

Subject: Tips and info for building with DuraForm® FR1200 Engineered Thermoplastic on sPro 60 HD-HS SLS® systems

DuraForm FR1200 is an engineered fire retardant production plastic for use in 3D Systems' sPro 60 HD-HS SLS systems. It is not recommended for general purpose use on a sPro 60 HD-HS SLS printer. DuraForm FR1200 offers a combination of mechanical properties, fine feature details, smooth surfaces on a sPro 60 HD-HS printer.

DuraForm FR1200 is available in two modes, Standard Production (SP) Mode, and Advanced Mode. Material configuration files for SP and Advanced modes are offered by 3D Systems. The process settings in the SP configuration files have been optimized to provide a good starting point to operate while using this mode. Process settings for the Advanced configuration files offer more processing latitude for advanced users. SP Mode is the default configuration and the recommended mode by 3D Systems.

The material process parameter set points may vary slightly from machine to machine, due to differences in material conditions and thermal sensors. As a result, the process parameters (more specifically the temperature set points) may need to be adjusted slightly from the defaults. An offline IR sensor calibration is required before using a material for the first time.

Below are the important pieces of information to know in order to build successfully with DuraForm FR1200 on a sPro 60 HD-HS SLS system. For more details about this material, please refer to the DuraForm FR1200 Material Guide and the DuraForm FR1200 Safety Data Sheet and for more details about the sPro 60 HD-HS SLS system, please refer to the sPro 60 HD-HS user guide.

- 1. Hardware Modifications:** DuraForm FR1200 Plastic material will require upgrading the sweeper roller to prevent cracking in the bed and provide a better roll out of material.

Counter Rotating Roller Upgrade: An upgrade to the Counter-Rotating Roller is required in order to successfully print with DuraForm FR1200. Please contact your 3D Systems field service representative for more information upgrade. This upgrade is very critical for running DuraForm FR1200 on a sPro 60 HD-HS printer.

- **132783-00**, /R ROLLER, TEXTURED, sPro 60 HD-HS, FRU KIT

Sifter Screen Upgrade: Recycling DuraForm FR1200 Plastic material will require upgrading the sifting screen of the sifter. Please contact your 3D Systems field service representative for more information about this upgrade;

- **75-0262** Screen Element, 120TBC, Sifter, Bonded, RVM-15E

- 2. Software version:** Software version 5.1 or higher is required. Sinter V5.1 and Build Setup V5.1 are the recommended software versions.

- 3. Build Setup software:** SLS Build Packet Files are created in the Build Setup software. A Build Packet File (BPF) contains special instructions that are system and material specific. The initial default parameter values, provided in the DuraForm FR1200 material configuration files, are a good starting place for initial builds. Modification to parameter values may be required upon application or system condition.

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4. **Material Configuration files:** LS 5.1 material configuration files are available for download from the 3D Systems website, InfoCenter.3dsystems.com>ProductionPrinters>SLS>sPro 60. The values in the material config will be a good starting point for initial builds with DuraForm FR1200.

NOTE: Two material configuration files are offered with DuraForm FR1200: SP mode, and Advanced mode; SP mode contains default values for general fire retardant parts building. Advanced mode allows users to modify values to achieve desired properties (this mode may extend scanning layer times). These material configuration files offer recommended parameters. Customers running DuraForm FR1200 may need to optimize certain parameters for their systems.

NOTE: A setting of 5 lpm for N2 laser window flow is recommended for DuraForm FR1200 Material.

5. **SP vs Advanced mode:** SP mode controls the limits of the sPro system to ensure customer get the performance they desire and removes variability that could occur during the standard print process. The Advanced mode offers more processing latitude for advanced users, and increases the allowed range for many of the parameter values.

NOTE: It is the customer's responsibility to validate results such as part quality and mechanical properties at the parameter values they use in Advanced Mode. Also, customers/users should note that 3DSystems Field Service might require the use of the SP mode during troubleshooting issues.

The following table highlights the default process parameter values for the SP print mode

Parameter	DuraForm FR1200 SP mode
Part Bed Heater Set Point	173°C
Feed Temperature Set Point	145°C
Powder Layer Thickness	0.1 mm
Fill Laser Power	40 W
Outline Laser Power	13 W
Scan Spacing	0.20 mm
Fill Scan Count	1
Outline Scan Count	1
SinterScan™	1

NOTE: Flammability properties are limited by part thickness. The minimum wall thickness of the part to pass a 12 second FAR25.853 test is 2.0 mm.

6. **Shrink and Beam offsets:** The shrinkage of 100% fresh DuraForm FR1200 is slightly close to 3%. You should expect to evaluate and adjust the scale values used to compensate for shrink. Note that shrinkage may vary slightly based on part geometry. The following table offers the starting values to use for scale and beam offsets. These are the same values as in the material configuration file.

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Parameter	DuraForm FR1200 SP mode
X scale	1.034
Y scale	1.034
Z scale	1.0240-1.181E-5z
X Fill offset	0.254mm
Y Fill offset	0.254mm
X outline offset	0.229 mm
Y outline offset	0.229 mm
Parameter	DuraForm FR1200 SP mode
X scale	1.034

- 7. Part orientation in the SLS build volume:** There are three primary considerations relative to part orientation.
- Large “blocky” sections or structures are susceptible to distortion (post-build curl). Rotating the .stl file a few degrees about X and/or Y can help to mitigate this distortion. Rotation to 30 degrees is shown to give good properties and less distortion.
 - Start these demanding parts later in the build (at greater Z) after other parts have already been built underneath.
 - Parts with wide flat bottoms are recommended to be oriented by 10 degrees in X and Y to eliminate distortion (i.e. bowing) at the bottom.
 - It is recommended to orient parts to match flat surfaces with the XY plane to reduce surface area on parts to optimize the flammability properties of the material.
- 8. LEAN:** Lean is a type of post build distortion. Lean occurs at the boundary of the acceptable build area, where the shrinkage of a part has different rates for different regions. Maintaining the most uniform temperature distribution, by modifying the various Heater Ratios, the Cylinder Heater Set Point, and the Piston Heater Set Point will minimize lean.
- 9. Routine maintenance:** Avoid leveling powder while purging the system. Exercise care when removing powder residue from sensitive surfaces. Powder buildup should be vacuumed and oily residue should be wiped with a scratch-resistant cloth. Clean laser window with mild liquid detergent under running warm water, then clean with ethanol and a dust-free lens wiping tissue. Refer to the sPro 60 HD-HS user guide and DuraForm FR1200 material guide for more details.
- Routinely clean the roller with a clean wipe with alcohol. During the build process, the components of the material tend to form a film on the roller as the material smokes when the laser is scanning the bed. This film may create a smooth surface that covers the rough pattern of the roller.
- 10. Material handling:** Follow proper PPE when handling DuraForm FR1200. This includes safety glasses, protective gloves, and a dust mask. Please refer to the sPro 60 HD-HS user guide and the DuraForm FR1200 material guide and DuraForm FR1200 Safety Data Sheet for more details.

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11. Part Breakout, Powder Recycling & Sifting: Do not remove the print cake from the process chamber until the part bed temperature is approximately 85°C. Allow parts to continue cooling to 50°C before trying to break them out of the print cake.

After a print with DuraForm FR1200, loose material from the print cake should **not** be sifted and reused in another print. The recycling of this specialty material is not recommended in order to maintain consistent material and fire retardant properties. Additionally, if 100% fresh material is not used, problems such as variable shrinkages and surface imperfections like “orange peel” may appear.

For the sPro 60 HD-HS system, the part breakout, powder sifting and powder recycling operations are performed at a station called the Break Out Station (BOS) System.

Should you (the customer) decide to recycle material, remove loose powder surrounding the parts with a brush. Use a combination of part breakout tools and a bead blaster to fully remove the powder adhering to the parts. Sift the loose powder into a container. Discard any hard, chunky powder and the powder directly surrounding the parts.

12. Blending Fresh and Used Powder: 3D Systems recommends using 100% Fresh material to maintain the integrity of flammability and mechanical properties.

NOTE: For a sPro 60 HD-HS system, the overflow powder is collected in bins to the side of the feed pistons. Settings (Smart Feed) for DuraForm FR1200 have been optimized to reduce the amount of Overflow, and optimize the use of Fresh material.

It is not recommended to recycle part cake material into a blend. If you decide to recycle material, use only fresh and overflow material. To blend FR1200 it is recommended to use a tumble mixer at less than 50 rpm for approximately 10 to 15 minutes. Once blended the material must be sifted with a 120TBC mesh size screen to avoid any agglomeration of large particles.

NOTE: Parts will require proper validation and qualification of mechanical and flammability properties resulting from the blend of recycled material by the customer.

NOTE: Approximately 0.55 Kgs (1.3 liters) of powder is required for every 10 mm of z-height (please include warmup, build, and cool down heights for calculation). This number holds true when the volume percentage of parts in a build is about 8%. For builds with higher part volume percentage a larger quantity of powder will be required. Preview or Build Time Estimate will update the Information tab in Build Setup with the amount of powder required to complete a build.

13. Additional Settings Information:

Customer Information Bulletin



3D Professional Printer

CIB00159

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