

Technical description

Status: October 2015

1 EOSINT M 270 Machine

The machine comprises a process chamber with recoating system, elevating system and platform heating module, an optical system with laser, a process gas management system, a process computer with process control software, and a set of standard accessories. The machine components are integrated into a robust machine frame. During operation the process chamber is secured by interlock. Requirements of laser safety class 1 are met. When closed, the control cabinet's specifications correspond to IP 54. The system carries the CE designation.





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1.1 Basic data

- | | |
|--|---------------------------------------|
| - dimensions (w x d x h) | 2000 mm x 1050 mm x 1940 mm |
| - weight | approx. 1130 kg (without powder) |
| - mains supply (three phase system) | 400 V +6 %/-10 % at 50/60 Hz |
| - mains fuse protection | 3 x 32 A |
| - maximum power consumption (incl. cooler) | 5.5 kW |
| - compressed air consumption | approx. 20 m ³ /h at 7 bar |

Full details including required floor space, connections and environmental requirements (temperature and humidity range etc.) are given in the Installation Conditions.

1.2 Optical system

The optical system creates and positions the laser beam to fuse (melt or otherwise solidify) the powder material. The laser emits a laser beam which is guided by an optical fibre, a beam expander optic, the scanner mirrors and a focussing objective. All optical surfaces have special coatings to guarantee effective beam guidance.

1.2.1 Laser

- | | |
|------------------------------|----------------|
| - Yb (Ytterbium) fibre laser | |
| - wavelength | 1060 - 1100 nm |
| - nominal power | 200 W |
| - power in the building area | 195 W |

1.2.2 Scanner

The scanner is a high-speed scanner unit comprising precision galvanometer scanners with temperature compensation, actively cooled ultra-high reflection mirrors, integrated servo- and interface electronics, digital data transfer from the system's control computer and digital signal processing. It also incorporates an integrated home-in sensor, which detects and corrects any scanner drift at regular intervals. A high positional stability of the laser beam is thereby maintained even under varying environmental conditions or with high thermal loading due to long exposure times and large building jobs.



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- exposure area 250 mm x 250 mm
- exposure speed up to 7000 mm/s
- repeatability, scanner position < 11 µrad

1.2.3 Focussing objective

The focussing objective is a so-called F-theta objective, which focuses the laser beam onto a flat field. Below the F-theta objective is a protective glass, with a pneumatic lens protection device which prevents dirt settling on the lens surface. The laser beam focus is automatically switched between two pre-defined sizes during the exposure using a dual focus system: A fine focus is typically used for accurate exposure of contours and a broader focus for fast exposure of larger areas. The sizes are manually selected according to the material being used.

- diameter of laser beam at building area (variable) 100 - 500 µm
- focal length of F-theta (flat-field) lens 410 mm

1.3 Recoating and elevating system

The recoating system creates the layers of powder. It comprises a recoating element, a recoater arm and a linear drive, which moves the recoater arm in the horizontal direction. Different options are available for the recoating element. For CobaltChrome and steel materials a wear-resistant ceramic blade is recommended. For titanium and aluminium materials a high-speed steel (HSS) blade is recommended.

- positioning speed 40 - 500 mm/s

The elevating system comprises dispenser, building and collector systems. The building system moves the platform carrier in the vertical direction. The part is built on a building platform which is mounted to the platform carrier.

The building platform carrier has a three-point mounting and two motorised adjustment screws for a simple and exact adjustment of the platform. In combination with a measurement tool which is mounted on the recoater arm, this allows a quick and easy alignment of the platform at the start of each job. It also includes reference positioning holes for a precise and reproducible positioning of the building platform with corresponding positioning holes and by means of positioning pins.



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The building system has two parallel guide rails with backlash-free guides for highest positioning accuracy and long operating lifetime.

- position repeatability $\leq \pm 0.005$ mm
- maximum build height 215 mm including building platform

Note: see section 3 for building platform thicknesses.

1.4 Process computer with process software

The process computer with process software (PSW) controls the building process and the system's measuring and control components.

1.4.1 Process computer

Industrial-type PC:

- processor at least Pentium 4 with at least 2 GHz
- main memory at least 1 GB
- hard disk > 10 GB
- monitor 15" flat-screen LCD colour
- data interface 10/100 Mbit Ethernet
- other peripherals wipe-clean keyboard, mouse

1.4.2 Process software PSW

Using the process software, the building process (job) is prepared, protocolled and filed. Data can also be displayed in a graphical layer format directly on the machine with this software. It includes many features which allow the operator to obtain optimal results from the build process. Further details are available on request.

- operating system Microsoft Windows
- data input format SLI (according to EOS specifications)



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1.5 Platform heating module

The platform heating module reduces temperature gradients between the building platform and the part to reduce internal stresses and ensure a good bonding of the first layers. It also removes any moisture from the powder and helps to maintain the part at a constant temperature during any interruptions in the building process to ensure maximum process reliability.

- operating temperature approx. 40 – 80 °C

1.6 Laser cooler

The laser of EOSINT M 270 requires cooling. A water-air cooler is included as standard.

- refrigerating capacity 1.4 kW

1.7 Standard accessories

A set of standard equipment for cleaning, tools for job start and removal of parts is included.



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2 Materials

A number of different materials are available for use with EOSINT M 270 systems, offering a broad range of e-Manufacturing applications, as summarized below. Please refer to the relevant material data sheets for further details. Further materials are continuously being developed. Please ask for the current status.

2.1 EOS CobaltChrome SP2

EOS CobaltChrome SP2 is a Co, Cr, Mo and W based alloy in fine powder form for production of dental restorations in EOSINT M 270 system. Its composition corresponds to type 4 CoCr dental materials in EN ISO 22674:2006 standard. The resulting parts also fulfil the chemical and thermal requirements of EN ISO 9693 for CoCr PFM (porcelain fused metal) of dental materials (Ni content: < 0.1 %, no Cd or Be) and requirements of EN ISO 7504, EN ISO 10993-1:2003 and EN ISO 10993-5:1999 regarding the biocompatibility and cytotoxicity of the dental materials. PSW 3.3 or higher is required for processing this material.

Typical applications:

- dental restorations (crowns, bridges etc.)

3 Building platforms

The parts are built on a building platform, which can either be integrated into the part (e.g. for tooling inserts) or separated from the parts after the building process. In the latter case the platform can normally be reused many times by remachining the surface. DirectBase building platforms are 250 x 250 mm in size to fill the build area, and are attached to the carrier plate in the process chamber by four corner screws. They are available in various materials and specifications, as summarized in the table below:

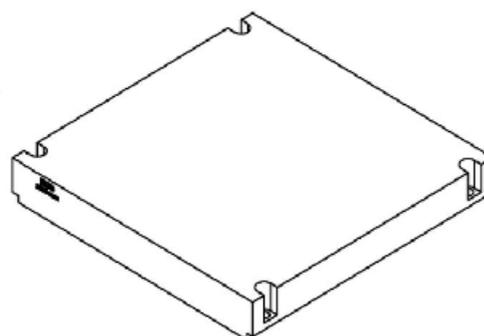


Fig.: Building platform DirectBaseTS36P

Name	Material	Nominal thickness	Features
DirectBase S22	1.1730	22 mm	ground surface; 8 mm fixation holes
DirectBase S36	1.1730	36 mm	ground surface; 8 mm fixation holes
DirectBase TS36P	1.2083	36 mm	ground surface; 8 mm fixation holes; reference positioning holes; undercuts for Platform Handling option.

Recommendations for use:

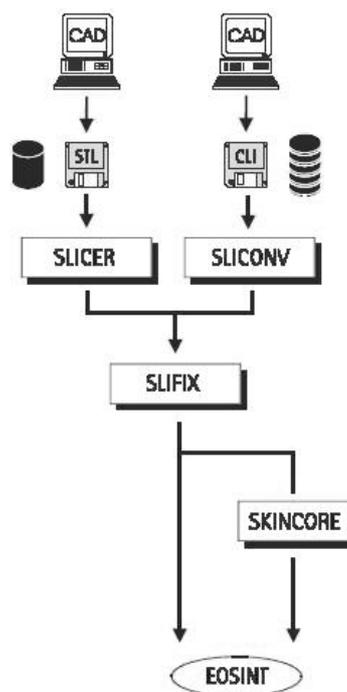
When building heavy jobs, it is recommended to use platforms with undercuts in combination with the Platform Handling option (DirectBase TS36P). See section 6.3.2 for details of the Platform Handling option.

When building large or massive parts, it is recommended to use thicker platforms, e.g. 36 mm.

4 Data preparation

Pre-processing of CAD data is necessary to create the SLI data which are required for the build process. The main requirement is the conversion of three-dimensional (3D) structures into a sequence of two-dimensional (2D) layers called "slices". Further requirements depend on the individual process chain from CAD design to the build process and may include repairing, cutting or scaling 3D structures. Applications which involve removing the built part from the building platform (typical DirectPart applications) require in addition the creation of supporting structures.

The most commonly used conversion of CAD data is to the STL format, which approximates the part geometry by a net of triangles. Several software packages are able to work with part data in IGES, VDA-FS, STEP, CATIA, PRO/E and many other formats as well.



An IBM compatible PC is required for this data pre-processing. The equipment should meet the following requirements:

- processor > 1 GHz, Pentium IV recommended
- RAM 512 MB (> 1024 MB recommended)
- graphic board > 128 MB recommended, open-GL
- network interface RJ45/100BaseTX
- network protocol TCP-IP
- operating system Windows NT 4.0, 2000 or XP
- disk-drives CD-ROM
- monitor 17" (1024x768 true colour)

For additional demands e.g. on processor performance or RAM, especially with simultaneous use of external data processing software, please refer to the corresponding supplier documents.

Various software packages are available for data preparation on a PC, as described below.



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EOSINT Systems:

- visualisation of parts in STL format
- process-compatible placement of parts
- repairing and editing functions
- quality assurance of STL files
- reinforcements and supports (depending on part geometry and technology) using additional module SG or volume SG
- import of IGES, VDA, CATIA and Unigraphics data using additional modules

4.4 EOSTYLE

EOSTYLE is a software package for advanced support generation. It has been programmed by Materialise exclusively for EOS and is strongly recommended for any EOSINT M customers who wish to build positive parts (DirectPart application) or loose inserts for tooling. EOSTYLE includes the features:

- Angled Supports can support overhanging surfaces from the side
- Improved Tooth Design minimizes surface defects when breaking away supports
- Radius Function improves the bonding of supports to the platform
- Optimized Block Support with definable orientation and fragmentation for easier and quicker removal
- Advanced Gussets reinforced gusset supports with definable angle
- Gap Support enables contactless supporting for certain geometries

This product is integrated within Materialise Magics RP and requires MagicsRP (minimum V9.05) and SG module. The price of EOSTYLE module already covers the maintenance fee for the first year of usage. Further agreements to ensure the compatibility for future versions of Magics have to be concluded directly with Materialise.

4.5 CAMbridge

CAMbridge is a software package for data preparation for dental restoration applications. It is available for every actual windows operating system (Vista, Win XP, Win 2000, Win 7) and covers the needs of data processing for EOSINT M 270 Dental:

- part visualisation



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- automated generation of support structures
- automated detachable ID tags
- automated positioning on the building platform
- fast and simple creation of a job-file for PSW

Note: A special dental training for production of dental restorations is obligatory due to statutory requirements, e.g. for production of medical devices.

EOS recommends the use of the optional data preparation software CAMbridge with the Dental package.

4.6 Software recommendations

The following software is recommended to run an EOSINT M 270 system.

For producing parts which do not need support structures, e.g. tooling inserts:

- EOS RP-Tools (single non-expiring licence)
- EOS PSW offline (single non-expiring licence)

For producing parts which need support structures additionally:

- Materialise Magics RP licensed version with additional module SG
- EOSTYLE

To ensure compatibility with future versions of Magics, a maintenance contract with Materialise can be purchased.

For producing dental restorations:

- CAMbridge



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5 Machine installation mode

5.1 Dental package

With this configuration the EOSINT M 270 system is set up for optimal production of dental restorations using EOS CobaltChrome SP2 material, in accordance with statutory requirements for the production of these Class IIa medical devices using the CE-certified material. The machine hardware is set up in the same way as for the Standard package but qualified especially for using EOS CobaltChrome SP2 material.

This package also includes a special training for the dental application and a certificate confirming a paid-up licence to certain third-party patents relating to the production of dental restorations. The training is obligatory due to the statutory requirements for the production of medical devices.

EOS recommends the use of the optional data preparation software CAMbridge with this package.

For details of connections, please refer to the Installation Conditions for EOSINT M 270 Standard Version.

6 Options

Depending on the application, various post-processing steps such as surface polishing may be required, for which additional equipment can be needed. The most relevant equipment and sources for obtaining these are summarized below. Further details and recommendations of how to use such equipment are available on request in EOS Application Notes, Training Manual etc.

6.1 Vacuum cleaner

A vacuum cleaner is used to clean the process chamber. To ensure safe operation, only industrial vacuum cleaners which are suited to these specific requirements, meet the required safety class and have correspondingly suitable accessories, should be used.

6.1.1 Standard industrial vacuum cleaner



This is an industrial-type vacuum cleaner with bag, specified for dust class H and electrically conductive accessories (hose and nozzles).

Fig.: Vacuum cleaner Ruwac WSZ 2210

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6.1.2 Wet separator (liquid-filled vacuum cleaner)



This vacuum cleaner collects sucked-in powder, dust etc. in liquid and therefore offers the highest safety level. It is suitable for use with all EOS materials including reactive powders as well as flammable and even explosive dust. When using EOS Titanium and Aluminium powder materials, only this vacuum cleaner must be used.

Fig.: Wet separator *Ruwac NA35 D1 B1*

6.2 Powder handling equipment

6.2.1 Sieving Module



Prior to re-usage in the EOSINT M 270, the metal powder should always be sieved to remove agglomerates or other coarse particles. A sieve insert for manually sieving powder inside the process chamber is supplied with the machine.

The Sieving module is used for sieving, mixing and ensuring the even consistency of the metal powder that has been conveyed from the dispenser duct, building duct and collector duct on the machine using the Conveying module. The Sieving module is an external sieve that allows the rapid sieving of larger amounts of powder in a closed unit.

Fig.: Sieving module
for EOSINT M 270

- Sieve fabric mesh size Standard 63 μ m, other sizes possible
- Principle of operation Vibrating sieving with ultrasound cleaning

6.3 Building platform handling equipment

6.3.1 Erowa clamping system

This option enables building platforms to be mounted in the EOSINT M 270 using a clamping system of the type Erowa Powerchuck 150. In this way, finished jobs can be quickly and easily removed from the machine and transferred to other machining stations e.g. milling or EDM machines which are fitted with an Erowa Powerchuck 150. To achieve this, the building platform is mounted onto a pallet which fits into the Powerchuck 150 unit. Clamping and releasing the clamping system is achieved via a compressed air connection with quick-release connection. Additional pallets can be ordered to enable several jobs to be processed on different machines at the same time.

The Erowa clamping system can be removed from the machine and replaced by a standard building platform at any time. When using the Erowa clamping system, the maximal build height is reduced by approx. 98 mm compared to standard operation.

- Position repeatability of the pallet 0.002 mm



Fig.: Erowa Powerchuck 150 clamping system
(mounted in an EOSINT M system)

6.3.2 Platform handling trolley



This option allows a safe and user-friendly removal of build platforms from the process chamber. It is especially recommended for users who build heavy jobs and/or use positioning pins or the Erowa clamping system. The trolley can also be used for safe and user-friendly removal of used filters from the recirculating filter system (2009 version).

- Maximum load

Fig.: Handling trolley for platforms

6.4 Micro shot-peening

Micro shot-peening is a post-processing method which enables the surface quality to be significantly improved very quickly and easily, both for direct use and as a basis for further polishing. It is strongly recommended for all materials. Depending on the application, the following packages are recommended. Detailed recommendations for certain applications are included in the Application Notes "Surface finishing of DMLS parts". For applications which demand a high metallurgical purity, for example medical implants, it is necessary to carefully consider which peening media to use and how to handle the parts.

Please note that EOS does not supply consumables or spare parts except as part of these packages. Such products should be ordered directly from the manufacturer Iepco (www.iepco.ch) or their local representative. Contact details can be provided on request.

6.4.1 Shot-peening basic package

For most DirectTool and DirectPart applications, it is sufficient to compact and peen with the following basic package:

- 2 shot-peening systems IEPCO Peenmatic 750S, each with rotary table

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- 1 fine nozzle Micropeen 250 (integrated into one of the Peenmatic 750S)
- 5 kg shot-peening medium IEPCONORM A (test quantity)
- 25 kg shot-peening medium IEPCONORM B-4
- 25 kg shot-peening medium IEPCONORM C

6.4.2 Shot-peening upgrade package Micropeen 250

For fine slots, which are not accessible with Iepconorm B-4, the finer Iepconorm B-2 can be used together with a Micropeen 250 fine nozzle. In this case care should be taken to avoid damaging other surfaces due to the more abrasive nature. The corresponding upgrade package comprises:

- 1 fine nozzle Micropeen 250 + console for mounting on the second Peenmatic 750S shot-peening system
- 25 kg shot-peening medium IEPCONORM B-2

6.4.3 Shot-peening premium package

To achieve the best quality with injection moulding inserts we recommend the steps of cleaning, compressing, peening and polishing with the Premium Package comprising:

- 3 shot-peening systems IEPCO Peenmatic 750S, each with rotary table, two of which with fine nozzle Micropeen 250
- 25 kg shot-peening medium IEPCONORM A
- 25 kg shot-peening medium IEPCONORM B-4
- 25 kg shot-peening medium IEPCONORM C

6.4.4 Shot-shot-peening single package (former called dental package)

To achieve the best quality with dental restorations we recommend the step of cleaning with the Single Package comprising:

- 1 shot-peening systems IEPCO Peenmatic 750S
- 25 kg shot-peening medium IEPCONORM C

6.5 Thermal post-processing

Depending on the material and application, a thermal post-processing can be advisable, for example for hardening or stress-relieving. This is especially recommended for the EOS StainlessSteel, MaragingSteel, CobaltChrome and Titanium materials. Detailed recommendations are available on request. For these materials we recommend the following equipment:

- Electrically heated chamber furnace type H 41/H with controller C 250
 - Furnace chamber size (w x d x h): 350 x 500 x 250 mm
 - External dimensions (w x d x h): 840 x 1100 x 1320 mm
 - Weight: 260 kg
 - Electr. connection: 15.0 kW
 - Connection voltage: 400 V
 - Tmax. 1280 °C
- Protective gas annealing box with protective gas connection
- Charging plate for N 41/H
- Charging trolley CW 1

This equipment can be ordered directly from the following supplier:

Nabertherm GmbH
Bahnhofstr. 20
D-28865 Lilienthal/Bremen

www.nabertherm.de
Tel: +49 (0) 4298 922-0
Fax: +49 (0) 4298 922-129



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7 Services

7.1 Set-up and installation

7.1.1 System EOSINT M 270

The system price includes set-up and installation at the customer's site according to given specifications. For set-up and installation requirements see the corresponding machine-specific Installation Conditions available from EOS. The qualification and commissioning of the system for one powder material by our service personnel is included in the system price. The qualification and commissioning for additional materials requires approximately one day of service work per material if ordered at the same time. Each material qualification uses typically two building platforms and a small amount of the relevant metal powder.

7.1.2 Software

Installing the EOS RP-Tools from CD ROM can easily be done by the user. To run the installation local administrator rights are required. The operation language can be selected between German, English, French or Italian. The use of the software is protected by a password provided by EOS.

The installation of Magics RP from CD ROM includes EOSTYLE, also requires administrator rights and can be done by the customer. The license password is provided by Materialise.

7.2 Documentation

7.2.1 System EOSINT M 270

Full documentation in accordance with CE-conformity is provided, including:

- Installation Conditions
- Operation
- Troubleshooting, Maintenance and Spare Parts
- Software Reference PSW
- Accessories and Options



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7.2.2 Software

EOS RP-Tools is provided with a user manual according to CE. The manual can be delivered in German, English, French and Italian language immediately; for other languages please ask for delivery time and costs.

Materialise Magics RP is provided with a user manual and a comprehensive online help in German or English language to be selected during installation. The operation language is English or German, also to be selected during installation.

EOSTYLE module in Magics SG contains a separate online help.

7.3 Training

7.3.1 System EOSINT M 270

To ensure that the machine is operated properly, basic training for operation of machine, its accessories and operating software are included in the purchase price.

Basic training includes:

- technology basics
- machine use
- handling of accessories
- process description and control
- data pre-processing* (EOS RP-Tools)
- part fabrication*
- post-processing (finishing) of parts

Basic training for up to three participants lasts five days and is held at EOS GmbH's premises in Krailling, Germany. If more than one powder material is ordered, additional training may be necessary (available by agreement). About 4 to 6 weeks after installation, a one-day start-up visit at the customer's site can be made. A training manual in English language is handed out to the participants.

A basic knowledge of PC operation including Microsoft Windows is a prerequisite for the basic training.

Upon special agreement, EOS GmbH is pleased to offer its customers additional training or workshops to gain deeper knowledge about the process chain and its optimisation.



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7.3.2 Software

Due to the comprehensive user manual, training for EOS RP-Tools is not necessary. Customers purchasing the software with an EOSINT M 270 will get an introduction into the use of the software during the basic system training.

Training for Magics RP and modules is provided by Materialise at its premises or at customer's site. For higher efficiency it is recommended to participate in a Magics training at Materialise before starting the training course at EOS.

Due to the online help in EOSTYLE, training is not necessary. Customers purchasing the software with an EOSINT M 270 will get an introduction into the use of the software during the basic system training.

7.4 Service program

To maintain the system's continuous availability, EOS offers different contract options in its service programme. The options take into account the individual requirements of the operator.

For detailed information about the services offered under the contract options please refer to our separate offer.

The data are based on our latest knowledge and are subject to changes without notice. They are provided as an indication and not as a guarantee of suitability for any specific application.

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