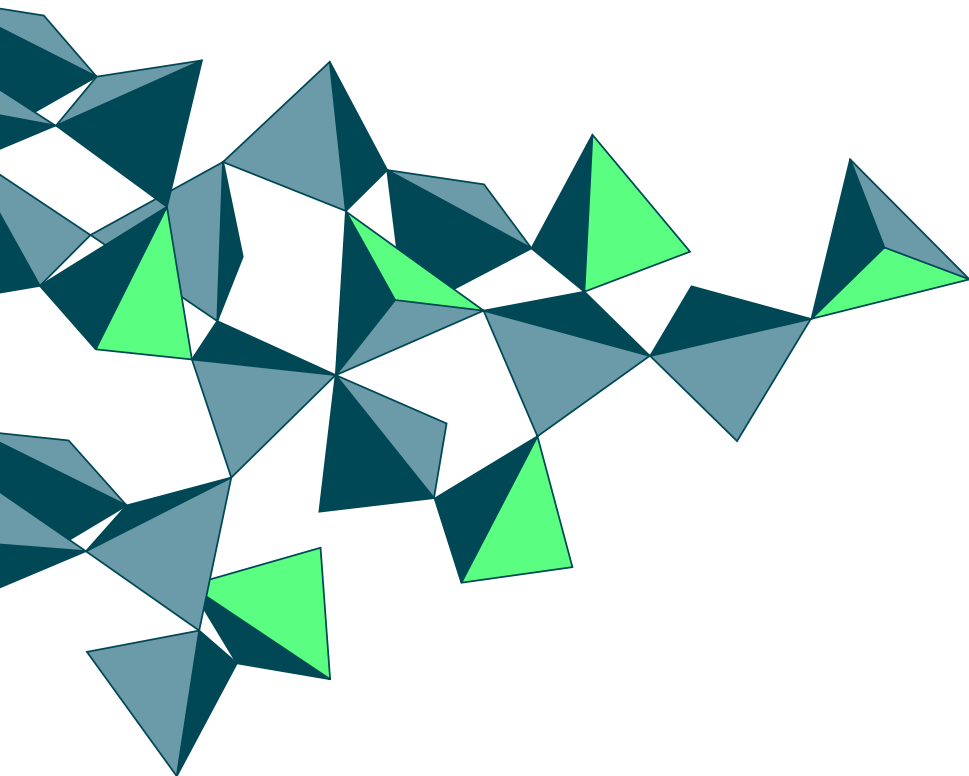




**IMAGINE ...**



**3D printing with silicones**

## 3D Printing with ACEO®

3D printing is the additive manufacturing of three-dimensional objects directly from digital models without the need for tools or molds. This technology is used for the production of prototypes, objects in smaller series, as well as spare parts. 3D printing also provides opportunities to create individualized geometries and objects that cannot be produced using conventional methods. New designs can be realized, using lattice structures and functional integration. ACEO®'s technology is based on printing real 3D (support material) with 100% real silicone elastomers, allowing complete freedom of design of high performance parts.

### ACEO® Imagine Printers



DROP-ON-DEMAND TECHNOLOGY

REAL 3D

100% REAL ELASTOMERS

ACEO® Imagine Printers are the result of a hand-in-hand development of materials, hardware and software. The ACEO® team carefully evaluated all possible methods to 3D print high-viscous silicone polymers in order to find the ideal solution to enable complete freedom of design. The drop-on-demand principle proved to be the most precise and reliable method. Parts 3D-printed with ACEO®'s technology have the same properties in all directions and come in various hardness and colors.

# Proven WACKER Silicones

Silicone elastomers offer a unique combination of chemical and mechanical properties that other elastomers cannot achieve. These properties make silicone the preferred material for many high performance applications. The ACEO® technology is based on WACKER ELASTOSIL® and provides 3D printed silicone quality comparable to other manufacturing methods such as 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 εr
Dissipation factor (50 Hz)	DIN VDE 0303	22 x 10 <sup>-4</sup> tan δ

**High-Performance Material:** 3D printed silicones feature outstanding properties such as flexibility and elasticity, weather stability, wide range of application temperatures, radiation resistance, haptics and physiological inertness. ACEO® Silicone GP is available in Shore A hardness from 20 to 60 and in various colors, including intensive black. The general purpose grades have been tested for biocompatibility and FDA compliance. ACEO® also offers an electrically conductive silicone.

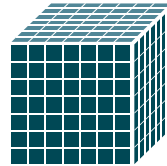
# ACEO® Technology

WACKER's 3D printing technology ACEO® is the world's first industrial-scale technology for the additive manufacturing of liquid silicone rubber components. The ACEO® technology is based on a combination of material, hardware and software. It was developed to 3D print high-viscous silicone polymers by using a drop-on-demand process. Combined with water-soluble support material, the technology allows the printing of real 3D geometries with 100% silicone elastomers.

## Computer

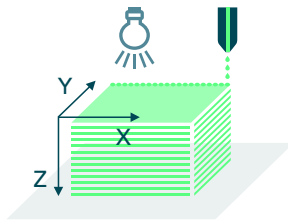


- ▶ Creation of part design in CAD
- ▶ Upload file format in shop

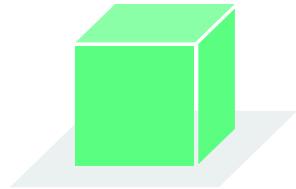


- ▶ Mesh as STL-format
- ▶ Software creates print instructions

## Industrial Printer

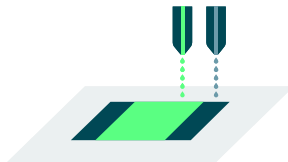


- ▶ Single droplets are dosed
- ▶ Curing via UV light



- ▶ 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. This is why we at ACEO® work hand in hand with designers, partners and customers to explore the unlimited possibilities of our technology. ACEO® printed silicone rubber components are used in high performance industries such as automotive, aerospace & aviation, healthcare, electronics as well as machines & equipment. Typical applications in these sectors are models, functional prototypes, small series and spare parts. ACEO®'s technology also allows new design solutions with integrated functionalities, or what we call 3D+: previously impossible designs that lead to revolutionary products.



Functional Rubber Prototypes



Multimaterial Printing

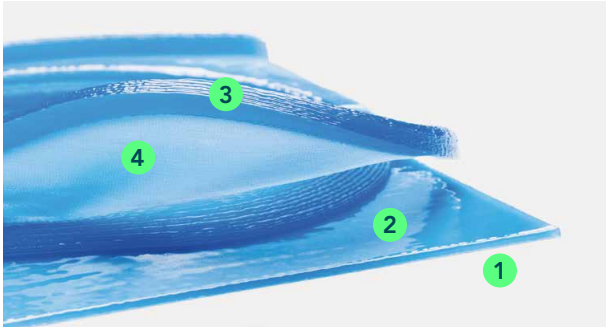


Unprecedented Flexible Designs



Soft Anatomical Models

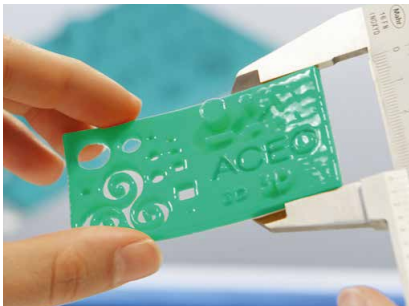
# Properties of 3D Printed Objects



3D printing with ACEO®'s drop-on-demand technology means additively manufacturing objects layer-by-layer. The typical layer thickness is 0.4 mm – a result of the high viscosity of silicone polymers. 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). In principal parts could be subsequently coated to improve surface appearance.

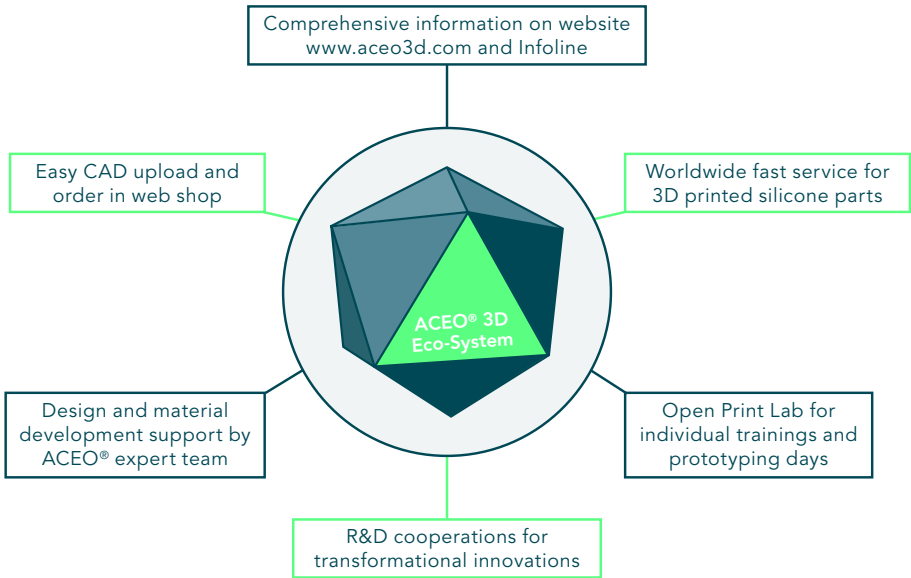
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## Design Guidelines



Product developers can explore the endless design opportunities offered by ACEO®'s 3D printing technology. However, some guidelines should be taken into account to obtain optimum results. In general, we recommend a wall thickness of 1 mm as minimum size for all geometrical features. For more detailed information, please consult the latest version of the Design Guidelines on our website.

# Service Portfolio



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## Product Life Cycle Support

WACKER has over 70 years of experience with silicones and in-depth knowledge of all silicone processing technologies. ACEO® 3D printing with silicones provides a great addition to WACKER's portfolio of processing technologies, allowing WACKER to support customers along the product life cycle. To further promote our revolutionary technology, we offer a range of services including design support or customized training sessions at the ACEO® Open Print Labs in Burghausen, Germany, and Ann Arbor, USA.



Let's stay in touch

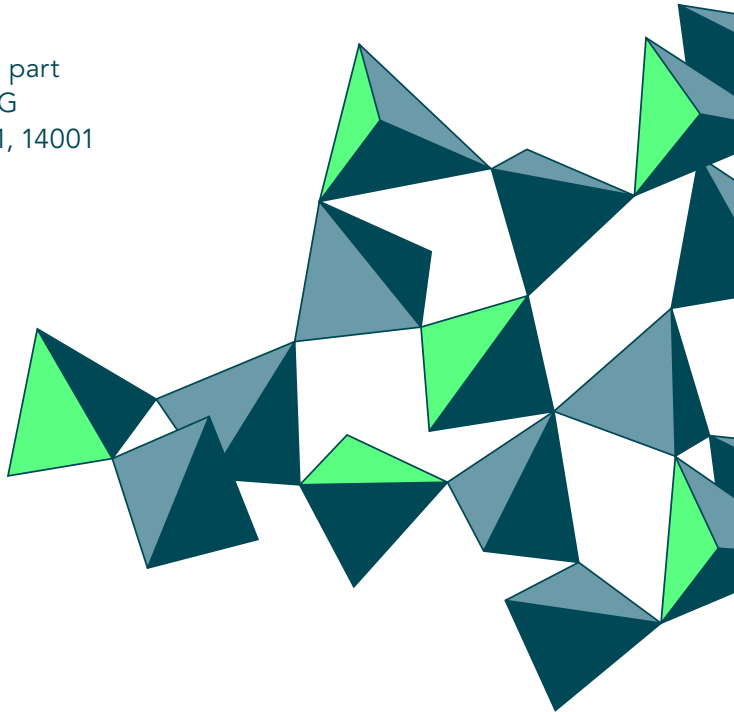


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