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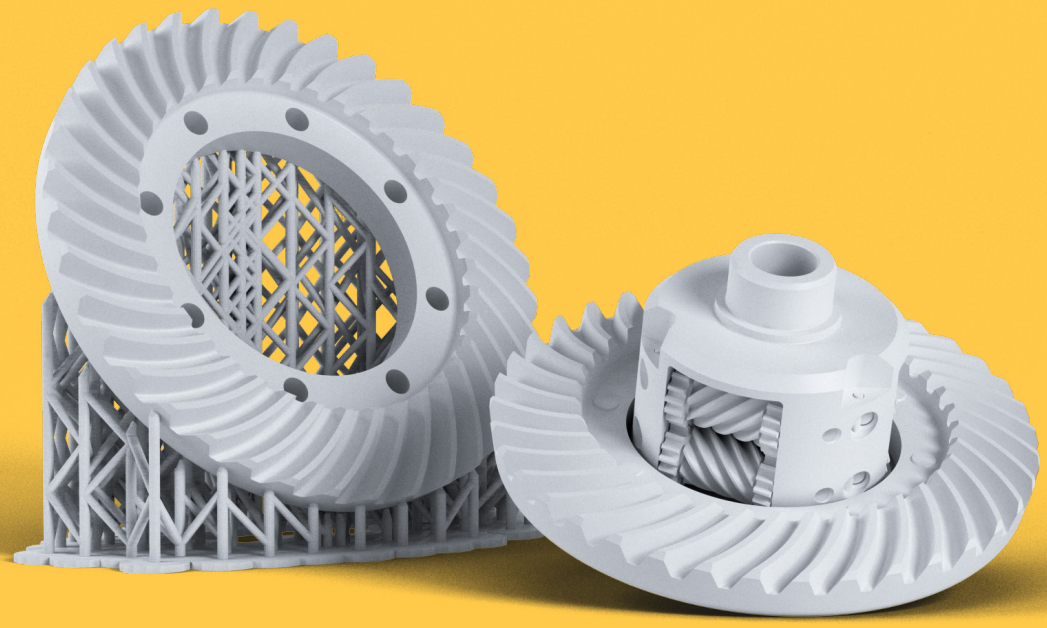
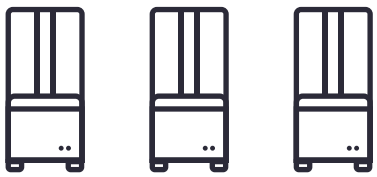
RESIN 3D PRINTING

8 examples of applications in modern industries



Introduction

about 3D printing



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The evolution of 3D printing

1984

The first 3D printer, which used the stereolithography technique, was created by Charles W. Hull. Back then it would cost you somewhere in the vicinity of $300k to purchase an SLA 3D printer.

1992

First Fused Deposition Modeling (FDM) machine is marketed and commercialized. In the coming years plastic extrusion would become the most commonly used technology.

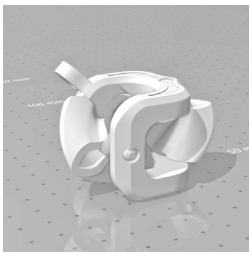
2009

Prices of 3D printers drop significantly as desktop devices and RepRap printers begin to appear, fueled by a large increase in 3D printer producers. The technology becomes viable for prosumers and cost-effective for manufacturers.

2019

Modern 3D printers are an affordable alternative for traditional forms of manufacturing by achieving fast production times, high quality results and the ability to be easily scaled up to large 3D printing networks, thus offering medium to high scale manufacturing capabilities. Such farms can make end-use products or serve as a support of traditional production lines.

How 3D printing works

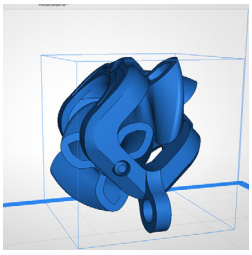


Design

The model is designed in CAD software, 3D scanned or downloaded/purchased from the web. The model must be exported to one of the file formats supported by the slicer software in use.

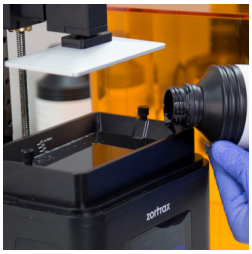
Digital pre-processing

Some models need to be optimized for 3D printing, especially when their triangle mesh is damaged. It can be done in a separate software or in a slicing program dedicated for a 3D printer.



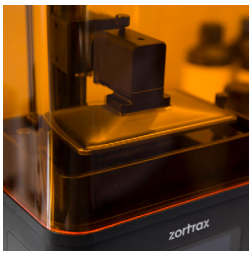
Slicing software

3D printing process is usually managed by software applications called slicers. A good slicer should be able to repair and optimize models if necessary, suggest the right settings for specific type of material, and convert the digital model into a set of instructions a 3D printer can follow to print it.



Choice of material

Depending on the technology, you will be able to choose mostly from 2 types of polymers: filaments for FDM/FFF or photopolymers for SLA/DLP/LCD. Each material requires specific printing settings to be chosen in the printer's software. You can go with default, predefined settings for the material or choose them manually.



Start printing

Already pre-processed or „sliced" models can be uploaded to a 3D printer via an SD card, a USB storage device, or through an Ethernet or Wi-Fi network, depending on the printer's connectivity options.

Managing the process

If the printers are connected to the software via Ethernet or WiFi, it's possible to manage them remotely from desktop or mobile devices.

FDM / FFF / LPD vs resin-based 3D printing

FDM / FFF / LPD 3D printers

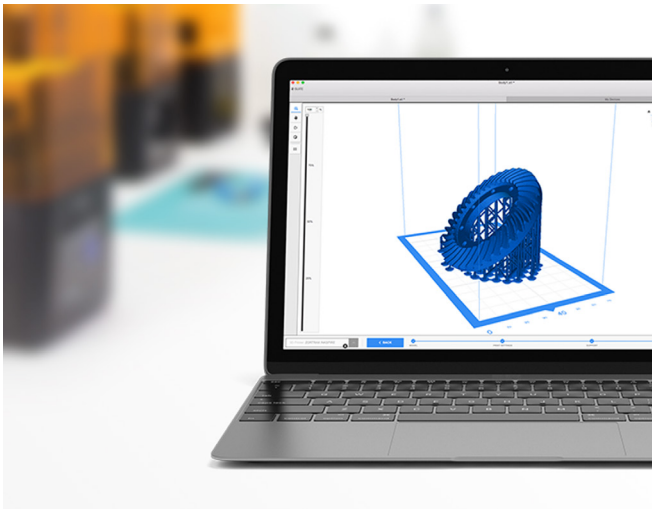
- Plastic filament based printers use material in a solid wire form.
- An FDM printer melts and then deposits the material onto the build platform which gets solidified.
- Most FDM 3D printers have a resolution of up to 90 microns.
- Sanding or vapor smoothing is often needed to achieve smoother surfaces.

Resin 3D printers

- A resin 3D printer uses photopolymer resins in a liquid form.
- Resin printers use UV light source (lasers, projectors or LED lights) to cure the liquid resins.
- Resin 3D printers usually achieve much finer layer resolution up to 50 microns.
- Excessive resin needs to be removed from the solidified model with liquid detergents like isopropyl alcohol.

Resin 3D printing is recommended for:

- Models with intricate details or a very smooth surface finish
- Creating molds for casting to facilitate mass-production
- Manufacturing multiple small prototypes in one printing session
- 3D printing of complex organic shapes
- Intricately designed 3D printed parts used in various fields of precision engineering



Why choose resin 3D printing?

Speed of operation

Curing resins achieves shorter 3D printing times than depositing melted thermoplastics.

Scalability

A large number of models on a build platform does not significantly increase the time of 3D printing since the entire layer is cured all at once.

Microscopic precision

High resolution resin 3D printing allows greater amount of detail.

No visible layering

The 3D printer cures the resin with UV light at a resolution that is tinnier than by depositing melted filament, which does not create visible layers on the model.

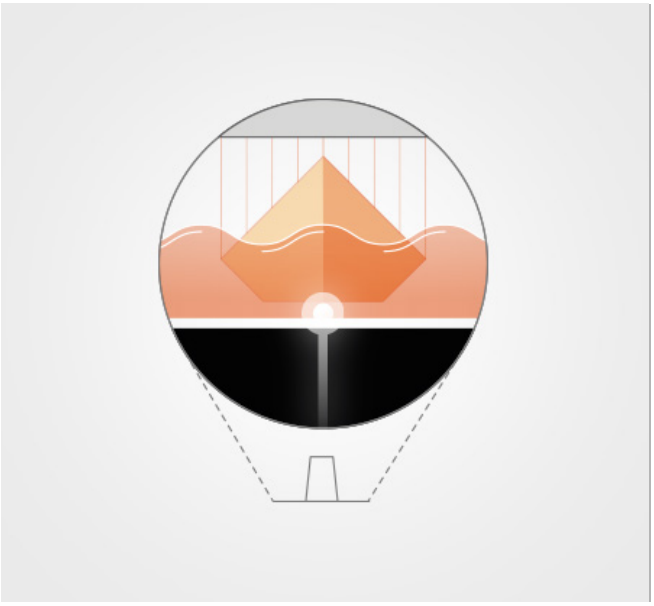
Main resin 3D printing technologies

DLP (Digital Light Processing)

The speed of operation is constant, but the precision falls as the amount of used workspace increases. Because popular DLP 3D printers are designed around digital projectors, they can work with relatively small pixel size, provided that the projected layer's image is limited to a small part of their available workspaces. But when the projected image is enlarged to fill the entire workspace, pixels grow dramatically to 70 microns or larger.

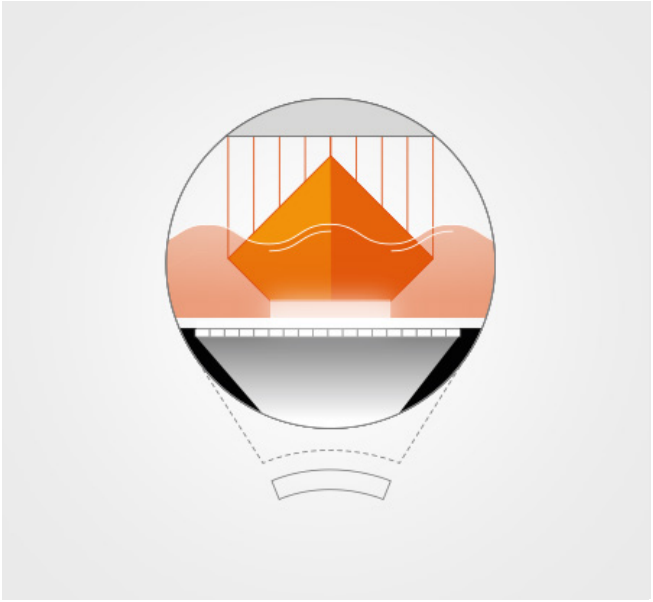
SLA (Stereolithography)

The SLA technology prints with constant and high precision. However due to its highly localized nature of polymerization approach, the process varies in speed of operation, which is in inverse proportion to the amount of workspace taken up by the model. It is so because a layer of the print is drawn with a concentrated amount of light to cure the resin in a given spot.



UV LCD (based on LCD screen)

The UV LCD technology maintains constant high speed of operation because it projects an entire layer onto the photopolymer's surface all at once, making it faster than SLA technology. It can also accurately print extremely small details barely visible to the naked human eye since each model's layer is displayed on a high-resolution LCD screen and solidified by a UV light source placed beneath.



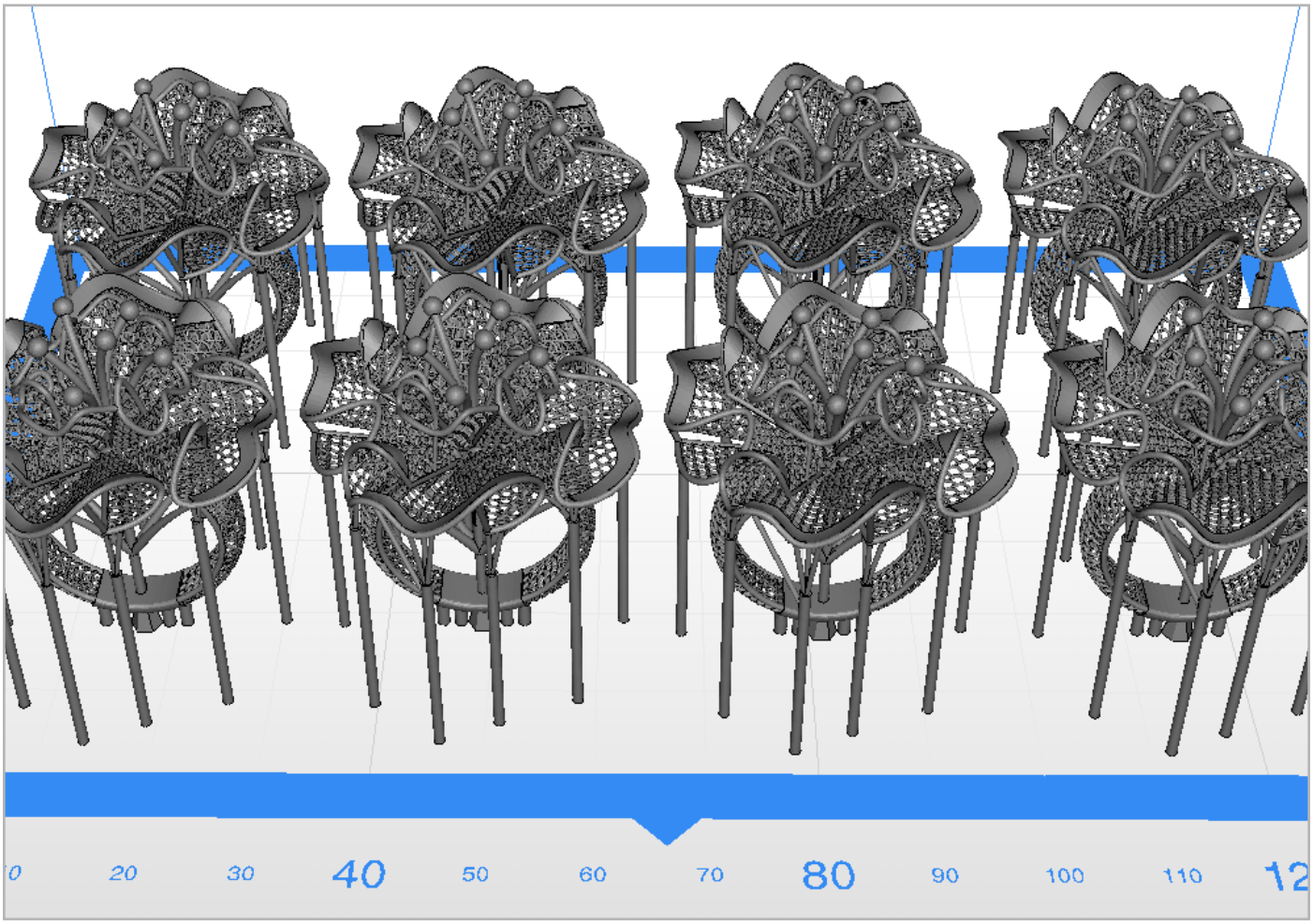
The efficiency of UV LCD technology

THE UV LCD TECHNOLOGY relies on a high resolution LCD screen with UV LED backlighting which solidifies photopolymers layer by layer. It works by flashing complete layers at the bottom of the resin tank, with the UV light coming from an LED light shining through an LCD.

THE UV LIGHT is filtered through polarizing films, revealing only the pixels necessary for the current layer.

That is why it achieves a constant high pixel resolution and works at invariable speed regardless of how much of the workspace is used.

AN ENTIRE BUILD-PLATFORM filling batch of models prints in the same time as a single part. That's why the technology allows scaling up when higher manufacturing output is needed.



Regardless of whether one or multiple rings are projected onto the platform, the printing speed remains the same.

Possible applications

UV LCD technology in modern industries

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Product design

- ✓ Faster innovations between new versions for a refined final design
- ✓ 3D printing prototypes simulating the end-use products to obtain feedback from shareholders
- ✓ Designing multiple versions at once without incurring heavy costs or long delays in production
- ✓ Keeping a digital inventory to save money on warehousing costs

EARBUD PROTOTYPE DIMENSIONS: 22 X 17 X 44 MM			
MATERIAL: ZORTRAX RESIN BASIC GREY			
NUMBER OF ITEMS	**EST. MATERIAL COST**		**EST. PRINTING TIME**
	EUR	**USD**	
1	€0.31	$0.36	**3 h**
MAX. NUMBER ON THE PLATFORM: **24**	€7.44	$8.64	

EARBUD PROTOTYPE. A prototype of an earbud or an earphone can be 3D printed with multiple iterations for testing during the design stage. Designers have the opportunity to test the best fit and size without the risk of incurring unnecessary costs.

Jewelry

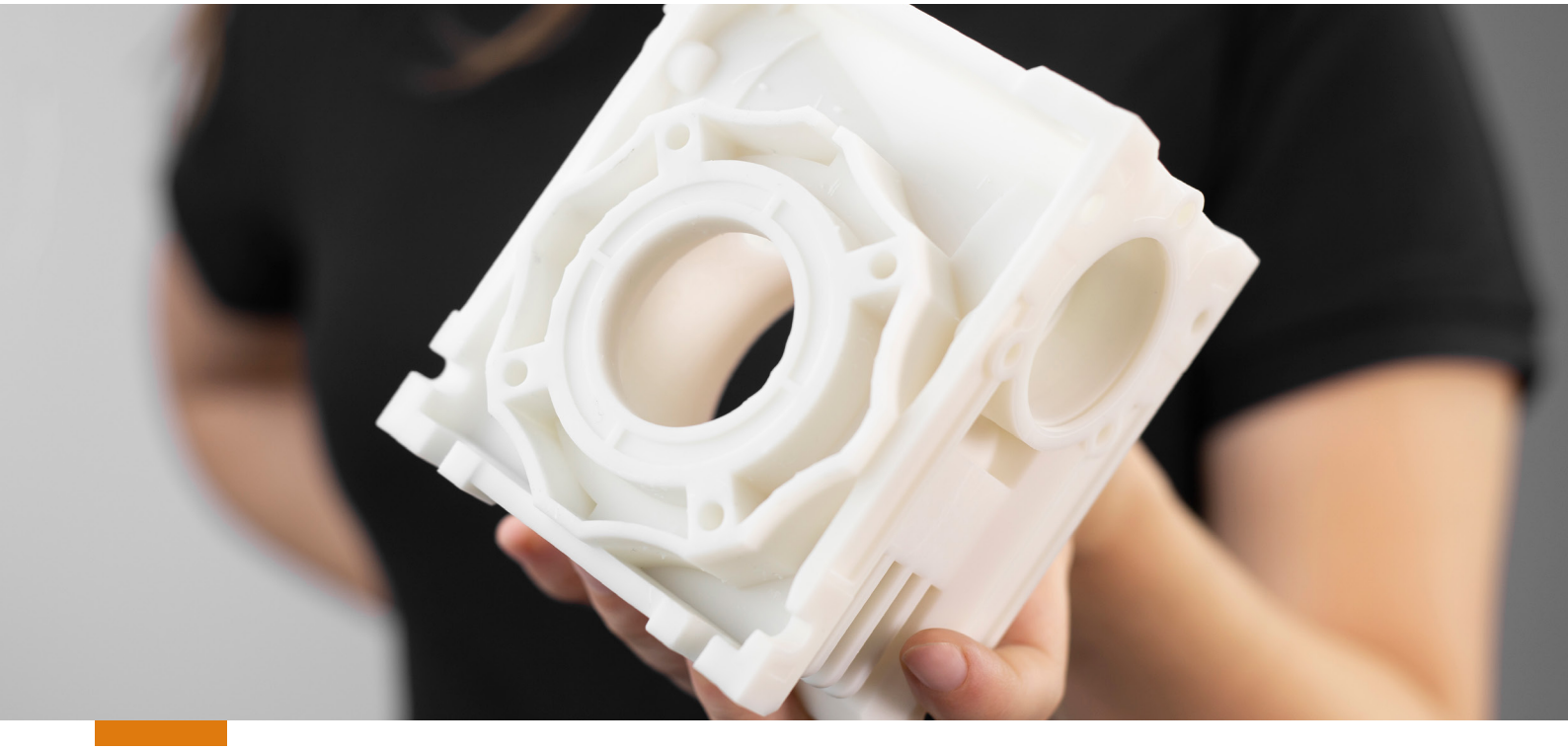
- ✓ Entirely digitized design stage for more freedom and focus on creative work instead of craftsmanship
- ✓ 3D printing of jewelry casting trees which requires no extra time
- ✓ Producing high quality models each time due to excellent results repeatability
- ✓ Achieving virtually all shapes to quickly personalize designs for individual customers

INVESTMENT CASTING PATTERN DIMENSIONS: 30 X 32 X 36 MM			
MATERIAL: BLUECAST X5 LCD/DLP			
NUMBER OF ITEMS	**EST. MATERIAL COST**		**EST. PRINTING TIME**
	EUR	**USD**	
1	€0.2	$0.25	**3 h 56 min**
MAX. NUMBER ON THE PLATFORM: **8**	€1.6	$2	

INVESTMENT CASTING PATTERN. Desktop resin 3D printers can make precise investment casting patterns with complex shapes. Satisfactory results are depenended on using quality castable resins and following a burnout procedure recommended by the manufacturer.

Automotive

- ✓ Creating prototypes of cases and gearboxes in-house, saving on costs of shipping
- ✓ Highly accurate models to clearly communicate design intentions and showcase the overall form of a concept
- ✓ Producing prototypes of parts tailored to specific vehicles for thorough testing
- ✓ Faster turnaround of design iterations to speed up the validation stage



WORM GEARBOX REDUCER. A worm gear reducer is one type of reduction gear box generally used to take a rated motor speed and produce a low speed output with higher torque value based on the reduction ratio. Designers can test the ratio of speed reduction as well as the torque output multiplier to achieve the best results.

WORM GEARBOX REDUCER DIMENSIONS: 96 X 71.5 X 115 MM			
MATERIAL: ZORTRAX RESIN BASIC WHITE/IVORY			
NUMBER OF ITEMS	**EST. MATERIAL COST**		**EST. PRINTING TIME**
	EUR	**USD**	
1	€26.9	$31.04	**9 h 45 min**
MAX. NUMBER ON THE PLATFORM: **1**	€26.9	$31.04	

Art & entertainment

- ✓ Designing complex creatures and character models for practical visual effects use
- ✓ Entirely digitized design stage for more freedom and focus on creative work instead of craftsmanship
- ✓ Creating highly detailed and film-ready models of art design objects and props
- ✓ 3D printing visually impressive and unique parts or accessories to supply the costume department

CHARACTER MODEL DIMENSIONS: 65 X 52 X 159 MM			
MATERIAL: ZORTRAX RESIN BASIC GREY			
NUMBER OF ITEMS	**EST. MATERIAL COST**		**EST. PRINTING TIME**
	EUR	**USD**	
1	€8.3	$9.58	**17 h 26 min**
MAX. NUMBER ON THE PLATFORM: **2**	€16.6	$19.16	

CHARACTER MODEL. Movie art designers can create highly complex digital 3D character models for visual effects reference and costuming departments. Renditions of character models can be made for toy making applications as well as marketing figurines.

Casings

- ✓ The opportunity to 3D print custom end-use products to suit all sorts of devices
- ✓ 3D printing multiple casings all at once to speed up production time
- ✓ Casings produced by the designers and tested immediately after the process is completed
- ✓ Printing different casing iterations in one go to achieve the best possible fit without wasting time

AIR CONDITIONING REMOTE CONTROL DIMENSIONS: 62.5 X 16.2 X 157 MM			
MATERIAL: ZORTRAX RESIN BASIC WHITE/IVORY			
NUMBER OF ITEMS*	**EST. MATERIAL COST**		**EST. PRINTING TIME**
	EUR	**USD**	
1	€4.57	$5.27	**13 h 45 min**
MAX. NUMBER ON THE PLATFORM: **4**	€18.28	$21.08	

*One item is a top or bottom half of a remote control case.

AIR CONDITIONING REMOTE CONTROL. 3D printed cases for remote controls can fit any model in any industry to serve multiple functions and be sold as end-use products thanks to UV LCD precision settings and increased output capabilities.

Packaging design

- ✓ 3D printing multiple different packaging iterations in one go to test designs, symbols and fonts
- ✓ Using a network of 3D printers for manufacturing of certain types of end-use packaging
- ✓ Design process made in-house to incurring additional costs connected to shipping
- ✓ Quick production of multiple prototypes and design concepts to obtain customer's approval

BOTTLE PROTOTYPE DIMENSIONS: 50 X 50 X 70.5 MM			
MATERIAL: ZORTRAX RESIN BASIC GREY			
NUMBER OF ITEMS	**EST. MATERIAL COST**		**EST. PRINTING TIME**
	EUR	**USD**	
1	€2.18	$2.51	**6 h 1 min**
MAX. NUMBER ON THE PLATFORM: **2**	€4.36	$5.02	

BOTTLE CAP DIMENSIONS: 55 X 55 X 19 MM			
MATERIAL: ZORTRAX RESIN PRO			
NUMBER OF ITEMS	**EST. MATERIAL COST**		**EST. PRINTING TIME**
	EUR	**USD**	
1	€3.35	$3.91	**2 h 53 min**
MAX. NUMBER ON THE PLATFORM: **2**	€6.70	$7.82	

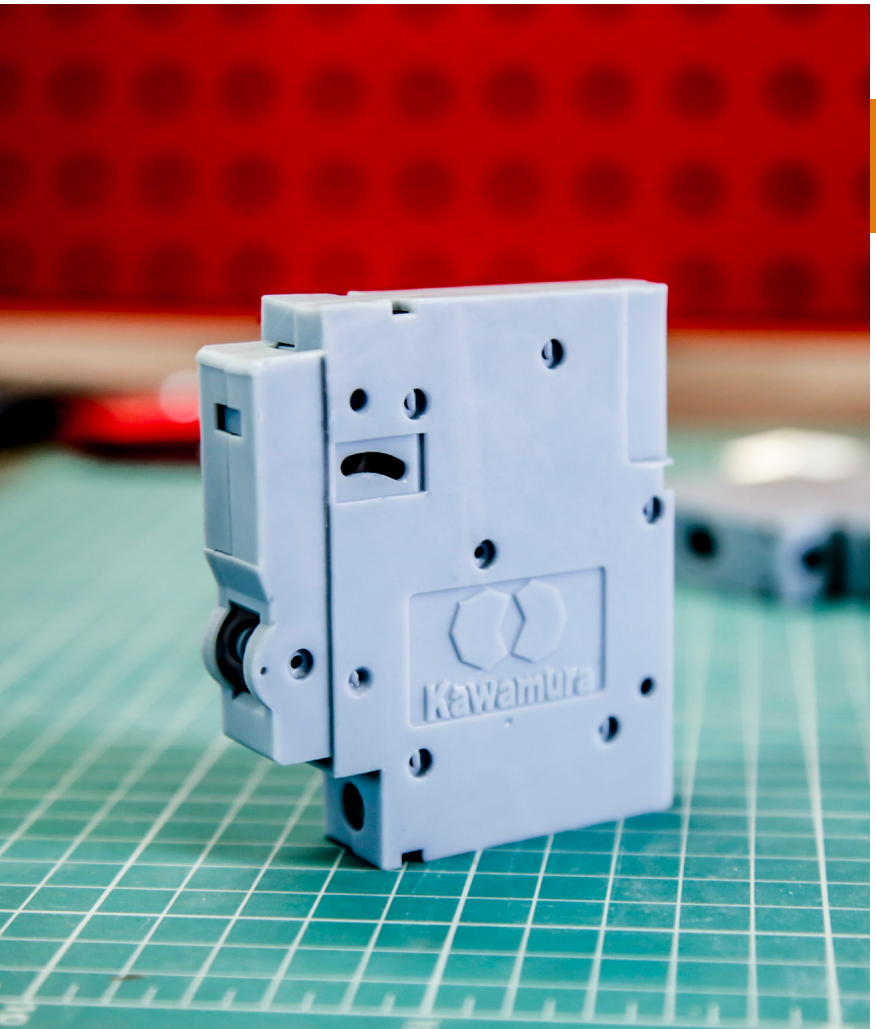
BOTTLE PROTOTYPE. A bottle of medicine and a cap can both be 3D printed with epoxy-based resins to serve as a functional prototype of an end-use container. The printer's dimensional precision allows inclusion of text and logos onto the packaging for a professional finish.

Electronics

- ✓ Rapid application of small changes necessary to make fail-safe devices
- ✓ Creating prototypes of circuit boards and circuit board cases in-house to lower shipping costs
- ✓ Creation of personalized electronic enclosures, keyboards or USB covers for demanding customers
- ✓ Eliminating fears over IP infringement with internal manufacturing

GFCI CASING DIMENSIONS: 14.5 X 74 X 81.5			
MATERIAL: ZORTRAX RESIN BASIC GREY			
NUMBER OF ITEMS*	**EST. MATERIAL COST**		**EST. PRINTING TIME**
	EUR	**USD**	
1	€2.43	$2.81	**7 h 21 min**
MAX. NUMBER ON THE PLATFORM: **3**	€7.29	$8.43	

*One item is a top or bottom half of a two-piece casing.



GFCI CASING. A casing for the ground fault circuit interrupter (GFCI) made for testing to prevent serious harm from an ongoing electric shock.

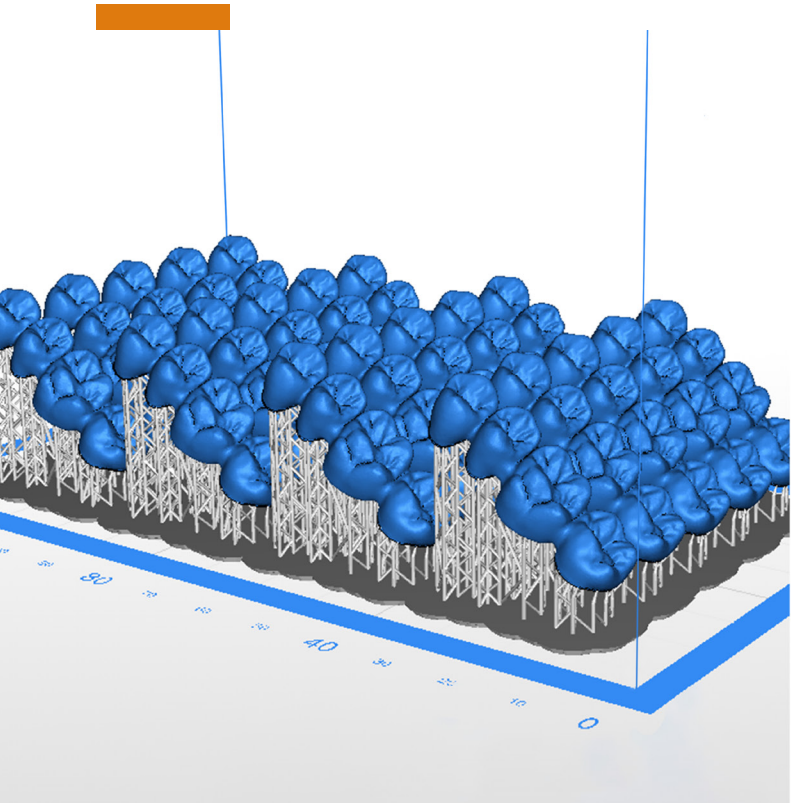
Dentistry

- ✓ Printing orthodontic appliances with microscopic precision for better overall patients' experience
- ✓ More patients can be appointed per day and obtain their orthodontic appliances faster
- ✓ An entire digital dentistry system with intra oral scanners and CAD/CAM software leaves lees space for human error
- ✓ Printing with biocompatible resins to produce end-use dental models

TEMPORARY DENTAL CROWN DIMENSIONS: 28.5 X 12.3 X 26.4 MM			
MATERIAL: RAYDENT CROWN & BRIDGE RESIN			
NUMBER OF ITEMS*	**EST. MATERIAL COST**		**EST. PRINTING TIME**
	EUR	**USD**	
1	€0.65	$0.73	**3 h**
MAX. NUMBER ON THE PLATFORM: **24**	€15.6	$17.52	

* One item is a single dental bridge spanning four teeth.

TEMPORARY DENTAL CROWN. Dental crowns made with Raydent Crown&Bridge Resin can be printed in one go or in multiple parts. The resin allows the models to keep smooth surfaces and anatomical shape over the entire period of intended use. The resin is safe for contact with a human body lasting for up to 30 days. However, the models must be sterilized prior to intraoral use.



Resources used in this study

Zortrax Ultrasonic Cleaner

Z-SUITE software

Zortrax Resins

Zortrax Inkspire
UV LCD 3D Printer

Contact us sales@zortrax.com
Read more at www.zortrax.com
Order a sample https://zortrax.com/order-sample/