



WHITE PAPER

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# RHINO TO STL — BEST PRACTICES

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# RHINO TO STL — BEST PRACTICES

## INTRODUCTION

In order to get the best quality 3D prints from RHINO CAD models it is important to be familiar with the parameters that effect STL file creation. It is essential to adjust these parameters before converting your geometries because STL files cannot be modified or made smoother. The primary factors that affect the quality of your 3D printed parts during modeling and STL creation are:

- WALL THICKNESS
- MESH SETTINGS
- MULTIPLE SHELLS // NESTED PARTS

## WALL THICKNESS

Wall thicknesses can be a major contributor to 3D printing errors. Thin walls in your CAD models can make for very fragile and delicate parts that can result in tears and holes during support material removal. On occasion, files can not be processed by the printers if the wall thicknesses are too thin.

Use the chart below to ensure wall thicknesses meet minimum requirements.

### MINIMUM FEATURE SIZE

POLYJET		SELECTIVE LASER SINTERING (SLS)	FUSED DEPOSITION MODELING (FDM)	CAST URETHANES (POLYS)	CNC MACHINING	RAPID TOOLING INJECTION MOLDING
FLEXIBLE	RIGID					
0.045 in	0.025 in	0.030 – 0.040 in	0.025 – 0.040 in <small>** Dependant on geometry &amp; size</small>	0.025 in	0.025 in	0.025 in

## MESH SETTINGS

RHINO describes geometry as NURBS surfaces, so files need to be converted as an STL to be processed by 3D printers. During this process, RHINO surfaces are translated into triangulated meshes approximating the NURBS geometry.

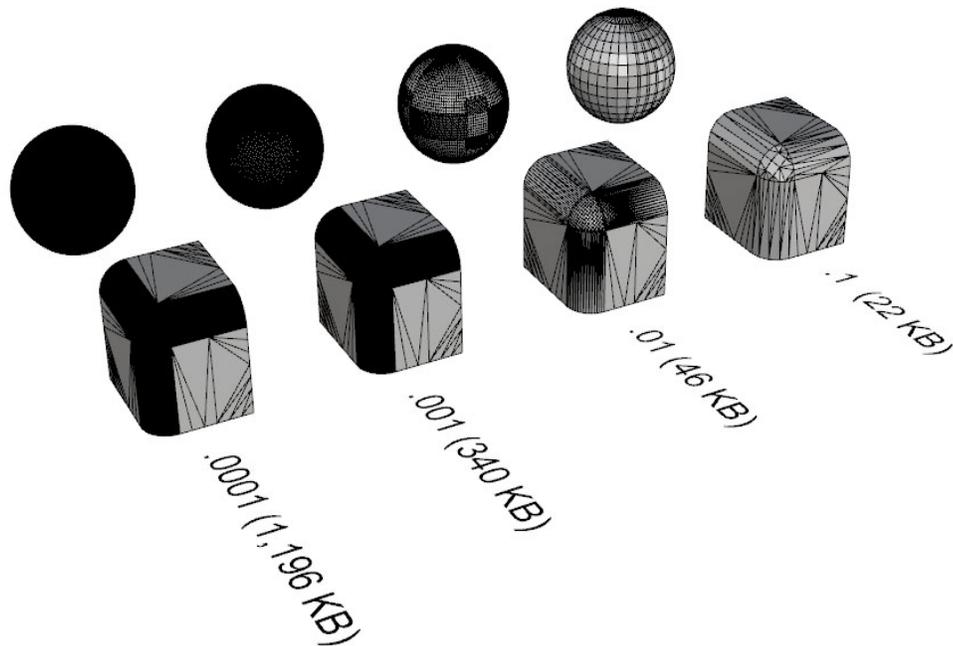
In general, the finer the resolution of your mesh, the larger the file size and the closer it will approximate your RHINO surface. Excessive faceting should be avoided though, as it creates larger files that can cause delays in processing and model upload. Super low faceting should also be avoided because it results in flat spots where models should be curved. The best option is to find a resolution that is detailed enough to build your model features accurately while keeping file size manageable.

## MESH SETTINGS IN RHINO

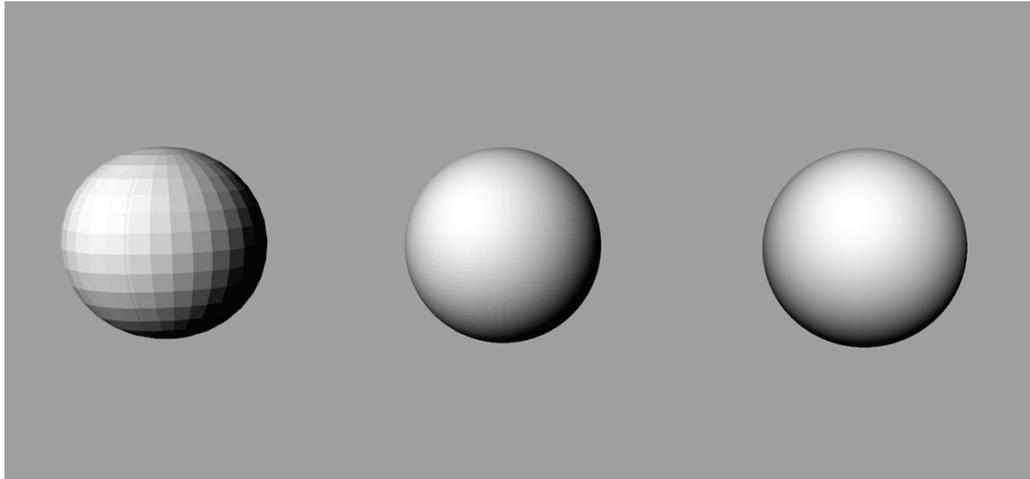
Within RHINO's mesh Detailed Controls there are seven numerical settings and three check boxes. Each of these settings will affect the resolution of the mesh and some will work together. The combined effects of these settings are complex so expect some trial and error. In the meantime, we will discuss the most important setting; max distance edge to surface. Reference RHINO's Help section for a detailed description of the other settings.

### MAX DISTANCE EDGE TO SURFACE

This setting controls how much polygons divide until the distance from a polygon edge midpoint to the NURBS surface is smaller than the setting's value. The smaller the value the more polygons divide to better approximate the NURBS surfaces which also creates for larger file sizes. Below are examples of surfaces that have been meshed with different Max Distance Edge to Surface values. Note the correlating file sizes in figure 2.1.



**Fig. 2.1** The higher the resolution of your mesh, the larger the file size. It is good practice to turn your NURBS into meshes within your rhino file and view them in Flat Shade mode (`_FlatShade` command). This mode shades models so individual mesh faces are visible (This creates a good preview as to what your part will look like once printed).



**Fig. 2.2** It is good practice to turn your NURBS into meshes within your rhino file and view them in Flat Shade mode (`_FlatShade` command). This mode shades models so individual mesh faces are visible and gives you a preview of what your part will look like.

To accommodate different 3D printer technologies the Maximum Distance Edge to Surface values should be less than half a printer's resolution. For example a setting of 0.01mm is a good value for a printer with a resolution of 0.03mm.

#### CREATING A MESH FROM YOUR NURB SURFACES

1. Select the surfaces you want to mesh
2. Enter into the command line **\_Mesh**
3. In the **Polygon Mesh Options** click on **Detailed Controls**
4. In the Detailed Option dialogue enter the following settings:
  - Maximum angle: **20**
  - Maximum edge length: **6**
  - Minimum edge length: **0.0001**
  - Maximum distance, edge to surface: **0.001 (< 1/2 printer resolution)**

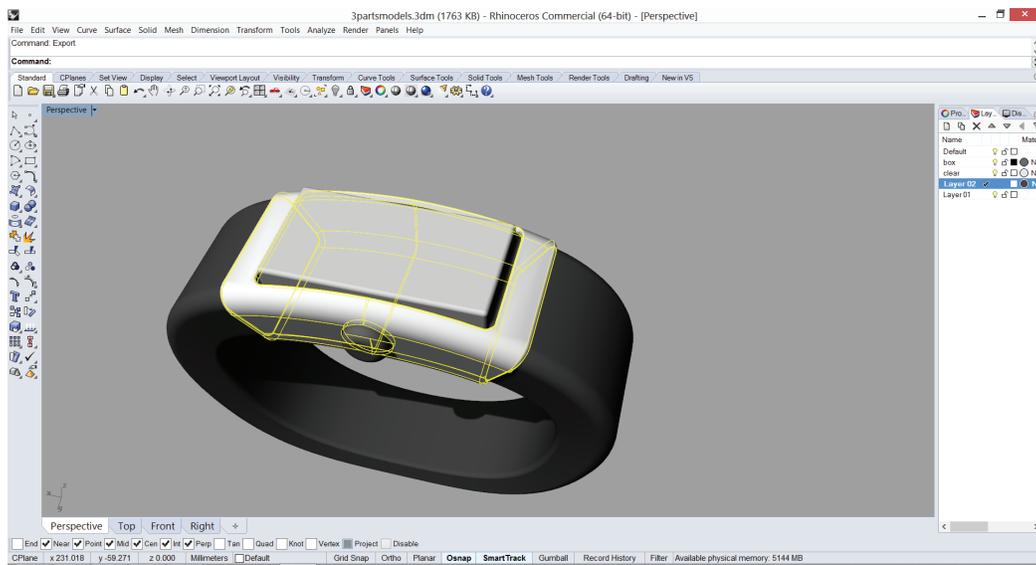
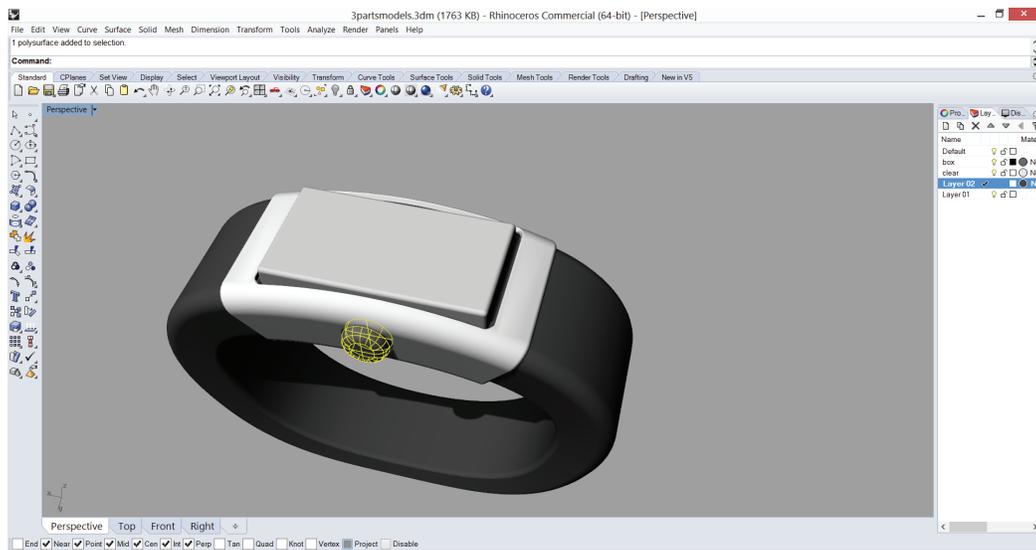
#### EXPORTING THE MESHES IN YOUR RHINO MODEL TO STL

Once the file has been meshed and you are satisfied with its resolution, export the file.

1. Select the mesh
2. Enter into the command line **\_Export**
3. Give the file a name and select STL from the file type menu
4. Hit **Save**
5. From the STL Export Options select **Binary** for File (this produces smaller files than selecting Ascii) — click okay

# MULTIPLE SHELLS AND NESTED PARTS

If your model is an assembly and is composed of multiple shells or nested parts you will need to export each shell individually creating as many STL file as there are parts in the model. Make sure that you are exporting each shell so that all STLs share the same coordinates. This way when each file is imported into the 3D printing software it will fall into its relative position within the assembly.



**Fig. 3.1** This model contains nested parts that will be printed in different materials. All shells that are of the same material are selected and exported as one STL. In the case above the outer housing will be printed in VeroWhite, while the knob will be printed in Tango Black. Items are selected in their relative position so that when imported into the 3d printing software, they drop into place with the same coordinates.