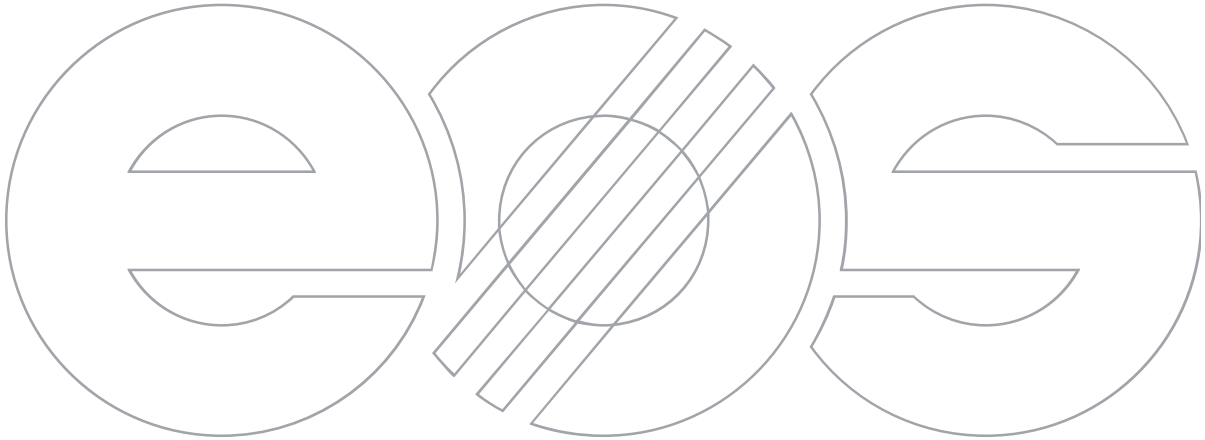
e-Manufacturing Solutions

Additive Manufacturing (AM)

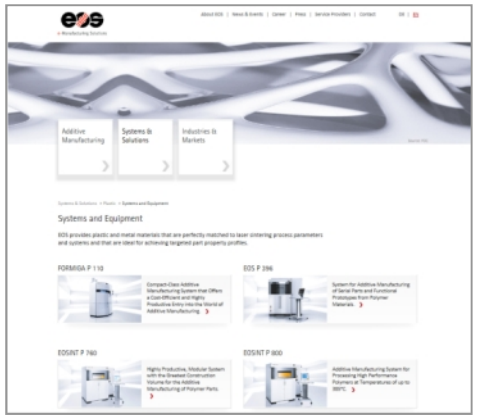
Basic Design Rules for Additive Manufacturing



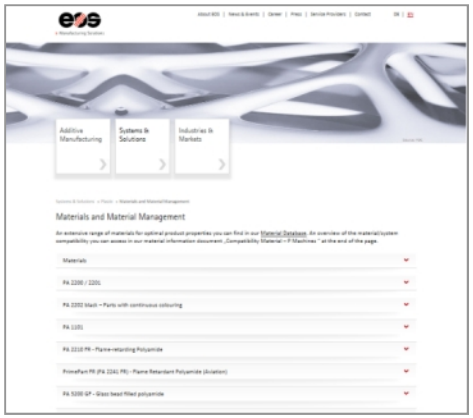
Click on the Pictures to Access Further Information on the Web

e-Manufacturing Solutions

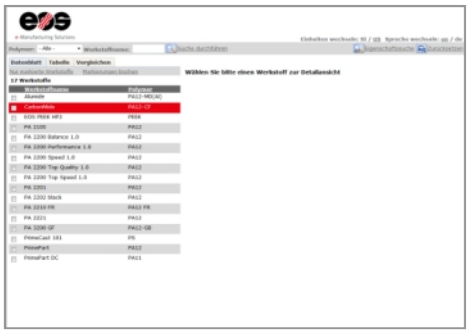
Overview of Machines



Overview of Materials



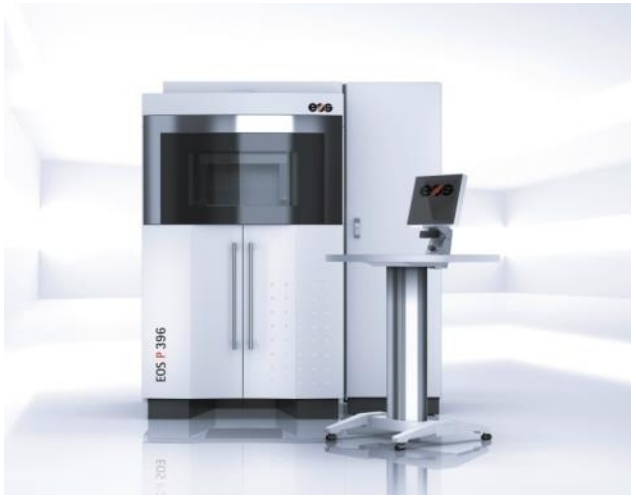
Plastic Material Properties



Design Rules for Metal

Source: EOS GmbH

Additive Manufacturing Design Rules for Plastic



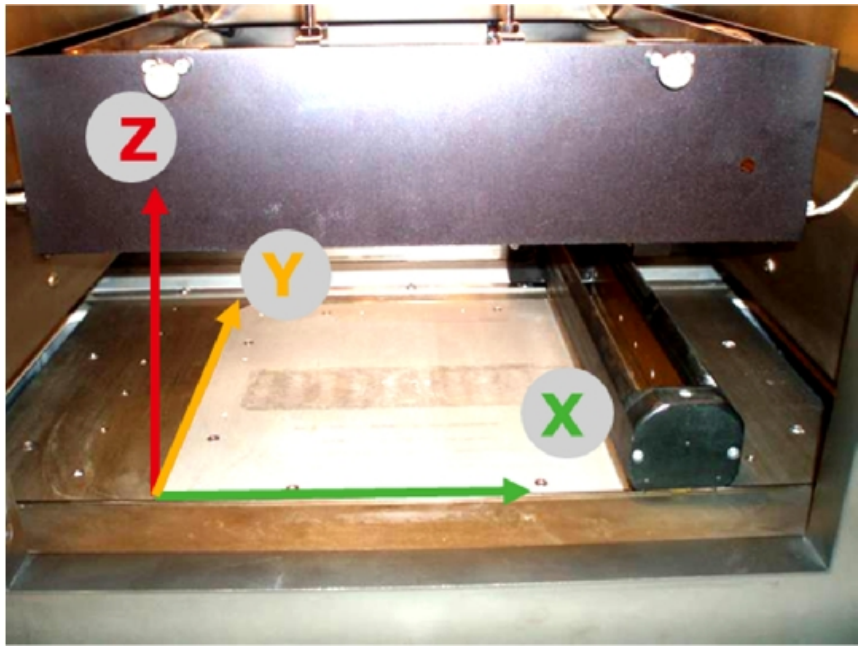
Source: EOS GmbH

Coordinates

Machine EOSINT P 760

§ Z à direction of platform

Process chamber EOS P 396



§ X à direction of recoater

Source: EOS GmbH

Building Chamber

FORMIGA P 110

§ 200 x 250 x 330 mm

EOS P 396

§ 340 x 340 x 620 mm

EOSINT P 760

§ 700 x 380 x 580 mm

Attention: Building chamber = Part + Scaling!

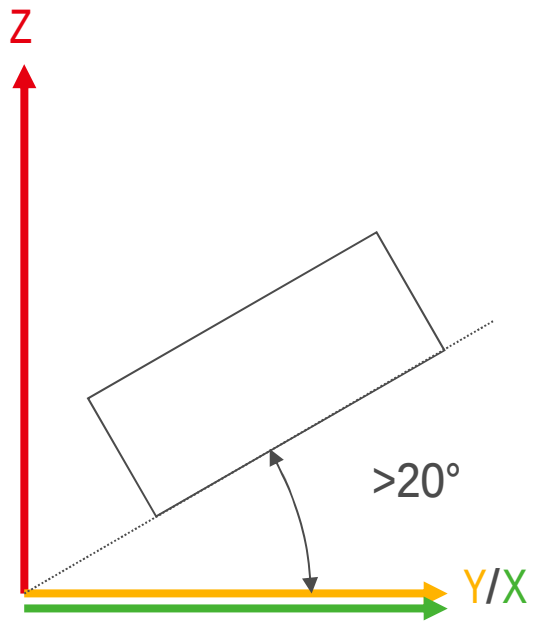
§ The possible part size is depending on the scaling factor
§ Scaling of 3.2 means a possible part size of 329 mm in X direction
§ It is not possible to build a 340 x 340 x 600 mm part for EOS P 396

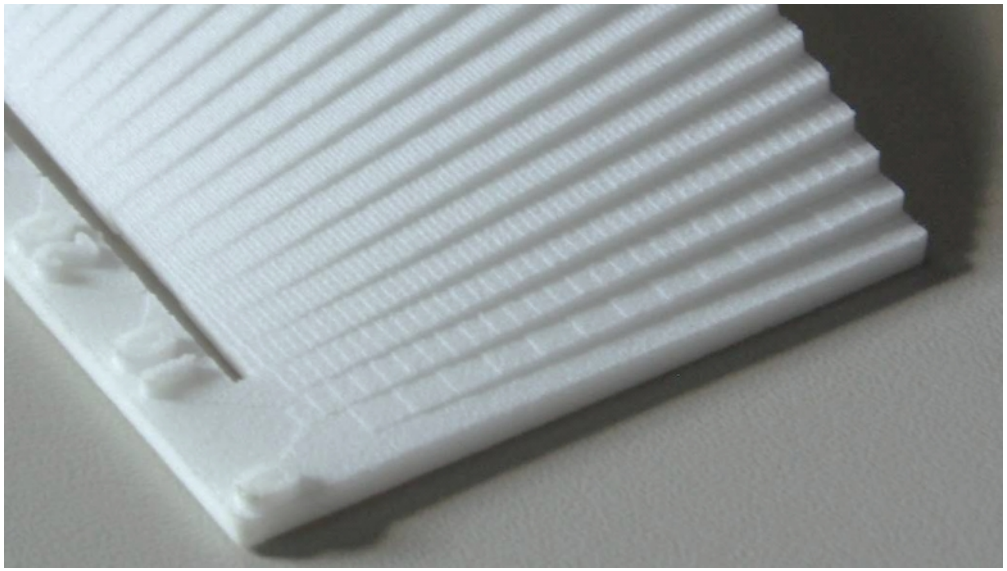
Source: EOS GmbH

Steps

§ To avoid steps on your surface, the angle of the plane should be 0° or >20° to the X-Y area

§ Visibility and size depending on layer thickness

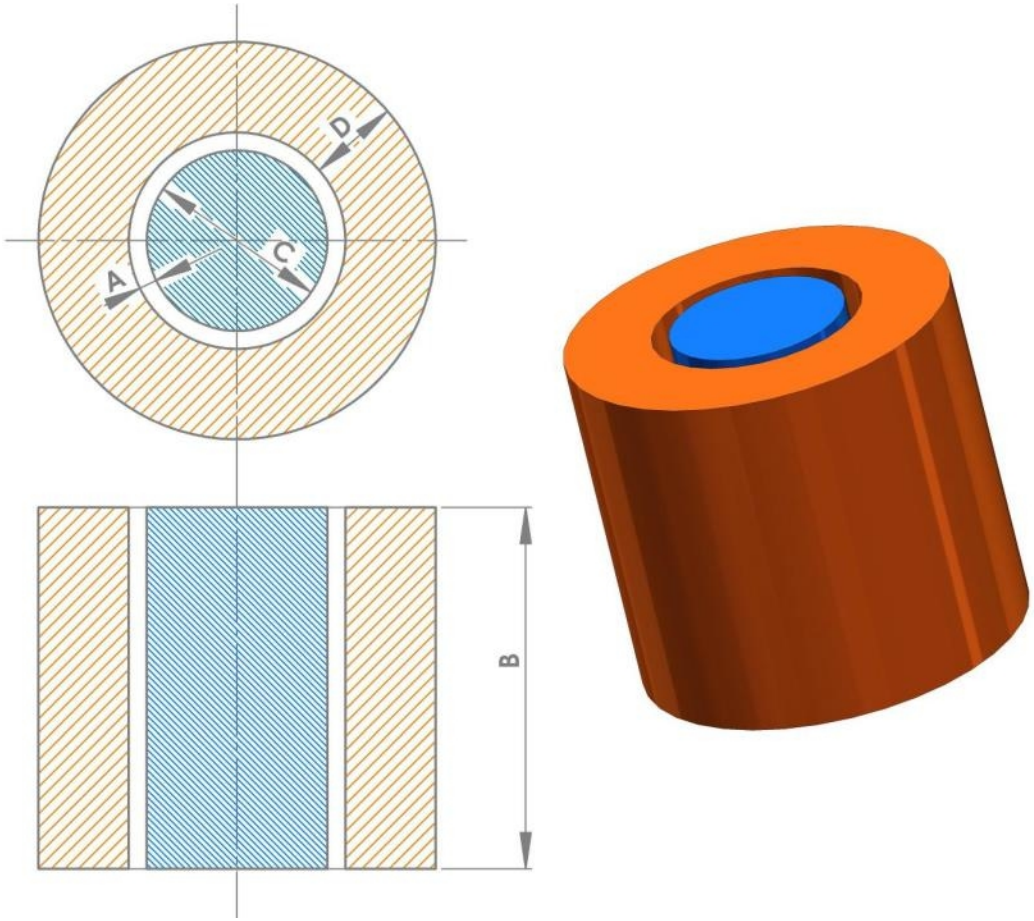




Source: EOS GmbH

Hinges

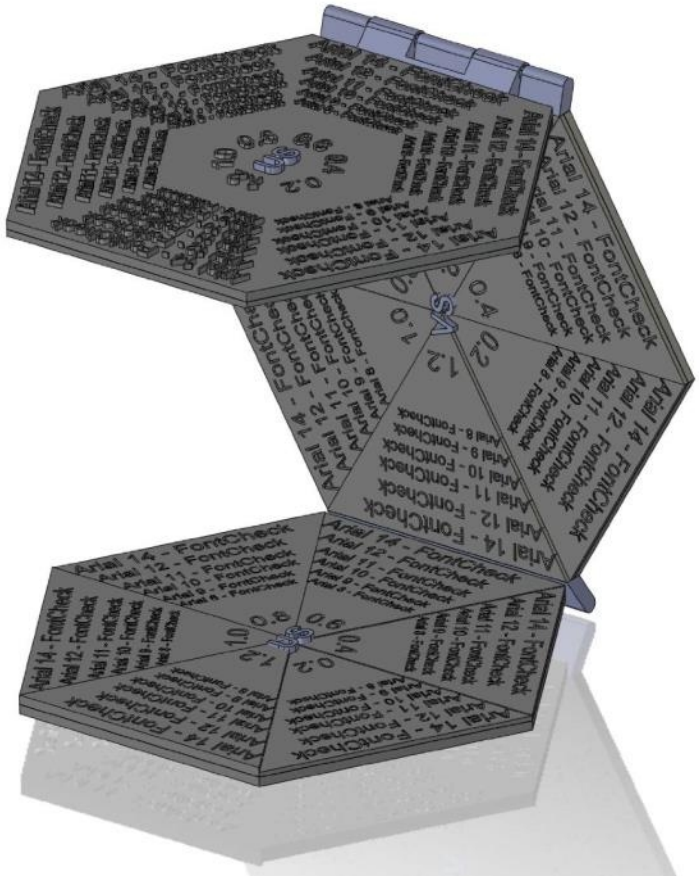
- Gaps (A) for Hinges:
  - x/y: 0.3 mm - 0.5 mm
  - z: 0.5 mm - 0.6 mm
- Variables:
  - gap between bush and bolt (A)
  - length of the hinge (B)
  - diameter of the bolt (C)
  - thickness of the surrounding bushing (D)
  - building direction
- With advance geometries smaller gaps are possible



Source: EOS GmbH

Fonts

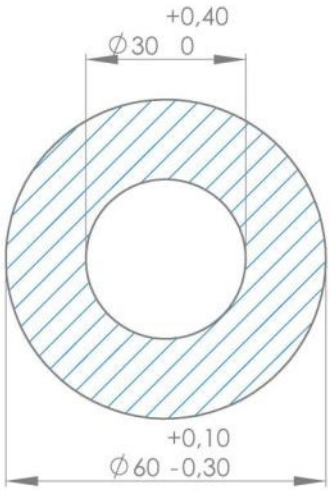
- Minimum font size 14 suitable for every direction
- Smaller fonts possible but it depends on:
  - building direction
  - inside / depth of font
  - outside / height of font
- Sans serif font is recommended



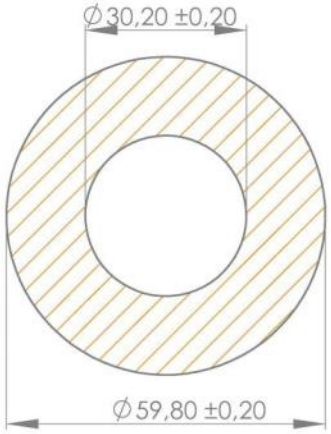
Source: EOS GmbH

Tolerances in Parts

- Depending on the fact that we build exact the same part as in the cad-system designed it is necessary to change your measurements to an symmetric tolerance zone
- The bad example has a unsymmetrical tolerance zone, the good one a symmetric
- In the AM process it is only possible to build with symmetric tolerances



Bad

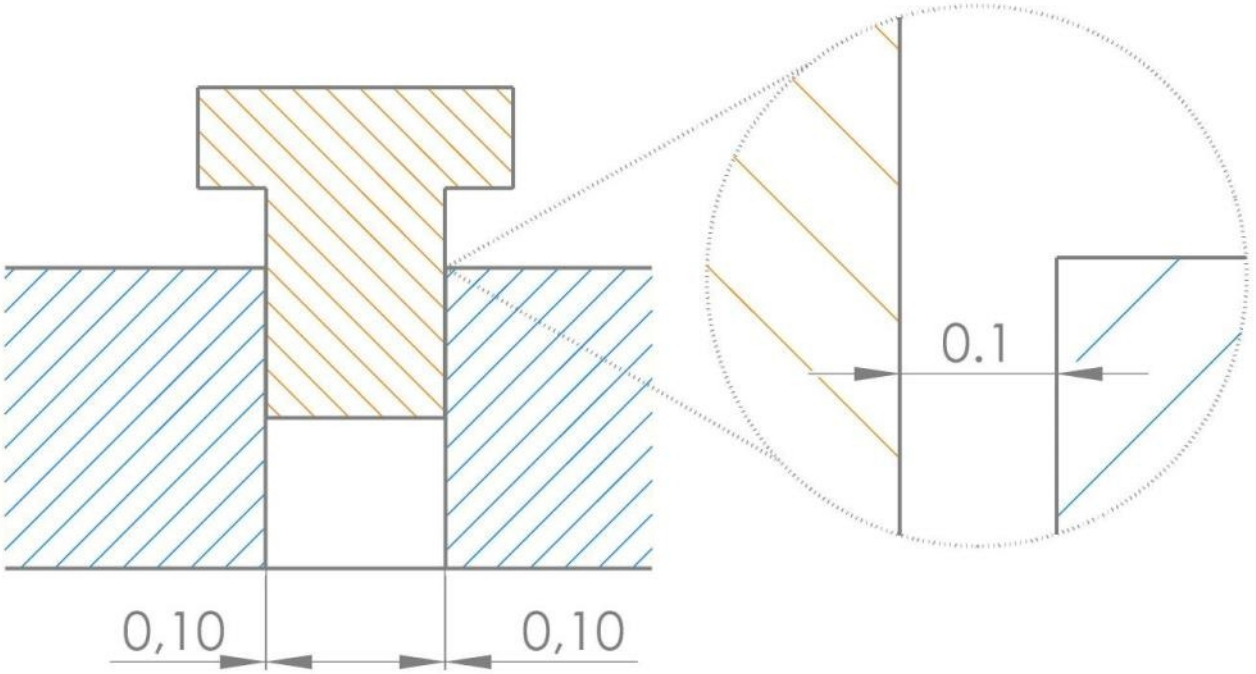


Good

Source: EOS GmbH

Lose Connection

- Use 0.1 mm distance for lose connection
- A mal and female part without a gap have a press fit
- Only for parts not built together! else see hinges



Source: EOS GmbH

Minimal Wall and Pin Sizes

Walls

X/Y

- min possible wall thickness = 0.7 mm for EOS P 396 / EOSINT P 760
- min possible wall thickness = 0.45 mm for FORMIGA P 110
- min wall thickness for reproducible measurements and mechanical properties = 1.5 mm

Z

- min possible wall thickness = one Layer; typical 0.15 for EOS P396 and 0.10 for FORMIGA P 110

Pins

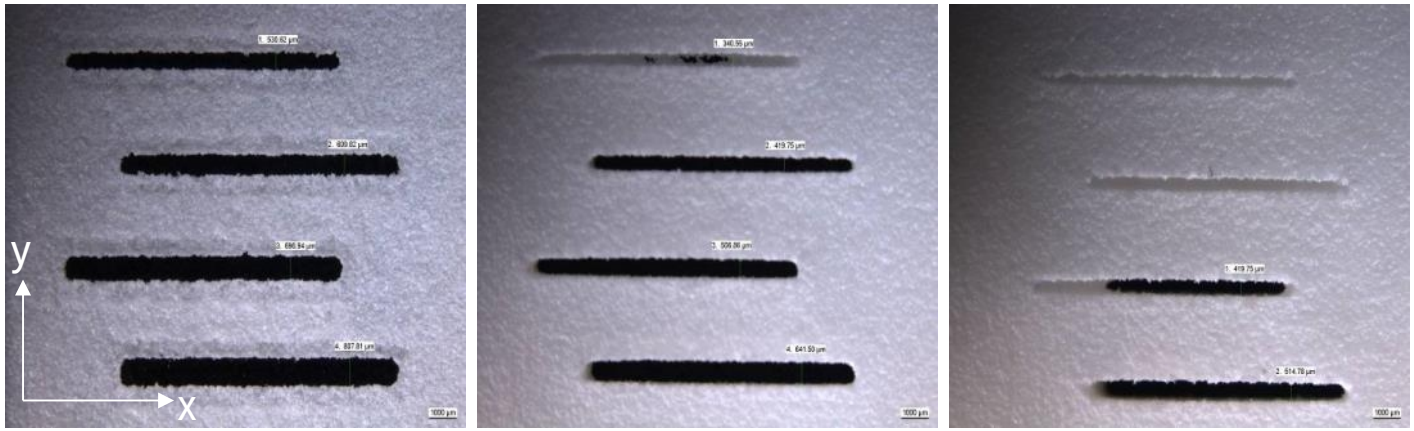
- min pin thickness = 0.8 mm
- min pin thickness for reproducible measurement and mechanicals properties = 1.8 mm

Source: EOS GmbH

Gaps

The min size of a gap depends on the wall thickness of the part

Gap width [mm]:



Wall thickness: 0.30 mm 3.00 mm 6.00 mm

Source: EOS GmbH

Holes

Possible min hole diameter depends on the thickness of the wall

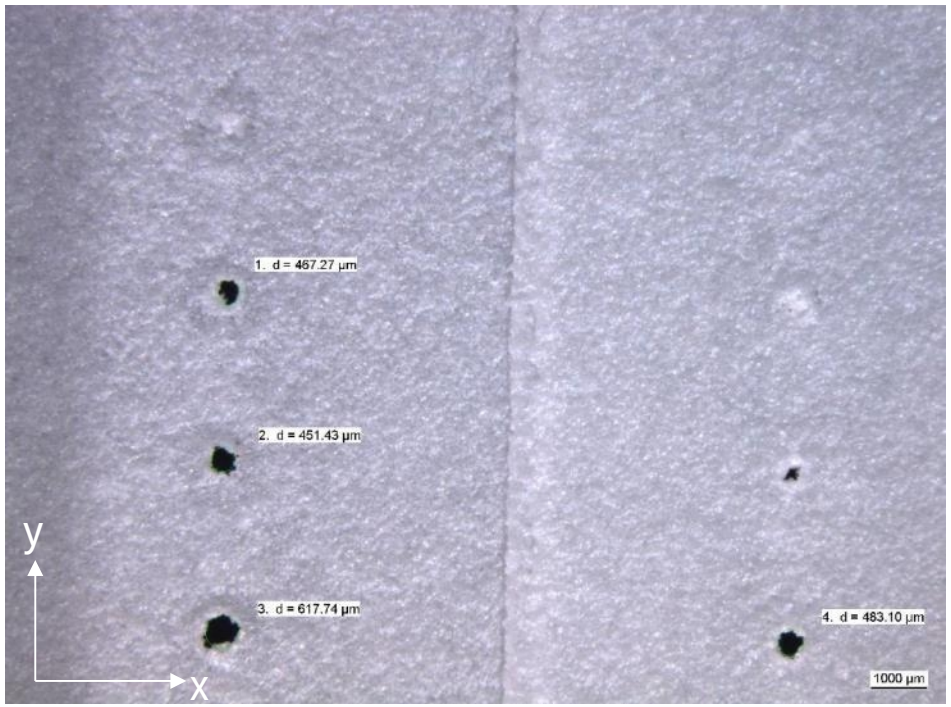
Hole diameter:

0.5 mm

0.6 mm

0.7 mm

0.8 mm



Wall thickness: 0.30 mm 0.60 mm

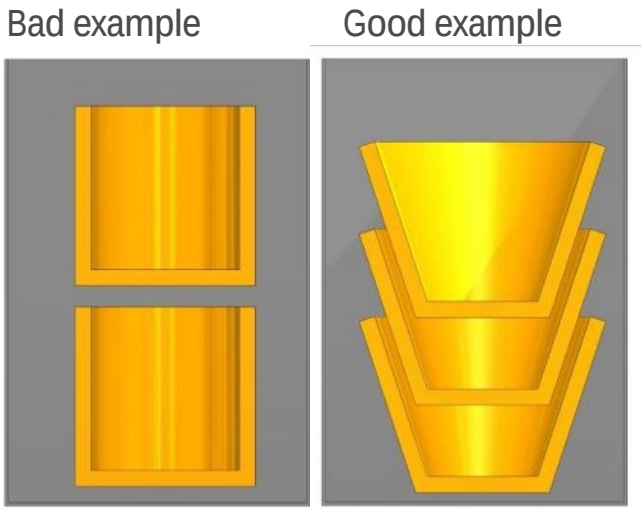
Source: EOS GmbH

Costs

- Costs depending on Z-height (machine hours) and part volume (powder)

- Reduce Z-height
  - design parts as low as possible in Z
  - stackable **à** increase filling rate

- Reduce part volume
  - integrated design
  - lightweight design
  - force flow optimized design



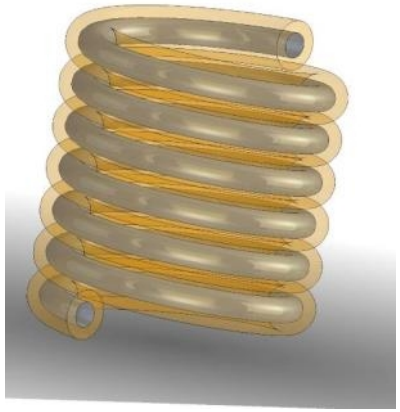
Source: EOS GmbH

Powder Removable Design

- Powder must be removable
  - Problems in small long pipes
  - Very complex parts with inside structure
  - The example is easy to produce but in the long hollow pipe inside it is impossible to remove the whole powder (pic2 grey). With compressed air is it possible to clean one or two windings but the rest remains inside.
- If the powder is removable very simple your post processing time is shorter

Example part

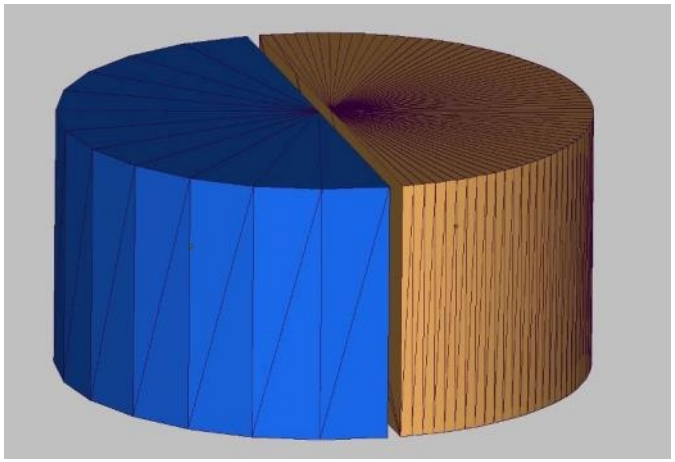
Example part (transparent)



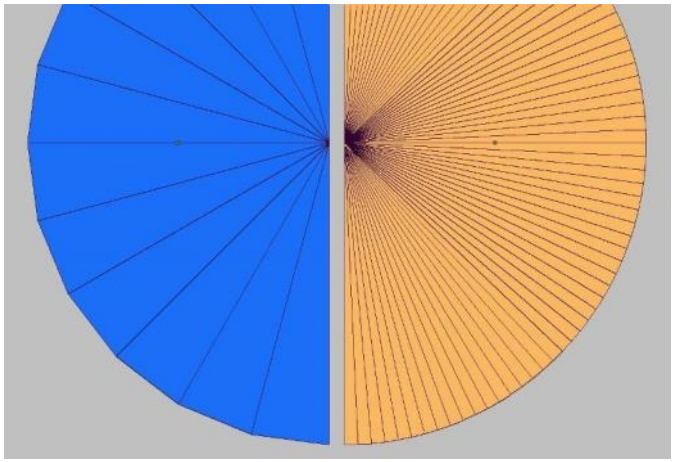
Source: EOS GmbH

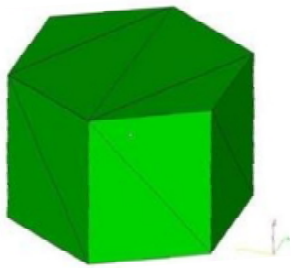
Data Format

- The interchange format for RP technologies is STL
- The file describe a surface by triangles
- The file size and detail resolution is depending on the number of triangles
- Square-cut surfaces are easy to describe exact pic1. For freeform or round shaped parts you need a lot of triangles pic 2+3
- A guide value for plastic parts is:
  - deviation tolerance: 0.01 mm
  - angle tolerance: 2°



Rough triangulation | fine triangulation





Source: EOS GmbH

e-Manufacturing Solutions

For further question please contact info@eos.info