



General recommendations for printing processes

Tuning your HP MJF technology to the design

Introduction

When using HP Multi Jet Fusion (MJF) technology, there are general recommendations to follow to optimize the printing process, keep the printer in top condition, and obtain the desired results.

General considerations

General considerations to keep in mind are as follows:

Equipment

- The operating temperature of the equipment should be between 20°C and 30°C to prevent thermal fluctuations. Going beyond these limits could have adverse effects on part quality.
- The printer's operating relative humidity (RH) should be between 30% and 70% for optimal system usage and performance. Depending on the material, a different operating relative humidity might be necessary for processing. For example, HP 3D HR PA 12 requires relative humidity levels between 50% and 70%. To verify specified environmental conditions, check the material data sheet.
- Power line quality is important. If it is suspected that the power installation at the site will suffer from variability or alterations, it is recommended to install an uninterrupted power supply (UPS) system.
- The set-up altitude should be based on the location of the facility and the printer. A wrong selection could directly affect the cooling system and pressure parameters.
- Read the User Guide to master the key aspects related to cleaning, maintenance, and calibration practices.
- Make sure that the glasses that cover both fusing lamps and the thermal camera are clean.
- Ensure that the printer's thermal control is properly calibrated and meets the following parameters:

Temperature camera calibration: This calibration is used to compensate for small misplacements of the top temperature camera sensor. This calibration is only needed for new installations and after thermal camera replacements.

Fusing lamps calibration: This calibration is used to correct irradiance deviations and obtain the true statuses of the lamps. It is highly recommended to perform this calibration under 40% to 60% relative humidity and to double check the printer's RH readings with an external humidity sensor. This calibration is only needed after a fusing lamp replacement or intensive cleaning of burn spots.

- Some problems may be caused by printhead issues, so it is important to make sure that the printheads are correctly maintained and aligned, and that nozzles are in good condition.
- Even if the printer is perfectly clean and calibrated, it may be necessary to fine-tune the energy provided by the lamps. To do this, the operator can modify the irradiance of the lamps depending on an assessment after printing some control parts. Each print profile requires a specified fusing lamp irradiance. The fusing lamp irradiance value can be checked on the front panel before printing.

Printing profiles and materials

HP Multi Jet Fusion technology allows for the use of different powdered materials, such as HP 3D HR PA 11 ("HP PA 11"), HP 3D HR PA 12 ("HP PA 12"), and HP 3D HR PA 12 Glass Beads ("HP PA 12 GB").

Some materials like HP PA 11 and HP PA 12 can be printed using different print profiles, which are tested sets of parameters aimed toward maximizing specific final properties such as dimensional accuracy, mechanical strength, or part appearance.

There is a relationship—maintained across different current materials—between the energy received by the parts during the printing process and the general consequence of their mechanical properties and appearance, as shown in Figure 1:

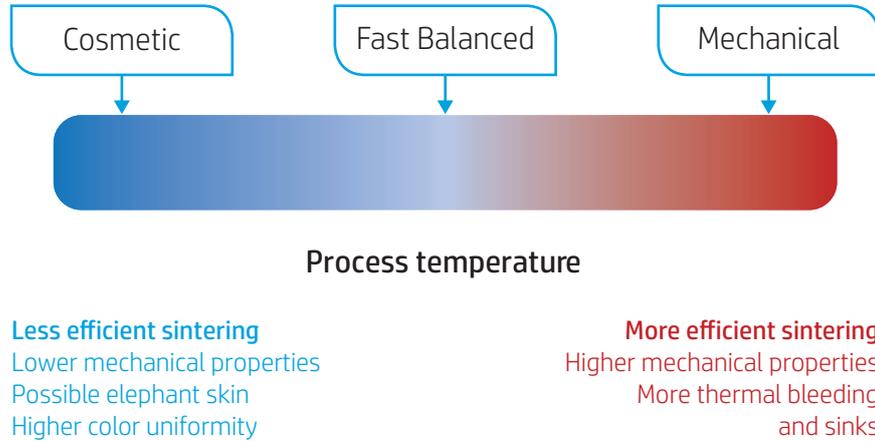


Figure 1. Relationship between process temperature and main part attributes

Thus, the hotter the part, the greater the sintering of the powder, leading to denser parts with stronger properties. However, excessive heat can result in adjacent powder sticking to the surface of the parts (thermal bleeding) and contraction-related artifacts such as sinks.

On the colder side of the spectrum, these effects are minimized, thus improving the overall look of the parts at the expense of mechanical performance and localized non-homogeneous shrinkage.

Print profiles are placed on the scale as a guideline, but their exact position would be determined by their fine-tuning potentiality. Fine-tuning is required to center these print profiles at the optimum levels according to the specific application.



Figure 2. Fine-tuning process

- Extremely high-packing density jobs, non-recommended powder mix ratios, and poor system maintenance may lead to some part quality issues.
- It is recommended to use balanced print profiles (HP PA 11, HP PA 12, and HP PA 12 GB), which require two passes per layer, for a compromise between look and feel, dimensional accuracy, and mechanical properties. The compromise in dimensional accuracy in HP PA 11 occurs mainly in the Z-direction with respect to HP PA 12.

Balanced print profiles result in greater elongation and impact resistance for HP PA 11 compared with HP PA 12, while HP PA 12 GB provides a higher modulus with lower elongation.

HP PA 12 GB has a single print mode without a specific name, but it must be considered as balanced.



- It is recommended to use mechanical print profiles (HP PA 11 and HP PA 12), which also require two passes per layer, to achieve the best elongation at breakpoints and impact resistance results while maintaining tensile strength, which is not affected with respect to balanced print profiles.

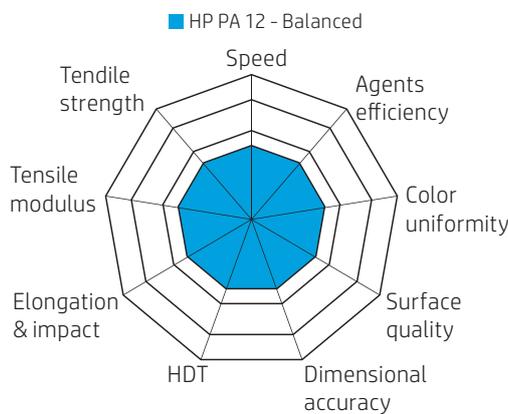


Fast print profiles result in greater elongation and impact resistance for HP PA 11 compared with HP PA 12.

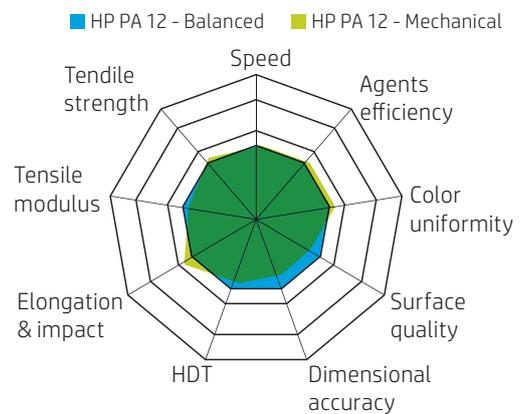
- Fast print profiles (HP PA 11 and HP PA 12) are recommended for reducing time and cost as they use half the number of printing passes as Balanced or Mechanical modes and require a lower volume of fluid agents. In both cases, tensile strength remains comparable to their respective Balanced modes but elongation at breakpoints is lowered, especially in the Z-direction. This trade-off is less pronounced for HP PA 11 than for HP PA 12, since the overall mechanical performance is higher for all HP PA 11 print profiles. Furthermore, the Fast print profile for HP PA 11 generally yields linear accuracy comparable to that of Balanced HP PA 11 but shows reduced warpage.
- The cosmetic print profile is only available for HP PA 12 and aims to reduce the occurrence of geometric artifacts such as sinks on the tops of parts. It requires two passes per layer.

To highlight the differences between the current print profiles and materials, the behavior of their general characteristics is approximated, as shown in Figure 3:

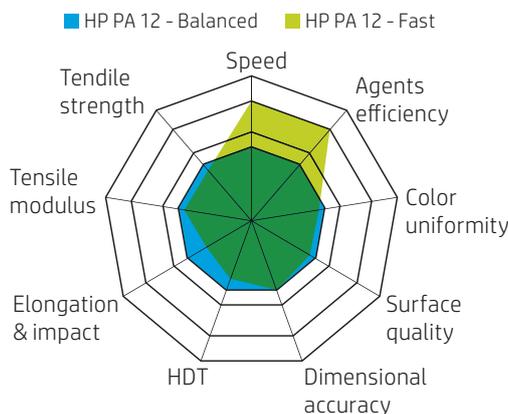
HP PA 12 Balanced print mode



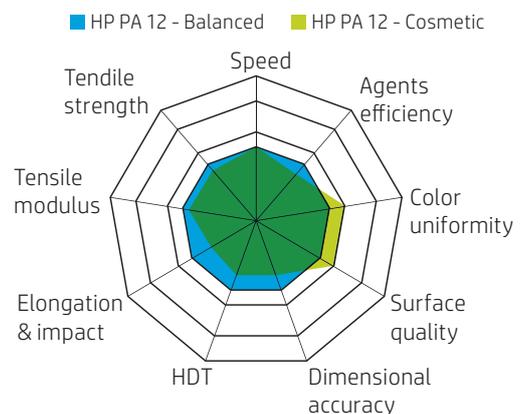
HP PA 12 Mechanical print mode



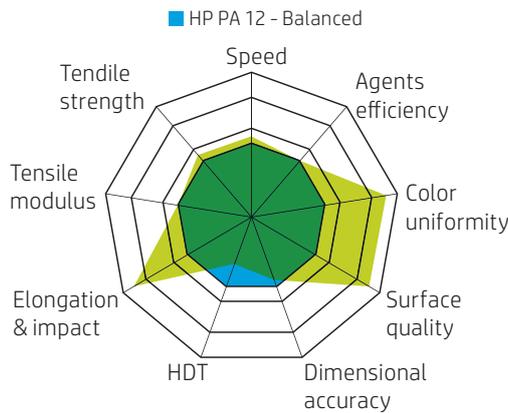
HP PA 12 Fast print mode



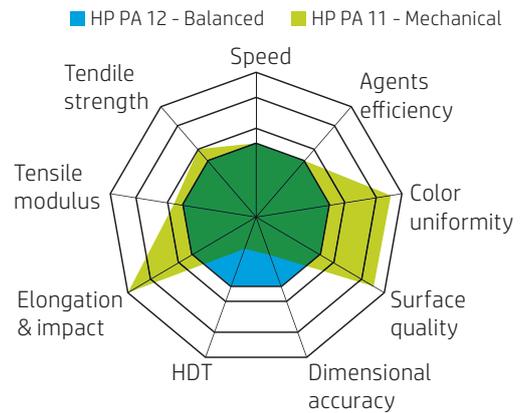
HP PA 12 Cosmetic print mode



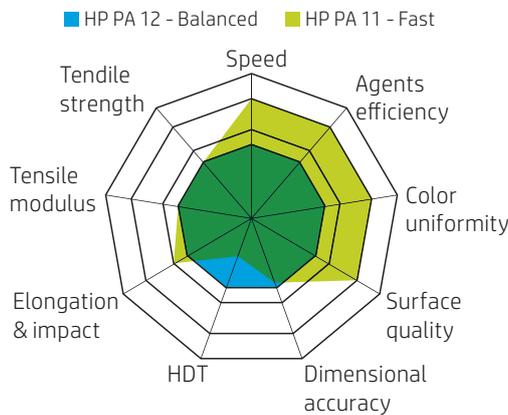
HP PA 11 Balanced print mode



HP PA 11 Mechanical print mode



HP PA 11 Fast print mode



HP PA 12 GB print mode

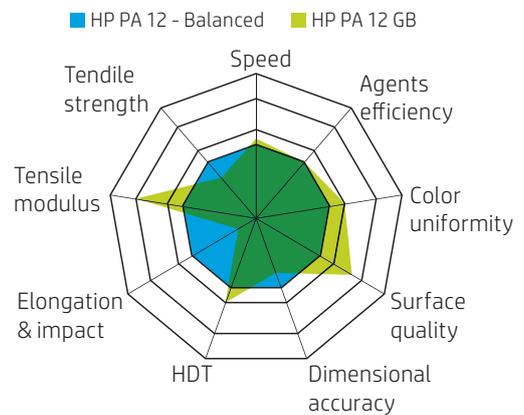


Figure 3. Comparison of the general characteristics of the available print profiles for HP 3D HR PA 11, HP 3D HR PA 12, and HP 3D HR PA 12 GB. Speed refers to the total printing time of a full bucket. Agents efficiency represents the amount of fluid agents used per bucket, with higher values meaning lower consumption. Color Uniformity and Surface Quality are based on representative parts evaluated for known artifacts (e.g., stair-stepping, thermal bleeding, etc.). Dimensional Accuracy refers to the deviation of printed parts with respect to their digital files, combining linear accuracy and shrinkage-related effects. Heat Deflection Temperature (HDT) at 1.82 MPa. Elongation at breakpoints & Impact, Tensile Modulus, and Tensile strength are measured according to international standards

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