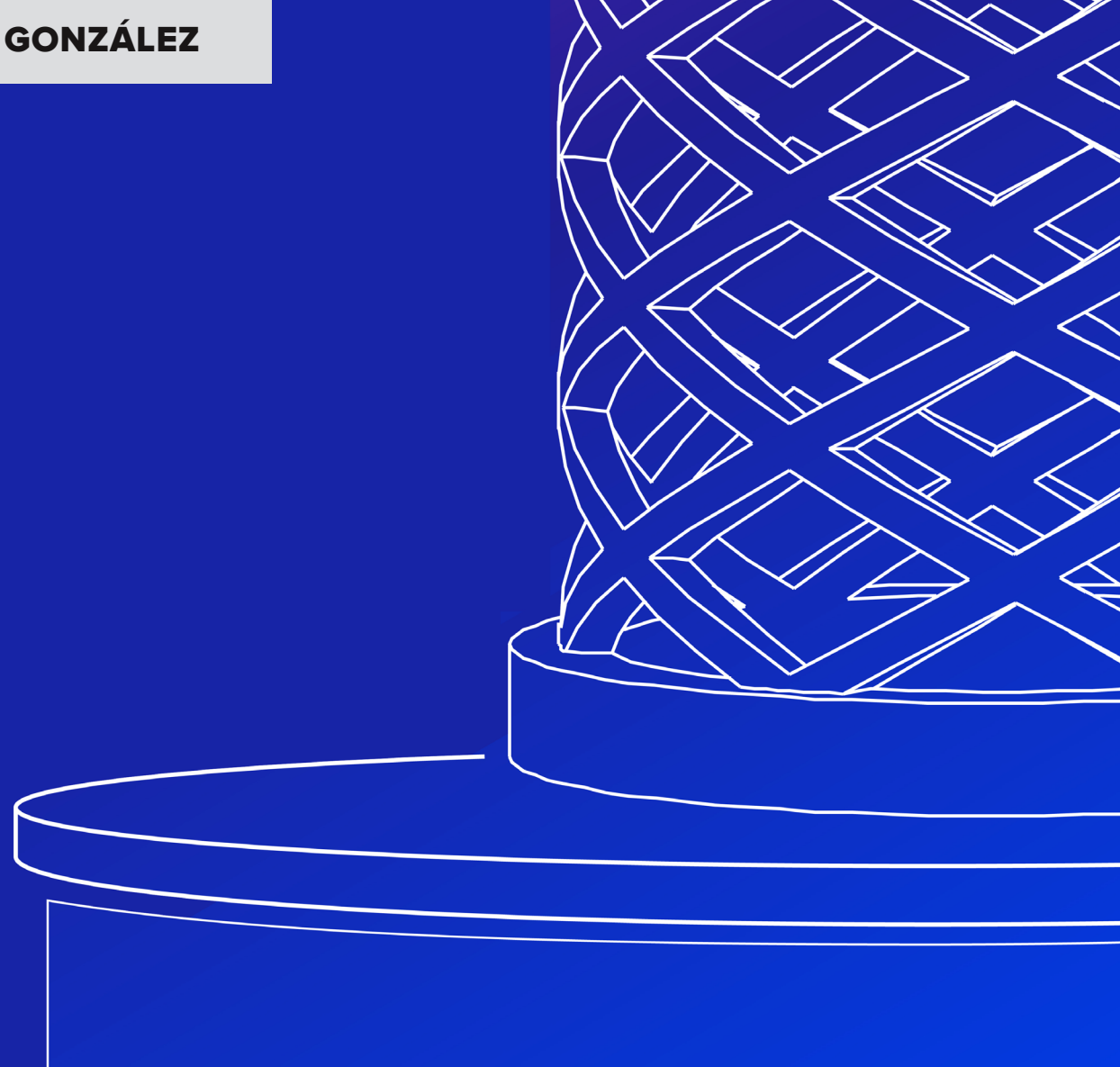


# 3D PRINTING DESIGN TIPS

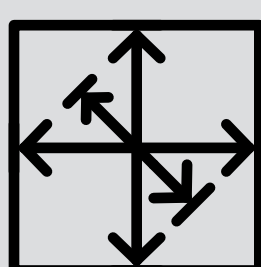


New materials are being added every day to the additive manufacturing industry. Most recently, **polytetrafluoroethylene (PTFE)**, or more commonly known as Teflon, is now a material available for 3D printing. 3M has recently introduced a new process to print **PTFE**.

**PTFE** is well known for its chemical inertness and impenetrability, as well as for its extreme resistance to water. The chemical is also very tough, flexible, and has a high-temperature range from -200 to +260 degrees Celsius.

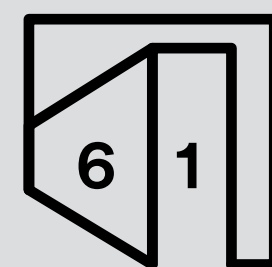
However, those same properties are what makes **3D printing PTFE** a difficult process.

3M has created a design guide for engineers looking to create their own **3D-printed PTFE** parts. The guide is also useful as general tips for those looking to design pieces specifically for 3D printing.



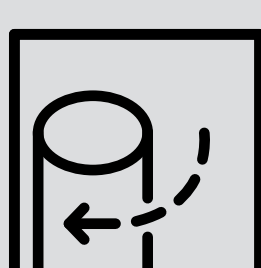
## PART DIMENSIONS

When designing parts for 3D printing, knowing the limitations of your print size is crucial. Part designs that exceed specified dimensions will have to be redesigned or broken down into parts for post-assembly. The PTFE process designed by 3M, for example, has a maximum print volume of 120 mm x 80 mm x 80 mm.



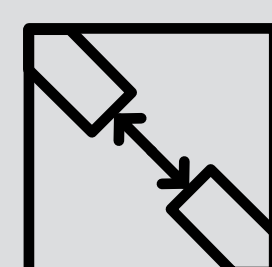
## ASPECT RATIO

The aspect ratio defines the relationship between width, length, or height dimensions of a feature. Features that exceed a specific aspect ratio may deform in the absence of supports. With high aspect ratios, bridges, and support features to ensure high print quality.



## PRINT ORIENTATION

Print orientation is crucial because it often determines which features are not self-supporting and which surfaces will face the build platform. Orientating a part in a particular direction can mean the difference in having few support finishes or several. For example, when printing a cylinder, it is better to have the dominant bounding curvature axis, or the long axis, normal to the build platform.



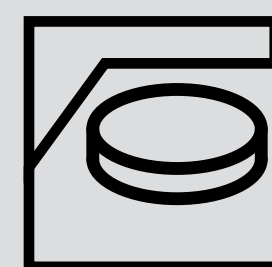
## SPACING

Appropriate spacing between features is essential to ensure that features do not join or print too closely together. For example, 3M recommends a spacing between separated positive features should be greater than 0.5 mm. Ultimately, the correct amount of spacing will depend on the overall print size.



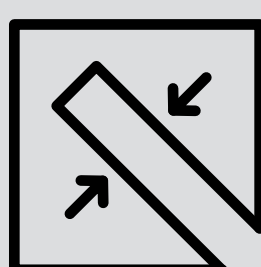
## SUPPORTS

When features go unsupported, such as overhangs and bridges, it could cause defects or print failures. Support structures are useful in linking the part to the build platform to increase stability throughout the printing process. When a part cannot support itself, these support structures are added to the design before printing and can be removed in the post-processing phase.



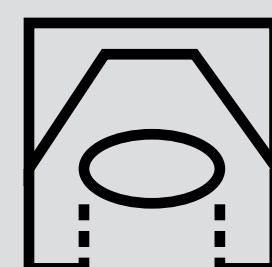
## SURFACE FINISHES

Often, a finished 3D-printed part will include a logo or a label from the manufacturer. These surface features are features that are slightly raised or lowered from the surface. Be sure to create a character height large enough so that the surface finish is visible on the finished part.



## CORRECT WALL THICKNESS

The structural integrity of a 3D-printed part is dependent on its wall thickness. The minimum wall thickness is typically dependent on the overall part size. As the part size increases, so should its wall thickness. When a part features hollow walls, the part should be reinforced with a latticework structure. Coring thick sections and adding fillets alleviate distortion issues related to changes in wall thickness. Lastly, designed-in reinforcements and supports should be used for free-standing walls, which can later be removed post-processing.



## HOLES AND CAVITIES

For parts that feature holes or cavities, the minimum width is needed so that the feature in the final print is not undersized. Be sure not to undersize the hole as that feature may fail in the final print. Post-processing drilling or boring work will ensure critical holes have the correct circularity. For a given hole width, shallower holes and through-holes have better outcomes.

Holes are also useful for resin drainage. Escape holes are often added to hollow features to prevent resin from being trapped inside a closed cavity. The optimal position of drainage holes depends on part orientation and may be included in the design prior to print.