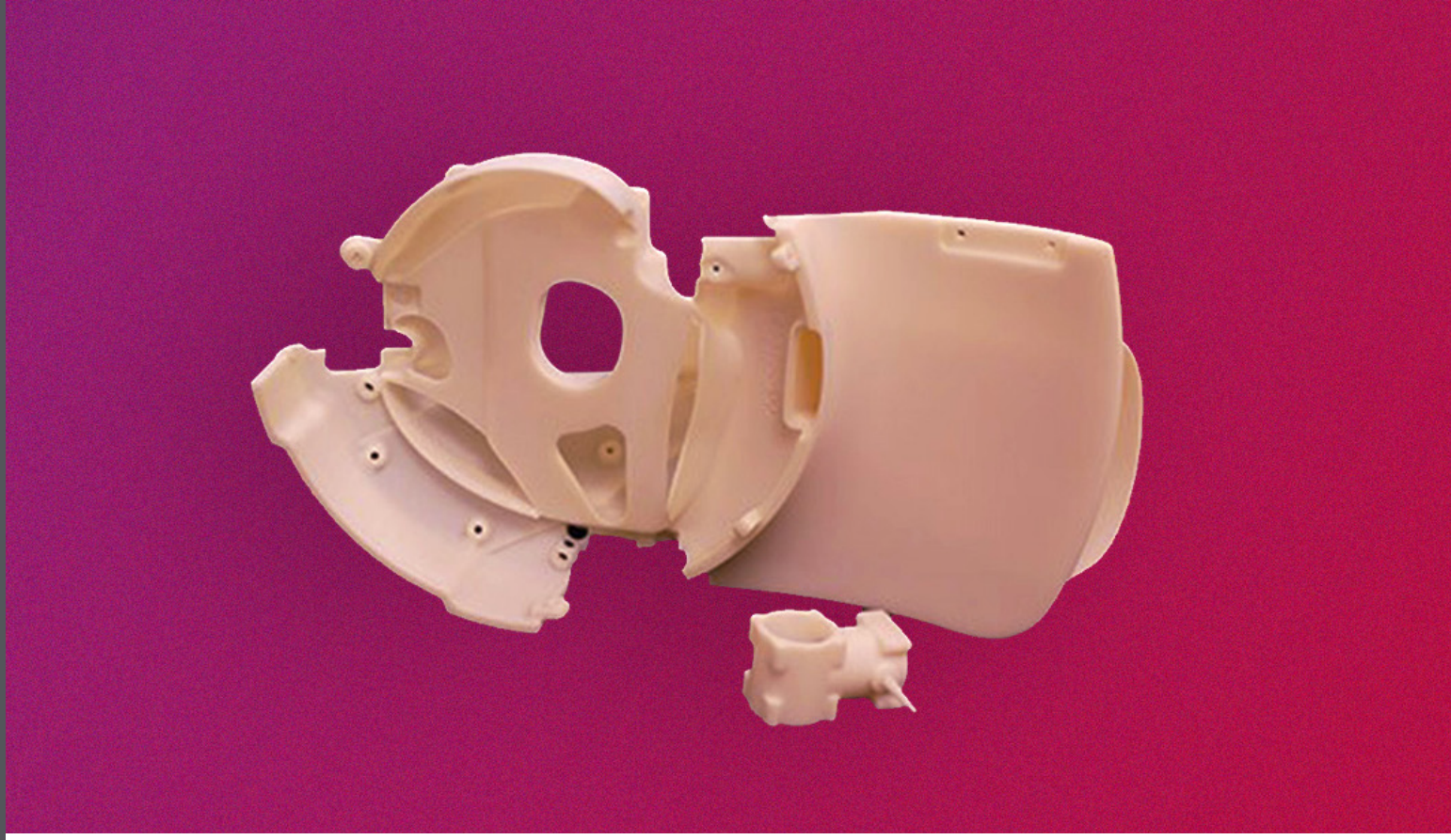

Somos® PerFORM™

Overview

Somos® PerFORM™ produces strong, stiff, high-temperature-resistant composite parts that are ideal for tooling and wind-tunnel testing applications. With the lowest viscosity of any composite stereolithography material, parts made from Somos PerFORM are faster to build, easier to clean post-process, show superior sidewall quality, and provide unmatched detail resolution.

Technical Data

Optical Properties

E_c	7.8 mJ/cm²	[critical exposure]
D_p	4.3 mils	[slope of cure-depth vs. ln (E) curve]

stratasys

Best Practice

Somos® PerFORM™

Safety Instructions

Avoid injuring yourself or others

Adhere to the following guidelines:

- Read and understand the Safety Data Sheet (SDS) before using the material.
- Avoid contact with eyes, skin & clothing by wearing the following Personal Protective Equipment (PPE):
  - Safety Glasses/Goggles
  - Gloves
  - Laboratory Coat
- Keep the work area clean.
- Avoid spreading material on clean surfaces.
- If material is found on clean areas, it should be cleaned off immediately with a disposable paper towel and isopropanol.
- Wash hands regularly after handling material.
- Provide adequate ventilation.
- Prevent build-up of volatile substances from materials and solvents.
- Remove dust from clean and finished parts.
- See the Stratasys® Handling of Cured Somos Stereolithography Resins guide for UV materials for further safety instructions.

Preparing Equipment

Operating Conditions

We recommend the following room conditions:

- Ambient temperature of 20°C – 25°C (68°F – 77°F)
- Humidity of less than 40%.
- Minimize dust, as it can build-up and reduce the performance of the optics on your SLA machine, potentially leading to an increase in scattered UV light. Ultimately, this could increase the viscosity of the material in the vat.
- Use UV filters for lighting and external windows.

Replacing Material

When replacing material, make sure you clean the vat thoroughly, dispose of used material and cleaning products (solvents, paper towels, etc.) properly and follow vat installation procedures.

Somos® PerFORM™

Machine Maintenance

Contact your equipment supplier for up-to-date technical support for your equipment. Below are a few common checks that will help you build parts successfully:

Recoater Blade

- Keep the re-coater blade clean. Remove debris from the bottom and periodically check the gap and rake of the blade.
- Periodically check the rim level.
- Keep bearing rails clean and oiled.
- Periodically check belts, sprockets and bearings.

Optics and Overhead Mirror

- Keep mirrors and optics dust free and clean. Periodic preventative maintenance will increase the life of the laser beam and improve its quality.
- Have the laser tuned and serviced periodically. The typical tuning frequency is two to three times a year. This reduces the risk of burn spots on the laser crystals.

Machine Computer

- Inspect the cooling fans for electronic components regularly to ensure they are working properly.
- Keep the build tree clean. Having too many build files can corrupt the procycon.mdb, which contains material data, start position and sensor locations.
- Install back up hard drives to ensure you do not lose any data. This is very important, especially for older equipment.
- Make sure the latest computer software service packs are installed are your system for optimal performance.

Mixing Guidelines

Composite material settles over time and so requires occasional mixing. To ensure proper consistency, adhere to the following guidelines:

- Mix the re-fill material before every build.
- Mix the vat after every build that takes longer than 12 hours.
- Mix the material every 72 hours, regardless of usage.

Pre-mixing

With any composite or filled material, it is important to mix the material prior to use. Using a small “paddle” attached to a hand drill, mix the material in the bottle for 30 seconds to 1 minute. Move the paddle around the inside of the bottle—including up and down on the inner edges—to make sure all the material has a homogenous consistency.

Somos® PerFORM™

Adding to the Vat

Once pre-mixed, the material is ready to add to the vat. A fine mesh sieve can be used to catch any "unmixed" lumps of material and prevent them from entering the vat. If you don't have a sieve, pour the liquid over the platform to give you a better chance of spotting any lumps. If you see lumps, press them through the sieve or platform using a spatula.

We recommend that after introducing any new refresh material to the vat, you run a 15-minute "Platform Stir". This will mix the new resin with any remnants of the material that is present in the vat. You can then continue to build.

If the resin is for use in a new, full vat fill or after a vat sieve procedure, we recommend you undertake a "Paddle Stir" of at least 2 hours on a medium speed setting. This will help blend the material batches together into a uniform, homogeneous consistency. It will also allow bubbles of trapped air to be released from the body of the material. We recommend you place the blade part of the mixing paddle as close to the bottom of the vat as possible. Doing this will avoid any potential settlement build up.

Vat Mixing Regime

To maintain the life expectancy of your material, all the benefits of process speed and material stability, you should follow the following mixing regime:

- Before and after every build, conduct a 30-minute "Platform Stir".
- At least once a week (or after very long builds of around 60 hours), perform a "Paddle Mix" of up to 3 hours, or until the viscosity returns to normal (1,000-2,000 cps).

If the vat is unused for periods longer than, 24 hours, you should periodically stir the vat of material. "Paddle Stir" for 2 to 3 hours for every 72 hours in which the vat has not been used.

Vat Sieving Regime

Remove the resin from the vat and pass it through a fine mesh sieve to remove foreign bodies, such as support structures, that may have entered the vat. This should be done at least every 3 months.

During this operation, any settlement should be mixed back into the resin that has been removed during the sieve operation.

Failure to run a sieve operation can result in continual settlement build up and, eventually, the formation of a hard-packed layer. This "hard pack" layer can cause issues for the elevator during part builds. Hard pack settlement cannot be mixed back into the material and must be removed and disposed.

Somos® PerFORM™

Build Parameters

Build parameters are subject to site conditions and machine efficiency. The parameters mentioned below can be considered base settings that you can tweak for improved styles.

Machine Settings

Check to see that the Zephyr blade is clean of any residue by running a gloved finger along each side of the blade. If there is any residue, gently wipe it off with the proper tool.

Before beginning a new build, always check the Zephyr blade to ensure there were no changes after any build crash or other adverse events that may have changed the gap.

Also, check that the resin level in the blade is set to the halfway point. On builds with large flat or trapped volumes, check that the blade does not run out of material. If it does, material starvation could be causing it to give an incomplete part re-coating.

Beam Diameter

The minimum beam diameter (in X or Y directions) should be used when calculating the maximum scan speed.

Smax Calibration

To ensure that the Smax is properly calibrated, refer to the following chart of common stereolithography machines.

Postprocessing

Part-cleaning Procedure

- Drain excess material off the parts in the vat.
- Remove the platform from the machine and remove the parts.
- Wash the parts for 20 minutes in an automated parts washer, such as Ramco, or an ultrasonic cleaner. Contact your machine's manufacturer for use of recommended solvents.
    - If needed, place the parts in an ultrasonic cleaner filled with non-volatile solvents, such as TPM or Propylene Carbonate, for 20 minutes. If excess material is still present after 20 minutes, repeat another 20 minutes in the ultrasonic cleaner.
- Drain parts, then rinse them with 99% isopropanol (IPA). Brush the parts with isopropanol. This removes the solvent, as well as any remaining excess material.
- Dry the parts with compressed air and place them in a well-ventilated area to allow all absorbed solvent to vacate the part.

Somos® PerFORM™

Manual and Ultrasonic Cleaning

During a build, you may find that excess material builds up on flat surfaces and in cavities. There are two ways to clean these:

- If the surface is flat, simply scrape it with a spatula to remove any excess material. You can return the excess material to the vat prior to re-mixing.
- Cavities and tight angles that act as trap volumes can be cleaned using an ultrasonic cleaner. The excess resin can then be returned to the vat prior to re-mixing.

Post Cure Procedures

UV Post-cure

After thoroughly air-drying the parts and checking that they are free from liquid resin residue, UV post-cure the parts for 20 minutes, rotating the part once after 10 minutes.

Thermal Post-cure

To increase the heat resistance and tensile strength of parts made with Somos PerFORM, we recommend you thermally post-cure them. Follow these steps to thermally post-cure your parts:

- Place the parts in a programmable oven and use the following cycle:
- Warm up: Raise the oven temperature above 160 oC and maintain this for 2 hours.
- Cool down: Ramp the oven temperature down to room temperature over 2 hours.

Disposal Instructions

Avoid injuring yourself or others

In some areas, partially cured or uncured waste UV material may be classified as hazardous waste, and requires special packaging.

Transportation Disposal

Contact the governmental or other body that regulates waste disposal in your area to determine the disposal protocols.

Packaging Transportation Disposal Methods

Packaging Transportation Disposal methods must prevent any form of human contact with the waste UV material, even if it is classified as nonhazardous or unregulated. This therefore precludes the use of disposal methods that might result in groundwater or surface water contamination.

Solvent Disposal

Solvents should be isolated in a sealed, marked container and disposed of as “hazardous waste” in accordance with all applicable laws and regulations.

Somos® PerFORM™

Clean-up Material Disposal

Soiled clothing, empty containers, etc., should be disposed of in accordance with the applicable “hazardous waste” guidelines. If any of these items contain uncured or partially cured UV-curable materials, the disposal method used must prevent any form of human contact, including any that could result in groundwater or surface water contamination.

FAQ/Troubleshooting

Below are some examples of common issues and troubleshooting solutions. Consult this part of the guide if you are having difficulties and do not hesitate to contact your local Stratasys representative.

Issue: Delamination

Delamination occurs on the bottom layer of parts at the corners or on part edges.

Solution: Check Blade

Have the physical gap on your re-coating blade checked.

- For Zephyr blades
  - Set the blade gap to 0.004 inches (0.102 mm)
- For doctor blades
  - Set the blade gap to 0.006 inches (0.1524 mm).

Watch the buildup of the first few layers of the part to determine that the surface is being properly coated with material. Check for signs of material starvation or de-wetting.

Issue: Roughness

The top surface of the part is not smooth and level.

Solution: Check Re-coating Blade

This condition is somewhat common and arises due to the viscosity of the material and the presence of debris that may become suspended in it.

Check the re-coating blade to make sure the bottom surface is clean and filter debris from the vat.

It is very important that you maintain the correct material viscosity in your stereolithography machine. The viscosity can increase over time, and this can cause problems in building parts. If the viscosity increase is severe enough, the material may have to be replaced, resulting in significant expense and lost production time.

If increasing viscosity is identified early, the material can, in most cases, be saved. Regularly measuring resin viscosity can provide an early indication of the problem. This must be done even if the machine is not used often, as resin viscosity can change even when the machine is idle.

Somos® PerFORM™

Viscosity Measurement

Depending on the viscosity range of the material you want to test, use the appropriate-sized cup, based on Zahn Cups guidelines. You will also need a long-stem thermometer that mounts onto the Zahn cup handle and a stopwatch.

Procedure:

- Ensure the material in the vat is at part-building temperature.
- Mount the thermometer on the Zahn cup handle and hold the tip of the thermometer so it is halfway up the bowl. The tip of the thermometer should not touch the material in the bowl, but be suspended above it.
- Turn the thermometer on and set it to Celsius.
- Lower the machine platform about 100 mm below the material surface.
- Slowly immerse the Zahn cup at a 45° angle into the vat of material, being careful not to create bubbles, and rest the cup on the platform. Be careful that it does not fall into the material.
- Monitor the temperature of the material with the thermometer. Wait until the Zahn cup and material have reached the vat temperature. Once the Zahn cup thermometer shows a steady reading, you can take a measurement.
- Slowly lift the Zahn cup completely out of the material. Start the stopwatch when the top of the cup leaves the material.
- Watch the stream of material flowing from the hole at the bottom of the cup. When the stream just under the cup breaks and changes from a continuous flow to individual drops, stop the stopwatch.
- Read the number of seconds on the stopwatch and use the table on the following page to determine the approximate viscosity of the material.
- Repeat the procedure to obtain at least two values that are close to each other. When finished, turn the thermometer off to save the battery.
- Record the following data in a chart for each material and machine:
    1. Date
    2. Temperature of material
    3. Readings (seconds)
    4. Viscosity (from table)
- If the viscosity of the material starts to increase significantly after having been stable for some time, contact your support or sales representative, and provide the data from the table.
- Clean the cup and thermometer by wiping them with a paper towel. Wash the cup and thermometer stem with solvent and dry them. Do not remove the long-stem thermometer from the Zahn cup until the stem is completely clean.

Note: Whenever you have material in your machine, measure and record its viscosity once a week.

Somos® PerFORM™

Table of approximate viscosity in cps linked to Zahn #4 cup test time

Seconds	Approximate Viscosity (CPS)
20	245
22	280
24	310
26	340
28	375
30	410
32	440
34	470
36	505
38	540
40	570
42	600
44	635
46	667
48	700
50	730

Seconds	Approximate Viscosity (CPS)
52	765
54	800
56	830
58	860
60	895
62	930
64	960
66	990
68	1030
70	1060
72	1090
74	1120
76	1150
78	1190
80	1220
82	1255

DOC-70012 Rev. A

Stratasys Headquarters

7665 Commerce Way,
Eden Prairie, MN 55344
+1 800 801 6491 (US Toll Free)
+1 952 937-3000 (Intl)
+1 952 937-0070 (Fax)

1 Holtzman St., Science Park,
PO Box 2496
Rehovot 76124, Israel
+972 74 745 4000
+972 74 745 5000 (Fax)

stratasys.com
ISO 9001:2015 Certified