White paper

Automatic dyeing post-process

for HP Jet Fusion 3D 4210/4200 Printing Solutions

Objective—What is achieved with this process?

Automatic dyeing is an optional post-process used to achieve color uniformity for 3D printed parts produced with HP Jet Fusion 3D printing solutions.

General overview

This process consists of immersing the parts into a hot dyeing bath for a prescribed period of time in order to color the parts.

Workflow

Before starting the dyeing process, parts must be clean, so a good cleaning process is mandatory. As much white powder as possible must be removed to avoid stains and achieve an optimal result.

As this process takes place in water, a drying step is required afterwards.

Production workflow

	Production workflow				Process
	Place into laundry bags	Dyeing process	Drying	Sandblasting / shot peening (optional)	Prepare dyeing solution
Operation time	5 min/batch	0 min/bath	10 min/batch	30 sec-5 min per piece	5 min/per 5 batch
Process time	5 min/batch	2.5 hr/batch*	2-3 hr/batch	30 sec-5 min per piece	40 min/per 5 batch

* If there is a hot water supply installation, the process times shown here will be faster, reducing the processing time to approximately 45 minutes.

Recommendations

This process is an easy and automatic option to achieve color uniformity for parts. Through this process, all details and cavities of the parts are reached and the process is repeatable.

To avoid the physical marks produced by movement of the pieces during the drying process, the use of laundry bags to separate pieces (with different weights) in the same batch is strongly recommended.

In addition, the process is not labor intensive, and many parts can be dyed at the same time.

However, as the process takes place in water, it is important to keep in mind that, as parts absorb some water during the process, their dimensional and mechanical properties may change slightly. Warpage of thin and flexible parts could be affected.

Suitable applications

This process is recommended for applications in which the look and feel is important: visible parts, covers, figurines, etc. We do not recommend this method for parts that have long-term contact with skin. This process is not tested to all the possible applications. Suitability to any special re-equipment should be specifically tested.

What do you need?

Recommended equipment

- Girbau DY130 Coloring System[1]
- Laundry bags
- Dye solution or powder; HP recommends TCN GTC 8211C black liquid dye

Site requirements

- Water supply installation is required. If there is a hot water supply installation, all the process times will be less than those published in this document.
- For TCN dye, a water softener is not required, but it is recommended to improve results and bath stability.
- A liquid disposal to recycle the dying solution.
- A wastewater system is required to recycle the dyeing solution, or treatment of the residual water is needed if the maximum permissible limits of the Standards for Effluent Discharge Regulations of the site do not allow discharge of the product directly into the local sewer system. Wastewater produced by this system must be disposed of according to local regulations.
- The work area must be well ventilated. Operators should wear protection equipment according to the TCN GTC dye MSDS (http://www.techniques-chimiques-nouvelles.com/en/home/).

Consumables

This consumable has been tested successfully by HP:

- GTC black liquid dye: 8211C

How does the TCN dye work?

Settings

Programs are predefined in the washing machine for use with the TCN dye.

These programs are specified to some essential procedures to dye HP Jet Fusion 3D parts:

- Dye bath mixing
- Dye bath conditioning
- Dyeing 60° C
- Dye bath disposal
- Cleaning

This is a description of the programs, what they do, and when to use them:

- Dye bath mixing
  - Program to produce a new dye bath
  - Requires a new TCN GTC 10L Carboy
  - Fills with water, mixes 1:10 ratio of GTC die, the mix heats up to 60° C while homogenizing and empties the mix into the dye bath tank
  - Prior to making a new mix, the old bath must be disposed of by using the dye bath disposal program

- Dye bath conditioning
  - Program to prepare the dye bath for dyeing
  - Not mandatory, but recommended to shorten the dye cycle and also to help proper homogenization of the dye bath if it has been in the tank but not in use for some time (>2 days)
  - Dye bath is raised into the tumbler and heated to 60° C while it is energically mixed, then it is returned to the dye bath tank
- Dyeing 60° C
  - Parts dyeing program at 60° C
  - Program performs a dye bath plus a rinse cycle; dye bath is returned to the dye bath tank and rinse is pumped out through the rinse outlet to the disposal tank
- Dye bath disposal
  - Program to empty the dye bath tank
  - Dye bath is raised to the tumbler and pumped out through the dye bath outlet to the disposal tank
  - Dye bath should be disposed of according to local regulations
- Cleaning
  - Program to perform a clean water rinsing cycle to clean the machine from dye remains
  - Perform according to recommended maintenance operations, or if the machine is not to be used for extended periods of time
  - Program performs a clean water cleaning cycle through the tumbler and conducts, including the dye bath tank, and pumps the remains through the rinse outlet into the disposal tank

Procedure

- Dye bath mixing: (volume concentration 1:10)

  For GTC black liquid dye 8211C, the recommended concentration is 1:10 by volume, that is 1 liter of dye to 10 liters of water. Girbau DY130 equipment has a program that generates the dye bath at the proper volume ratio by mixing 74 liters of water with 7.4 liters of dye.

  The recommended duration of the dye bath is up to five times, or one week, whichever comes first. After this period, the TCN bath must be disposed of, and a new bath made, in order to keep the coloring under optimal coloring conditions. After these uses, the bath will continue dyeing but the color uniformity may not be reached or a color hue may appear.

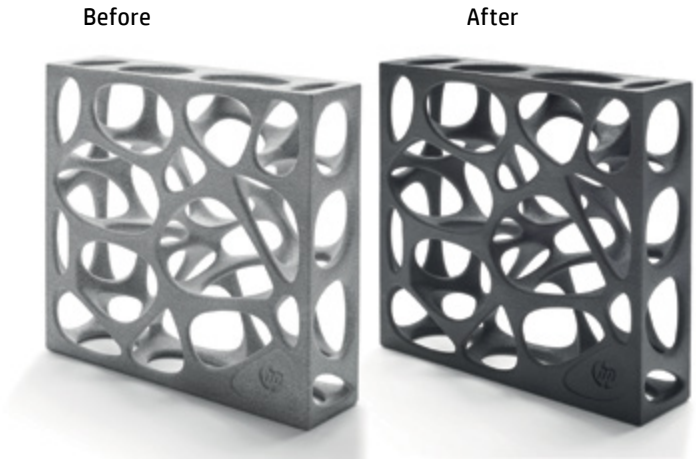
- Dye bath conditioning

  The purpose of this step is to warm and condition the dye bath mix prior to performing the dye process at 60° C. This step is needed ONLY if the dye bath is at room temperature or has not been used for some time. The recommendation is to use it at the beginning of the day if:

  - More than a single dye cycle per day is to be performed
  - To homogenize the dye bath after sitting for more than 2 days (i.e., after the weekend); the program warms the bath up to 60° C, with energic agitation, and returns the bath to the dye tank
- Dyeing 60° C
  - This step must be performed with the dye bath near 60° C
  - The parts should be placed in a laundry bag; it is recommended to group parts of similar mass in the same laundry bags and not to mix delicate parts with massive parts to avoid potential damage due to impact; this part separation avoids the stains due to parts rubbing against one another during the dye process
  - Place the laundry bags into the dye machine, well distributed spatially over the tumbler

- Drying process
  - When the dyeing process is finished, you can open the dye machine, gently turning the bag while inside the unit to drip any water remains
  - Remove the parts from the bag and place them over an absorbent mat or clean cloth/towel; parts can also be left to dry in the tumbler of the dyeing machine overnight which produces a more even drying condition which can reduce the appearance of drying marks
  - Some parts may be sensitive and prone to drying marks; a hot gun can be used to avoid these stains
- Bead blasting or sandblasting (optional)
  - To avoid the drying stains, shoot peening or bead blasting can be performed; this step can help homogenize the surface and remove the drying stains and can also remove scratches resulting from contact between parts

How do the results look?



Data courtesy of NACAR

Troubleshooting

- To prevent the appearance of drying stains, the use of heat gun at low power is recommended.
- If some stains do appear after the dyeing process, a bead blast or shot peening post-process is recommended; in the case that the esthetic parts must be applied, a shot peening after the dyeing process is recommended to improve the esthetic appearance of the parts.
- A blue shadow can appear if a critical parameter is below the validated parameters. These critical parameters are dye concentration, temperature, time and if concentrated dye is stored for a long period of time. We recommend using the dye within 2-3 weeks from the date of manufacture for best results. In the event of a blue color, check dye bath duration, dye fabrication date, and adequate mix. For example, if the tube of the peristatic bomb must be replaced, the quantity of dye will be less that the fixed quantity of dye.
- Red stains in the corner of the parts can appear due to impact during the dyeing process.

  This effect can be reduced by using “sinter boxes” through the drying process.

1. HP does not design, manufacture or sell the Girbau product or provide any warranty for the Girbau products. HP believes that the information herein is correct based on the current state of scientific knowledge and as the date of its publication, however, to the maximum extent permitted by law HP EXPRESSLY DISCLAIMS ANY REPRESENTATIONS AND WARRANTIES OF ANY KIND, WHETHER EXPRESS OR IMPLIED, AS TO THE ACCURACY, COMPLETENESS, NON-INFRINGEMENT, MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE (EVEN IF HP IS AWARE OF SUCH PURPOSE) WITH RESPECT TO ANY INFORMATION PROVIDED. Except to the extent that exclusion is prevented by law, HP shall not be liable for technical or editorial errors or omissions, and damages or losses of any kind or nature that result from the use of or reliance upon this information, which is subject to change without notice. Recipients of the Girbau product are responsible for determining the suitability of Girbau products with HP Jet Fusion 3D products, ensuring compliance with applicable laws and regulations, and being aware that other safety or performance considerations may arise when using, handling or storing the product.

4AA5-6674ENW, June 2018