



POLYJET BEST PRACTICE

Successful STLs For Polyjet 3D Printing

Overview

This document will help PolyJet 3D Printing users ensure their STL files produce successful 3D printed parts. You'll become familiar with popular manipulation software, gain a basic understanding of how STL files work, learn to fix common STL faults for successful 3D printing, and learn a few additional actions you can perform on an STL to expand your 3D printing options.

STL Manipulation Software

While all CAD software allows the creation of STL files, this process doesn't always produce a printable file. STL manipulation solutions allow fixing those models to produce 3D printable models, and performing several simple actions to change the model (such as cutting and labeling).

The following list describes popular STL manipulation software solutions, tested to be compatible with Objet Studio. Magics RP is the most extensive solution available. Meshlab is satisfactory as a free tool, although not very easy to use and lacking some functionality. Pricing is not specified, as this greatly varies from region to region. Additionally, most vendors offer several packages. Please consult your local distributor for pricing.

Program	Viewing	Fixing	Multi Section	Cut Function	Boolean Operation	Triangle Reduction	Offset Part	Labeling	Compress Format
Meshlab	✓	✓	✗	✓	✓	✓	✗	✗	✓
VRmesh	✓	✓	✓	✓	✓	✗	✓	✓	✗
Netfabb	✓	✓	✓	✓	✓	✓	✓	✗	✓
TransMagic	✓	✓	✓	✗	✓	✓	✗	✗	✗
DeskArtes	✓	✓	✓	✓	✗	✗	✗	✗	✓
Magics	✓	✓	✓	✓	✓	✓	✓	✓	✓
Viscam	✓	✗	✓	✓	✓	✓	✓	✓	✗
Solidview	✓	✓	✗	✓	✗	✗	✓	✗	✗

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Online Services

Online STL fixing services provide an alternative to purchasing software. A user can upload a file and receive a fixed file, usually within a few minutes. Some vendors offer free automatic services, while some will have a specialist look into more complex issues. Pricing (if applicable) is typically per use, greatly reducing the initial cost. Some examples are Netfabb, a free cloud service (<http://cloud.netfabb.com>) and STLFIX by Materialise (www.stlfix.com), which offers free automatic fixing and 15 EUR per-file attended fixing.

Solid Modeling

Most CAD software requires the user to create models that conform to these rules:

- Each model defines a final volume
- Each volume is confined only in one model
- Each volume has a positive value (larger than zero)

When a model conforms to all three rules above, we typically refer to it as “watertight.” In the remainder of this document we will show:

- What makes a model watertight
- Common issues with converting native CAD files to STL files
- Common STL manipulation software suites, which allow converting a faulty STL to file into a printable one, and performing operations that are popular with PolyJet users

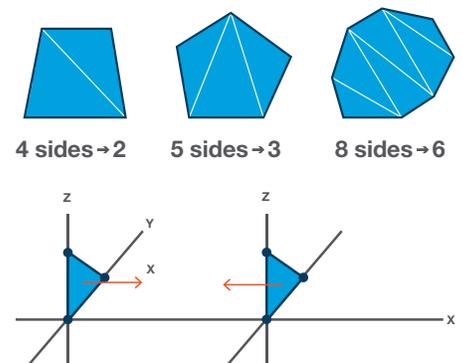
An Introduction to STLs

STL stands for Standard Triangulation Language, meaning that each CAD model can be represented as surfaces made of triangles. This format has long been the industry standard in rapid prototyping. Let’s look into the process of approximating surfaces with triangles:

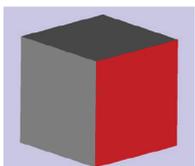
Each 3D form is made out of polygons. A polygon is defined as a flat shape bounded by a closed circuit. Each polygon with n sides can be represented using $n-2$ triangles.

Imagine a box, for example. It has 6 sides. Each one is a polygon. Each one of those sides is a square, meaning it can be represented using 12 triangles. Since we are dealing with three-dimensional shapes, each triangle has a direction. This direction is expressed by the normal of the triangle. (The outward direction is represented by the normal.)

The two triangles at the right, though they are identical, are facing in opposite directions.



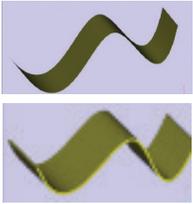
Common Errors in CAD-to-STL Conversion



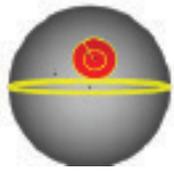
Inverted normals: An inverted normal is a surface whose direction is inconsistent. Occasionally, the interpretation of the surface between CAD and STL results in an inverted normal. Here’s an example: The box below has one face with an

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inverted normal, so the user will need to fix it to make the model 3D printable. We will discuss how later in this document.

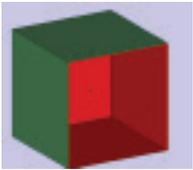


Zero thickness: To be fabricated in the real world, models must have a volume larger than zero. Sometimes, a model is represented on the CAD software using just a 2D model, which has no volume. The top part at left is a sheet of material that has no volume, though it is three dimensional. For the file to be printable, we must give it some volume, like the part below it.



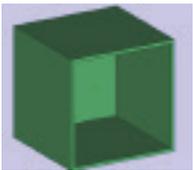
Bad edges: If we look into the definition of watertight, we discover that all triangles must be connected. Gaps are commonly referred to as “bad edges.” Here’s an example: The two hemispheres are not connected, and are marked with a thick yellow line to indicate the bad edge. (Note that each software suite has a different marking.) You can fill the gaps in an action referred to as stitching.

There are two types of bad edges: near bad edges and real bad edges. Near bad edges have a neighbor triangle that is closer than a set threshold. Most software solutions close these automatically. Real bad edges typically enclose a hole in the shape. This is slightly more complex, as it might cause a fault due to zero thickness.

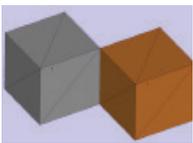


This part has a real bad edge in one of his faces. As a result, the boundaries of the box have zero thickness. Since 3D printers require a positive thickness for a file to be printable, this will require one of two solutions:

Close the hole. Once you add triangles to the hole, the model is once again watertight, has a positive volume and is printable.



Or create thickness. If the design intent was to create a box with one missing face, the user would need to create thickness, making the part printable. This is typically achieved using the “offset” command.



Non-manifold objects: Non-manifold objects are parts where an edge touches more than two faces. For example, in this image, does the yellow edge belong to the left or right box? To solve the problem, verify this model has two distinct shells by inserting some distance between the boxes.

Common STL manipulation actions

Below are some common procedures in preparing files for printing. These are not mandatory, rather they let the user optionally edit files outside the CAD software.

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Cutting



Cutting can be used for several reasons, from dividing a big part into several print jobs, to assigning materials in multi-material 3D printing, or preparing a part for gluing. On most software solutions, a cutting can be done along a line, contour or multi section. Consult the documentation of your software suite for more details. The model at left was cut with teeth for easy assembly.

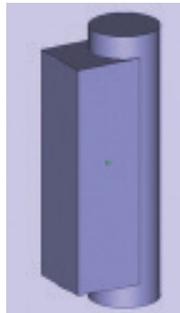
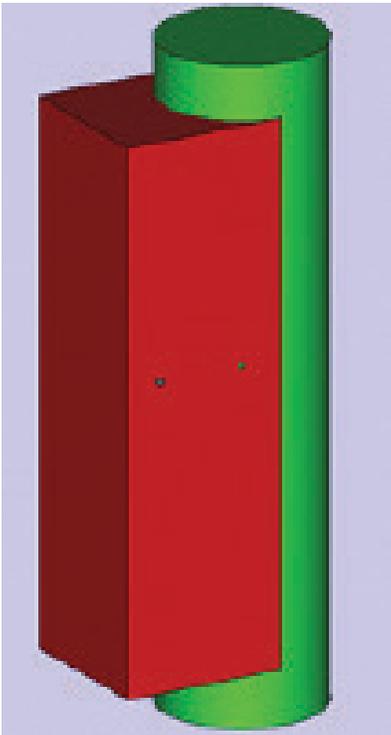


Labeling

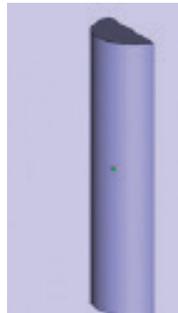
Labeling can help the user identify parts that were on the same print job, or add text or an image to a part. When preparing a part for multi-material 3D printing, you may want to create the label on a separate file or shell and assign a different material to it. The box at right has a label that extends outside its surface for a 3D look.

Boolean operations

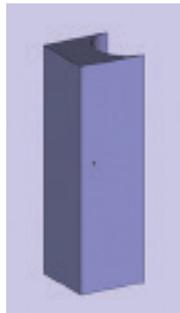
Boolean operations are applied to two models and typically include:



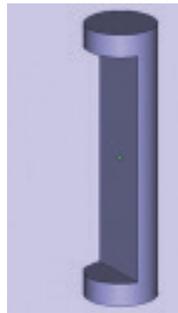
Unite, in which the two models are joined together, leaving only their external shell.



Intersect, in which only the parts common to both models remain.



Remove green from red, in which green model is subtracted from the red one.



Remove red from green, in which the red model is subtracted from the green one.

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CONTACT

For questions about the information contained in this document, contact Stratasys at www.stratasys.com/contact-us/contact-stratasys.

stratasys[®]

E info@stratasys.com / STRATASYS.COM

HEADQUARTERS

7665 Commerce Way, Eden Prairie, MN 55344
+1 888 480 3548 (US Toll Free)
+1 952 937 3000 (Intl)
+1 952 937 0070 (Fax)

2 Holtzman St., Science Park, PO Box 2496
Rehovot 76124, Israel
+972 74 745-4000
+972 74 745-5000 (Fax)

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