



Recommended formats and resolutions

Design for HP MJF

Introduction

Before sending a job to print, the 3D model must be converted into a file extension that HP Jet Fusion 3D Printing Solutions are able to interpret.

The most commonly used file extension in 3D printing is STL, despite the fact that it lacks even basic 3D model information such as color or the identification of distance units.

For this reason, HP and other 3D printing leaders have identified the need to develop a file extension that supports the needs of current 3D printing applications, services, and devices. A 3MF consortium has been formed to deliver a format—3MF—that meets the needs of the 3D printing industry with the possibility to grow as the industry evolves.

Moreover, a 3MF extension file will have a much lower weight compared with an STL file for a specific 3D model and resolution.

Tessellation

To convert a 3D model into a 3D printing file, it is necessary to tessellate the model, which means converting its geometry into linked triangles to convey its surface.

Once the 3D model has been tessellated, it is imported into slicer software, which slices the 3D model into layers and prepares it to be sent to the printer. It is very important to pay attention to this step: If it is not done correctly, it can cause problems such as geometric inaccuracies or slow processing.

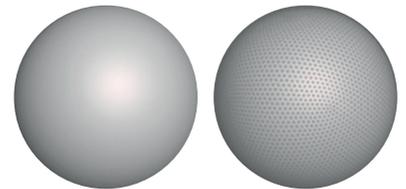


Figure 1. Example of tessellation

A normal file size for a 3D model is between 1 and 30 MB, but the size depends on the type of software that created it, the number of triangles, and the amount and level of details (e.g., a higher resolution means in a higher number of triangles, which will result in a heavier file size).

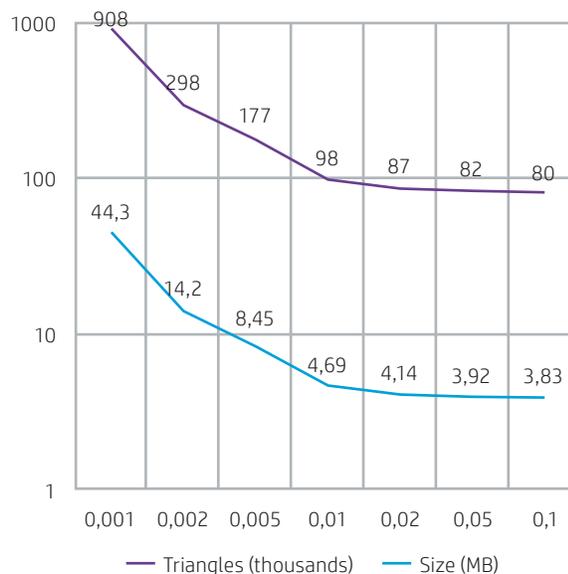


Figure 2. Triangle counts and file sizes vs. exported accuracy

Exporting a model from CAD

Although each version of CAD software uses a different method to export a 3D model to an STL or 3MF file, it is often necessary to manually enter some exporting parameters such as deviation chord height and angle tolerance, which define the resolution and the size of the STL or 3MF file by altering the tolerance in CAD software.

Deviation chord height

The deviation chord height is the maximum distance between the geometry of the 3D model and the surface of the STL or 3MF file. The recommended value for the chord height is 0.05 mm. A smaller deviation chord height will result in a more accurate surface.

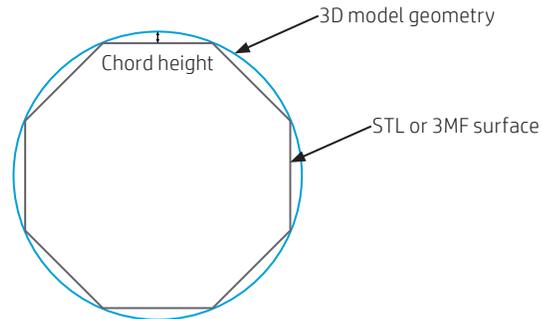


Figure 3. Deviation chord height

Angle tolerance

The angle tolerance is the maximum angle between the normal vectors of adjacent triangles. The recommended value for the angle tolerance is 1° .

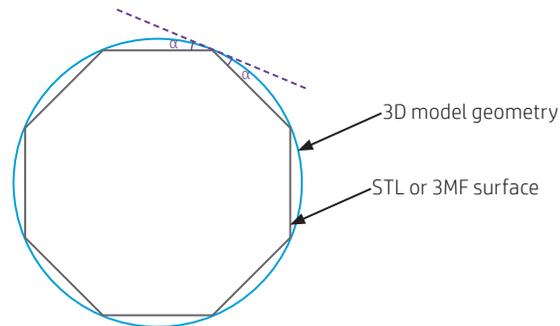


Figure 4. Angle tolerance

Exporting errors

Unexpected results such as surface inaccuracy (e.g., unexpected holes, unjoined triangles, overlapped triangles, tiny shells, flipped-direction triangles) or poor resolution are common errors that may occur when an STL or 3MF file is inadequately exported.

Too many or too few triangles

Although a mesh with more triangles tends to be more accurate, too many triangles are difficult to process and, when a certain size is reached, the additional triangles do not provide enhanced accuracy. For this reason, an excess number of triangles could increase processing time with no benefit.

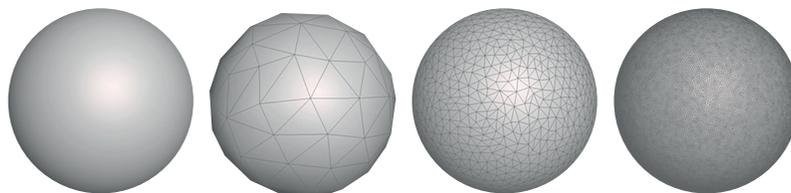


Figure 5. Examples of tessellation (from left to right): 3D model, tessellation with too few triangles, correct tessellation, tessellation with too many triangles

Similarly, too few triangles can lead to poor resolution results. Triangulation of a surface causes faceting of the 3D model. The exporting parameters used to output an STL or 3MF file affect how much faceting occurs.

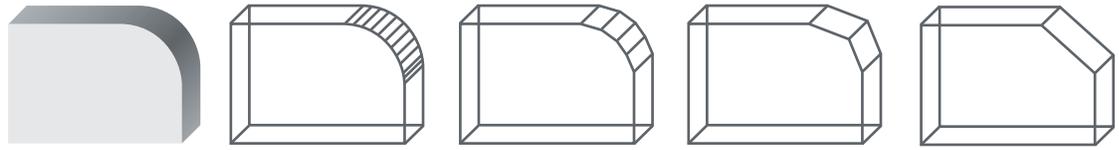


Figure 6. Exporting quality is dependent upon 3D model design



A small mesh doesn't necessarily mean lower quality. Rectilinear surfaces result in very high quality with a very small number of triangles. The necessary exporting quality is very design-dependent.

Repairing STL files

Common errors can normally be fixed by properly designing and exporting the 3D model using CAD software or another appropriate repair software. The most common software for repairing STL or 3MF files are the following:

- Materialise Magics with Materialise Build Processor
- Autodesk® Netfabb® Engine
- HP SmartStream 3D Build Manager

Dimensions in printer resolution

The minimum controllable printable volume when printing with HP Multi Jet Fusion technology is known as a voxel, which defines the resolution.

The HP Multi Jet Fusion voxel resolution in the Z axis is 80 microns. Thus, it is important to align critical dimensions to an integral number of voxels: It is possible to obtain a 3D printed block of 160 microns or 240 microns, but it is not possible to obtain one with 168.5 microns.

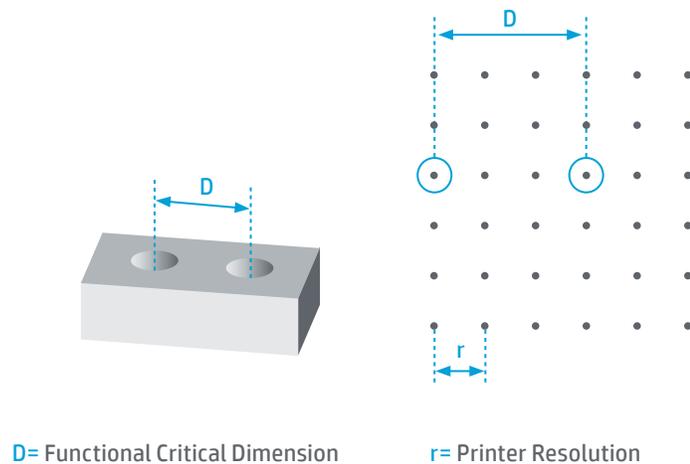


Figure 7. Printer resolution

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