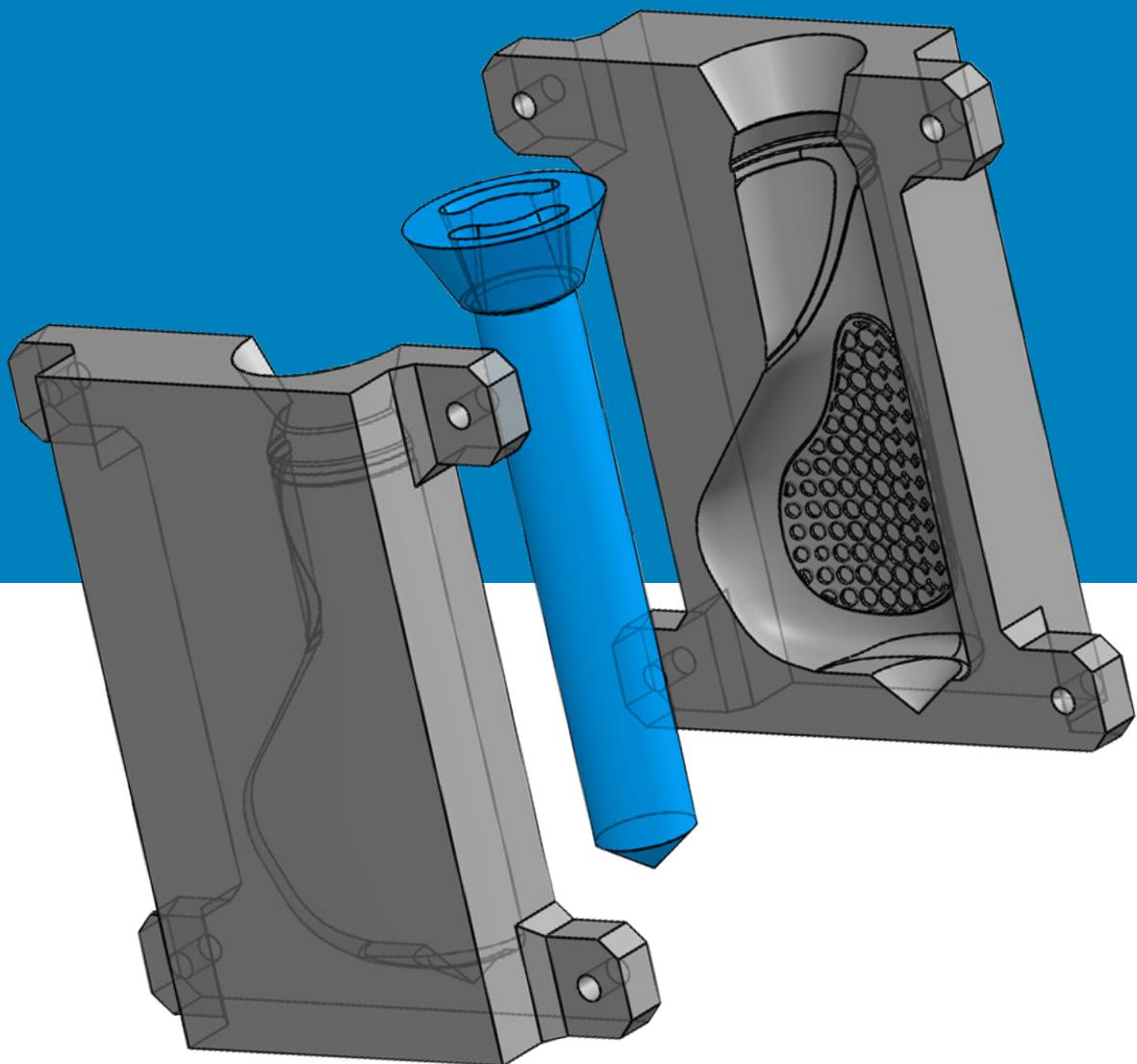


zortrax

3D PRINTING IN MODERN MOLD MAKING.

Cutting Time & Costs in Short Run Production.



Index

| | |
|---|----|
| 1. The Introduction | 3 |
| 2. Raw Facts and Figures | 4 |
| 3. FDM Patterns for Modern Mold Making | 5 |
| Preliminary Ergonomics | 5 |
| Slicing in CAD | 7 |
| Printing and Testing | 8 |
| Creating the Model | 9 |
| Designing the Mold | 9 |
| 3D printing | 10 |
| Preparing the Mold | 11 |
| Preparing the Material | 11 |
| Pouring the Rubber | 12 |
| The Finished Cast | 13 |
| List of Materials | 13 |
| 4. Utilizing 3D printing in RTV Tooling | 14 |
| Designing Models in CAD Program | 15 |
| Designing the Mold Box | 15 |
| Exporting the File to the Slicing Program | 16 |
| Preparation for Printing | 16 |
| Printing the Elements | 17 |
| Post-Processing | 18 |
| Preparing the Mold Box | 20 |
| Preparing the Solution | 21 |
| Making the Form | 21 |
| Creating the Cast | 23 |
| Preparing and Injecting the Resin | 24 |
| Opening the Form | 25 |
| Removing Gates and Vents | 25 |
| The Finished Object | 25 |
| List of Materials | 26 |
| 5. The Conclusions | 27 |



3D PRINTING IN MODERN MOLD MAKING.

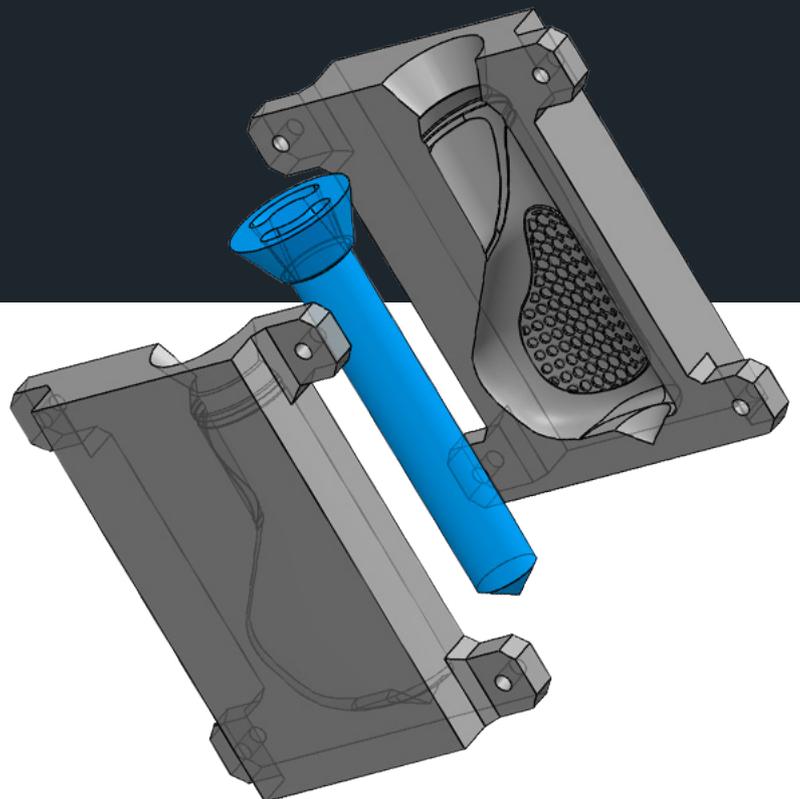
Cutting Time & Costs in Short Run Production.

Some of us already know that a 3D printer is in fact a multi use tool that cuts costs, labor and additionally gives lots of joy to many engineers and individuals. But there are other ways to use this device to boost the efficiency of an old and popular industrial technique known as RTV molding. Our tutorial simply shows that anyone who fancies doing molds can use the help of Zortrax Ecosystem just for the sake of greater convenience and saving time and materials.

Read this tutorial to see how by changing only a few steps of a common molding technique you can make such great difference in effects of your work.

The basic role of a 3D printer this time boils down to creating the master pattern, form and the mold box. However, there is a lot more in store. Thanks to incorporating 3D printing the process is faster and easier as you can have customized models within just a couple of hours - perfect if you need to test multiple versions before you create an end-use part.

You can get the necessary tools with one print, without the need to look for a special container or building a frame by yourself. This also makes 3D printing an ideal solution for ergonomics testing which, as we all know, engages a lot of time and trials of various shapes, angles and patterns.



Raw facts and figures:

- » Replacing machined pattern with 3D printed one makes the mold-making process shrink by 40%.
- » High printing speed allows fast iteration - get instant results of your work and show it to your stakeholders, even at the earliest stage of your work.
- » With 3D printing each variation could be created in 1-2 hours and alterations are made on the spot. One can easily change the pattern in Z-Suite and recreate/remaster the previous design.
- » Accuracy of printing guarantees the proper quality of the castings and complexity of details which gives the molds properties close to end-use parts. It allows creating complex master patterns which would be difficult or impossible to create by other means.
- » Preparation of the master pattern is quicker and much cheaper compared to traditional methods - time is reduced from 50% up to 80% while costs are lowered by 40%-75%.
- » The transition from the design stage to the test stage takes 1 day only and each stage of product design takes days instead of weeks thanks to the use of 3D print.
- » Having a 3D printer makes the whole process less complicated as you don't have to delegate creating the master pattern or other elements to other companies.



FDM Patterns for Rubber Mold Making

Combining rubber molding and 3D printing creates the opportunity that facilitates ergonomics testing and enables adding remarks and making instant changes in the model. It also gives the designers the chance to control and modify the looks of the product at every phase of production, starting from the designing stage. Evaluating the results is simplified and within the reach of the designer who finally provides the most satisfying effects by taking into the consideration recent opinions on the model and adjusting the product by making it highly functional and convenient for using.

Step 1 | Preliminary Ergonomics

3D print the cylinder to determine the ergonomics. The inner diameter of your model should match the diameter of bike's arm.

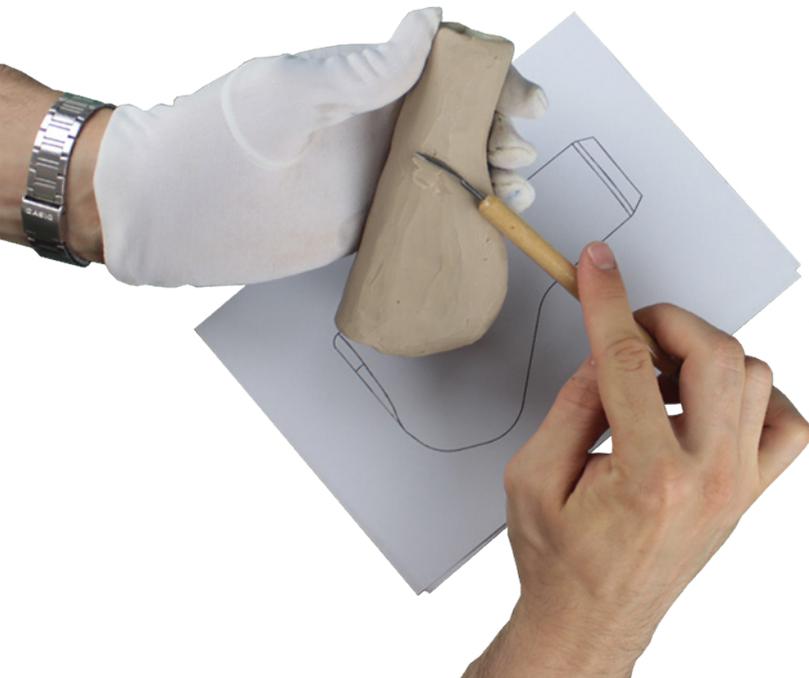


TIP | Use Z-ULTRAT and light infill option to 3D print the cylinder. Make sure that the diameter is correct.



Step 2 | Preliminary Ergonomics

Use technical plasticine to determine the shape of the grip. Focus on ergonomics – match the grip with the anatomy to maximize the contact surface between the grip and the hand.



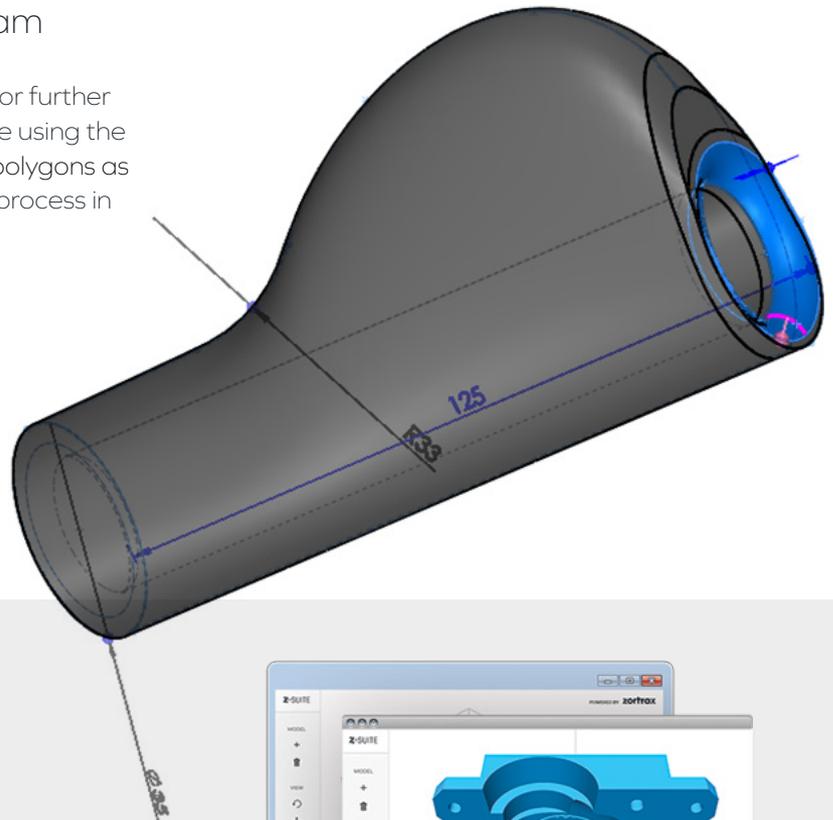
Step 3 | Preliminary Ergonomics

Transfer your model to a CAD program. You can also use a 3D scanner but with simple shape as this one, a caliper and a protactor should be enough.



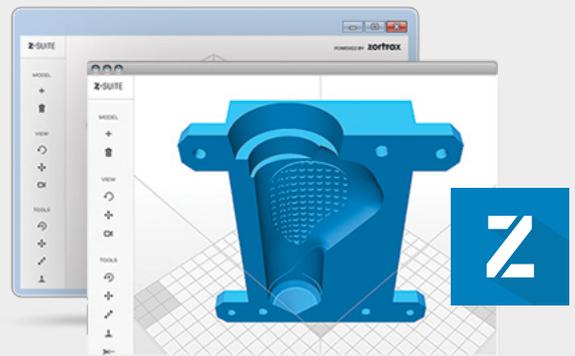
Step 4 | Models in CAD Program

Design the grip using any CAD program. For further processing it is important to map the shape using the simplest techniques and adding as many polygons as possible. It should be easy to recreate the process in subsequent stages.



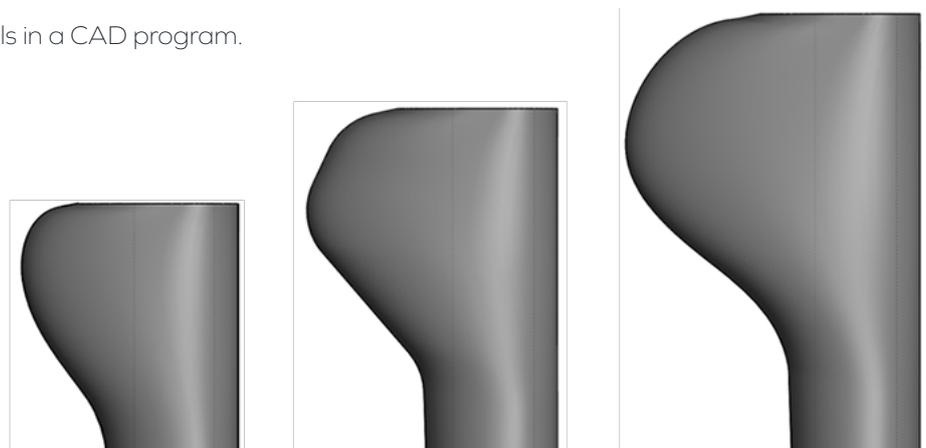
Z-Suite Software

Z-Suite slicing software is compatible with most 3D modeling programs and operates with all universal formats such as .stl, .obj and .dxf.



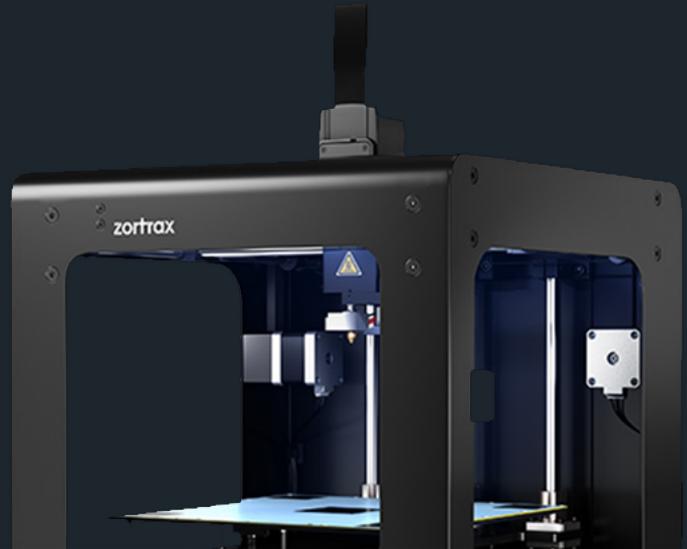
Step 5 | Models in CAD Program.

Create several various grip models in a CAD program.



Step 6 | Print & Test

3D print each model using Z-ULTRAT, layer thickness 0.14, Shell option. Printing time for the grip is approx. 2 hours. Z-ULTRAT works perfectly with Shell option, it is durable enough to test its ergonomics on a bigger test group.



Step 7 | Print & Test

The initial model was based on a small test group. To make the trial conclusive, it is necessary to create several variations of the same ergonomics and test it on the bigger test group.



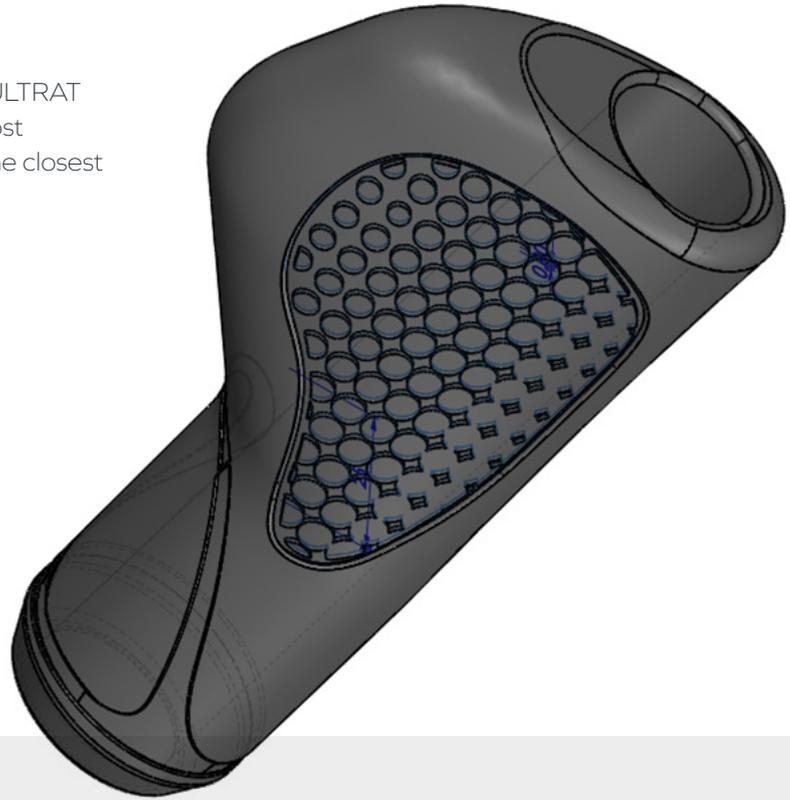
Step 8 | Print & Test

3D print more variants and test it until you obtain the desired effect.



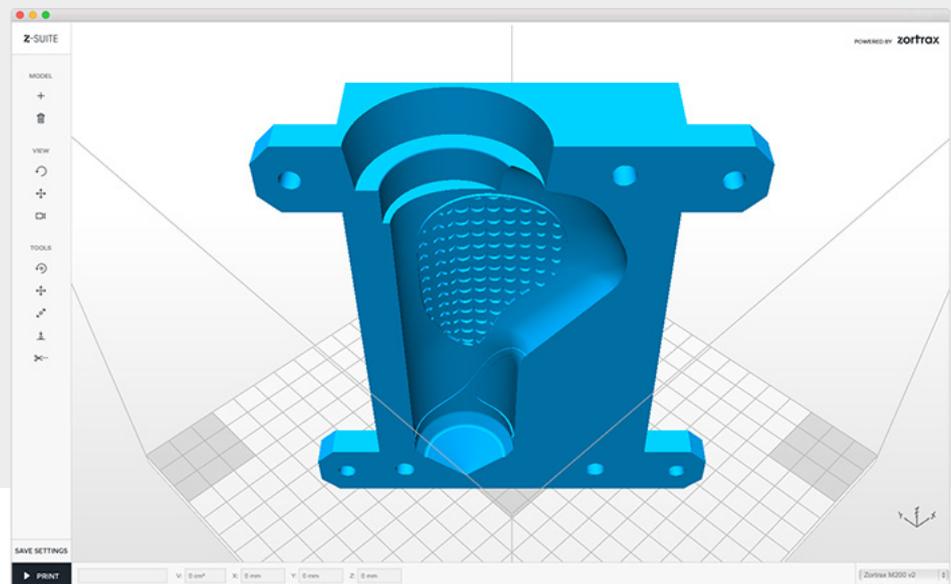
Step 9 | Create a Model

Create a model with patterns. Print it with Z-ULTRAT and 0.09mm layer thickness to obtain the most detailed effect. It is important to test model the closest to the target product.



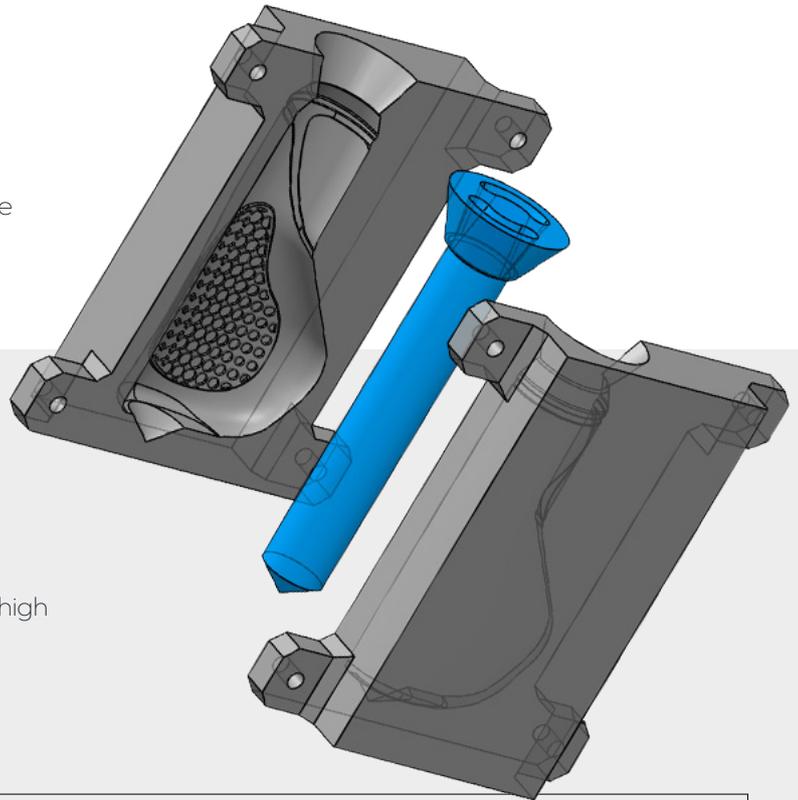
Step 10 | Design the Mold

Prepare the negative of the model for the mold.



Step 11 | Design the Mold

Our mold is a two-piece cast with the shaft. The size of the mold was enlarged to compensate material shrinkage.

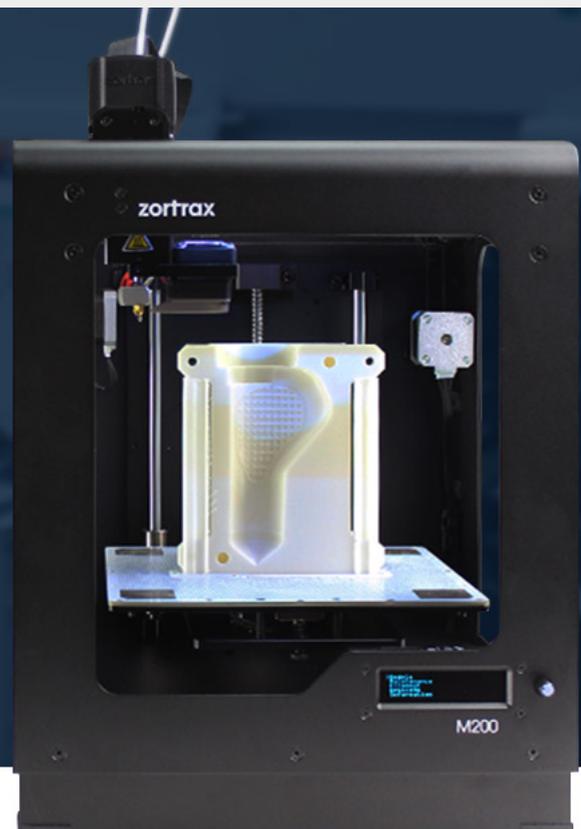


Step 12 | Print the Mold

Use Z-ULTRAT material to 3D print the mold. Z-ULTRAT has the highest softening point which allows pouring the material with temperature as high as 110°C.



Z-ULTRAT Perfect for mold making with high softening point and endurance.



Step 13 | Prepare the Mold

Prepare the mold for casting. Put the shaft inside the mold and screw both covers together.



Step 14 | Prepare the Material

Add the hardener in a volume ratio of 33%. Use a glass heat-resistant container.



Warning!

Do not exceed the temperature of 150°C to avoid degradation of the mixture manifested by a change in color and appearance of air bubbles. To avoid that perform short cycles of heating.

Step 15 | Prepare the Material

Place the mixture in the microwave. The mixture should be heated and then mixed couple of times. With this amount of material we've performed 5x50 sec cycles – 3 x 1200W and 2 x 700W.

Repeat this process until the mixture is clear.

Step 16 | Prepare the Material

Measure and mix the rubber and the pigment.



Step 17 | Pouring the Rubber

Slowly pour the rubber over the pattern. Allow to cure for 30 minutes.

Warning!

Remember to heat the mixture up when the mold is ready. If the mixture gets cold, you will have to heat the mixture once again!



Step 18 | Finished Cast

Unscrew and open the mold. Gently remove the model. Pull out the shaft and trim off sprues. Your model is ready for further testing.



List of materials

- » Z-ULTRAT
- » Rubber
- » Plasticine
- » Modeling spatulas
- » Heatproof container



Utilizing 3D Printing in RTV Tooling.

RTV (Room Temperature Vulcanization) molding is a popular technique applicable to various fields ranging from automotive, electronics and industrial in its broadest sense. By offering such benefits as low-cost and time-effective production it contributes to efficient labor and boosted performance. And first of all, it allows to obtain quick results of your work and equips users with a powerful tool for fast prototyping and iteration. In this tutorial our

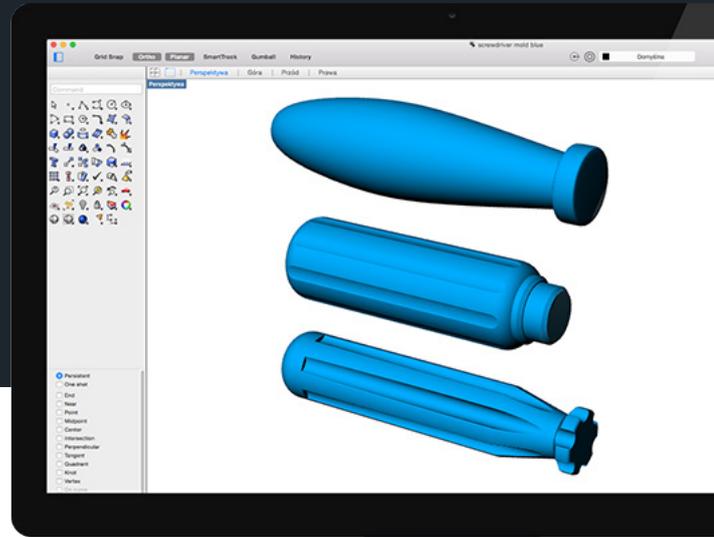
designers succeeded in proving how this technique was improved resulting in easier and faster tooling which example can be seen below.

RTV molding is safe as it doesn't involve using high temperatures or hazardous substances. What is more, the process itself doesn't require complicated or expensive supply base. The basic list of materials can be found in the practical section of this tutorial.



Step 1 | Models in CAD Program

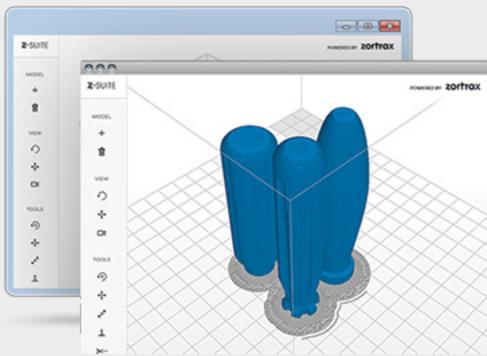
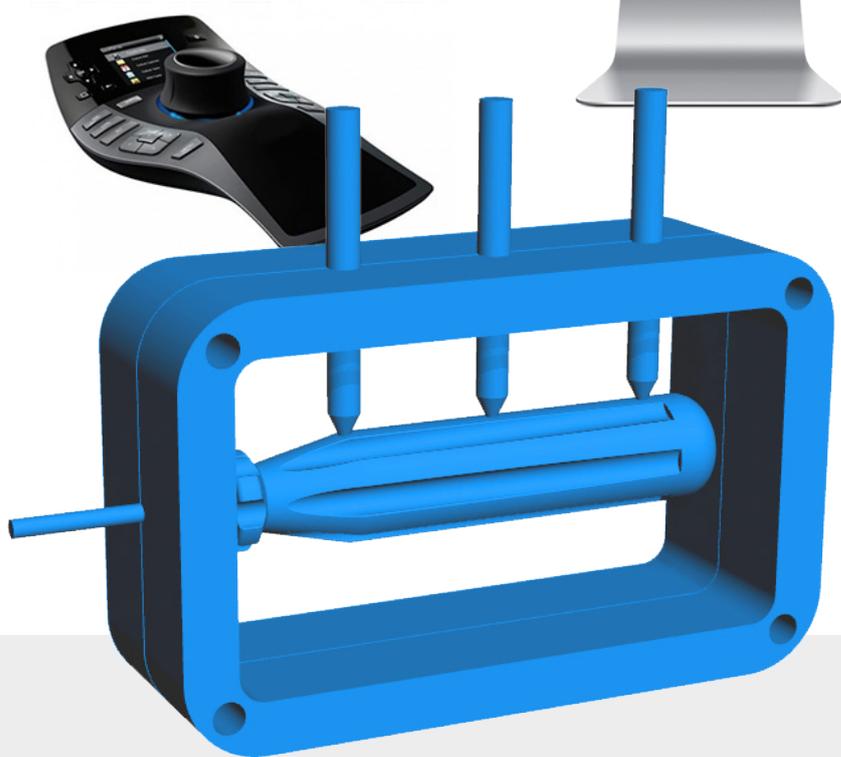
In this case our designers decided to use Rhino to create the master pattern of a screwdriver handle which will be printed and used to prepare the silicone form.



TIP | There are various CAD programs that can help design the model precisely and prepare it for printing. Choose the one according to your own preferences.

Step 2 | Design the Mold Box

The next step is to design the mold box, master pattern, gates and vents.

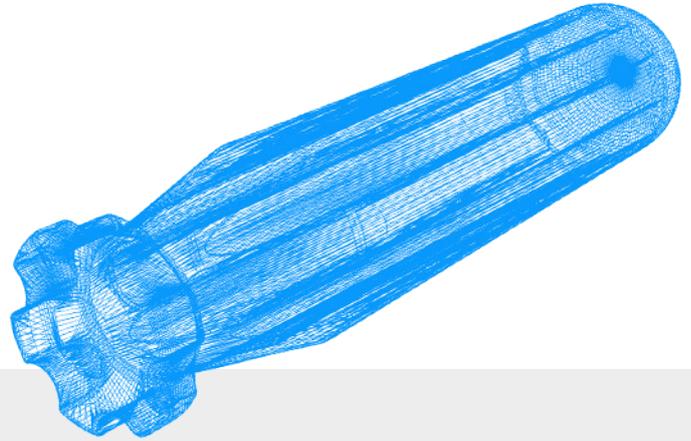


Z-Suite Software

A selection of features to modify the dimensions and the final look of your object can be found in our dedicated software. Find more about Zortrax Ecosystem and its components.

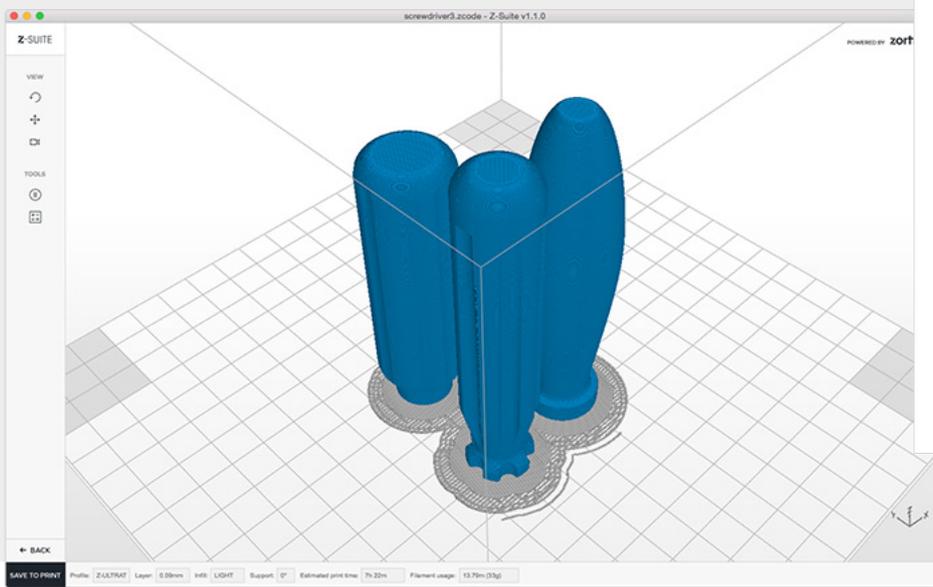
Step 3 | Export to Z-Suite

While exporting your model make sure it has got many polygons - it will ensure that your model is extra smooth and doesn't require much post-processing.



Step 4 | Prepare to Print

Setting the proper parameters in Z-Suite.



PRINTING SETTINGS ?

PROFILE: Z-ULTRAT LAYER THICKNESS: 0,09 mm

SPEED: NORMAL HIGH

INFILL:


FULL


SOLID


MEDIUM


LIGHT

SUPPORT:

ANGLE: 0° NOT RECOMMENDED

PRINT COOLING:

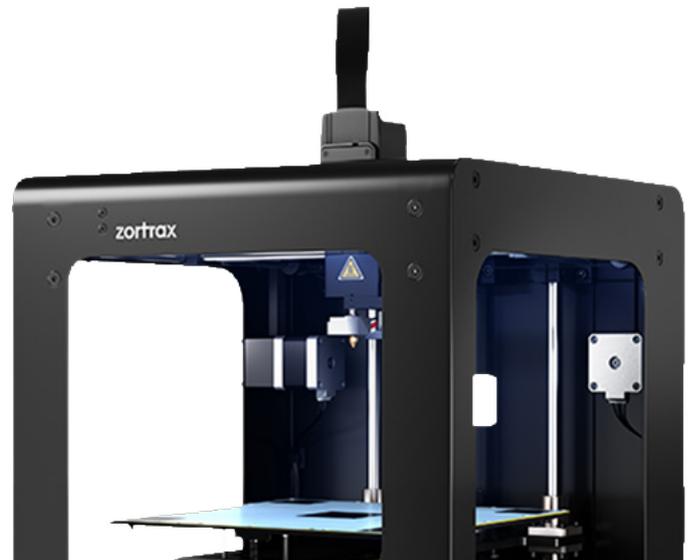
FAN SPEED: 100% AUTO

PREPARE TO PRINT ADVENCE SETTINGS

TIP | In case of this model full infill is not necessary. It is better to use light infill to reduce the amount of used filament and save money. Choosing 0,09 mm layer thickness guarantees the smoothest surface. The maximum fan speed minimizes possible deformations.

Step 5 | Printing the Elements

Our designers recommend using Z-ULTRAT to print all the elements as it is the most resistant and durable material which guarantees that your form will keep its shape and resist the molding process.



Zortrax M200 printer | It is a proper device to obtain high quality prints that will allow to create precise, smooth patterns.

Step 6 | Printing the Elements

Remove the support (if necessary).



Step 7 | Printing the Elements

The finished model can be presented to the stakeholders. You can start testing its ergonomics and check the proper dimensions.

Step 8 | Post-Processing

Use degreaser to remove all the debris and prepare the model for sandblasting.

DEGREASER | Its main purpose is to remove the residue of grease and dirt to ensure better adhesion of primer and spackling paste.



Step 9 | Post-Processing

Cover the surface of printed models with spray primer.

TIP | Use the printing chamber to make the process odor-free and to avoid spreading the substance around the model.



Step 10 | Post-Processing

Post-processing of the master pattern.
At this stage various options are available:

SAND BLASTING | A technique where sand at pressure is used to polish the surface and remove minor imperfections.

SANDING | Use sandpaper to polish your object and remove unwanted residue from it. For the best results it is advisable to gradually increase the grit of sandpaper.

GLASS BEAD BLASTING | Perfect for giving the final touch to your models. This post-processing technique allows obtaining really smooth and polished surfaces thanks to its fine abrasive.



TIP | If you decide to try various abrasive techniques, remember that sanding and sandblasting should be performed before glass bead blasting, as they are more abrasive and can leave fine scratches on the surface which can be further removed by glass beads.

Step 11 | Post-Processing

Put a thick layer of the primer over the surface of the model.

TIP | Use the printing chamber to make the process odor-free and to avoid spreading the substance around the model.



Step 12 | Post-Processing

Cover the model with spackling paste. Repeat sanding and spackling if necessary.

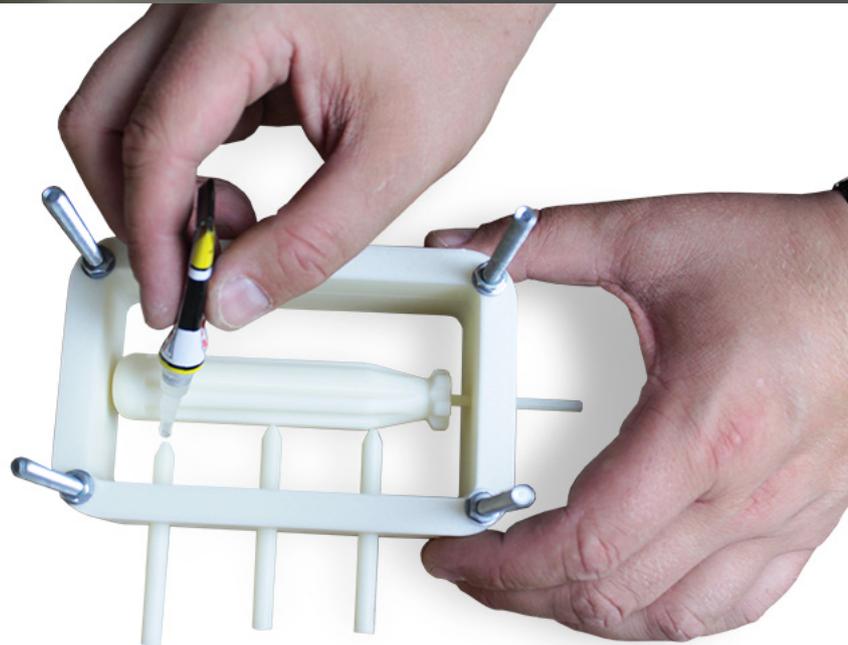
PRIMER | This substance is mainly used as a preparatory coat to enhance adhesion between surfaces.

SPACKLING PASTE | Putty is used to eliminate any holes or irregularities on a model. It is recommended to put it over the surface to prepare the print for painting, polishing or other post-processing techniques.

Step 13 | Prepare the Mold

Sticking gates and vents to the mold box.

TIP | You can design and print a mold box that already has gates and vents, but printing the parts separately allows to create more precise objects as you don't have to remove the support manually and risk damaging the smallest pieces.



Step 14 | Prepare the Solution

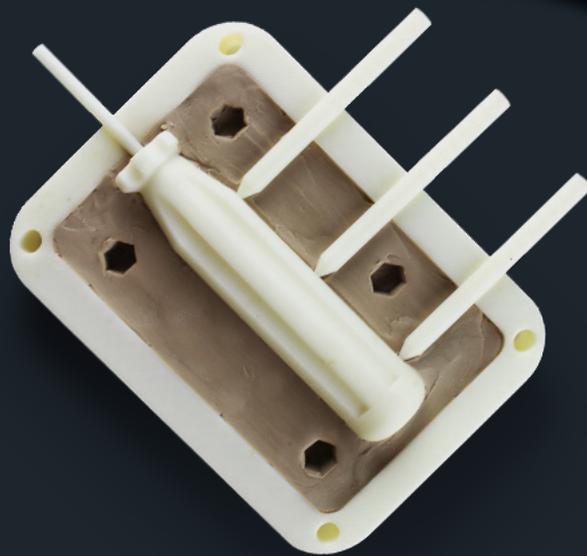
Prepare the solution by pouring catalyst and silicone into a container. Stir slowly to avoid air bubbles to appear.



Step 15 | Prepare the Form

Insert the pattern into the mold box, at this stage two options are available:

- A | Fill the lower half of your form with plasticine and cut out the locators—they will help the two halves of a pattern to line up and stay in one position. Then insert the vents and pour the liquid silicone into the pattern.



TIP | This method is advisable for very complex patterns comprising of many details.



- B | Pour the liquid silicone into the form and allow it to cure. Cut out the locators.

TIP | We decided to use this method as it is faster because you don't have to remove the plasticine from the moldbox.



Step 15 | Prepare the Form

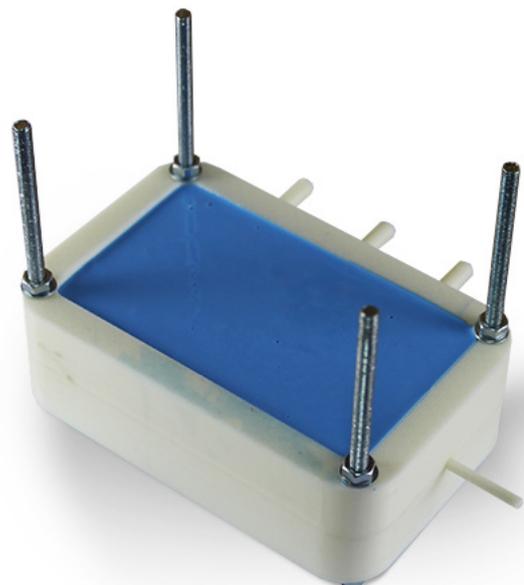
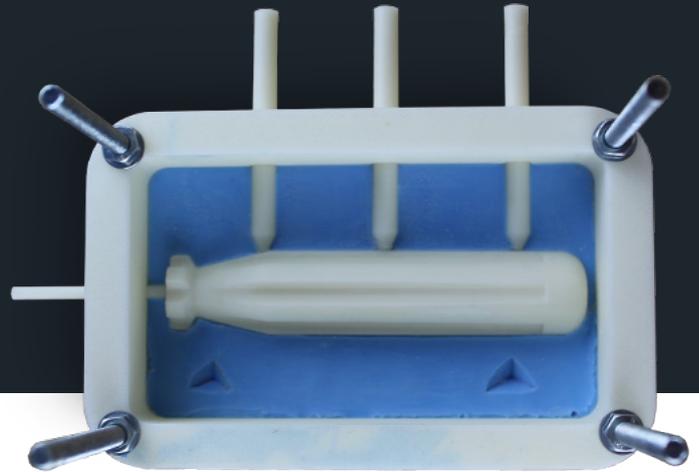
Cover the finished part with mold release to prevent sticking.



Step 16 | Prepare the Form

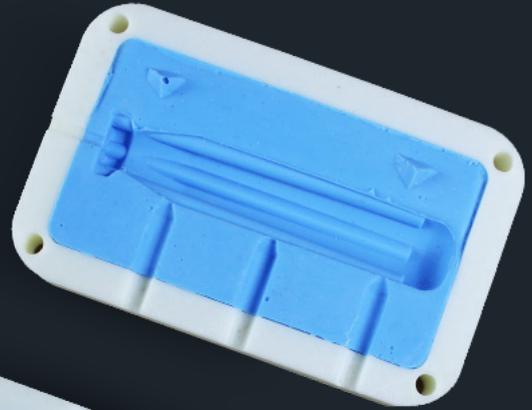
Screw two parts of the mold box together, then pour the liquid silicone rubber over it. Allow it to cure.

TIP | The liquid should be poured slowly starting from one corner of the form to avoid air bubbles.



Step 17 | Prepare the Cast

After the second part is cured we can unscrew the mold box - our pattern is ready and can be used multiple of times.



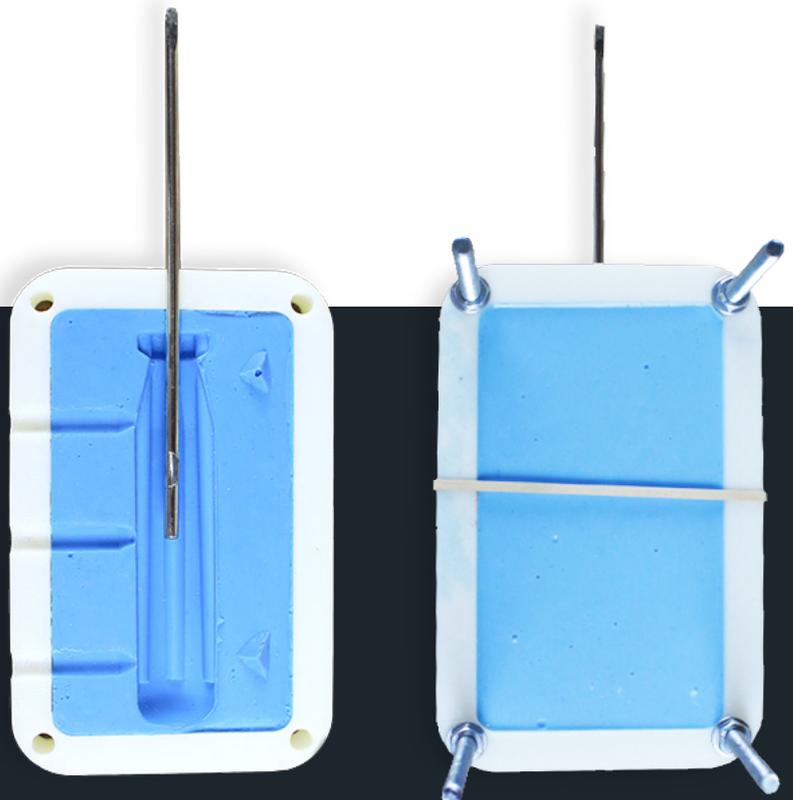
Step 18 | Prepare the Cast

Cover two surfaces of the form with mold release.



Step 19 | Prepare the Cast

Put the element which is to be molded (the metal shaft) into the pattern and screw it.



Step 20 | Prepare the Resin

Add the proper amount of polyurethane resin and mix it until you get a smooth lump-free texture. Add color to the mixture (optional).

MOLD RELEASE | A greasy substance used to prevent two surfaces from bonding.

POLYURETHANE RESIN | We recommend using polyurethane resin as it is non-hazardous, almost odor-free compared to e.g. epoxy, and has got low shrinkage level.

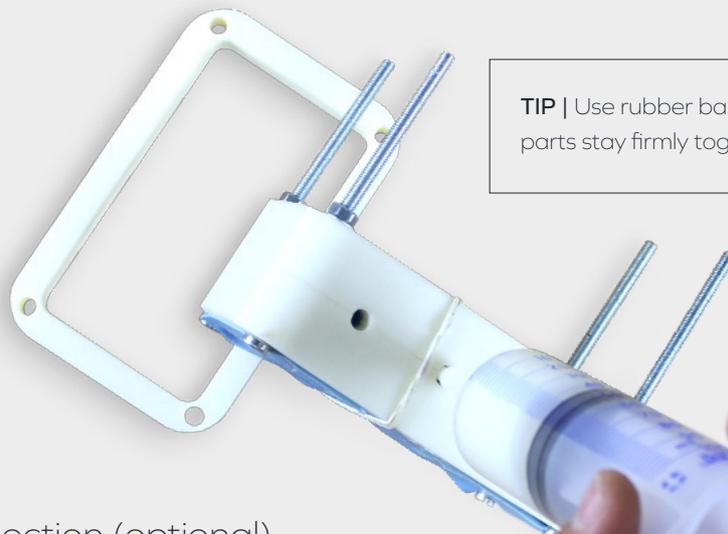
RESIN DYING | You can modify the finish look of your model by adding colors to the liquid resin.

TIP | Put the resin into a vacuum chamber to remove air bubbles.



Step 21 | Injecting the Resin

Inject the resin. Be extra careful to avoid air bubbles.



TIP | Use rubber bands to ensure that two parts stay firmly together.

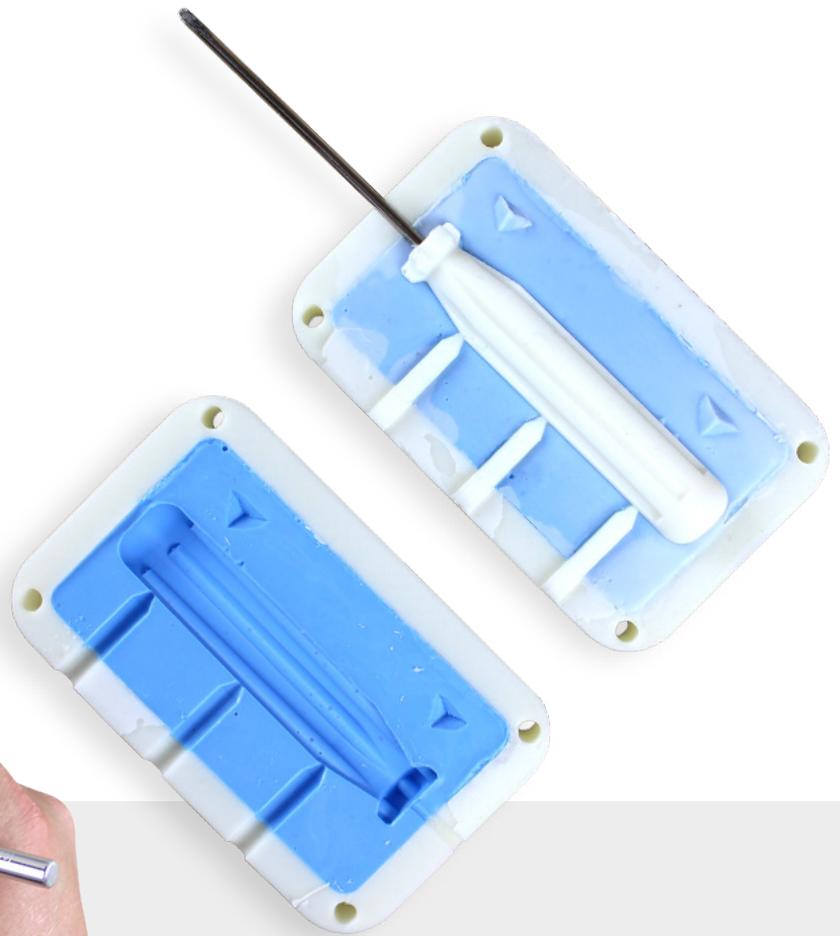
Step 22 | After Injection (optional)

Put the form into a vacuum chamber. It is a closed container connected to a vacuum pump which removes gases from its inside. By removing air from the compound we can assure that the mold is free from air bubbles which can cause defects like small holes that may damage the final model.



Step 23 | Open the Form

After opening the form the model is ready.



Step 24 | Remove gates and vents

Use a hobby knife or a scalpel to remove gates and vents.

Step 25 | The finished object.



List of materials

- » Z-ULTRAT
- » degreaser (optional)
- » spray primer
- » spacklig paste or spray (optional)
- » glue for plastics
- » silicone rubber
- » polyurethane resin
- » plasticine (optional)
- » mold release
- » screws and nuts
- » hobby knife or scalpel
- » containers
- » stirrers
- » protective gloves
- » protective glasses
- » vacuum chamber (optional)
- » cloth
- » rubber beads (optional)
- » abradant for sandblasting (optional)
- » glass beads for sandblasting (optional)
- » syringe (optional)
- » brush (optional)
- » sand paper
- » sand spreader/ sandblasting cabinet (optional)
- » painting chamber (optional)

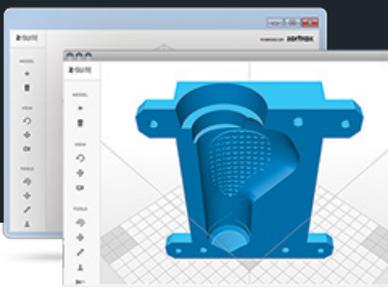


3D Printing in Present Industry

By creating these tutorials we wanted to show how Zortrax Ecosystem can both simplify and intensify your work by giving quick and high quality tangible results. By presenting new approach based on incorporating 3D printing we can freshen up the common technique and get impressive results. However, this paper is also to show the massive impact of 3D printing on today's industry, the way it prospers and adjusts to the present requirements to reach various global markets. It's not only about the time and money saved during the production process, but mainly about new possibilities for your overall business performance. Be innovative and up-to-date by using reliable solutions from additive manufacturing field.

Zortrax Ecosystem

Zortrax products are a complete package of integrated solutions – professional printers, compatible materials, and dedicated software. Thanks to this, our printers achieve high quality prints, dimensional accuracy and repeatability, while eliminating the hassle of adjusting equipment from third-party materials or software. The Zortrax Ecosystem is everything you need in one smart box.



Z-Suite software

Perfectly integrated with the machine, helps convert 3D model files and it's compatible with most of 3D design software.



Printing materials

A wide range of carefully picked colors, only quality materials, exceptional printing features.



3D printer

Zortrax M200 and Zortrax Inventure. Reliable and almost maintenance-free, working out of the box, tested by thousands of users worldwide.