


E-TEC Tecnologias de Engenharia

Sua melhor parceria em prototipagem rápida e pequenos lotes de produção

E-TEC
e-manufactured parts

Fernando Almeida
(35) 8897-5090 e (35) 9115-5190
etecprototipos@gmail.com
www.e-tecbrasil.com.br
Cambuí – Minas Gerais

eos
e-Manufacturing Solutions

Clientes de várias indústrias de vários países já se beneficiam com a tecnologia da EOS para construir seus protótipos e seus produtos

Apenas alguns clientes:

Source: EOS

EOSINT P 385 – SLS (Selective Laser Sintering)

Características

- **Envelope de construção: 340 mm x 340 mm x 620 mm**
- **Quais quer peças de dimensões maiores que o envelope de construção, podem ser cortadas, construídas e coladas posteriormente**
- **Precisão do processo +/- 50 mícrons**
- **Formatos de CAD 3D suportados:**
  - **X_T, STP, IGES, Unigraphics, Pro-Engineer, Solidworks e STL**
- **Todas as peças constuídas são protótipos funcionais**
- **As peças podem ser furadas, fresadas, torneadas e retificadas.**
- **Podemos facilmente tornar as peças a prova d'água e sem vazamento de ar**
- **Espessura da camada 0.10mm ~0.15mm**

EOSINT P 385

Pictures not scaled

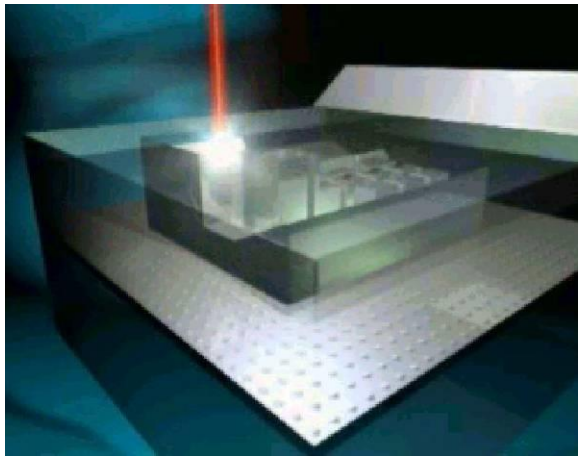
Source: CDR

Sinterização a laser, o que é isto?

Definição de Sinterização a Laser

"Um grupo de procedimentos que produz peças layer a layer através do endurecimento de materiais em pó por exposição da superfície deste pó a um feixe de laser de alta potencia"

Material em Pó

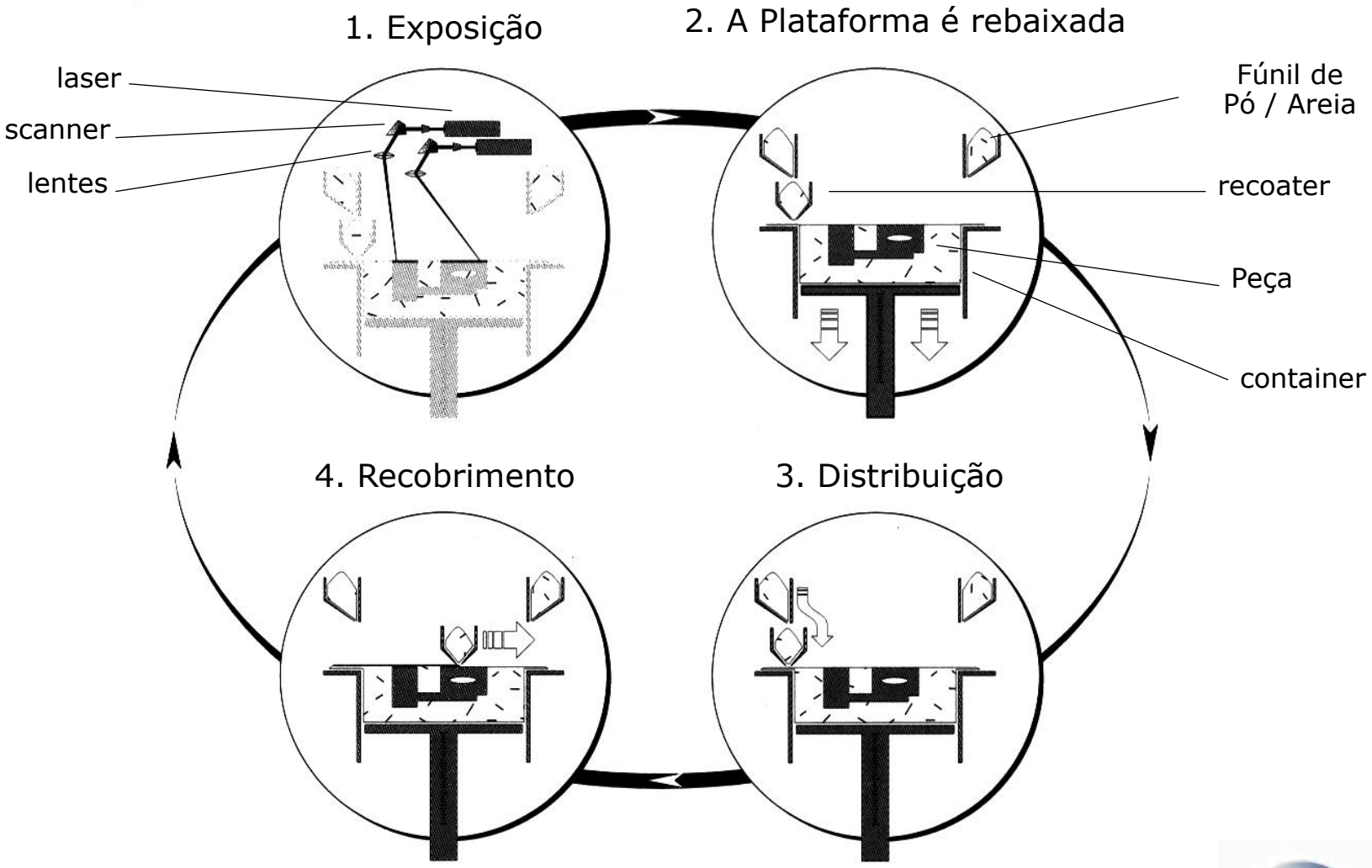


Sinterização a laser

Peça

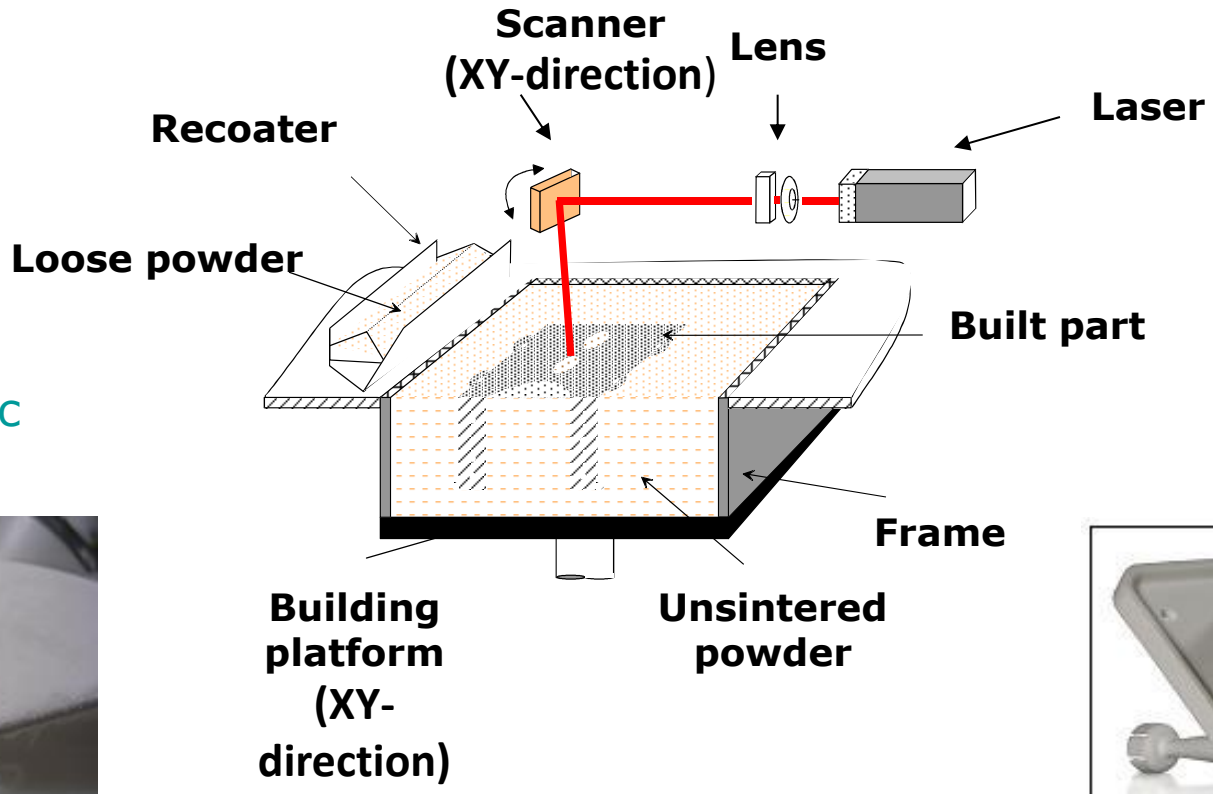
Source: EOS

EOSINT – Princípio de trabalho da sinterização Laser



SOURCE: EOS

O sistema EOS P gera peças plásticas diretamente a partir de polímero em pó



from plastic powder

directly to the plastic part

Source: EOS

EOSINT P 385

Exemplos de componentes laser-sinterizados produzidos com EOSINT P 385

Funil de pó

Acento de caixa de controle

Unidade de ajuste fino

Pyrometer housing

Pictures not to scale

Source: HP

Peças únicas com EOSINT P - Liberdade de criação

requisito:
novos produtos com funcionalidade especial
solução:
DirectPart em EOSINT P
Design para e-Manufacturing

resultado:
tecidos laser-sinterizados
acessórios de moda personalizadas
iluminação, etc

Examples of laser-sintered parts designed by Freedom of Creation

project partner: FOC

SOURCE: EOS, Freedom of Creation

DirectPart – Exemplar único

- Necessidade:
  - Construir uma peça para uma única aparição
- Solution:
  - Sinterização a Laser na EOSINT P 385 com Material PA 2200 material
- Resultado:
  - Milhões de pessoas vêem mas ninguém sabe que o lançador de foguete foi sintetizado a laser

JAGUAR XKR Special Bond Edition

project partner: JAGUAR

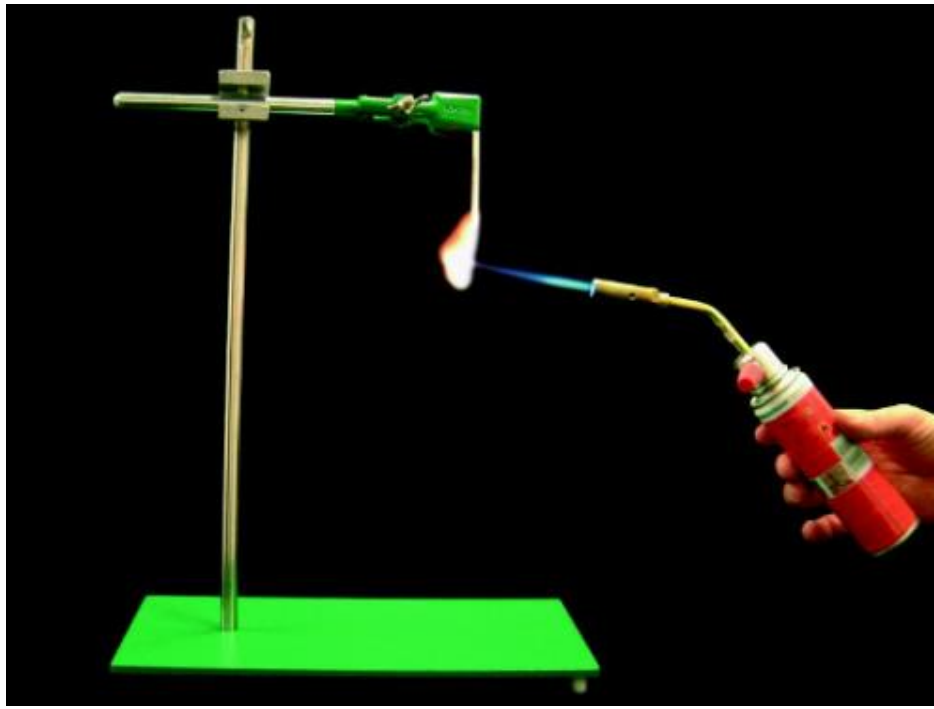
SOURCE: EOS, JAGUAR

E-TEC e-manufactured parts

Novos Materiais

Novas necessidades, novos materiais: Poliamida com retardador de fogo

- PA 2210 FR
  - Norma UL 94 V0
  - Qualificação para uso em aeronaves
  - Baixa inflamabilidade
  - Baixa densidade de fumaça
  - Baixa toxidade de fumaça
  - Baixa liberação de calor
- Novas faixas de temperatura
- Melhorias nas propriedades do material



SOURCE: EOS

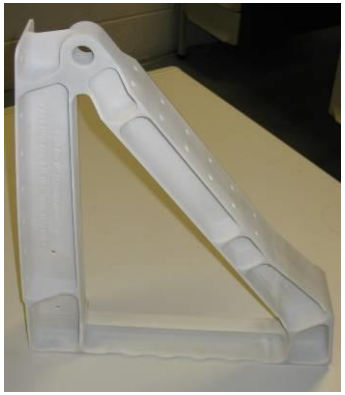
Fabricação de gabaritos de montagem

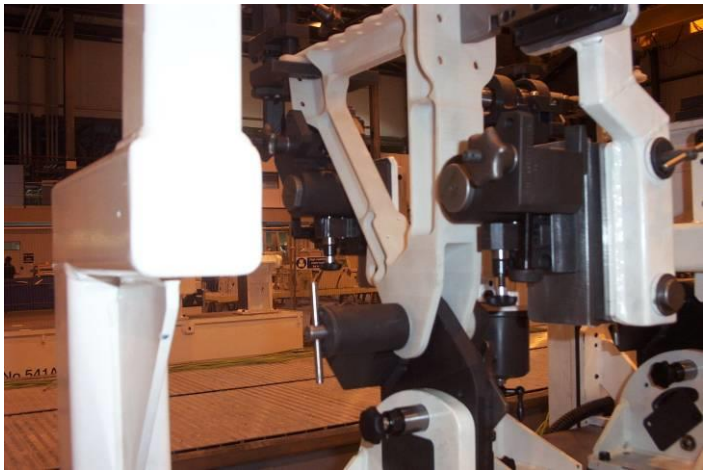
Assembly Brackets

Fixação resistente com parafusos, porcas e arruelas

Marcação de posições de furação e aterragens

Verificação de posições de suporte de ferramentas





AIRBUS

E-TEC e-manufactured parts

Materiais disponíveis
SLS - Selective Laser Sintering

Optimized polymer materials for EOS P systems

Summary of some relevant characteristics

Name of material	Average grain size (µm)	Tensile Modulus (N/mm^2)	Tensile strength (N/mm^2)	Elong. at break (%)
PA2200 SG20	60	In Test	>50 ± 3	In Test
PA 2200	60	1700 ± 150	45 ± 3	20 ± 5
PA 3200 GF	60	3200 ± 200	48 ± 3	6 ± 3
Alumide®	60	3800 ± 150	46 ± 3	3.5 ± 1
PA 2210 FR	-	2250 ± 150	45 ± 3	-
PrimeCast 101	80 ± 5	1600 ± 250	5.5 ± 1.0*/ 1.2 ± 0.3	-
CarbonMide®	60	6100/3400/ 2200**	72/56/25**	4.1/6.3/1.3**

All data are guide values; please see material data sheets for further details

***x-/y-direction**

****x-/y-/z-direction**

Source: EOS

PA2200 SG20®

PA2200 SG20 - very fine multi-functional Polyamide

Properties and applications

Properties

- low refresh rate
- exceptional mechanical properties
- high detail resolution
- high long-term constant behaviour
- parts withstand high-temperature painting and metal coating
- material developed by E-TEC (Out '09) to provide high strength functional parts with special emphasis to minimal part deformation, good tolerance control and minimal porosity
- also available in 20, 30, 38 and 50% glass content

Typical applications

- load-bearing functional parts with durable flexible features
- design parts
- end products
- spare parts

Laser-sintered sports helmet

(Photo: DSM)

Source: EOS

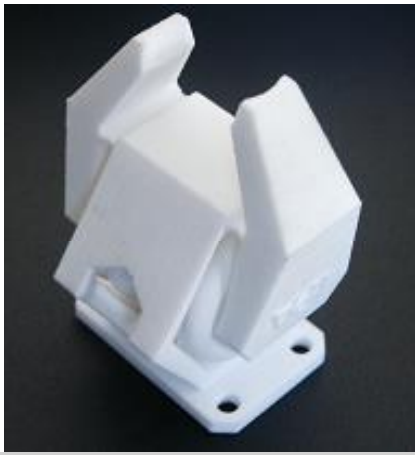
PA2200 SG20 for a fast and cost-effective production of laser-sintered parts

Essential material properties

General material data
- **Average grain size: 60 µm**
- **Bulk density: In Test**
- **Density of laser- sintered parts: In Test**

Mechanical properties
- **Tensile Modulus: In Test**
- **Tensile strength: >50 ± 3 N/mm²**
- **Elongation at break: In Test**
- **Ball indent. hardness: In Test**

Thermal properties
- **Melting point: Greater than180 °C**



Source: EOS

Precision polyamide PA 2200

PA 2200 - very fine multi-functional polyamide

Properties and applications

Properties

- good mechanical properties
- biocompatible with ISO 10993-1
- certified for use with food (except high alcoholic foodstuff)
- high detail resolution
- high long-term constant behaviour
- parts withstand high-temperature painting and metal coating

Typical applications

- parts in design quality
- functional parts
- vacuum casting pattern
- end products
- spare parts

Vacuum cleaner Volta Bolido

16-piece fully functional parts with all mechanical properties like the series part

By courtesy of GT Prototyper AB.

Source: EOS

E-TEC e-manufactured parts

PA 2200 - for fully functional parts under high mechanical and thermal loads

Essential material properties

General material data

- **Average grain size: 60 µm**
- **Bulk density: 0.435 - 0.445 g/ cm³**
- **Density of laser- sintered parts: 0.9 - 0.95 g/cm³**

Mechanical properties

- **Tensile modulus: 1700 ± 150 N/mm²**
- **Tensile strength: 45 ± 3 N/mm²**
- **Elongation at break: 20 ± 5 %**
- **Ball indent. hardness: 77.6 ± 2 N/mm²**

Thermal properties

- **Melting point : 172 - 180 °C**

Steering wheel

Physically identically with series parts. Tests with different design variations.

Source: Volvo Car Corporation, Sweden.

Source: EOS

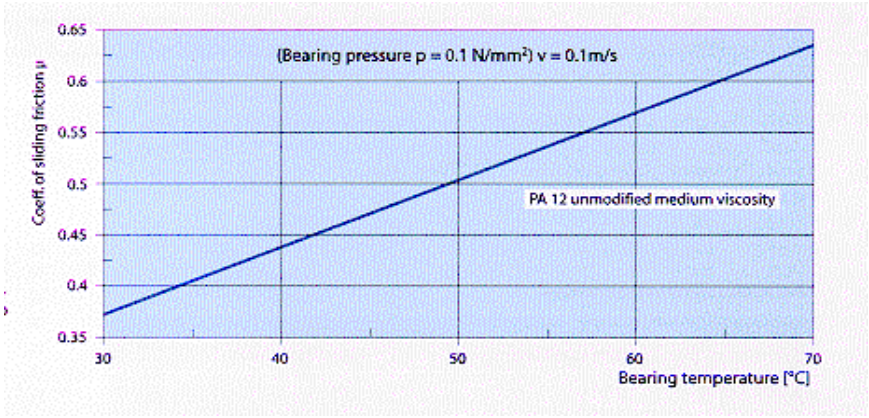
PA 2200 - for parts under high mechanical and thermal load

Property	Measurement Method DIN/ISO	Unit	Value
Volume Resistance	DIN 53482 IEC-Publ. 93	Ω*cm	10^{13} – 10^{15}
Surface Resistance	DIN 53482 IEC-Publ. 93	Ω	10^{13}
Relative Permittivity (1 kHz)	DIN53483 IEC-Publ. 250	10^{2} Hz	3,8
Dielectric Strength	DIN 53481	KV/mm	92
Dielectric Dissipation Factor (1 kHz)	DIN 53483 IEC-Publ. 250	-	0.05 – 0.09

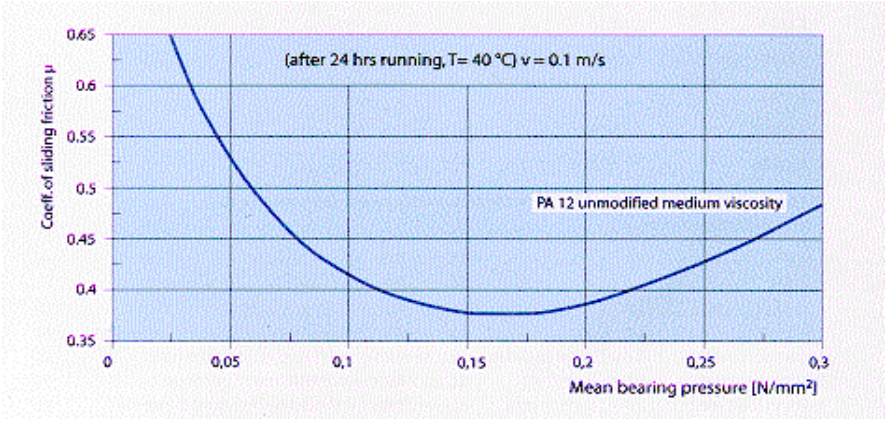
Note: The electrical properties depend on temperature and relative air humidity strongly. The above mentioned values characterise the polyamide material at following conditions: storage at 23 °C, 50 % air humidity up to saturation.
The details contained herein characterise the electrical behaviour of the material and not of a specified building part. The details are based on our present state of knowledge and experience. We do, however, pass them without any warranty or property assurance.

Source: EOS

PA 2200 – low coefficient of friction and very good abrasion resistance* (1)



Coefficient of sliding friction in dependence of bearing temperature
(Lubrimeter test acc. A. Bartel)

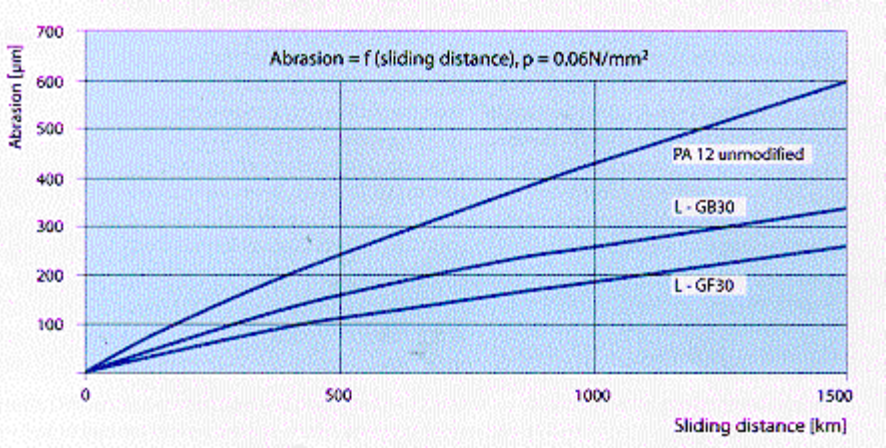


Coefficient of sliding friction as function of pressure load
(Lubrimeter test acc. A. Bartel)

* by the example of PA12

Source: EOS

PA 2200 – low coefficient of friction and very good abrasion resistance* (2)



Abrasion on bearing as function of the sliding distance
L-GB 30 - glass spheres
L-GF 30 - glass fibres

Abrasion of sintered parts to Taber-Test

Material	Measurement method DIN/ISO	Unit	Value
PA 2200	DIN 53754	mg/2000 U	34
PA 3200 GF	DIN 53754	mg/2000 U	30

* by the example of PA12

Source: EOS

Precision polyamide PA 3200 GF

PA 3200 GF - glass-filled, very fine precision polyamide

Properties and applications

Properties

- excellent stiffness
- good thermal properties
- excellent long-term constant behaviour
- parts withstand high-temperature painting and metal coating

Typical applications

- design models with high detail resolution and excellent surface quality
- end products
- spare parts
- load-bearing functional parts with high stiffness
- thermally stressed parts

Elux Twister

Fully representative prototype for series production with savings of 50 % of the development time

Project partner: Electrolux

Source: EOS

PA 3200 GF - suitable for use in all EOS P systems with fine polyamide option

Essential material properties

General material data

- **Average grain size:** 60 µm
- **Bulk density:** 0.59 - 0.62 g/cm³
- **Density of laser- sintered part:** 1.23 - 1.28 g/cm³

Mechanical properties

- **Tensile modulus:** 3200 ± 200 N/mm²
- **Tensile strength:** 48 ± 3 N/mm²
- **Elongation at break:** 6 ± 3 %
- **Ball indent. hardness:** 98 N/mm²

Thermal properties

- **Melting point:** 172 - 180 °C

Air intake unit

Fully functional prototype for development purposes

Project partner: Mann + Hummel

Source: EOS

Fire retardant PA 2210 FR

PA 2210 FR- increased requirements on fire protection

Properties and applications

Properties

- flame-resistant
- good mechanical properties
- high detail resolution
- good long-term constant behaviour
- parts withstand high-temperature painting and metal coating
- wall thickness > 2 mm conform with UL94-V0

Typical applications

- fully functional parts in design quality
- functional parts
- vacuum casting
- end products
- spare parts

Fuel tank

Fully functional part, built within 4 days, and filled with fuel for testing purposes.

By courtesy of FKM Sintertechnik

Source: EOS

E-TEC e-manufactured parts

PA 2210 FR with flame-retardant additives free of halogens

Essential material properties

General material data

- **Bulk density:** **0.52 g/cm³**
- **Density of laser- sintered parts*: 0.05 ± 0.05 g/cm³**

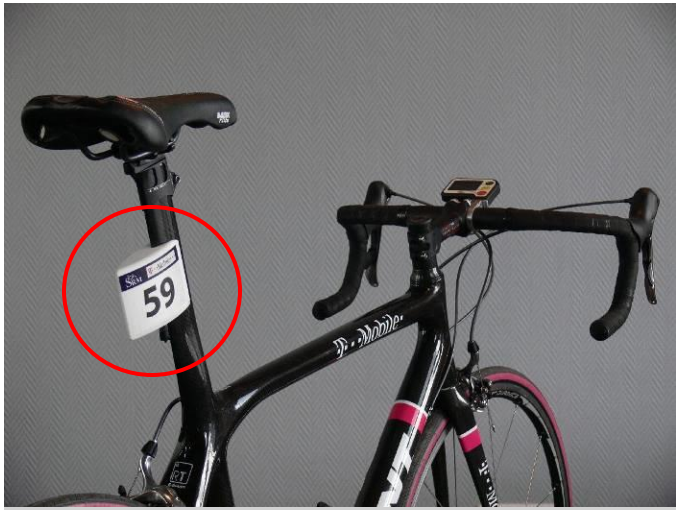
Mechanical properties

- **Tensile modulus:** **2250 ± 150 N/mm²**
- **Tensile strength:** **45 ± 3 N/mm²**
- **Elongation break:** **5.0 ± 1 %**
- **Flexural strength:** **45 ± 2 MPa**

Thermal properties

- **Melting point:** **172 - 180 °C**

*



Telemetric housing

Laser-sintered telemetric housing for Tour de France

Project partner: SRM

Source: EOS

E-TEC e-manufactured parts

PA 2210 FR - for flame resistant parts with high mechanical properties

Burning behaviour

Property	Measurement Method	Value	Unit
Flammability for parts in devices and appliances	UL 94 / HB UL 94 / V-0	1.1 2.0	mm
Flammability properties (Aircraft)	FAR 25.853 b(4) ABD 0031 / AITM 2.0002 BSS 7230 F2	1.5 / 2.0 1.5 / 2.0 0.06 / 0.08	mm inches
Smoke generation (Aircraft)	FAR 25.853 (d), App. F - Part V ABD 0031 / AITM 2.0007 BSS 7238	1.5 / 2.0 1.5 / 2.0 0.06 / 0.08	mm inches
Toxic gas generation (Aircraft)	ABD 0031 / AITM 3.0005 BSS 7239	1.5 / 2.0 0.06 / 0.08	mm inches

Source: EOS

E-TEC e-manufactured parts

Alumide®

Alumide® - aluminium-filled PA 2200

Properties and applications

Properties

- excellent dimensional accuracy
- high stiffness
- metallic appearance
- good finishing properties
- low tool wear post-processing possibilities

Typical applications

- illustrative models
- thermally stressed housings
- jig manufacturing
- tool inserts for injecting and moulding for small series, end products and spare parts

Train door opener

Laser-sintered functional prototype of a door opener for a sliding train door

Source: Createc Engineering Products

Source: EOS

Alumide® - for special requirements on temperature, surface and optics

Essential material properties

General material data

- **Average grain size: 60 µm**
- **Bulk density: 0.64 ± 0.04 g/cm³**
- **Density of laser- sintered parts: 1.36 ± 0.05 g/cm³**

Mechanical properties

- **Tensile modulus: 3800 ± 150 N/mm²**
- **Tensile strength: 46 ± 3 N/mm²**
- **Elongation at break: 3.5 ± 1 %**
- **Flexural strength: 74 ± 2 N/mm²**

Thermal properties

- **Melting point: 172 - 180 °C**
- **Heat conductivity**: 0.5 - 0.8 W(mK)⁻¹**

** 170 °C, hot wire method

Rubber boot sole

Alumide material as DirectTool for rubber injection moulding.

Source: Tecnologia & Design

Source: EOS

E-TEC e-manufactured parts

PrimeCast 101

PrimeCast 101 - the polystyrene laser-sintering material

Properties and applications

Properties

- **excellent dimensional accuracy**
- **very high surface quality**
- **good strength**
- **exceptional finishing properties**

Typical applications

- **lost patterns**
  - master patterns for plaster casting
  - master patterns for ceramic shell casting
- **master patterns for vacuum casting**

Turbocharger housing

Source: 3K-Warner

Source: EOS

PrimeCast 101 - the high performance pattern material

Essential material properties

General material data

- **Average grain size: 80 ± 5 µm**
- **Bulk density: 0.61 ± 0.02 g/cm³**
- **Density of laser- sintered parts: 0.70 - 0.85 g/cm³**

Mechanical properties

- **Tensile modulus: 1600 ± 250 N/mm²**
- **Tensile strength x/y: 5.5 ± 1.0 N/mm²**
- **Tensile strength z: 1.2 ± 0.3 N/mm²**
- **Elongation at break: 0.4 ± 0.1 %**

Thermal properties

- **Glass transition temp.: 105 ± 1 °C**
- **Material destruction: 250 - 550 °C**
- **Remaining ash content: 0.002 %**

Gearbox housing

Laser-sintered fully functional gearbox housing (DirectPattern® for casting in titan)

Quelle: Poggipolini

Source: EOS

CarbonMide®

CarbonMide® - carbon-fibre filled polyamide

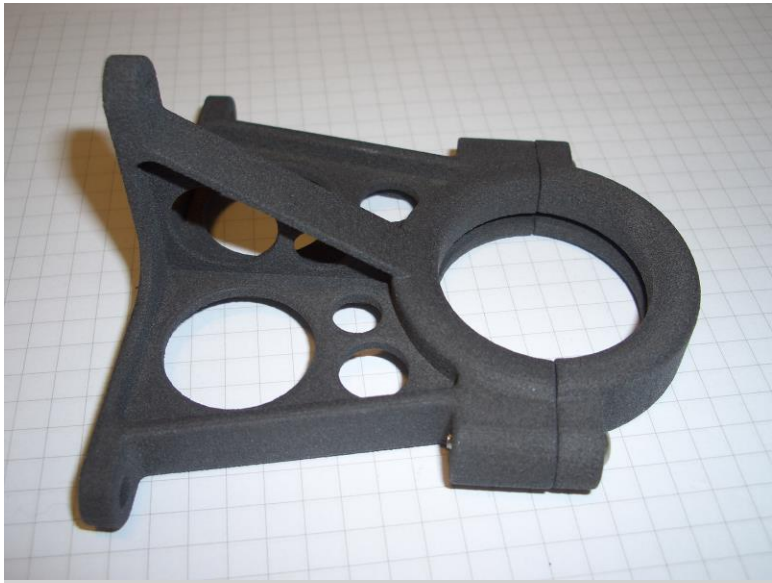
Properties and applications

Properties

- **outstanding mechanical properties**
- **extreme resistance and strength**
- **high stiffness**
- **anthracite-coloured parts**
- **electrical conductivity**

Typical applications

- **fully functional prototypes with refined surface (e.g. for wind tunnel tests)**



Bearing block

Source: EOS

Source: EOS

CarbonMide® - for parts under high mechanical load

Essential material properties

General material data
- **Average grain size: 60 µm**
- **Bulk density: 0.50 g/cm³**
- **Density of laser- sintered parts: 1.04 g/cm³**

Mechanical properties
- **Tensile modulus x/y/z: 6100/3400/2200 N/mm²**
- **Tensile strength x/y/z: 72/56/25 N/mm²**
- **Elong. at break x/y/z: 4.1/6.3/1.3 %**

Thermal properties
- **Melting point: 172 - 180 °C**

Electrical properties
- **Specific resistance: 46.3·10⁻³ Ωm [-5…+5V] x**

Airduct

Source: EOS

Source: EOS

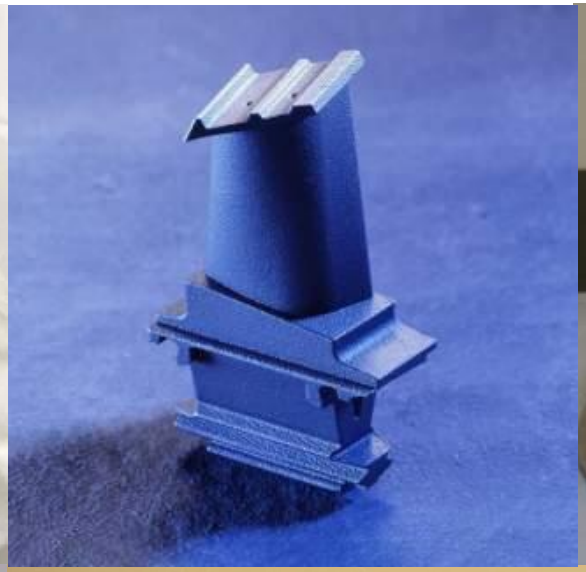
A EOSINT M 270 para sinterização direta de Metal

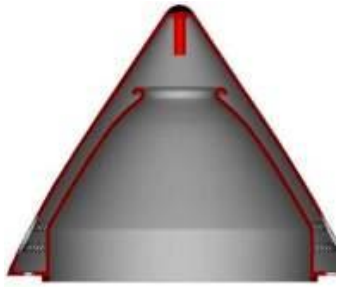
Direct metal laser sintering (DMLS)

EOSINT M 270

Source: CDR

Peças de metal complexas

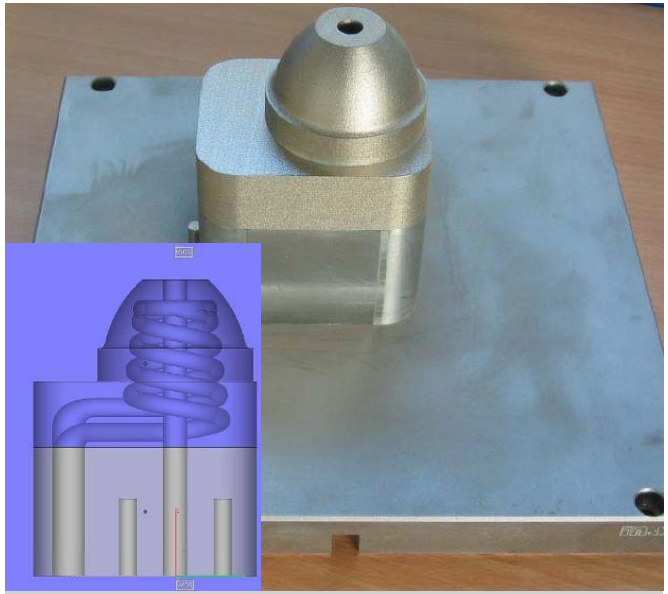




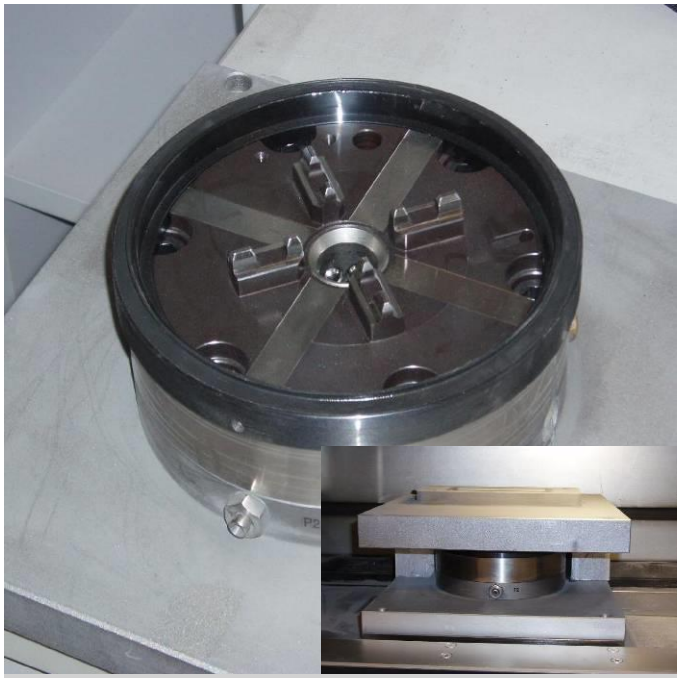
Source: EOS

EOSINT M pode construir insertos em ferramentas e sistemas de fixação montados

Exemplos de aplicação:



Hybrid insert produced in EOSINT M270 by building on top of a machined preform



Erowa Powerchuck 150 clamping system mounted in EOSINT M system

project partner: LBC

Source: EOS, LBC

EOS oferece materiais metálicos em pó para uma larga faixa de aplicações em sistemas EOSINT M

Material name	Material type	Typical applications
DirectMetal 20	Bronze-based mixture	Injection moulding tooling; functional prototypes
EOS MaragingSteel MS1	18 Mar 300 / 1.2709	Injection moulding series tooling; engineering parts
EOS StainlessSteel GP1[1]	Stainless steel 17-4 / 1.4542	Functional prototypes and series parts; engineering and medical
EOS StainlessSteel PH1	Hardenable stainless 15-5 / 1.4540	Functional prototypes and series parts; engineering and medical
EOS CobaltChrome MP1	CoCrMo superalloy	Functional prototypes and series parts; engineering, medical, dental
EOS CobaltChrome SP1,2	CoCrMo superalloy	Dental restorations (series production)
EOS Titanium Ti64	Ti6Al4V light alloy	Functional prototypes and series parts; aerospace, motor sport etc.
EOS Titanium TiCP	Pure titanium	Functional prototypes and series parts; medical, dental

[1] Note: this product was previously called EOS StainlessSteel 17-4
For system requirements please refer to information quotes or ask for details

Source: EOS

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Vários outros materiais estão em desenvolvimento ou estão sendo testados com sucesso pela EOS

Inconel 718

Hastalloy X

Aluminium AlSi10Mg

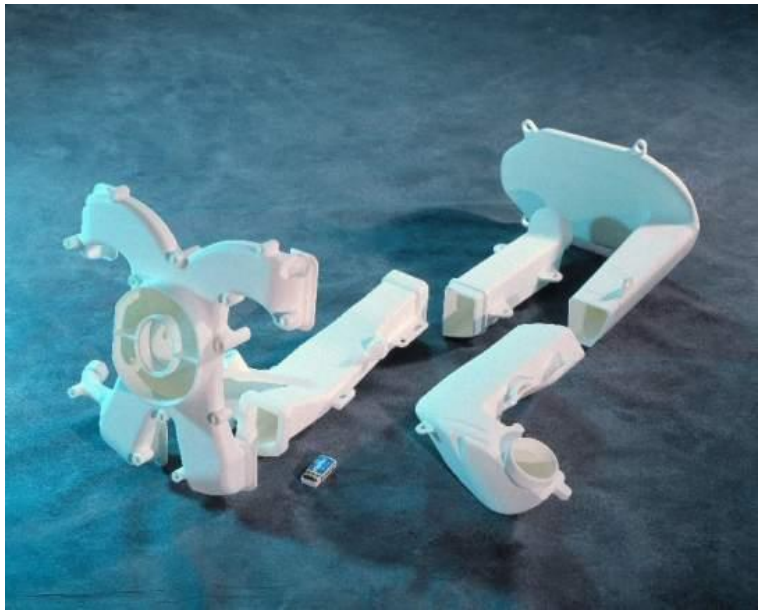
Al2O3 and SiO

Micro-laser-sintering, built in 2.5 µm layers (3D Micromac)

Source: EOS

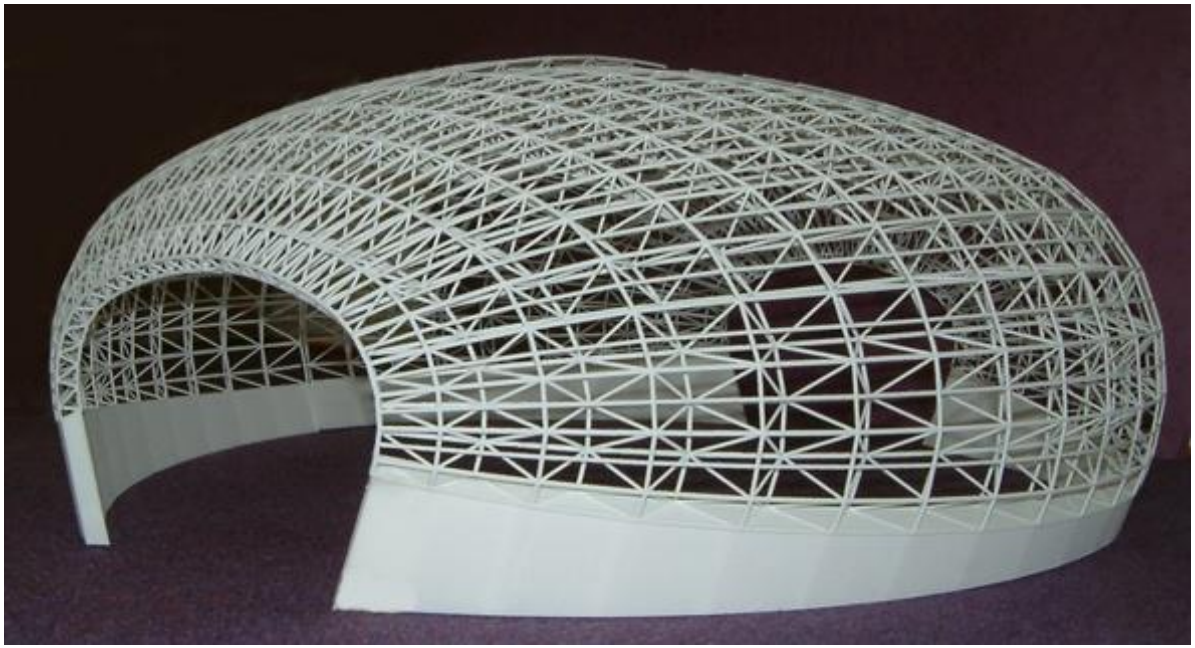
E-TEC e-manufactured parts

Peças aeroespaciais



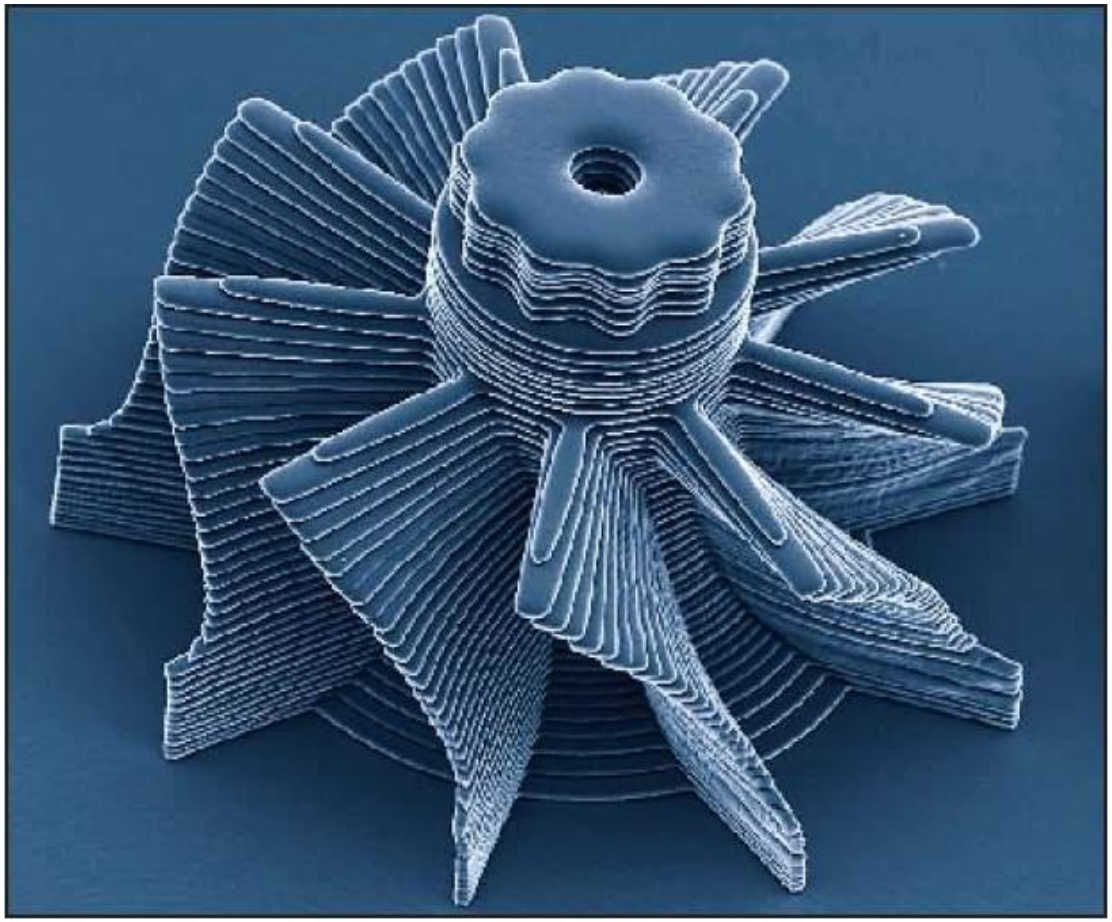
SOURCE: EOS

Maquetes



Peças automotivas

Micro turbina em microscópio eletrônico de varredura

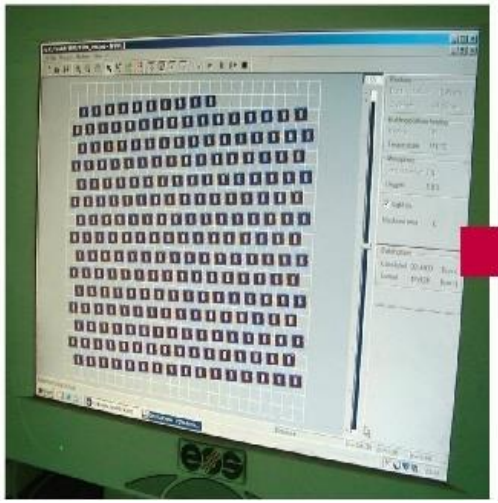


e-Manufacturing

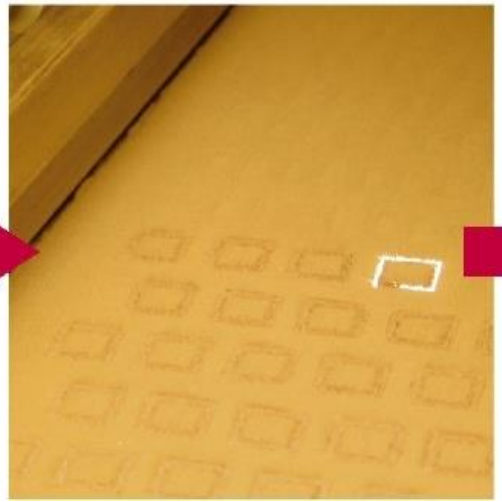
Source: EOS

e-Manufacturing é o mais rápido, mais flexível e mais eficiente método de produção diretamente a partir de um arquivo de CAD

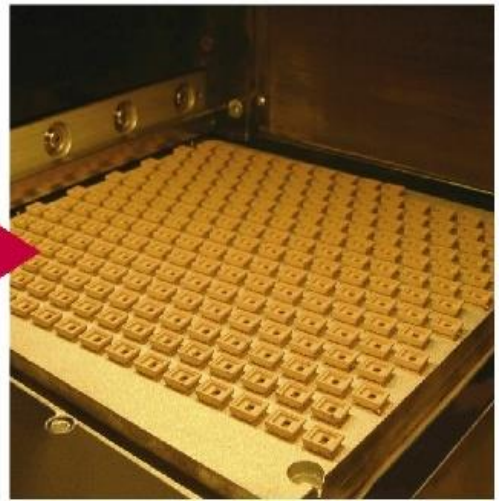
Processo *e*-Manufacturing:



Dados de CAD 3D...



... Sinterização a Laser...



... ao produto final

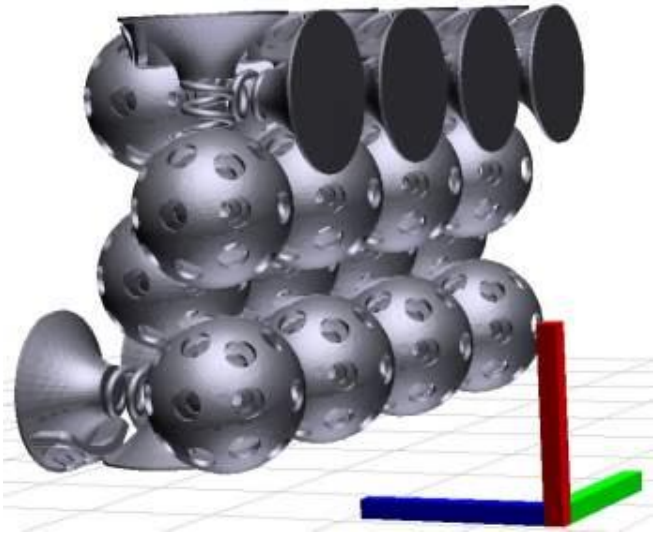
Sinterização a Laser é automática e orientada a aplicação – Chave para o *e-Manufacturing*

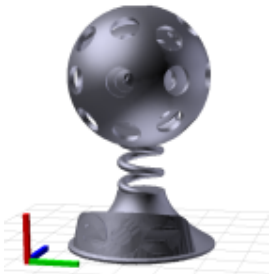
Source: EOS

e-Manufacturing™

Benefícios desta tecnologia

- Sem ferramentas
- Pequenos lotes
  - Sem investimento em ferramental
- Longa vida útil do produto
  - Facilidade de modificações e upgrades
  - Peças de reposição sob demanda
- Design voltado a função e não produção
  - Redução de peso em produto
  - Facilidade de integração com sub-sistemas
  - Novas funcionalidades
- Produção flexível
- Investimento em peças e não em ferramentas
  - Retorno imediato sobre o investimento





SOURCE: EOS

Laser-sinterização, normalmente, significa a libertação do projeto de restrições de fabricação

Mudança de paradigma no design e produção

A produção norteia o Design

O Design norteia a Produção

Source: EOS

Vacuum Casting

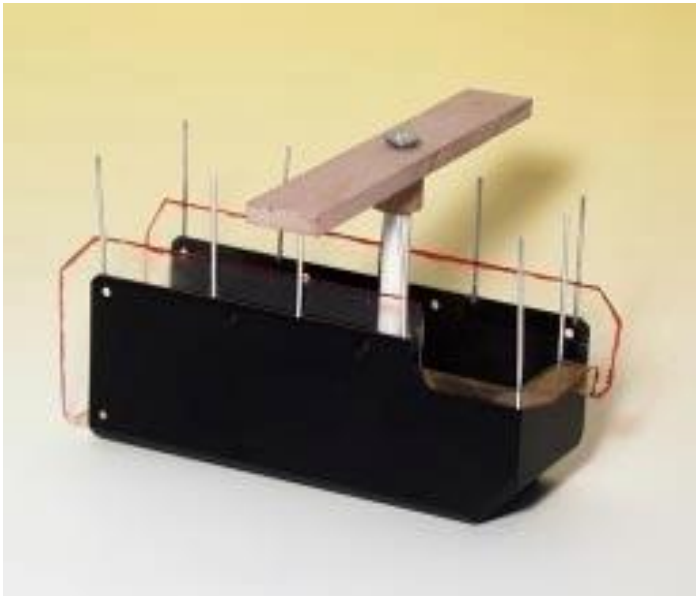
Source: EOS

Sistema Vacuum Casting

- Solução para pequenos lotes de produção

Sistema Vacuum Casting

— Preparando a peça modelo e a caixa de moldagem



Sistema Vacuum Casting

— Misturando o silicone e retirando as bolhas de ar com vácuo

Sistema Vacuum Casting

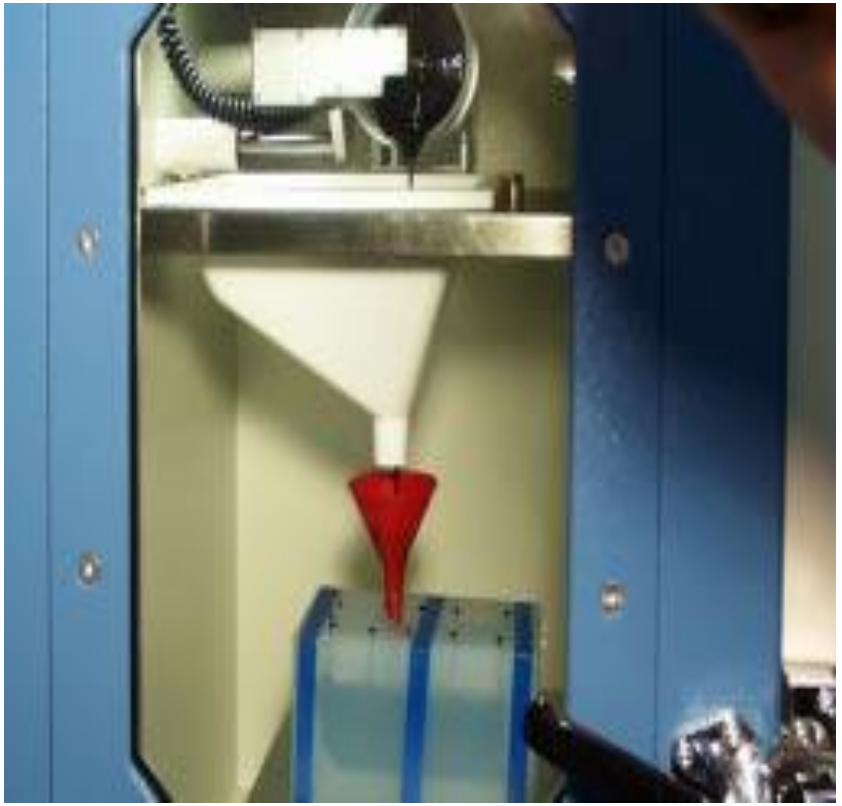
— Derramando o silicone e retirando as bolhas de ar do molde

Sistema Vacuum Casting

— Cortando o molde e preparando para derramar a resina de poliuretano

Sistema Vacuum Casting

— Preparação dos materiais, mistura automática e vazamento controlado da resina para o molde



Sistema Vacuum Casting

— De moldagem da peça (tempo total do processo de 40 minutos / peça)


Entre em contato para maiores informações ou solicite uma visita.

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Fernando Almeida (35) 9115-5190
etecprototipos@gmail.com
www.e-tecbrasil.com.br
Cambuí – Minas Gerais

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