

KTH PrototypeCenter - Casting Instructions

This document is read-only for the general public, but can be edited by Prototype Staff
If you have any suggested edits, please email prototype@kth.se

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This is currently for staff and assistants only - please contact us about using it!

Key Pointers

- clean up your mess!
- practice while everything is cold

FAQ

- How long does the process take?
 - ☒ 17 hours after your part is printed
- What metals can I use?
 - ☒ the maximum melting temperature the kiln can go is 1100C

Resources

Formlabs manual: <https://formlabs.com/media/upload/Recommended-Burnout-Process.pdf>

Investment powder: [link](#)

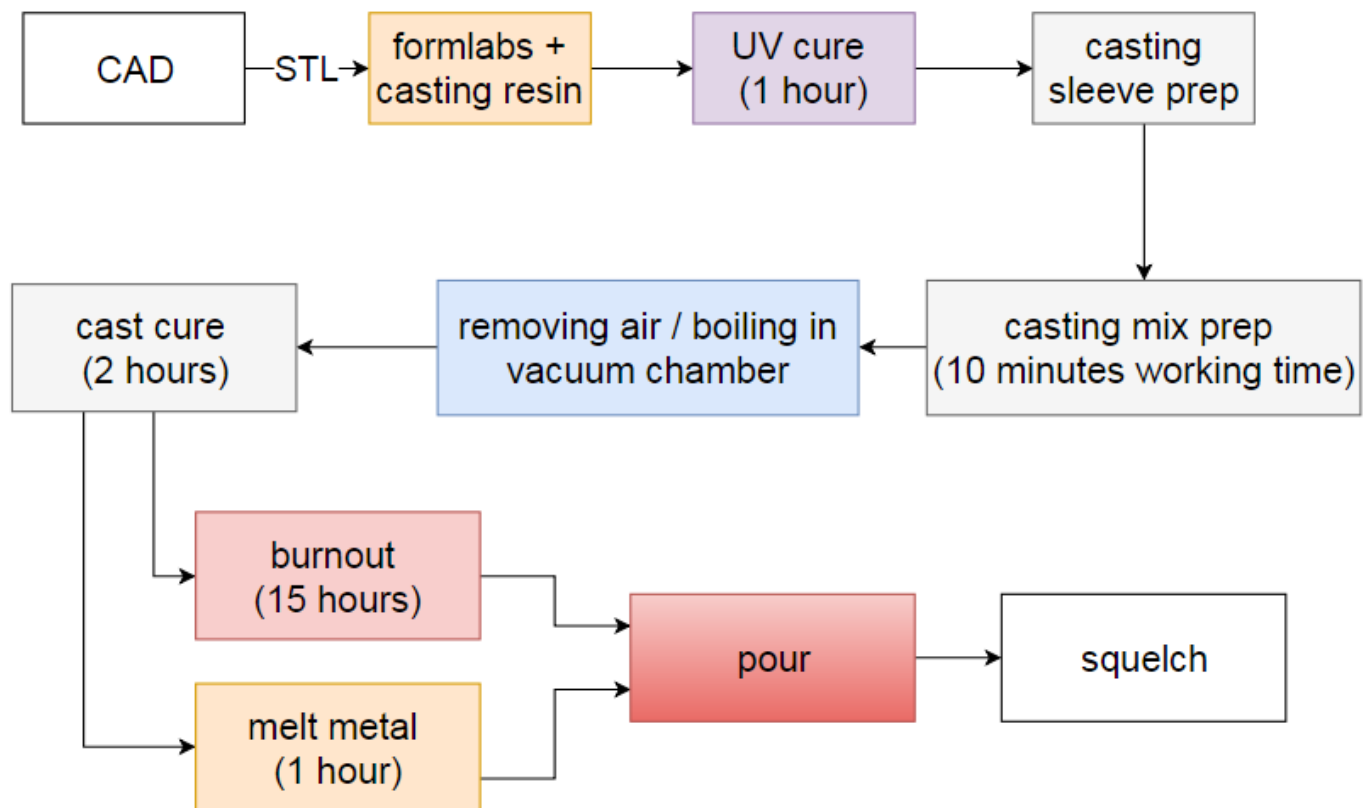
Manual

Introduction

The general way investment casting is as follows:

1. a part (the positive) is 3D printed using casting resin on the formlabs
2. the part is then cured in UV light
3. the part is then put in a casting cup and filled with a plaster
4. the plaster and cup are then put in an oven and the plastic positive melts away
5. metal is then melted and poured into the plaster (the plastic gone, leaving a negative mold)
6. the entire cup, plaster, and cooling metal is thrown in a bucket of water, the plaster dissolves in the water, your part is left

The casting procedure takes over 17 hours - and that is after your print is ready. I suggest you visit the tools you will be using and those which are described in this manual before designing. The general workflow is as follows:



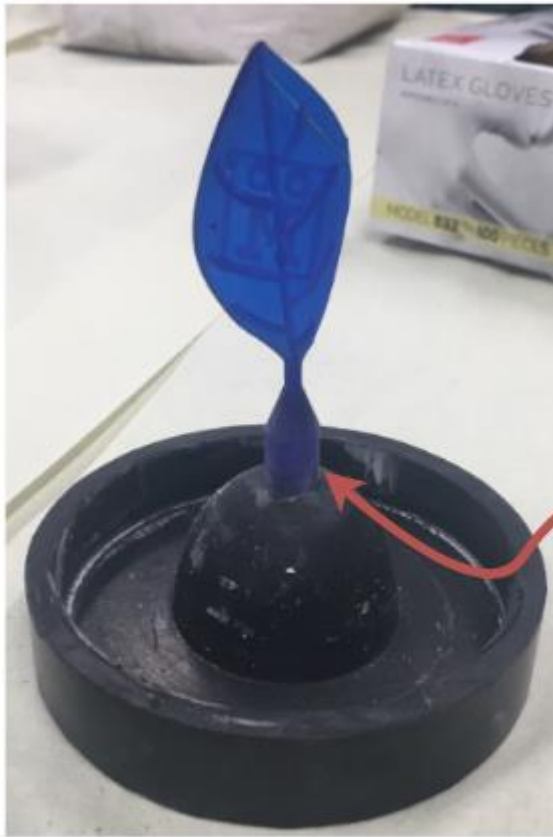
It is highly suggested that you go to the pour section of this manual and practice the pour as if everything was ready before you try it when it is hot. This makes sure your tools are in place!

Constraints on 3D printed part

The formlabs prints a casting material. The limit on the volume of the print depends on how much melted metal the casting kiln can hold (stone cup). The height and width of part depend on the sleeve you cast the part into. The limits are summarized below:

Design	limit
max volume of printed part	~190 cm ²
max height of printed part (including sprue)	~80 mm
max width of printed part	~70 mm
sprue diameter	~9.5 mm
min. sprue height	~10mm

The part should include a sprue, which feeds the melted metal. The sprue initially is set in a rubber cap. The hole for the sprue is 10mm in diameter.



sprue
integrated
into print

Once the part is printed, it should be fully cured in the UV bath - which should take around an hour.

The oven can accept two cups at a time, so two prints can be done at once!

Setup

Here is a typical setup of the cast. It is suggested to work not when Tomas needs the room. Work with another person for safety reasons. Always leave the place better than you found it.

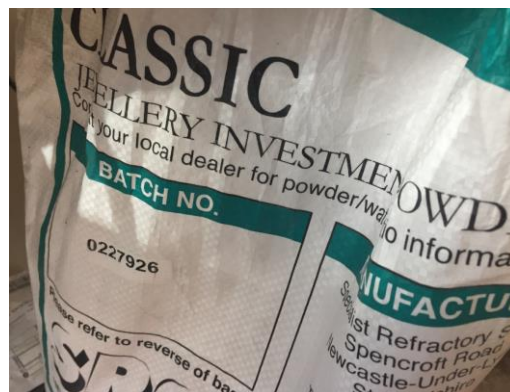


Preparing the cast

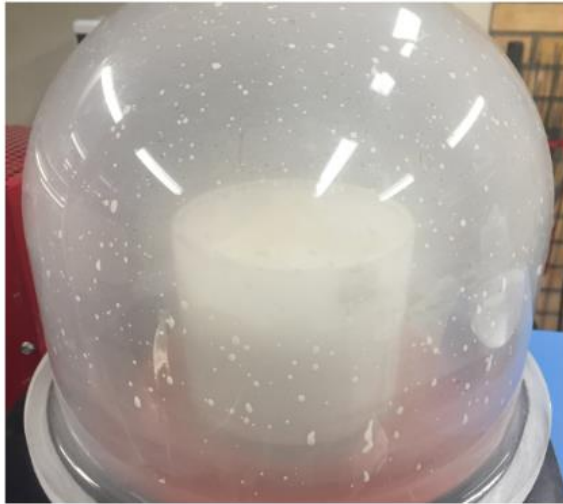
Here you can see the print in rubber cap and installed on the sleeve (metal). The sleeve is wrapped in tape. The duct/silver tape is used to contain the investment mix while it dries. Make sure this is ready before you do anything.



The investment mix is a powder mixed with water and follows a 38% ratio (weight or volume? which one) and should resemble slightly viscous pancake mix when done right.



If the mix is too light - when you remove the air bubbles it will make a mess like this. If it is too heavy, the the air won't escape and it won't fill the cast well. The working time is approximately 10 minutes.

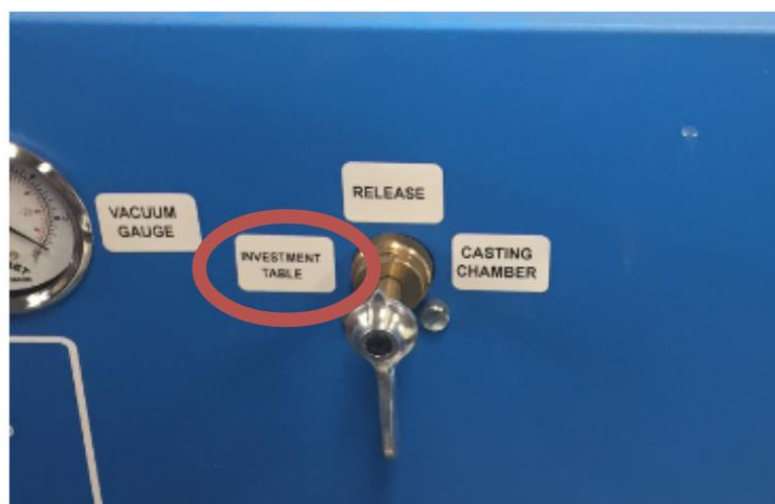


too viscous
of mix
results in
mess!

Mix in the clear mixing assembly. The clear cup and the metal sleeve have the same volume so if your part reaches the very top of the sleeve as it did for mine, then you need to make a full clear cup of mix. There is a vacuum port on the lid which is not currently used. Mix until consistent (a minute or so) and then place the clear assembly with the lid off in the vacuum chamber to remove the air. Feel free to use other tools to mix.



Set the pump to investment and make sure the bell cover is sealed. Turn on for approx 3 minutes or until the mix boils for some time. Some mixes never stopped boiling for me so boil just until it starts drying I suppose. From the image below, the handle should be turned counter clockwise. This removes the air bubbles from the mix so that there are no errors in the cast.



If required, you can add more mix, quickly stir, and then vacuum again but this should only be required if you need a completely full cast for a long part.

Fill the casting sleeve with mix, making sure to shake the sleeve as you go. It doesn't hurt to throw the sleeve with mix back in the vacuum chamber for another minute if the mix is still not too cured.



Hopefully your positive 3D printed part is covered. Full drying time for the cast is 2 hours.



Here you can see after the part was dried, the rubber cap as removed. The part is now ready for the oven.

The oven

It is highly suggested that you go to the pour section of this manual and practice the pour as if everything was ready before you try it when it is hot. This makes sure your tools are in place! After you practice you should then start the oven.

The oven has a preset program for a burn out that works. It didn't align with what I read, but it works. The motivated reader is encouraged to solve the mystery or start their own program.



Insert your sleeve with the sprue down and rubber cap off. Don't forget to remove the duct tape. You simply turn on the oven select program 1 or rD1 and press start. The plastic melts down and burns out. It does not make a mess. It takes 15 hours for the burn out. Since melting the metal usually takes about an hour, you should be there about 13 hours later for prep. Verify that the oven is warming up.



Turn switch on, press enter for program 1. When running the oven should flash between the temperature and the time.

The metal to melt

It is important to time the end of the burnout with the melting of the metal. Find the volume requirements of your model on your CAD program and find an appropriate volume of metal and a bit more if needed. The metal needs to fit in this stone cup. The cup needs to be in the heater while it warms. Find the melting of your metal.



It took me about 1 hour to melt the brass in this example. You can start the heater and then go find the metal and add the metal in the end, it does not need to be in the stone cup the entire time.



For this you just turn the machine on, and select the temperature you want using the up and down arrow. You may have to press U or P once. The machine should start flashing the goal temperature and the current temperature.

While it is warming up - safety!

Once everything is nearly ready - put on protection. There are gloves on the cart and you should wear glasses that shield from the brightness of the melted metal and hot stone. Production has better equipment. Here is a good example without the gloves from production.



The pour

Once the metal is melted and the burnout is done. You are ready to pour. The cast needs to be at the 700C or so temperature to cast. Do not pour melted metal into a cold cast.

1. find all the tools you need
2. find a bucket and fill it with water. this is where you will squelch the cast once done.



- 3.
4. rotate the stone cup so that the pouring lip is in a smart orientation. it will be bright, make sure to have good eye protection.
5. open the oven where the cast is, take out the cast and tenaciously grab it with the tongs. You will be flipping it upside down into the casting location



6. either set it on a metal table and flip it over, or flip it over in the air and place it carefully in the casting location



- 7.
8. grab the stone with the lip of the stone cup in a smart place



9.
10. pour carefully into the cast



- 11.

I let it sit for a minute or so in the casting chamber and then set it in a bucket of water. Give it some time to cool (5 minutes or so).

Your part then can be cleaned. I suggest the wirewheel but to each their own. I believe production has a media blasting kit if needed!

Good luck and be safe!

(edit this manual as needed)