# 3D printing using iglidur<sup>®</sup> Design for quality **Design for manufacture Design for function Design for cost** Design for parts consolidation plastics for longer life® www.igus.eu/tribo-printing



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# Your path to the ideal tribo component

In order to achieve an ideal 3D printing result, it is important to consider limits of the process. The objects must fit in the manufacturing space (220mm x 170mm x 300mm). For gears, the gear modules must not be smaller than 0.5mm, and the tooth head thickness not less than 0.4mm. The wall thickness of components must not fall below 0.7mm. Ensure that you work in CAD models with integer multiples of the 0.1mm layer thickness - an adaptation to 0.05mm is only possible in a few cases. If you want to mark components with information, you can use engraving (at least 0.5mm) or a constructive font ( $\geq$  0.5mm).

To minimise rework, openings such as holes and slots should be straight - if necessary, conical for long holes. In addition, make sure that internal channels can be reached with the drill to remove the printing powder (alternative: multiple division of the component). Note that reworks such as chemical smoothing can result in deviations of up to 0.4%.

# **Design for quality**

Ensure sufficient data quality, which directly affects component quality and function

Design for manufacture

Create a production-oriented CAD model, keeping an eye on the process limits

# **Design for function**

Ensure the desired component functionality

# **Design for cost**

Optimise your component from an economical point of view: Costs, material consumption and production time

### **Design for part consolidation**

Benefit from the entire design freedom of additive manufacturing for functional integration, reduction of parts and assembly costs



**Design for quality Export 3D model for printing Choose the highest possible resolution for your STL file** You have created the CAD model of your component. Now it's time to export the file for printing as an STL file. Attention: select the highest resolution in the STL export setting to get the best possible print result. This is the only way to ensure that the 3D printer, for example for printing gears, works out the tooth profile correctly. For

only way to ensure that the 3D printer, for example for printing gears, works out the tooth profile correctly. For your CAD model, make sure you avoid open contours, join multiple solids, and hide surfaces and sketches. If you do not have your own CAD programme, you can use the igus® CAD configurators for plain bearings, rollers, gears and racks for your tribo parts at www.igus-cad.com.



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# Design for manufacture Make CAD model

#### Pay attention to manufacturing space, wall thickness, layer thickness and reworking

Would you like to produce your additive manufactured component as cost-effectively and time-efficiently as possible? Design for manufacture deals precisely with this topic - economical and design-oriented adjustments to your component, which are adapted to the igus® 3D printing process. The following illustrations demonstrate what you have to consider in terms of manufacturing space, wall thicknesses and layer thicknesses. Furthermore, we will point out which design guidelines you should internalise in terms of reworking.

#### Process:

#### SLS/FDM Problem:

The part does not match the model: some features are wrong or not implemented at all

#### Solution!

The process limits must be observed: maximum manufacturing space 220x170x300mm / smallest features and wall thickness min. 0.7mm, manufacturing tolerance size-dependent for component dimensions up to 50mm: ± 0.1mm, moreover ± 0.2%, adaptation to 0.05mm possible in some cases, design in average tolerance





### Process:

all (mainly laser sintering) Problem:

Teeth of the gear are not properly developed or not functional Solution!

Note the process limits for laser sintering of gears: Minimal tooth module: 0.5mm Minimum tooth head thickness: 0.4mm Max. outer diameter: 172mm

#### Process: all

#### Problem:

Small structures/wall thicknesses below 0.7mm and general component dimensions that are built in Z-oriented Solution!

Dimensional variations must, if possible, be constructed in whole layer thicknesses, that is as a rule, 0.1mm layer thickness. (No dimensions with 0.0x, especially when oriented in Z-direction).

#### Process:

SLS Problem: Small holes are closed or cause rework

#### Solution!

If possible, select the hole diameter depending on the depth in order to avoid reworking, if necessary widen the holes conically



#### Process:

### SLS

Problem:

#### Inner channels cannot be freed from powder Solution!

Drill a hole of at least 3mm, widen the channels on the inside so that it is easier to remove the powder/ make the component in several parts so that the channels are open.



#### Process:

#### SLS Problem:

Component variants are difficult to distinguish/logo or label should be attached

# Solution!

Fonts engraved:  $\geq 0.5$  mm, font height > 5 mm Constructive fonts:  $\geq$  0.5 mm, font height > 6 mm independent of orientation (smaller fonts are feasible in the x/y-direction)



 $R_{z}$  [µm]  $R_{a}$  [µm]

80-125 20-30

15

10

n.b.

n.b.

240

120

n.b.

#### Process:

#### SLS

Problem: The surface quality is not sufficient for the intended application

#### Solution!

If necessary, request the following reworking procedures to achieve the specified surface characteristics:

colouring

 surface machining Chemical polishing

Vibratory finishing

#### Process:

SLS

Problem:

Parts that are too big for the manufacturing space cannot be manufactured

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#### Solution!

Divide component and provide joint geometry (form-fitting), which allows a precise assembly during bonding



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Nature, glass bead

Vibratory finishing\*

Chemically pol-

blasting

ished

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# Design for function Make CAD model

#### Make sure that geometries work

Make sure all functional elements are correctly designed. Example of threaded component: while some CAD programmes illustrate a threaded texture, they do not make it part of the 3D model. The printed part then has a non-functional hole. Pay attention to consciously design the geometry - or get that done by igus<sup>®</sup>. We implement printable thread sizes from M6 upwards. In addition, we recommend a thread clearance of +0.3mm at the diameter for lead screw nuts, and a clearance of +0.1mm at the thread flank in the Z direction. For the best possible function in interlocking structures, a gap of 0.2mm is recommended.

#### Process:

#### all

#### Problem:

The printed part should receive a functional thread **Solution!** 

- Use one of the following options:
- Let threads be cut (M1.6 M6)
- Provide threaded insert, see table (M3 M8)
- Design printable threads (from M6)

# Process: all

#### Problem:

Threads are inserted into CAD, but are not included in the printed part

#### Solution!

CAD illustrates thread texture to indicate threading in the drawing (left picture). However, the 3D model contains no matching geometry, so the part has only one hole in the result. The thread must be designed (right picture) - by the customer or by igus<sup>®</sup>. Printable nut size from M6

#### Process:

#### SLS

Problem:

Parts that interlock and are designed precisely to size do not match

#### Solution!

Interlocking structures provided with the appropriate gap size. A distinction is made between assemblies produced in one piece (here 0.4-0.5mm gap, right picture) and individually built components (here 0.2mm gap, left picture).

#### Process:

#### SLS

Problem:

Printed drive nuts run poorly or not at all on the lead screw Solution!

Thread clearance at the diameter (D1 and D4): +0.3mm Thread flank clearance in the Z direction: +0.1mm Printing of drylin lead screw geometries can be requested



M3 M4 M5 M6 M8

4.7 6.1 7.5 9.2 11.2

10 14 15

Hole

min.

depth

6 8

X

ter

diame-

# Design for cost Think additive - save costs Consider material recesses

3D printing gives you the opportunity to save production costs. Unlike conventional manufacturing processes such as machining, complex geometries can be implemented in additive manufacturing without additional cost. The process does not require expensive special tools. So think additively and only add material where it fulfills a function - for example, in the gear, where you place sufficiently sized spokes instead of a solid disc.

Volume: 100%

#### Process: SLS

#### Problem:

High component costs due to high volume, material unnecessary

#### Solution!

Save material where reasonably possible

- Use braces instead of solid material for rigidity
- Prefer thin-walled construction (see injection
- moulding)

#### Process:

SLS, FDM

#### Problem:

The part is not optimal (in terms of cost, function, etc.), since a production-oriented design was selected for conventional methods

#### Solution!

Production-oriented design for additive manufacturing: "Additive Thinking". Only add material where it is needed. Perform analysis based on the functional areas



Volume: 40.3%

# Design for parts consolidation

#### Make your component multifunctional

3D printing is a production technology that allows you to implement complex geometries at no extra cost. It is therefore advisable to equip the component with as many functions as possible, thereby reducing part costs and assembly costs. For example, optical instructions for operation, bearing points, sprockets for belt drives, snap hooks, logos or addresses can be integrated. Complexity plays (almost) no role - unlike traditional methods such as milling.



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igus<sup>®</sup> is certified in accordance with ISO 9001:2015 and IATF 16949:2016 in the field of energy supply systems, cables and harnessing, as well as plastic bearings.

# Do you have any questions about additive manufacturing?



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