Digital ABS Plus and Digital ABS2 Plus materials simulate standard ABS plastics in combining high temperature resistance and high toughness. Parts printed with Digital ABS Plus and Digital ABS2 Plus offer:

- An impact resistance of 90-110 J/m (1.69-2.06 ft lb/in.)
- An initial heat deflection temperature (HDT) of 58–68°C (136–154°F) upon removal from the printer. A higher HDT of 82–90°C (179–194°F) can be achieved after thermal treatment in a programmable oven (see section E).

These properties make Digital ABS Plus and Digital ABS2 Plus suitable for printing parts that require high impact resistance, strength and dimensional stability.

Digital ABS Plus and Digital ABS2 Plus are fabricated using RGD515Plus together with RGD535 or RGD531 and yield printed parts in a choice of two colors, green and ivory.

This Application Note describes recommendations and tips for achieving optimum quality and enhanced mechanical properties when printing Digital ABS Plus parts.

A. Cleaning Printer Components
B. Preparing Trays for Printing
C. Drying parts
D. Photobleaching
E. Thermal Treatment

**Printing Recommendations and Tips**

**A. Cleaning Printer Components**

Micro-cracks adversely affect the mechanical properties of printed parts. To avoid micro-cracks:

- After a print job has completed, run the Head Cleaning Wizard, the Wiper Cleaning Wizard.
- If the Head Cleaning Wizard is not run for 33 hours of printing, the wizard automatically opens when starting or resuming printing. If this occurs when a print job is interrupted, cancel the wizard to resume printing. (Run the Head Cleaning Wizard after the print job is completed.)

**Note:** You cannot cancel the Head Cleaning Wizard to resume printing if head cleaning has not been performed for 99 hours.

- Every 15 minutes of printing, several sequences of purge are automatically performed.

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1 Objet 1000 printers (18 kg containers) use RGD515Plus B.
B. Preparing Trays for Printing
The arrangement of the parts on the build tray affects the quality of the printed parts.

- If surface matching is required, place all matching surfaces **face up**.
- Internal stress may cause parts to curve upwards and detach from the tray. To reduce this possibility:
  - When printing parts that have a high aspect ratio (X:Y), position the longer edge along the Y-axis (see Figure 3).
  - Prefer printing full trays. This enables easier removal of Support material from printed models.

C. Drying Parts
Printed parts may require longer time to dry than parts printed with Vero materials.

To dry parts thoroughly:

- Place them on a dry surface or on a drying rack.
- To avoid deformation, orientate the parts so that there is minimal strain on thin walls (see Figure 4).
- Allow the parts to dry overnight.

D. Photobleaching
The yellow tint fades naturally over time, but you can greatly accelerate this process by using a suitable photobleaching treatment. This involves exposing parts to intense fluorescent light.

After 24 hours, there is tint reduction of 90%.

**Method A: Using an Illumination Chamber**

- Off-the-shelf chamber
- Enables controlling temperature and light intensity
- Assures predictable results

**Method B: Using Desk Lamps**

- Self-assembly from readily available components
- Low cost solution
- Varying results, due to the lack of precise control over temperature and light intensity

**Note:** The fluorescent lamps should be rated 45W, 6500K.

**Photobleaching Instructions:**
1. When using desk lamps, place the models in a container. The inside of the container must be covered with aluminum foil. Use at least two lamps, more when treating model in a large container.
2. Arrange the printed models in the chamber/container with enough distance between them to allow light to reach all sides of each model.
3. Turn on the lights. Verify that the ambient temperature around the models is approximately 40°C (104°F). Higher temperatures may cause model distortion; lower temperatures may not produce satisfactory results. When using desk lamps, you can achieve the required temperature by positioning the lamps approximately 10 cm (4 in.) above the models.
4. Inspect the model tint after 24 hours of treatment. If necessary, continue the photobleaching treatment.

E. Thermal Treatment

Thermal treatment of Digital ABS Plus and Digital ABS2 Plus parts in a programmable oven improves their heat resistance.

Note: The actual thermal resistance depends on the part’s geometry.

Special Instructions:

To avoid distortion during the thermal post process procedure:

- Parts with thin walls and overhangs must be properly supported before placing them in the oven.
- Consider the best placement for the printed part inside the programmable oven.
- Place the part on a flat surface in the oven and not directly on the oven rack. The rack may exert forces on model.

Procedures A and B, below, are suitable for all part geometries. They differ in the duration and expected HDT.

HDT test method: ASTM D 648-06, HDT at 0.45 MPa

Procedure A

- Desired HDT: 90°C (194°F)
- Time in oven: approximately seven hours (including cooling time)

1. Clean the part and remove the support material.
2. Place the part in a programmable oven (see specification below) at room temperature.
3. Set the ramp-up rate to 1°C (1.8°F) per minute.
4. Increase the temperature to 60°C (140°F).
5. Turn on the oven. The oven temperature reaches 60°C (140°F) after approximately 35 minutes.
6. Maintain the temperature at 60°C (140°F) for two hours. Increase the temperature to 70°C (158°F). The oven temperature reaches 70°C (158°F) after approximately 10 minutes.
7. Increase temperature to 80°C (176°F) and maintain for one hour.
8. Cool in oven.
9. When the oven temperature is below 35°C (95°F), you can remove the part from the oven.

![Caution:]
Always wear oven gloves when handling hot parts.

Figure 8: Oven temperature over time (Procedure A)

Procedure B
- Desired HDT: 100°C (212°F)
- Time in oven: approximately nine hours (including cooling time)

**Note:** This procedure may cause greater distortion to unsupported thin walls and overhangs. If this is a concern, use procedure A.

1. Clean the part and remove the support material.
2. Place the part in a programmable oven (see specifications below) at room temperature.
3. Set the ramp-up rate to 1°C (1.8°F) per minute.
4. Increase the temperature to 60°C (140°F).
5. Turn on the oven.
   - The oven temperature reaches 60°C (140°F) after approximately 35 minutes.
6. Maintain the temperature at 60°C (140°F) for two hours.
7. Increase the temperature to 70°C (158°F).
   - The oven temperature reaches 70°C (158°F) after approximately 10 minutes.
8. Increase temperature to 80°C (176°F) and maintain for one hour.
9. Increase temperature to 100°C (212°F) and maintain for one hour.
10. Cool in oven.
11. When the oven temperature is below 35°C (95°F), you can remove the part from the oven.

![Caution:]
Always wear oven gloves when handling hot parts.

Figure 9: Oven temperature over time (Procedure B)
Figure 9: Oven temperature over time (Procedure B)

F. Programmable Oven

Recommended Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum operating temperature</td>
<td>250-300°C (480-570°F)</td>
</tr>
<tr>
<td>Temperature stability (PID controller On/Off)</td>
<td>±0.1/±0.2 degrees</td>
</tr>
<tr>
<td>Temperature uniformity</td>
<td>At 300°C±5° (at 570°F±10°)</td>
</tr>
<tr>
<td>Heat-up time to maximum temperature</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Recovery time to maximum temperature</td>
<td>4 minutes</td>
</tr>
<tr>
<td>Dimensions</td>
<td>as required</td>
</tr>
<tr>
<td>Volume (liters)</td>
<td>as required</td>
</tr>
<tr>
<td>Air changes per hour</td>
<td>10-50 (depends on oven size)</td>
</tr>
<tr>
<td>Maximum power</td>
<td>depends on oven size:</td>
</tr>
<tr>
<td></td>
<td>750 W for 28-liter oven</td>
</tr>
<tr>
<td></td>
<td>9000 W for 900-liter oven</td>
</tr>
<tr>
<td>Holding power</td>
<td>depends on oven size:</td>
</tr>
<tr>
<td></td>
<td>300 W for 28-liter oven</td>
</tr>
<tr>
<td></td>
<td>3500 W for 900-liter oven</td>
</tr>
<tr>
<td>Controller</td>
<td>stores 4 programs and up to 16 segments (Eurotherm programmer, or similar)</td>
</tr>
</tbody>
</table>

Recommended Oven Manufacturers and Models

The following oven manufacturers and models are recommended by Stratasys and are available worldwide.

Note: Other manufacturers and oven models may be suitable if they meet the specifications listed above.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Oven model</th>
<th>Chamber size</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Despatch Industries</td>
<td>LLB oven series</td>
<td>as required</td>
<td>May require an additional controller</td>
</tr>
<tr>
<td><a href="http://www.despatch.com">www.despatch.com</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nabertherm</td>
<td>TR oven series</td>
<td>as required</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.nabertherm.com">www.nabertherm.com</a></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Disclaimer

Stratasys Ltd. is not responsible for misuse of our products or their use in conjunction with unsafe or improperly maintained equipment or for uses other than intended as specified in this application note.

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