

# Machining recommendations

## Tuning your HP MJF technology to the design



### Introduction

HP Multi Jet Fusion (MJF) technology allows for the design and production of accurate parts with small features, complex geometries, and functional assemblies. These advantages can be enhanced by adding complementary post-processes such as machining, especially for applications where very tight tolerances are required such as small threads, bearing housings, or engineering fits.

A machining post-process can add value to the following aspects:

- **Dimensional accuracy:** A standard machining post-process can provide very tight tolerances—up to  $\pm 0.05$  mm—in a particular area or for a critical feature where high function and tolerance are required.
- **Geometry references:** In addition to dimensional accuracy, a machining post-process can also improve geometric requirements like flatness, concentricity, perpendicularity, or parallelism, reaching very tight tolerances up to  $\pm 0.08$  mm.
- **Small features:** A machining post-process also allows for the implementation of small features such as small threads, ensuring accurate results.
- **Surface roughness:** By default, the mean surface roughness or roughness average (Ra) of a part that is 3D printed using HP MJF technology is between  $8\ \mu\text{m}$  and  $12\ \mu\text{m}$ , depending on the face orientation. This surface roughness can be significantly improved with machining post-processes such as milling or turning, which have roughness values of up to  $0.30\ \mu\text{m}$  and  $0.60\ \mu\text{m}$ , respectively.
- **Repeatability:** A machining post-process can also decrease the variation in applications that require repeatable specs.



Please note that some plastics cannot be machined. The more rigid the plastic, the easier it is to be machined. Cutting tools used in machining rely on the rigidity of the component. Some reinforced plastics would behave better than less rigid plastics, which tend to bend and require expertise to be machined to achieve high accuracy. Softer and flexible plastics are not suitable for machining.

### Design recommendations

When designing a part for HP MJF, it is important to bear in mind the requirements for the final part. Some applications may require adjustments in the design in order to machine the printed part accordingly.

#### Surface grinding

This abrasive post-process removes material to create very flat surfaces with fine finishes and very accurate tolerances. For this reason, the machined surface needs to be designed with additional material to achieve a suitable result. The minimum recommended thickness is 0.5 mm, bearing in mind that an excess of material will lead to increased costs as well as manufacturing and post-processing time.



Surface grinding also allows for the improvement of the part's surface roughness.

## Process recommendations

When machining a part for HP MJF, it is important to select the right parameters for each post-process in order to achieve a suitable result.

### Milling

When milling a part for HP MJF, the recommended machining parameters are as follows:

| Operation                        | Through holes (direct diameter) | Through holes (large diameter) | Face grinding                                | Turret heights        |
|----------------------------------|---------------------------------|--------------------------------|--|-----------------------|
| <b>Tool recommended</b>          | Drill of required diameter      | Drill of Ø12                   | End mill of Ø63 with interchangeable inserts | End mill of Ø8        |
| <b>RPM recommended</b>           | 4000                            | 10000                          | 6000   | 6000                  |
| <b>Cutting speed recommended</b> | 200 mm/min                      | 2000 mm/min                    | 1000 mm/min                                  | 1000 mm/min           |
| <b>Depth of cut recommended</b>  | 1 mm                            | 1 mm                           | 0.25 mm                                      | 0.25 mm               |
| <b>Other comments</b>            | NA                              | Helical interpolation          | NA   | Helical interpolation |

Table 1: Milling recommended parameters



Using metal cutting tools can lead to high temperatures, which can worsen the surface finishing and dimensional tolerances due to the melting of the material.

### Turning

When turning a part for HP MJF, the recommended machining parameters are as follows:

| Operation                        | Facing        | Cylindrical facing | Boring                     | Reaming                     |
|----------------------------------|---------------|--------------------|----------------------------|-----------------------------|
| <b>Tool recommended</b>          | Cutting tool  | Cutting tool       | Drill of required diameter | Reamer of required diameter |
| <b>RPM recommended</b>           | 650           | 650                | 500                        | 150                         |
| <b>Cutting speed recommended</b> | 50-100 mm/min | 50-100 mm/min      | 200 mm/min                 | 200 mm/min                  |
| <b>Depth of cut recommended</b>  | 0.5 mm        | 0.5 mm             | NA                         | NA                          |

Table 2: Turning recommended parameters



When turning big series of parts, it is recommended to use custom tools made from widia or cobalt. In addition, to achieve good results and avoid vibrations, customized chucks can also be used.

### Coolant and lubrication

Although an HP MJF part can be machined without the aid of air or water cooling, it is highly recommended to use air cooling.

Cutting fluid also can be used if the part is attached with chucks and if the part is not going to be painted or the surface is not going to be treated in some way. For holes deeper than 10 mm, it is highly recommended to use the cutting fluid as the chips cannot be removed easily.

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