you can use a low-humidity, temperature-controlled room with gentle airflow to dry coats. However, improper drying may weaken the shell.

Do not dry:

- In direct sunlight
- Using strong airflow
- In cold or high humidity conditions

7. What causes air bubbles in the slurry, and how can I prevent them?

Air bubbles form due to over-mixing or improper stirring. Avoid vigorous mixing and allow bubbles to settle before applying the slurry.

Burnout & Shell Preparation:

8. What temperature should the furnace be set to for burnout?

The burnout process follows a staged temperature profile:

1. Pre-heat furnace to 500°C before inserting the shell.
2. Hold at 400°C for 8 minutes to allow wax evacuation.
3. Gradually increase to 700°C at 50°C per minute.
4. Hold at 700°C for 3 minutes to remove carbon residues.

9. Why do shells sometimes crack during burnout?

Cracking can occur due to rapid temperature changes, uneven heating, or moisture retention in the shell. Ensure shells are fully dry, pre-heat the furnace, and use multiple burners for even heat distribution.

10. What happens if carbon deposits remain inside the shell?

Residual carbon can ignite upon metal pouring, leading to porosity in the metal or shell explosions. Holding the shell at 700°C ensures all carbon is burned off.

Metal Pouring & Shell Removal:

11. Why is pre-heating the shell important before pouring metal?

Pre-heating prevents thermal shock and ensures molten metal fills the shell completely without solidifying prematurely. Shells should be heated to 700°C for at least 30 minutes before pouring.

12. What is the best way to remove the ceramic shell after metal has cooled?

Use a hammer or pneumatic air chisel to break off the shell. To reduce dust, soak the shell in water for 20 minutes before removal.

13. How can I clean the casting after shell removal?

Use a wire brush or a sandblaster to remove any residual ceramic or metal oxides from the casting.