e-Manufacturing Solutions
Dental

e-Manufacturing Solutions

EOS GmbH
Electro Optical Systems

Corporate Headquarters
Robert-Stirling-Ring 1
D-82152 Krailling/Munich
Phone +49 89 893 36-0
Fax +49 89 893 36-285

EOS of North America, Inc.
28970 Cabot Drive
Novi, MI 48377-2978
Phone +1 248 306 0143
Fax +1 248 306 0298

Further EOS subsidiaries

EOS France, Lyon
Phone +33 (0) 4 37 49 76 76

EOS India, Chennai
Phone +91 44 2815 8794

EOS Italy, Milan
Phone +39 02 33 40 16 59

EOS Singapore
Phone +65 65 62 78 50

EOS UK, Warwick
Phone +44 19 26 62 31 07

Web: **www.eos.info/dental**
E-Mail**: info@eos.info**

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Dental models laser-sintered on FORMIGA P 100

Profile

EOS was founded in 1989 and is today the worldwide market leader in laser-sintering systems and materials. Laser-sintering is the key technology for e-Manufacturing, the fast, flexible and cost-effective production of products, patterns or 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 you application-optimized solutions for the dental market adapted to successfully implementing e-Manufacturing with laser-sintering.

EOS Worldwide

- Worldwide recognized technology
- Leader for high-end systems for e-Manufacturing
- Customers in over 30 countries
- EOS subsidiaries in over 7 countries
- Distributors in over 20 countries

Dental copings laser-sintered in dental CoCr-alloy on EOSINT M 270, before and after veneering

Direct Metal Laser-Sintering (DMLS) – Metal Parts Directly from CAD Data

Direct Metal Laser-Sintering (DMLS) is a manufacturing technology that builds up parts additively layer by layer. In order to manufacture complex parts out of metal powder, this material is processed via laser-sintering on the EOSINT M 270 system from EOS. Even highly complex geometries are created directly from 3D CAD data, fully automatically, in just a few hours and without any tooling. It produces parts with high accuracy and detail resolution, good surface quality and excellent mechanical properties. The EOSINT M 270 machine fuses metal powder into a solid part by melting it locally using a focused laser beam. In the process, 20 micron layers are created, controlled by sophisticated hard and software. The laser only exposes material used for the copings and bridges. Non exposed material can be used as virgin material, thus minimizing the need for recycling. As a consequence, e-Manufacturing saves up to 75% on material costs.

Benefits of DMLS

- High accuracy and detail resolution
- Good surface quality
- Excellent mechanical properties

Vision - The End of Casting

Historically, porcelain fused to metal (PFM) restorations have been manufactured through the traditional lost wax casting process. The recent proliferation of dental CAM/CAM systems is having little effect on the PFM manufacturing process because machining metal substructures in popular alloys is inefficient and costly. However, now with e-Manufacturing from EOS, dental laboratories can produce bridges and copings directly from CAD data – without investment casting. The technology virtually relieves the dental laboratory of the least valuable tasks in the prosthesis manufacturing chain. The lab no longer needs to spend time waxing, embedding and casting but instead can concentrate on core competencies such as the ceramic veneering of the metal framework. The e-Manufacturing process is faster, more economical and requires only a minimum amount of manual labour, while providing the dental lab with a scalable technology, irrespective of technician availability. At the same time, the cycle times decrease to a minimum, thus resulting in an enormous increase in productivity and a definite technological advance for the dental industry.

Platform with copings laser-sintered on EOSINT M 270

e-Manufacturing - Revolutionary Technology for Dental Laboratories

With the traditional casting production process a dental technician can currently only produce about 20 dental frames per day. With e-Manufacturing via laser-sintering, however, around 450 units for crowns and bridges can be produced within 24 hours, at the same time ensuring constant product quality. This corresponds to approximately three minutes average build time per unit. Operating unattended, one DMLS machine can run two manufacturing cycles per day, thus producing approximately 80,000 units per year. The process requires human operation only for loading and unpacking. This makes laser-sintering a true industrial production process where high productivity meets consistent quality standards at reduced costs.

PFM restorations manufactured by the DMLS process exhibit the type of consistent quality that only CAD/CAM can achieve. For dental prostheses, the EOSINT M 270 processes a metal powder in a special EOS CobaltChrome SP2 alloy which is 100% biocompatible and CE certified (CE 0537) for use in the dental industry. Dentists will appreciate the consistent fit and margin lines providing more value than simple cast parts. The 0.1 mm spot sized fibre laser of the DMLS system allows for a typical accuracy of +/- 20 micron. Thus, DMLS enables a more precise manufacturing process for this critical region than most other metal manufacturing alternatives. Laser-sintered metal substructures are fully dense and accurately match the plaster model.

Benefits

- e-Manufacturing is an industrial manufacturing method
- One laser-sintering system produces approx. 80,000 units per year
- e-Manufacturing costs less than investment casting
- e-Manufacturing offers consistent margins and fit
- e-Manufacturing can be scaled up as the lab grows

Efficiency with CAD/CAM-Enabled Production of Dental Prostheses

3D-Scanner

Impression

Dentist takes dental impression (Alternatively: Intraoral Scanner)

Photo: CURADENT

CAD-Design / STL Data

3D-Scanner

Dental lab scans plaster model or impression (Example Scanner 3Shape)

CAMbridge

STL Data

Designing crowns and bridges via CAD-Design

EOSINT M 270

CAMbridge

Professional software for automatic part placement, orientation and identification with "one click".

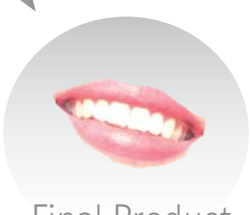
Veneering

EOSINT M 270

Building parts on EOSINT M 270

Final Product

Veneering



Final Product

Mass Customization - With Optimized Materials from EOS

EOS has developed a biocompatible cobalt chrome alloy especially for dental prostheses. EOS CobaltChrome was developed in close collaboration with dental laboratory technicians and is a cobalt chrome molybdenum-based superalloy designed specifically for porcelain fused to metal (PFM) restorations. The material has a coefficient of thermal expansion of 14.0 - 14.5 x 10^{-6} m/m °C and thus provides optimum adhesion of commercial ceramics.

EOS CobaltChrome is long lasting and has gained broad market acceptance since its market introduction in 2005. Its composition corresponds to type 4 CoCr dental material in EN ISO 16744 standard. It also fulfils the chemical and thermal requirements of EN ISO 9693 for CoCr PFM dental materials and the requirements of EN ISO 7504 and EN ISO 10993 regarding the biocompatibility and cytotoxicity of dental materials. The material has also been certified according to CE regulations (CE 0537).

Material Data - EOS CobaltChrome SP2

Mechanical properties of parts at 20 °C

	as built	**after stress relieving at 750 °C for 1 hour**
Ultimate tensile strength	Min.: 800 MPa, 116 ksi	Min.: 900 MPa, 131 ksi
	(typical: 1050 ± 100 MPa, 152 ± 15 ksi)	(typical: 1100 ± 100 MPa, 160 ± 15 ksi)
Proof strength (Rp 0.2 %)	Min.: 600 MPa, 87 ksi	Min.: 700 MPa, 102 ksi
	(typical: 750 ± 80 MPa, 109 ± 12 ksi)	(typical: 900 ± 80 MPa, 131 ± 12 ksi)
Elongation at break, A5	Min.: 10 %	Min.: 2 %
	(typical: 14 % ± 2 %)	(typical: 10 % ± 2 %)
Young's Modulus	Min.: 170 GPa	Min.: 180 GPa
	(typical: 200 ± 20 GPa)	(typical: 200 ± 10 GPa)
Hardness HV10	Min.: 320 HV	Min.: 350 HV
	(typical: 360 ± 20 HV)	(typical: 420 ± 30 HV)

Thermal properties of parts in as-built condition

Coefficient of thermal expansion	14.0 – 14.5 x 10^{-6} m/m°C
(25 - 500 °C)	7.78 – 8.06 x 10^{-6} in/in°F
Coefficient of thermal expansion	14.2 – 14.6 x 10^{-6} m/m°C
(20 - 600 °C)	7.89 – 8.11 x 10^{-6} in/in°F
Melting interval	1380 - 1440 °C,
	2516 – 2624 °F

Please refer to the relevant EOS Material Data Sheet for details.

Properties and values of parts at 20 °C after firing at 800°C for 5 minutes according to EN ISO22674: 2006.

EOSINT M 270 - The Technological Heart of Direct Dental Manufacturing

EOSINT M 270 is the only system that provides restorations made with the DMLS process. Its solid-state fibre laser offers high performance and reliability over years of use. Fine focusing optics enable excellent detail resolution and part quality, while a variable focus diameter allows increased productivity and broad process control. The inert gas environment in the process chamber results in fully dense restorations without porosity.

EOSINT M 270 - Direct Metal Laser-Sintering (DMLS) system for the production of dental substructures and other end products directly in metal.

Technical Data - EOSINT M 270

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 - 25 mm^3/s (0.0001 - 0.001 in^3/sec.)
Layer thickness (material-dependent)	20 - 60 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^3/h (102 psi; 26.2 yd^3/h.)

Dimensions (B x D x H)	
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.)

EOS & Partners - BEGO

Laser-Sintered Dental Products "Made in Germany"

Bremen-based BEGO is one of the leading dental companies worldwide offering a broad range of products and services "Made in Germany" with its three business units BEGO Dental, BEGO Medical and BEGO Implant Systems. BEGO has been using EOS laser-sintering technology with great success.

Licence Agreement: EOS GmbH Electro Optical Systems, BEGO Medical GmbH and BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG have signed a patent licence agreement under which EOS receives from both BEGO companies a worldwide licence for all patents relevant for laser-sintering. This especially pertains to the production of dental prostheses and/or dental auxiliaries using laser-sintering and includes, among others, EP 1021997 and US 7,084,370. EOS dental customers receive a sublicence to these patents for dental manufacturing.

Benefits

- Provides legal security for the customer
- Enables future synergy effects
- Advances technology in the dental area

BEGO
Partners in Progress

EOS & Partners - Sirona

Building Dental Restorations with DMLS

Sirona is a company dedicated to producing the finest dental equipment. EOS and Sirona joined forces to develop a dental process using the M 270 technology from EOS, to replace the traditional lost wax casting production process. As a result, Sirona's dental laboratory now works significantly more efficiently. Patients benefit from shorter turnaround times for orders and dental technicians can focus on their key competence: the craftsmanship of veneering.

Benefits

- Reduced turnaround times for orders (appr. two working days only)
- More rapid production processes
- Dental technicians can focus on their key competence: veneering

sirona.
The Dental Company

Beyond Metal Laser-Sintering - Dental Model Manufacturing

The newest scanners – among them impression and intraoral scanners – can scan the data of a desired restoration and send it directly to the dental laboratory for further processing. This no longer requires the creation of a plaster model though it is still needed for post-processing and occlusion testing. This is where polymer laser-sintering comes into play and can fill the gap. Using the existing data created with the scanner, a FORMIGA P 100 can create a plastic model to enable the proper post-processing of the restorations. Moving forward, metal as well as plastic laser-sintering will play a vital role in the cost efficient production and veneering of dental restorations.

Benefits

- Dental Model is manufacturable in 2 variants:
  - 100 µm: economically priced; good quality
  - 60 µm: economically priced; excellent quality
- Proven accuracy
- No manual finishing needed (no supports)

FORMIGA P 100 - Plastic laser-sintering system for dental models.

Dental model laser-sintered on FORMIGA P 100