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STL Files: What They Are and How to Use Them

STL files and 3D printing

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The most common 3D printer file format is the .STL file. The file format is believed to have been created by 3D Systems from its **ST**ereo**L**ithography CAD software and machines.

Like many file formats, there are other explanations for how this file-type received its name: Standard Tessellation, which means tiling or layering of geometric shapes and patterns (more or less).

What Is the STL File Format?

An easy-to-understand definition of the STL file format explains it as a triangular representation of a 3D object. If you look at the image, a CAD drawing shows smooth lines for the circles, where an STL drawing shows the surface of that circle as a series of connected triangles.

As you can see in the photo/drawing, the full CAD file of a circle would look like, well, a circle, but the STL version would insert a collection, or mesh, of triangles to fill that space and make it printable by most 3D printers. This is also why you will hear people refer to or describe 3D printer drawings as mesh files – because it is not solid but made up of triangles creating a mesh or net-like appearance.

3D Printers work with the STL formatted files. Most 3D software packages, such as AutoCAD, SolidWorks, Pro/Engineer (which is now PTC Creo Parametric), among others, can create an STL file natively or with an add-on tool.

We should mention that there are several other major 3D printing file formats in addition to .STL. These include .OBJ, .AMF, .PLY, and .WRL. For those of you who do not need to draw or create an STL file, there are plenty of free STL viewers or readers available.

Creating an STL File

After you design your model in a CAD program, you have the option to save the file as an STL file. Depending on the program and the work you are doing, you may have to click **Save As** to see the STL file option. Again, the STL file format is rendering or creating the surface of your drawing in a mesh of triangles.

When you do a 3D scan of an object, with a laser scanner or some digital imaging device, you usually get back a mesh model and not a solid one, as you would if you had created a drawn-from-scratch 3D CAD drawing.

CAD programs make most of this pretty easy, doing the conversion work for you, however, some 3D modeling programs will give you greater control over the number and size of the triangles, for example, which can give you a more dense or intricate mesh surface and thus a better 3D print. Without getting into the specifics of a variety of 3D software, you can change several factors to create the best STL file:

Chordal Tolerance / Deviation

This is the distance between the surface of the original drawing and the tessellated (layered or tiled) triangles.

Angle Control

You can have gaps between triangles, and changing the angles (deviation) between adjacent triangles will improve your print resolution – meaning specifically that you have a better weld of two triangle surfaces. This setting enables you to increase how close objects are layered or tiled together (standard tessellation).

Binary or ASCII

Binary files are smaller and easier to share, from an email or upload and download perspective. ASCII files have the advantage of being easier to visually read and check.

If you want a quick rundown of how to do this in a variety of software, visit Stratasys Direct Manufacturing: How To Prepare STL Files article.

What Makes a ‘Bad’ STL File?

“In short, a good stl file must conform to two rules. The first rule states that adjacent triangles must have two vertices in common. Second, the orientation of the triangles (what side of the triangle is in and what side is out) as specified by the vertices and normals must agree. If either of these two criteria are not met, problems exist in the stl file...

> *"Often an stl file can be termed "bad" because of translation issues. In many CAD systems, the number of triangles that represent the model can be defined by the*

user. If too many triangles are created, the stl file size can become unmanageable. If too few triangles are created, curved areas are not properly defined and a cylinder begins to look like a hexagon." — GrabCAD: How to Convert STL Graphics To A Solid Model