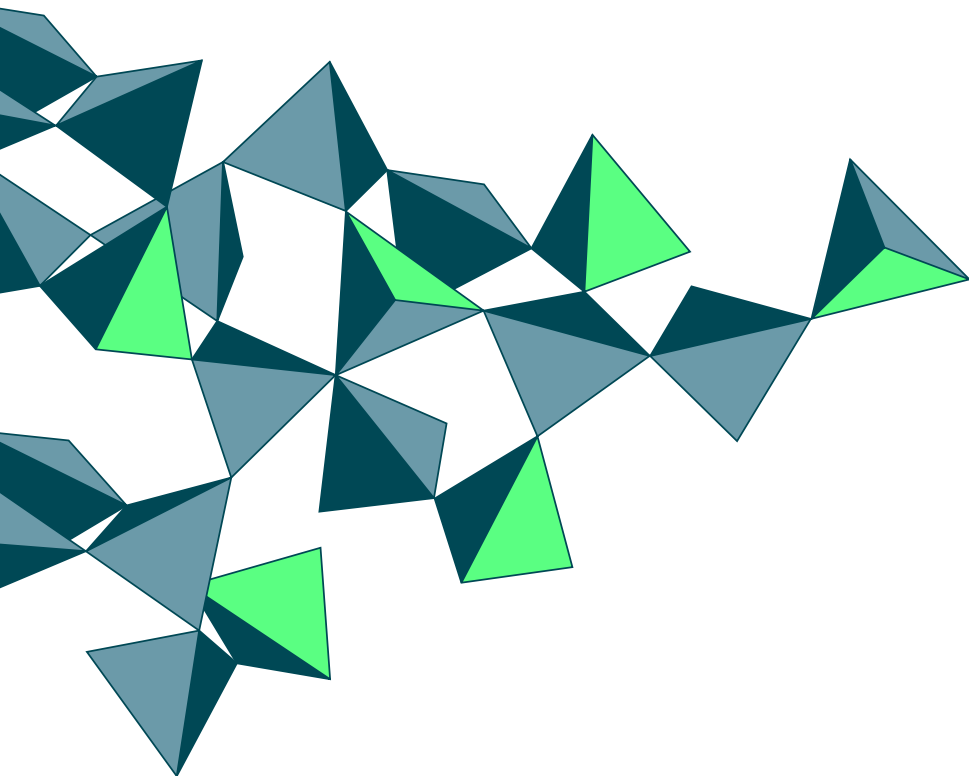




**IMAGINE ...**

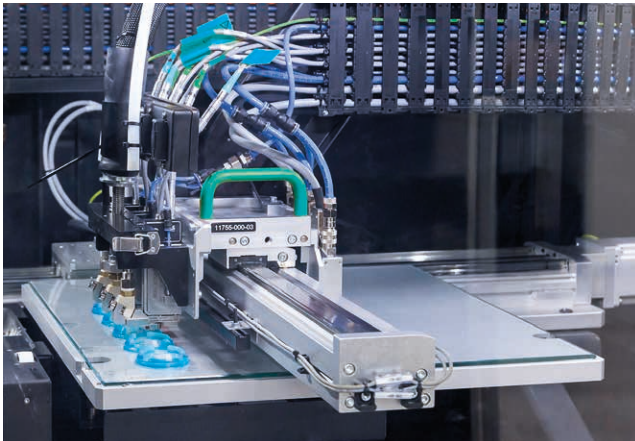


**3D printing with silicones**

# What is 3D Printing

3D printing is the manufacturing of three-dimensional objects directly from digital models (CAD) without the need for tools or molds. 3D printing is used for the production of prototypes, as well as objects in smaller quantities. Growing opportunities have individualized geometries and objects which can't be produced by other methods. These objects can be made with integrated structures or functions. ACEO® technology enables the 3D printing of 100% silicone, thus real elastomers, with complete freedom of design.

## ACEO® Imagine Printer



DROP-ON-DEMAND TECHNOLOGY

UV-CURING CHEMISTRY

100% REAL ELASTOMERS

ACEO® Imagine Printers are the result of a hand-in-hand development of materials, hardware and software at WACKER CHEMIE AG in Germany. After careful evaluation of all possible methods to 3D print high-viscous silicone polymers, the drop-on-demand is the solution to enable complete freedom of design. The printed parts have the same properties in all directions and come in various hardness and colors. The technology enables manufacturing of individual objects as well as serial production.

# What are Silicones

Silicone elastomers are inorganic synthetic rubbers. They offer the unique combination of chemical and mechanical properties which organic elastomers can't achieve. These properties make silicone the preferred material for many applications. The ACEO® technology provides 3D printed silicone objects comparable to other manufacturing methods, e.g. injection molding.

**Typical data for 3D printed objects from ACEO® GP Silicone in Shore A 60 after post-cure.**

Product Data		
Typical general characteristics <sup>A)</sup>	Inspection method	Value
Hardness Shore A	DIN 53505	60
Appearance		transparent
Density	DIN EN ISO 1183-1 A	1,12 g/cm <sup>3</sup>
Tensile strength	ISO 37 Type 1	> 7,00 N/mm <sup>2</sup>
Elongation at break	ISO 37 Type 1	> 200 %
Tear strength	ASTM D 624 B	> 15 N/mm
Tear strength	DIN ISO 34-1 A	> 5 N/mm
Rebound resilience	ISO 4662	68 %
Compression set	DIN ISO 815-B (22 h / 175 °C)	20 %
Further typical characteristics <sup>A)</sup>	Inspection method	Value
LOI-value	EN ISO 4589-2/ASTM D2863	25 %
Dielectric strength	DIN IEC 243-2	16 kV/mm
Volume resistivity	DIN IEC 93	4 x 10 <sup>16</sup> Ω cm
Dielectric constant at 50 Hz	DIN VDE 0303	2,6 ε <sub>r</sub>
Dissipation factor (50 Hz)	DIN VDE 0303	22 x 10 <sup>-4</sup> tan δ

**A modern high-tech material:** 3D printed Silicones convince with their manifold advantages. Among other outstanding properties, silicones display flexibility and elasticity, weather stability, wide range of application temperatures, radiation resistance, haptics and physiological inertness. They are available in Shore A hardness from 10 to 80 and various colors, even intensive black. FDA compliance and biocompatibility is provided.

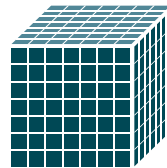
# ACEO® Technology

The ACEO® technology accomplishes the ideal combination of material-, hardware-, software- and product-design-competence of WACKER CHEMIE AG. It results in the capability to 3D print high-viscous silicone polymers in a drop-on-demand process and enables all imaginable product designs. Integrated functionalities become possible by the use of water-soluble support materials perfectly matching the silicone elastomers.

## Computer

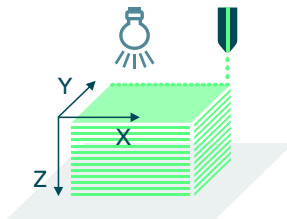


- ▶ Creation of part design in CAD
- ▶ Upload file format in shop

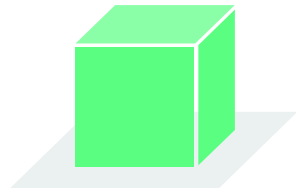


- ▶ Mesh as STL-format
- ▶ Software creates print instructions

## Industrial Printer

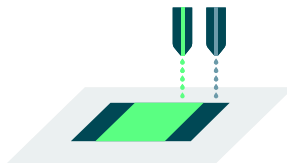


- ▶ Single droplets are dosed
- ▶ Curing via UV light



- ▶ Printer forms part layer by layer
- ▶ No tools or molds required

## Support Material



- ▶ Simultaneous printing of silicone and support material



- ▶ Allows overhangs or hollow parts
- ▶ Support material is washed out afterwards

# Markets & Application

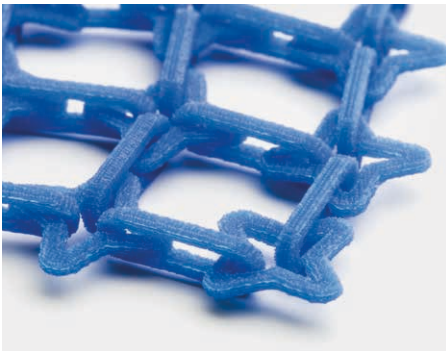
3D printing of silicone is an emerging technology. It is new to the world and this is why we at ACEO® believe in joint efforts with designers, partners and customers to explore the unlimited possibilities. There are some industrial areas, in which this new technology already solves unmet needs or generates new ideas. Among those are medical application, e.g. anatomical models or prosthetics, transportation with prototypes or spare parts and soft robotics. In particular integrated functionalities, what we call 3D+, will lead to revolutionary product designs.



Functional Rubber Prototypes



Individualized Geometries

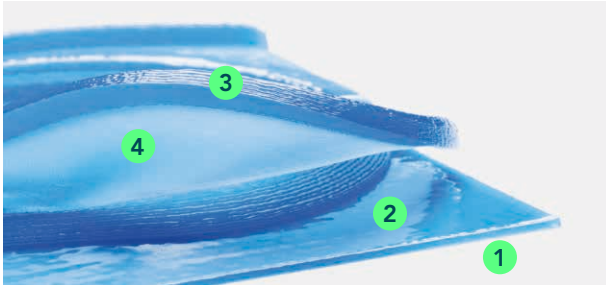


Unprecedented Flexible Designs



Soft Anatomical Models

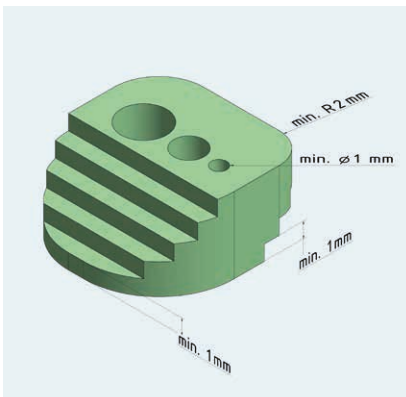
# Properties of 3D Printed Objects



3D printing by the ACEO® drop-on-demand technology is the manufacturing of objects layer-by-layer. A typical layer thickness due to the high viscosity of the silicone polymers is 0.4 mm. As a consequence the printed objects are characterized by 4 different surfaces: the bottom surface on the build platform (1), the top surface from the last layer (2), the side walls with the layer structure (3) and the contact surface to support material (4). Two different support material are applied leading to more or less roughness. In principal parts could be subsequently coated to improve surface appearance.

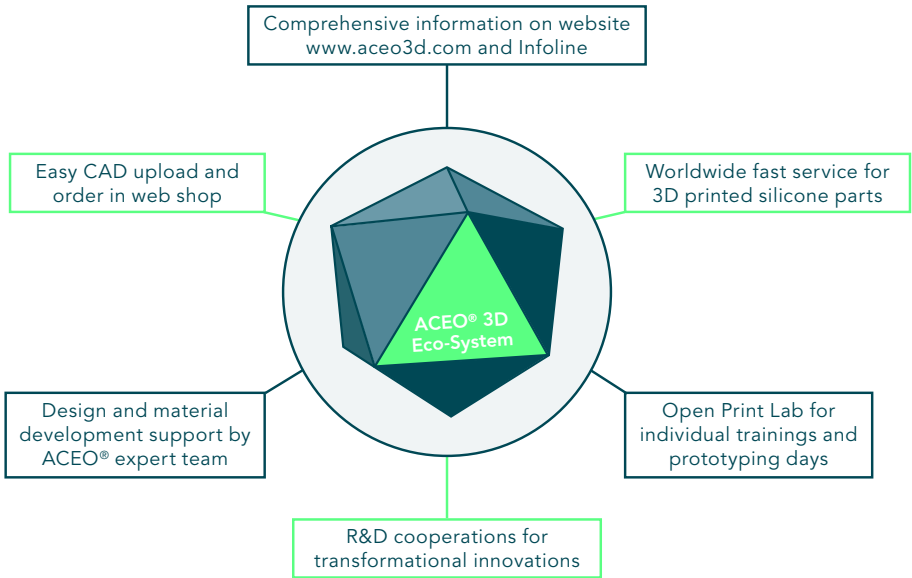
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## Design Rules



The product designer can make use of the complete freedom of design enabled by the ACEO® 3D printing technology. However, some limitations should be taken into consideration to obtain satisfactory results. Aside the different types of surfaces, the following rules for designing a part apply.

# Service Portfolio



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## Technology Roadmap

Silicone 3D printing by ACEO® technology today is only at the beginning. The ACEO® expert team follows distinct roadmaps for materials, hardware and software and grows its capabilities steadily. It is about product resolution and reproducibility. New material will complement the portfolio: media resistance, electrical conductivity or high strength and hardness in multi-material printing. 3D+ will enable unprecedented product designs. Spare parts on demand can revolutionize supply chain concepts. Be part of it. IMAGINE ...



Let's stay in touch

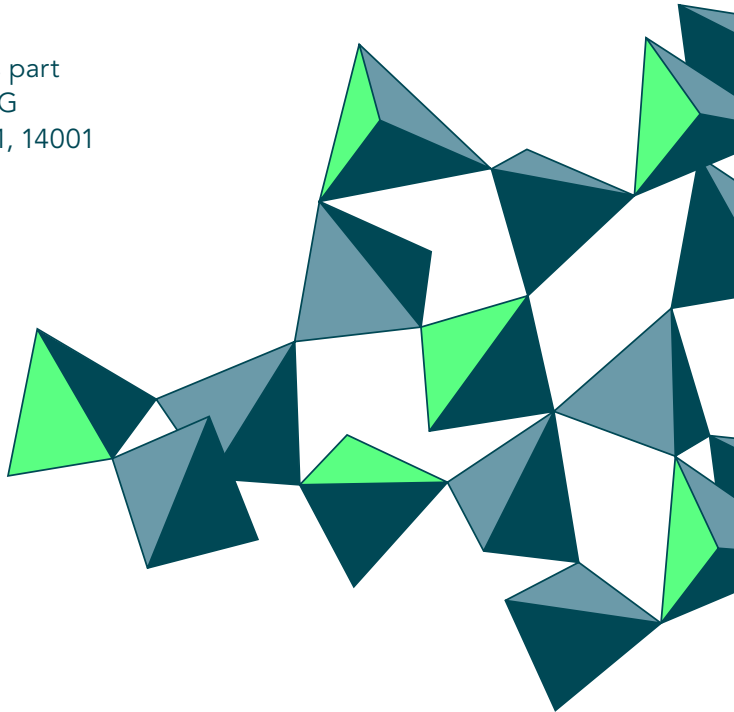


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