

Think the impossible. You can get it.

e-Manufacturing Solutions  
Dental



Laser-sintered dental prosthesis (with support structures; surface ready for veneering; after veneering) on laser-sintered dental model with identification tag.



e-Manufacturing Solutions

# Digitalization of the Dental Market

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Dental prostheses have long been conventionally produced primarily from metal through the use of casting techniques. Dental models for appropriate restoration of prostheses and for checking the quality have been produced through time-consuming production and preparation of cast dental impressions. Currently, though, dental technology is undergoing a radical shift and a process of industrialization that has already taken place in other markets. The use of digital dental technology is on the rise and manufacturing processes are being automated.

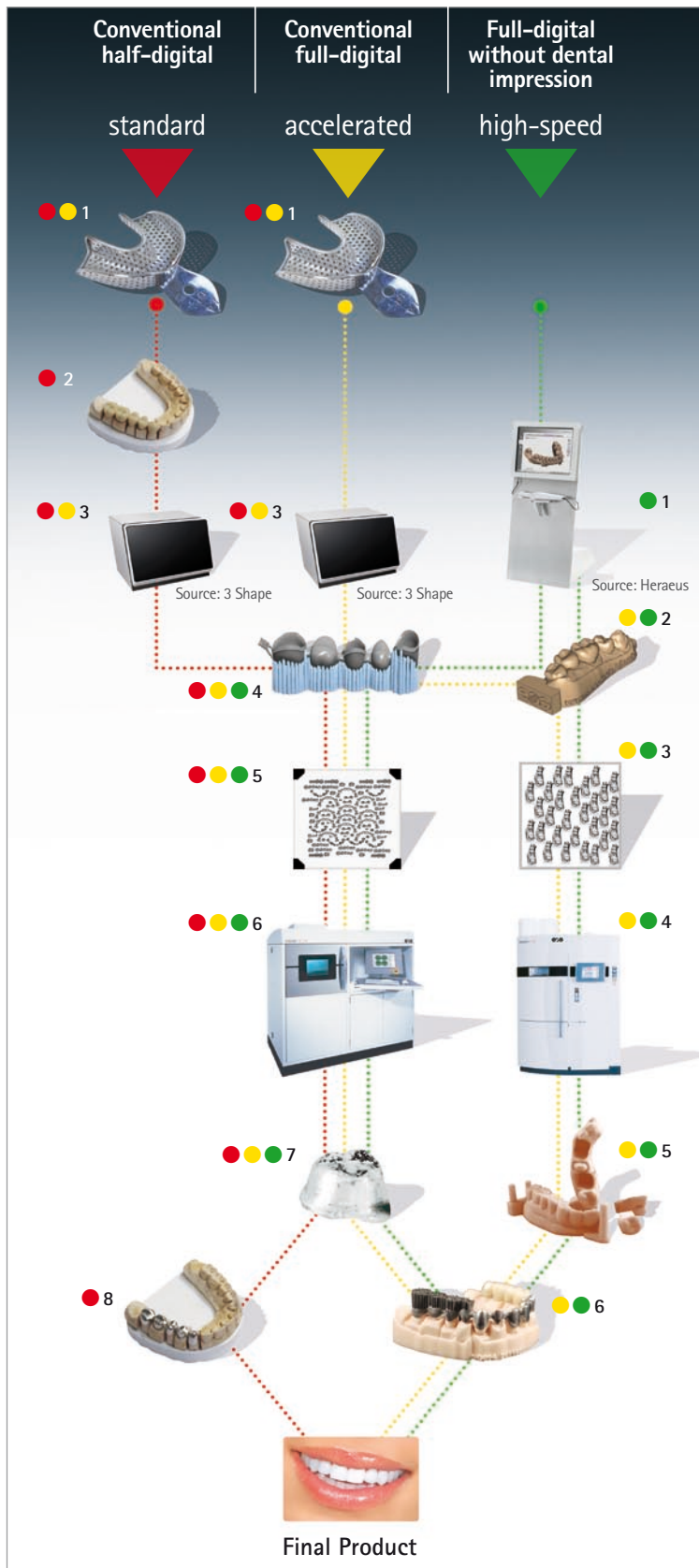
It is already quite common for the patient's oral situation to be assessed digitally by means of intraoral scanners or by means of mold or model scanning. This affects important subsequent processing and production steps such as the production of the dental prostheses, as well as the dental models. This digital three dimensional data can be processed directly and without a molding-induced loss in precision by means of metal laser-sintering, for example in order to produce crowns and bridges. A second set of data contains the digital description of the dental model, ready

for polymer laser-sintering. Both of these forms of individualized series production are based on e-Manufacturing – the quick, flexible, and cost-effective production of parts directly from electronic data. Laser-sintering permits dental labs and service providers to perform the virtually impossible balancing act between a standardised process with consistent high quality of the end products on the one hand and cost efficiency and time savings on the other.

By digitizing the work steps, it is possible to weed out error sources from the assessment of the patients to the production in the lab and to guarantee consistent high quality. This reduces the risk of incorrect preparation or molding, of imprecisions in fit as well as the finishing work, or costly repetitions. The patient is also spared the uncomfortable procedure of producing conventional dental impressions. In addition, software-supported work processes reduce processing times, permitting dental technicians to concentrate on the vital peripheral processing steps of value creation such as aesthetic and function-oriented ceramic veneering.

# Three Pathways for 3D-Data

- 1  
**Impression**  
For the assessment of the patient's oral situation
- 2  
**Dental cast**
- 3  
**3D-Scanner**  
Dental lab scans dental cast or impression
- 4  
**STL Data**  
Designing crowns and bridges via CAD-Design
- 5  
**CAMbridge**  
Professional software for automatic placement, orientation and identification of crowns and bridges with "one click"
- 6  
**EOSINT M 270**  
System for the additive layer manufacturing of crowns and bridges
- 7  
**Coping**  
Built with CE-certificated EOS CobaltChrome SP2 material
- 8  
**Veneering on plaster model**



- 1  
**Intraoral Scanner**  
For the assessment of the patient's oral situation
- 2  
**STL Data**  
Designing dental models via CAD-Design
- 3  
**CAMbridge**  
Professional software for automatic placement, orientation and identification of dental models with "one click"
- 4  
**FORMIGA P 100**  
System for the additive layer manufacturing of dental models
- 5  
**Dental model**  
Built with PA 2105 material
- 6  
**Veneering on plastic model**

# Crowns and Bridges

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**Dental platform with copings laser-sintered on EOSINT M 270.**



Using the conventional casting production process, a dental technician can currently produce about 20 dental frames per day. Using e-Manufacturing with laser-sintering, however, it is possible to produce approximately 450 high-quality units of crowns and bridges within 24 hours. This corresponds to a production speed of approximately three minutes per unit on average. The technological centerpiece of this is the EOSINT M 270 – the only system of its kind that produces cost-effective, high-quality dental prostheses using Direct Metal Laser-Sintering (DMLS). In order to be able to manufacture dental prostheses using this additive layer manufacturing method, the 3D-CAD data is sliced into layers. Using these as a model, the desired geometry is produced in layers by selectively fusing cobalt chromium powder using a laser.

Since operating a DMLS system requires personnel only for loading and unpacking the machine, two production cycles per day can be executed, thus permitting production of up to 80,000

units per year. This makes laser-sintering a true industrial process in which high productivity at a reduced cost is accompanied by consistent quality standards.

## **Advantages**

- A DMLS system produces approximately 80,000 units per year
- More cost-effective than conventional precision casting
- Consistent tolerances and fit
- High precision of prostheses and reproducibility of production properties
- As the lab size increases, the process can be ramped up accordingly
- Resource conservation through reuse of unfused powder
- Highly profitable because of the small dimensioning of dental prostheses and the accompanying increase in production time efficiency
- Controlled process: production parameters are established and documented; parts production can be monitored
- Certified powder material and laser parameters for the validated production of medical products



# Dental Models

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Dental model laser-sintered on the FORMIGA P 100 and corresponding crown produced using the EOSINT M 270.

Digitally assessing the patient's oral situation eliminates the need for a time-consuming production of a plaster model. However, a model is still required for finishing work, occlusion adaptation or other applications in orthodontics. This is where polymer laser-sintering comes into play, permitting you to close this gap. By using digital three dimensional data, the FORMIGA P 100 produces a plastic model that is used both for checking prosthesis quality and for veneering and production of the dental prosthesis. Moreover it is possible to generate models for analysis.

Polymer laser-sintering is an additive layer manufacturing method. To enable its use for manufacturing dental models, the three dimensional data is sliced into layers. Using these as a model, the system produces the model in layers by fusing plastic powder using a laser.

Thanks to this efficient production method - the dental model is ideally produced in parallel with the associated crown or bridge - the manufacturing

process is shortened by an average of one working day. In addition, valuable dental technician time can be dedicated exclusively to profitable professional veneering of the dental prosthesis.

## Advantages

- High model precision for precision of prosthesis fit
- Color contrast eases veneering of dental prosthesis
- Abrasion resistance despite frequent prosthesis insertion and removal
- High economy through production of a hollow model and multilayer building
- Reliable process with minimal personnel requirements
- No manual finishing required because no support structures needed
- Fast integration into dental lab workflows
- Function-oriented handling of the model by dental technicians
- Resource conservation through reuse of unfused powder

# About EOS

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**Laser-Sintering:**  
With 200 watts and a temperature of 1400 degrees Celsius, the laser fuses the metal powder layer by layer.



## **Profile**

EOS was founded in 1989 and is today the world-leading manufacturer of laser-sintering systems. Laser-sintering is the key technology for e-Manufacturing, the fast, flexible and cost-effective production of products, patterns and tools. The technology manufactures parts for every phase of the product life cycle, directly from electronic data. Laser-sintering accelerates product development and optimizes production processes. EOS offers application-optimized solutions for the dental industry for the successful implementation of e-Manufacturing based on laser-sintering technology.

## **EOS Worldwide**

- Worldwide recognized technology
- Leader for high-end systems for e-Manufacturing
- Customers in over 30 countries
- EOS subsidiaries in over 9 countries
- Distributors in over 26 countries

# EOS Laser-Sintering Systems



**EOSINT M 270 – Direct Metal Laser-Sintering (DMLS) system for the production of dental crowns, bridges and other products directly from metal.**

## **EOSINT M 270 – certified production of dental prosthesis**

The EOSINT M 270 is the system for additive manufacturing of crowns and bridges using Direct Metal Laser-Sintering (DMLS). The system provides a controlled melting of material, producing a dental prosthesis of consistent higher quality than simple cast parts. With the fiber laser, the system is capable of achieving a typical precision of +/- 20 micrometers.

<b>Technical Data EOSINT M 270</b>	
Effective building volume (including building platform)	250 mm x 250 mm x 215 mm (9.85 x 9.85 x 8.5 in)
Building speed (material-dependent)	2 - 20 mm <sup>3</sup> /s (0.0001 - 0.001 in <sup>3</sup> /sec)
Layer thickness (material-dependent)	20 - 100 µm (0.001 - 0.004 in)
Laser type	Yb-fibre laser, 200 W
Precision optics	F-theta-lens, high-speed scanner
Scan speed	up to 7.0 m/s (23 ft./sec)
Variable focus diameter	100 - 500 µm (0.004 - 0.02 in)
Power supply	32 A
Power consumption	maximum 5.5 kW
Nitrogen generator	standard
Compressed air supply	7,000 hPa; 20 m <sup>3</sup> /h (102 psi; 26.2 yd <sup>3</sup> /h)
<b>Dimensions (B x D x H)</b>	
System	2,000 mm x 1,050 mm x 1,940 mm (78.8 x 41.4 x 76.4 in)
Recommended installation space	approx. 3.5 m x 3.6 m x 2.5 m (137.9 x 141.8 x 100 in)
Weight	approx. 1,130 kg ( 2,491 lb)
<b>Data preparation</b>	
PC	current Windows operating system
Software	EOS RP Tools; Magics RP (Materialise)
CAD interface	STL. Optional: converter for all standard formats
Network	Ethernet
Certification	CE, NFPA

**FORMIGA P 100**  
Plastic laser-sintering System for dental models.



You can find a detailed description of the system in the corresponding system brochure.

## **FORMIGA P 100 – Plastic laser-sintering in the compact class**

With an overall building volume of 200 mm x 250 mm x 330 mm the system produces 48 single dental models in two stacked layers within ten hours\*. Its economical, flexible design permits the system to be ideally integrated into dental lab workflows for a comparatively low investment cost.

\* Sample calculation for a model with a size of 74 mm x 23 mm x 25 mm

# Materials for Dental Applications

## **EOS CobaltChrome SP2: CE-certified metal material for series production.**

For manufacturing crowns and bridges, the EOSINT M 270 processes a special cobalt chromium molybdenum-based superalloy. It is biocompatible and CE-certified for use in the dental industry (CE 0537). This established dental prosthesis material has seen considerable demand in recent years and is very inexpensive compared to precious metal alloys. The Schwickerath bonding strength according to EN ISO 9693 using recommended VITA VM13 ceramic is 42 MPa. The amount of extractable ions released from EOS CobaltChrome SP2 laser processed according to Instructions for Use is 1.86 mg / cm<sup>2</sup> / 7 days determined in the static immersion test according to EN ISO 10993-15.



Dental copings laser-sintered with EOS Cobalt-Chrome SP2, before and after veneering.

Material properties after stress relieving (1 hour at 750 °C), oxide fire simulation (5 min. at 950 °C) and ceramic fire simulation (4 x 2 min at 930 °C) procedures according to EN ISO 22674

Material composition		
Co: 63.8 wt-%	Relative density	approx. 100 %
Cr: 24.7 wt-%	Density	8.5 g/cm <sup>3</sup>
Mo: 5.1 wt-%	Proof strength (Rp 0.2 %)	850 MPa
W: 5.4 wt-%	Ultimate tensile strength	1350 MPa
Si: 1.0 wt-%	Percent elongation	3 %
Fe: max. 0.50 wt-%	Young's Modulus	approx. 200 GPa
Mn: max. 0.10 wt-%	Vickers hardness HV10	420 HV
Free of Ni, Be and Cd according to EN ISO 22674	Coefficient of thermal expansion (25 - 500 °C)	14.3 x 10E-6 m/m°C
	Coefficient of thermal expansion (20 - 600 °C)	14.5 x 10E-6 m/m°C
	Melting interval	1410 - 1450 °C

Detailed information about the material properties can be found on the corresponding Instructions for Use.



Dental model laser-sintered with PA 2105.

## **Colored plastic material for series production**

PA 2105 is a pigmented polyamide-12 powder for manufacturing laser-sintered dental models that are based on the color of the plaster used in conventional models. The usual color contrast with the dental prosthesis and the high mechanical strength and thermal stability enable optimal fit control and veneering of the dental prosthesis.



## ... and Partners



### BEGO

The BEGO Bremer Goldschlägerei Wilhelm Herbst GmbH & Co. KG is one of the leading international dental companies. The owner-led company provides a wide selection of products and services "made in Germany" through their divisions BEGO Dental, BEGO Medical, and BEGO Implant Systems.

Christoph Weiss, Managing Director of the BEGO group: "The long R&D activities of BEGO in the field of laser-sintering finally pay out – the unbeatable advantages of the technology in the dental area are obvious. The company EOS with its comprehensive technology know-how is a very attractive cooperation partner."

### Heraeus

Heraeus Dental is a global supplier of dental products headquartered in Hanau, Germany, with subsidiaries in the US, Europe, and Asia.

Dr. Uwe Böhm, Head of R&D Prothetik at Heraeus Dental: "We have integrated laser melting into our CAD/CAM-systems, because this technology now allows us to build dental frames in high quality. We offer our customers a flexible and efficient way to process base metal. In cooperation with EOS, Heraeus offers CAD/CAM users an up to date SLM\* technology, that enables tailored and homogenous crowns and bridges."

### Phibo

Phibo® is a European leading multinational company in implantology, prosthesis in CAD/CAM, bone regeneration, digital solutions and services. Phibo® has been researching, developing, manufacturing and selling dental solutions for more than 20 years with a strong research vocation, high scientific component and digital integration interest.

Juan Roma, Chief Executive Officer of Phibo: "In the CAD-CAM field, EOS laser-sintering technology has proved to be a relevant partner for Phibo®. Through our R&D in this field Phibo® has gained a differential positioning regarding solutions for complex implant restorations incorporating processes that complement the benefits of laser-sintering. This approach has meant a significant leap for the dental sector increasing the volume of CAD/CAM prosthesis solutions."

Here is a selection of our partners:



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Electro Optical Systems

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