MJF PROCESSING TOLERANCES

The MJF technology, like any production process, has inherent dimensional tolerances related to the process and the production system, as well as the interaction of these with the material used.

In the case of PA12 material, these tolerances are equal to:

- ± 0.50 mm fro dimensions smaller than 100.00 mm;
- ± 0.50 % per dimensions larger than 100.00 mm.

For BASF Ultrasint TPU01 material, the tolerances are as follows:

nominal: 0 - 30 mm		**nominal: 30-50 mm**		**nominal: 50-80 mm**	
XY	**With**	**XY**	**Z**	**XY**	**Z**
± 0.50 mm	± 1.10 mm	± 0.60 mm	± 1.40 mm	± 0.70 mm	± 1.80 mm

For nominal values greater than this, the manufacturer (HP) does not provide specific guidelines due to the high variability of results.

The following will not be considered defects:

Missing details

Parts to be produced with MJF technology that have details with dimensions comparable to the processing tolerances indicated for the technology (i.e. of the same order of magnitude, for example with PA12 material 0.70 mm versus 0.50 mm in the case of dimensions less than 100.00 mm), or even smaller, may be produced with such details differing from the mathematical model or even absent. Similarly, holes or openings of inadequate dimension may be closed. Products that have 'moving' parts that do not have the right clearances and grafts may not be mobile.

Distortions and deformations

Parts produced with MJF technology that have an unbalanced thickness-to-surface ratio, i.e. parts with very large and thin planar geometries, may exhibit undesired deformations and distortions due to the thermal phenomena that occur during the printing phase, especially if such geometries do not have support and reinforcement structures (such as ribs or removable diaphragms).

Print Layers

Parts produced with MJF technology must be oriented within the print build. If the parts to be produced have oblique and linear details (rounded edges, freeform surfaces), print layers may be visible on these, due to the discretization of the production height into powder layers with a height of 0.080 mm.

Stepping

Parts produced with MJF technology must be oriented within the print build. If the parts to be produced have oblique and linear details (e.g., bevels, draft surfaces, or more generally oblique details), steps may be visible on these, due to the discretization of the production height into powder layers with a height of 0.080 mm.

Printing lines

Parts produced with MJF technology, especially those with extended planar surface geometry, may have different embossed and colored surface lines compared to the rest of the reference surface, due to the accuracy of the manufacturing process subject to the reference processing tolerances.

Fragmented surfaces

Parts with walls thinner than 1.00 mm (especially when located near internal cavities, external profiles, section variations and similar features) may result in fragmented surfaces both due to the printing process itself and the depowdering/sandblasting process to which all parts produced with this technology are subjected. In the latter case, the medium used in the process, impacting on these thin and extremely fragile surfaces, may cause localized damage.

Burrs from Insert Inspection

When requested by customers, metal inserts can be placed in parts produced with MJF technology. The insertion process involves the deformation of the housing seats using specialized hot or ultrasonic tools. The housing seats may therefore have slight burrs due to the aforementioned process.

Scratches from automatic processes

Parts produced with MJF technology can be subjected to automated processes (e.g.,depowdering/sandblasting) if the geometry allows it. The resulting parts may have very slight surface marks caused by contact with other parts undergoing the same process.

Pigmented parts with markings

Parts produced with MJF technology subjected to a pigmentation process may have markings, i.e. localized areas with different coloring from the rest of the part. These are due to the presence of other details of the part (inserts, ribs, flanges, walls, etc.) that cause a variation in local density (for example, a box with cylindrical features in its internal bottom may show circular markings on the corresponding external surface,which are more intensely colored than the rest of the surface).

Parts painted with localized paint accumulation

Parts produced with MJF technology and subjected to a painting process may have localized accumulations of paint in areas such as recesses, cavities, holes, openings, profiles, or variations in section. This is due to

the nature of the process itself and the material used (water-based paint).

Parts with non-homogeneous or differing characteristics

In the case of serial production of parts using MJF technology (i.e. the production of a certain quantity of the same item code), the parts produced, especially if they do not require post-processes of vapor smoothing, pigmentation, or painting, may exhibit different characteristics. This occurs because their production might take place in different print jobs. The use of multiple print jobs is related to optimizing the job based on production requirements.

Cross contamination (evaluated on a case-by-case basis)

The MJF manufacturing technology involves powder sintering when it is treated with two specific agents (detail and fusion) and then subjected to heat. These two agents are deposited on the powder via printheads. There can be instances of cross-contamination between the agents, resulting in the following printing issues:

1) Sintering of powder that should not be involved in the process, leading to the appearance of thin ridges on the part;
2) Non-sintering of powder that should have been involved in the process, resulting in slight, shallow depressions on the part.

Elephant Skin

Elephant skin is a defect in parts produced with MJF technology, where the product exhibits a rough surface. This defect occurs is due to excessive massiveness of the part to be produced, which causes localized excessive heat during the printing phase, resulting in uneven heat distribution on the print bed.

Thermal Bleeding

Thermal bleeding is a surface defect in parts produced with MJF technology, where the product shows traces of unsintered powder, identifiable by its virgin color (for example, for PA12 and BASF Ultrasint TPU01, the color is whitish in contrast to the grey of the sintered part). This defect is caused by the heat generated during the printing phase, which also causes the fusion of material that was not intended for sintering. It can occur in cases where the geometry of the part being produced does not allow optimal heat flow, such as internal edges, cavities (especially when undersized or blind), undercuts, and others.

PROCESSING TOLERANCES

FDM technology, like any production process, has intrinsic dimensional tolerances related to the process and the production apparatus. These tolerances are equal to:

- ± 0.50 mm for dimensions under than 100.00 mm;
- ± 0.50 % for dimensions over than 100.00 mm.

List of conditions that can be verified with FDM technology

Warping

The warping defect in parts produced with FDM or FFF technology is caused by shrinkage phenomena that occur during the material cooling process. During printing, the molten material is deposited layer by layer, and as it cools, it tends to contract. This contraction can cause deformation in the parts, lifting corners off the build platform and compromising the accuracy and quality of the final product.

Stringing o cobwebbing

Parts produced with FDM technology may exhibit thin, transparent filaments. These are caused by the extrusion process during production when molten material continues to leak out of the 3D printer's nozzle as the print head moves from one point to another, creating these thin, transparent filaments

between the various areas of the printed part.

Elephant foot

Parts produced with FDM technology can have areas at the base of the print that are wider than those above, referred to as “the elephant foot”. This situation can be due to different shrinkage effects that occur between the print bed base and the subsequent layers above.

Burrs from Insert Installation

When requested by customers, metal inserts can be placed in parts produced with FDM technology. The insertion process involves the deformation of the housing seats using special hot or ultrasonic tools. The housing seats may therefore have slight burrs due to the aforementioned process.

Stepping

Parts produced with FDM technology are created by depositing material layer by layer. If the parts to be produced have oblique or linear details (such as chamfers, lead-in surfaces, or other oblique details) or curved details (such as rounded edges, freeform surfaces, etc.), steps may be visible on these areas. This is due to the discretization of production height into layers of powder, typically of 0.200 mm or 0.100 mm in height.

Surfaces that interface with the print bed

Parts produced with FDM have a surface in contact with the print bed. The surfaces of the part in contact with that plane will necessarily have a different appearance (texture and color) when compared to that of the other surfaces.

Interface surfaces with supports

Parts produced with FDM technology may require support structures for production where there are overhanging features, internal cavities, and similar details. The surfaces of the part in contact with the support structures (which may or may not be removed according to the customer's request) will necessarily have a different appearance compared to that of the other surfaces.