

STL files are the foundation of rapid prototyping, rapid manufacturing and 3D printing. They are the fundamental to producing the highest resolution 3D prototype. Often data is lost while transitioning from CAD to STL, this guide will provide insights on how to avoid this problem, and others during the process.

## What is an STL File?

The STL file format has become the industry standard for rapid prototyping, and digital manufacturing. In order to optimize the interaction between the machines and the design, this default data transmission standard was created, and often produces the best results. The STL format approximates the surface of an object using triangles. Simple objects, like the cube in figure 1, can be approximated with 12 triangles as seen in figure 2. Complex objects, like figure 3, require many triangles to be produced.



Figure 1



Figure 2



Figure 3



Most leading CAD programs are able to produce an STL file, including Solid Edge, SolidWorks, Pro-E and NX. Proto3000 provides specific instructions on "How to properly save an STL file" which can be found on our website.

Most CAD programs however, do not allow the ability to view an STL file. Premium software, or a CAD viewer would be needed in this case.

## Key Optimization Settings

When it comes to STL files, there are seven key settings that determine the overall quality of the finished file. These key settings are:

1. Angle, Deviation, and Chord Height
2. Surfaces
3. Wall Thickness
4. Inversed Normals
5. Multiple Shells or Nested Parts
1. Edges
2. Tabbed Areas

These settings will alter the resolution of your STL file. As a generic rule, adjusting options such as Chord Tolerance or Angular Control will create different resolutions. The higher the resolution, the more triangles placed on the surface of the model. **\*NOTE:** A higher file size does not necessarily mean a better part.

## Angle, Deviation, and Chord Height

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You can change the angle, deviation and chord height to adjust the roughness or smoothness of your part. Faceting is determined by the relative coarseness of curved areas of the adjoining triangles. Deviation or chord height, and angle control or angle tolerance are the most common variables.

Faceting Type	Cause	Example File Size
Coarse faceting (poor) - Results in flat spots on curved surfaces.	Angle setting is too high, or deviation/chord height settings are too large (or both)	705 KB
Excessive fine faceting (fair)	Angle settings are too low, or deviation/chord height settings are too small. (or both)	17,350 KB
Good quality faceting (best).	Happy medium between two extremes.	2,760 KB

**NOTE\*:** *The final rendering of the STL file will be exactly what is built. Base your final file on the quality that you want to achieve with your part.*

## Wall Thickness

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The width of your wall thickness should be determined by the type of rapid prototyping process being used. In some rapid prototyping methods, a thin wall thickness will lead to very delicate parts. The thinner the part the more susceptible it is to breaking, or cracking during support removal and handling.

The following is a generic guide to the thinnest possible wall resolutions in the most popular rapid prototyping processes.

Technology/Process	High Resolution	Standard Resolution
Polyjet	0.0006"	0.001"
Fused Deposition Modeling (FDM)	0.01"	0.02"
Stereolithography (SLA)	0.002" - 0.004"	0.005" - 0.006"
Selective Laser Sintering (SLS)	0.004"	n/a
ZPrint	0.0035"	0.004"

## Multiple Shells, Nested or Tabbed Parts

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When it comes to assemblies, nested parts, or tabbed parts, saving each piece as a separate STL file is ideal for rapid prototyping. The quoting process of multiple files will result in the best possible cost, as importing multiple files into a build tray will allow for the optimized positioning of each file. Separate files will also result in a better functioning prototype.

## Inversed Normals, Edges and Surfaces

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"Water-tight" STL files are those that do not have any missing surfaces, overlapping surfaces, or bad edges. Most popular CAD software design programs that use "solid modeling" techniques will automatically produce clean STL files. CAD programs that are based on "surfaces" often have more problems, as well as CAD data acquired by a 3D laser scanner.

Acquiring an STL file viewer would assist in locating the problems in a CAD file. If you do not have one, Proto3000 has the ability to fix broken files.

## Additional Assistance

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If you find you are unable to achieve your desired file quality, feel free to contact Proto3000. Our CAD designers deal with numerous files on a daily basis, they can assist in finding a solution.

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