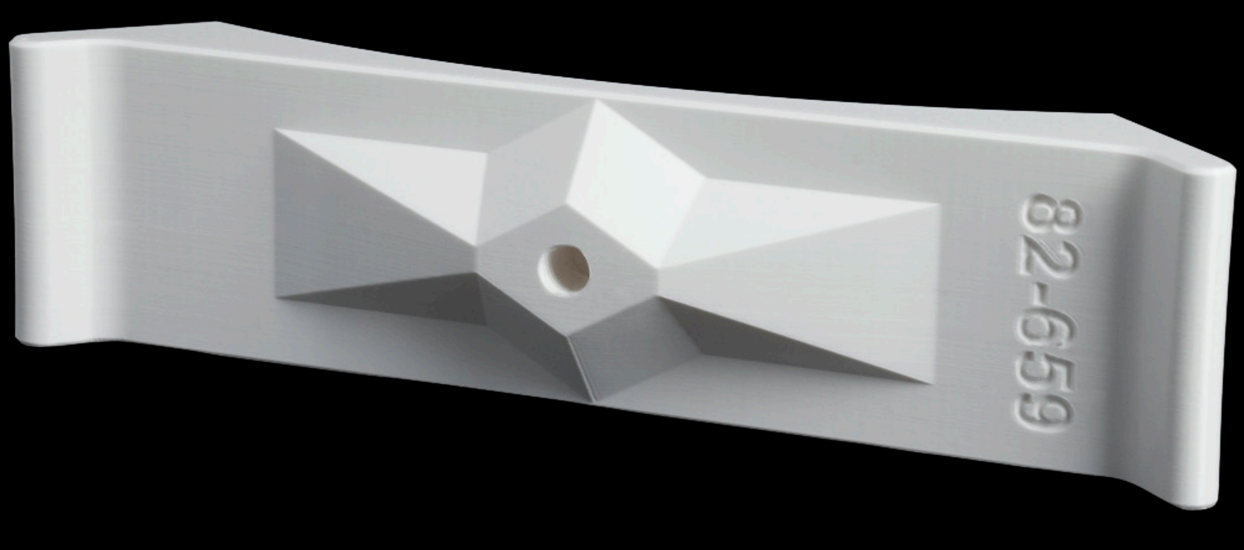
Markforged

3D Printing Guide for Food and Beverage Applications



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The print settings and part design advice contained in this document are targeted at food and beverage parts that have been additively manufactured on Markforged fused filament fabrication (FFF) printers. The aim is to minimize moisture build up and microorganism growth, and to manufacture parts that are easy to clean and sanitize.

General best practices are provided here, but following both internal and external guidelines on designing for food and beverage applications is advised where such guidelines are more restrictive than those contained in this guide. This guide is not a substitute for internal qualification processes to determine suitable parts for a given application.

Food-Contact Certified Material—Nylon White FS

Nylon White FS is an unfilled, non-abrasive nylon that is certified by NSF to NSF/ANSI Standard 51, Food Equipment Materials and is compliant with FDA CFR Title 21.

The NSF certification applies to Nylon White FS only. End users are responsible for validating that their printed parts satisfy their food safety standards and requirements.

Nylon White FS is suitable for production tooling and maintenance, repair, and overhaul (MRO) applications on food and beverage factory floors where the use of a food-contact certified material is required or preferred.

Nylon White FS is a great fit for parts that are in close proximity to food products. For direct food contact applications, it is the end user's responsibility to validate that printed parts meet their specific food safety standards and requirements.

Nylon White FS is certified by NSF for all NSF food contact categories except alcohol.

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Part Geometry Considerations

The following guidelines were derived from [Hygienic Design Standards and Guidelines]:

Avoid sharp crevices, engravings, and embossings where possible

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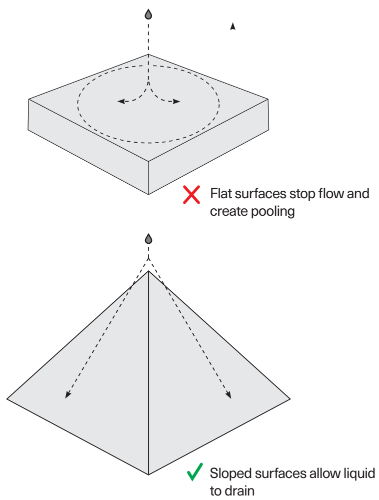
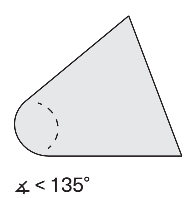


Avoid geometries that may hold liquid or debris after use or cleaning

- Give preference to sloped surfaces rather than flat surfaces to allow drainage
- Where possible, opt for solid infill rather than hollow tubes



For angles less than 135°, implement a 0.25 inch (6.35mm) radius.

The top and bottom surface of Nylon White FS parts are typically the smoothest with an average max roughness (Ra) of 2µm and 3µm Ra, respectively. Walls are slightly rougher at an average max roughness (Ra) of 8µm. Overhangs and slopes can have varying degrees of roughness, so where possible, implement 90° side walls to maintain low global roughness values.

Post-Processing

Markforged recommended glues, Print Bed Adhesion Stick and High Temperature Adhesion Stick, are water soluble. Glue can be washed from printed parts with soap and water.

Vapor smoothing and other post processing options may be available to provide a smoother surface finish. However, parts that are subject to these processes still need to be evaluated for food safety by the end user.

Sanding, polishing or otherwise smoothing surface of parts is possible with Nylon White FS. The exact method and materials are based on user preference.

Cleaning and Testing for Microorganisms

- Cleaning Nylon White FS parts: low temperature, low moisture exposure procedures such as damp cloths with diluted ethanol or alkali cleaning solutions are recommended
- Do not use a cleaning agent that exceeds 40°C when cleaning Nylon White FS
- It is not recommended to soak or submerge Nylon White FS during cleaning procedures

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Nylon White FS Part Usage Conditions

- In general, room temperature conditions with low moisture content are recommended
- Short-term use in environments up to 40°C is allowable

Printer Usage

Consider using a dedicated printer for printing Nylon White FS parts to avoid contamination from other materials that are not food-contact certified.

When changing from a non-certified material to Nylon White FS in your printer, the following printer components may be replaced to reduce risk of foreign materials in the printed part:

1. Nozzles
2. Tubes
3. Print Head

Disclaimers

The information provided in this guide does not, and is not intended to, constitute legal or compliance advice; instead, all information, content, and materials available in this guide are for general informational purposes only.

It is always the end user's responsibility to validate that printed parts, any application, meet any specific applicable food safety standards or requirements.

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