

Somos® NanoTool™

User's Guide

Strong, stiff, high-temperature composite resin for Stereolithography

Description

Somos® NanoTool™ is a filled liquid material that produces strong, stiff, high-temperature resistant composite parts on conventional stereolithography machines. Parts created with **Somos® NanoTool™** have an off-white appearance and excellent sidewall quality.



Application

Somos® NanoTool™ is the most advanced composite liquid resin for conventional stereolithography machines. It is ideal for applications requiring superior stiffness and strength and a high heat deflection temperature. Current applications include automotive components, wind tunnel test parts, light reflectors, pump housings, pump impellers and injection molds.

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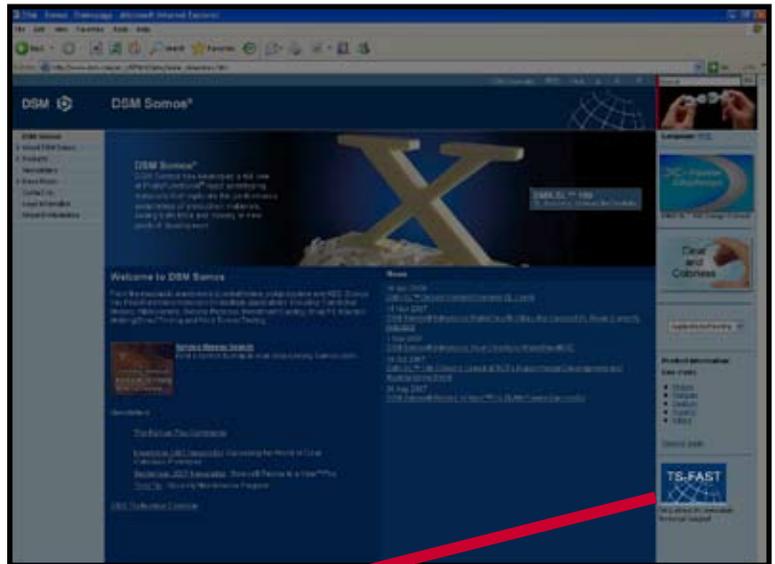
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Technical Service Fast (TS Fast)

For prompt response to your questions regarding the proper use of Somos® NanoTool™, contact us via our TS Fast service on our website.

Log on to www.dsmsomos.com

From the main page, click the link in the dark blue column under “Somos at Your Service”



Somos at Your Service:

[click here for Immediate Technical Support](#)

TS Fast Link

Fill out all of the required information on the Technical Service Request form and click “Submit.”

Your request will be processed within 15 minutes, and a text message will be sent to a DSM technical service representative who will contact you promptly.

TS Fast Service Request Form



**To avoid personal injury,
please adhere to the
following guidelines:**



Read and understand the Material Safety Data Sheet (MSDS) before using the resin.



Avoid contact with eyes, skin & clothing by wearing Personal Protective Equipment (PPE):

- Safety Glasses/Goggles
- Gloves
- Laboratory Coat



Keep the work area clean.

- Avoid spreading resin onto clean surfaces.
 - If resin is found on clean areas, it should be cleaned off immediately with a disposable paper towel and isopropanol.
- Wash hands regularly after handling resin.



Provide Adequate Ventilation.

- Prevent build-up of volatile substances from resins and solvents.
- **Remove dust from clean & finished parts.**

For further safety instructions, consult the Safe Handling Guide.

Preparing the Machine

Installing a New Vat

For machine-specific vat installation and resin replacement, please consult Appendix B of this guide.

Replacing Resin

Be sure to clean out the vat thoroughly, properly disposing of used resins and cleaning materials (solvents, paper towels, etc.), and consult Appendix B of this guide.

Machine Settings

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



Remember!

- Always check the Zephyr blade after any build crash or other adverse event that may cause a change in the gap before beginning a new build.
- Also check that the resin level in the blade is set to the halfway point. On builds with large flats or trapped volumes, check that the blade isn't running out of resin and giving incomplete part recoating due to resin starvation.

Preparing the Machine

The following procedures are for the SLA 7000, SLA 5000, SLA 500ss and SLA 3500. For Viper™ and SLA 250ss machines, simply unload the vat and stir with the recommended mixer and procedures.

Mixing Procedures

Remove the platform.

From “Motion Control,” lower the vat 0.5”. This allows clearance to clean the zephyr blade and ensures that resin does not enter the zephyr system during the mixing procedure.

Lower the elevator arms approximately four inches so that the elevator assembly breaks the resin surface. This will keep resin from overflowing the vat.

NanoTool will settle over time, to avoid hard setting of inventory or idle vats, the containers and/or vats of NanoTool need to be remixed on a regular basis (page 7). Frequent mixing will result in highest quality parts. Follow table on Page 6 for mixing frequently.

Disposal of Used Resin

Partially or uncured UV material waste may be classified as hazardous in some areas, thereby requiring special packaging, transportation, and disposal. Contact the governmental body which regulates waste disposal in your area to ascertain what disposal protocols exist.

The packaging, transportation and disposal methods which are used must prevent any form of human contact with the waste, even if it is classified as nonhazardous or unregulated. This precludes the use of disposal methods which will result in groundwater or surface water contamination.

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

Clean-up materials, soiled clothing, empty containers, etc., should be disposed of in accordance with the preceding guidelines. Whenever any of these contain uncured or partially cured UV-curable materials, the disposal method must preclude any form of human contact, including any which could result in groundwater or surface water contamination.

Preparing the Machine

Mixing

Because the composite material settles over time, it requires occasional mixing. To ensure proper consistency, adhere to the following guidelines:

Mix the refill material before every build.

Mix the vat after every build exceeding 12 hours.

Mix the material every 72 hours, regardless of use.

Attach a wire mesh strainer to the mixer arm during mixing. This removes suspended debris from the vat.

Use a length of metal bar stock, approximately 0.375" in diameter, to feel for any settled material on the bottom of the vat.

Mixing Times (approximated)

Large frame vat.....	60 minutes
Small frame vat.....	45 minutes
Refill can.....	30 minutes

Build Parameters

The build style of choice is Exact™ (Old Aces™). It offers the best mechanical and physical properties, closest dimensional tolerances, and clarity of substance. However, to achieve the even thickness Exact™ was designed for, the following calculation must be performed for machines operating a solid-state laser:

$$S_{\max} = 0.4 * D_L * F_L * 1000$$

Where:

S_{\max} = Maximum recommended scan speed

0.4 = Factor required for 60% overlap of laser pulses (to produce even thickness)

D_L = Laser beam diameter in the imaging field (inches)

F_L = Laser beam repetition rate (Khz)

1000 = Conversion from Khz to Hz



Remember!



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

Build Parameters

To ensure that the S_{max} is properly calibrated, the following chart of common 3D Systems stereolithography machines has been provided.

Examples of the S_{max} of 3D Systems Stereolithography Machines

Machine	Nominal Spot-Diameter (inch)	Nominal Spot-Diameter (mm)	Repetition Rate (Khz)	S_{max}
Viper	0.010	0.254	30	120
Viper	0.003	0.085	30	36
250ss	0.010	0.254	60*	240
3500	0.010	0.254	22.2	89
500ss	0.010	0.254	60*	240
5000	0.010	0.254	40	160
7000	0.030	0.762	35	420
7000	0.010	0.254	35	140



Remember!



The S_{max} should not exceed the recommended hatch speed for the machine being used.

Cleaning Procedures

An ultrasonic cleaner is recommended to clean NanoTool™ parts. During builds, filler settles into trap volumes and onto flat surfaces. This material can be scraped off the parts with a spatula and returned to the vat prior to mixing.

The following is the proper procedure for cleaning parts:

- Remove the parts from the platform and proceed to remove the supports.

- Place the parts in the ultrasonic cleaner (filled with a non-volatile solvent, such as TPM or Propylene Carbonate) for 20 minutes.

- ➔ If filler remains after 20 minutes, repeat another 20 minute cycle in the ultrasonic cleaner.

- Brush the parts with Isopropanol. This removes the solvent, as well as any remaining filler or resin.

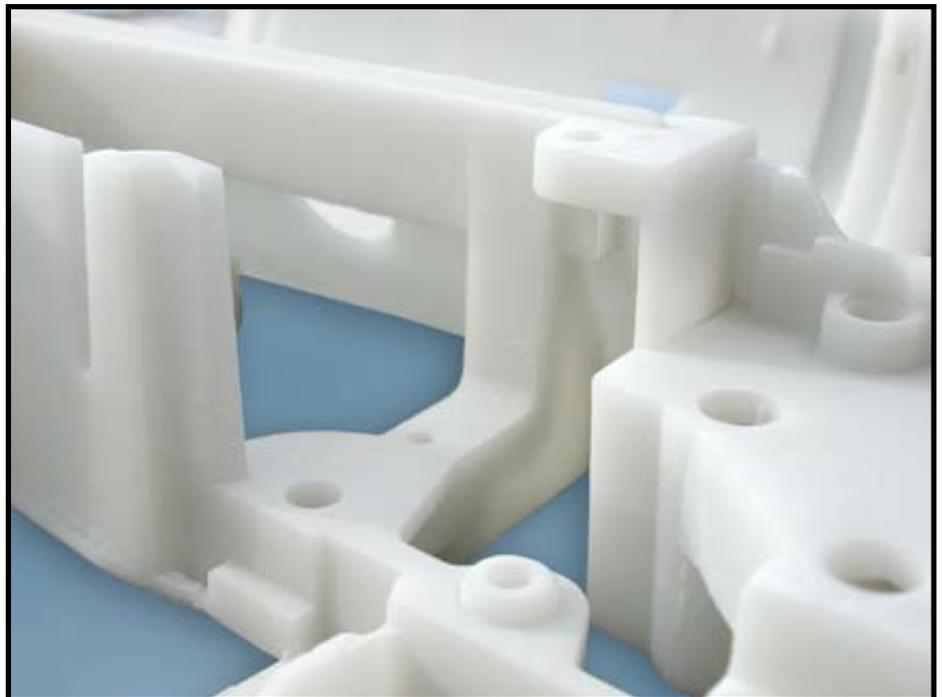
- Dry the parts with compressed air and place them in the post-cure apparatus for 20 minutes, rotating once after 10 minutes.

Post-Cure Procedures

In order for parts to achieve a high heat deflection, they must be thermally post-cured. To thermally post-cure your parts, follow these steps:

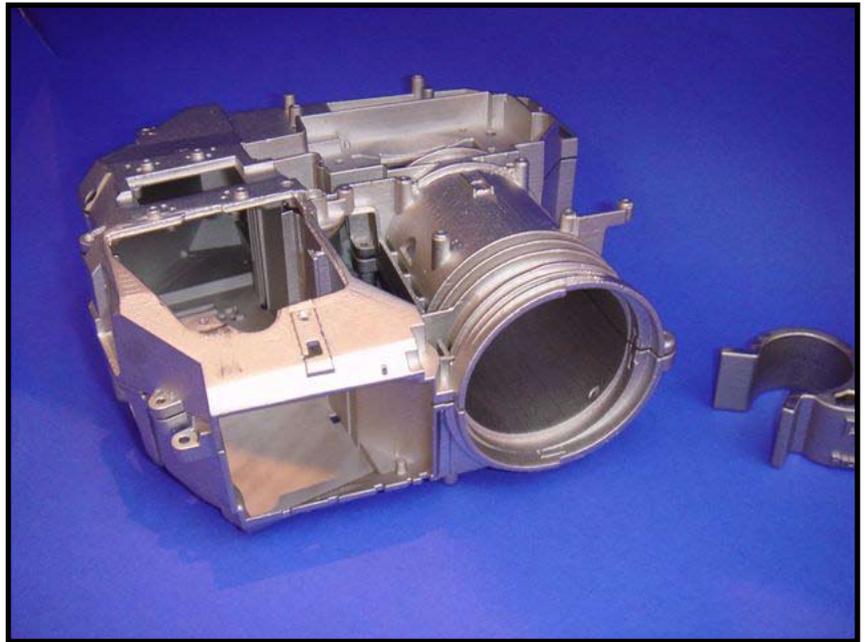
UV + Thermal Post-Cure

- ▶ Clean and UV post-cure parts for 20 minutes, rotating the part once after 10 minutes.
- ▶ Place the parts in a programmable oven and use the following cycle:
 - a) Warm up: Ramp the oven from ambient temperature to 160° C over two hours.
 - b) Hold at 160° C for two hours.
 - c) Cool down: Ramp the oven down from 160° C to room temperature over two hours. Note that the oven parts may take longer to cool.



Metal Coating

The properties of this resin can be enhanced by way of a metal coating provided by Repliform Incorporated. A metal coating can enhance the aesthetic appeal of the resin in addition to providing a more durable structure.



Benefits of Metal Coating

- ▶ Increased abrasion resistance
- ▶ Improved heat distribution across entire part
- ▶ Strengthens fine features & mold details
- ▶ Prevents resin from sticking to parts

For more information on part metal coating, contact Repliform Incorporated:

Sean Wise, sales representative
(410) 242-5110
sean@repliforminc.com

Repliform Inc.
1583 Sulphur Spring Road
Baltimore, MD 21227



Below are documented cases of common problems and possible solutions. Consult this part of the guide if you are having difficulties, and do not hesitate to contact us via TS Fast as discussed on page 3.

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

Solutions:

Have the physical blade gap on your recoating 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 building of the first few layers of the part to see that the surface is being coated properly with resin. Check for signs of resin starvation or dewetting.

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

Solution:

This condition is somewhat normal, due to the viscosity and debris that may become suspended in the material. Check the recoating blade to make sure the bottom surface is clean and filter debris from the vat.

Appendix A

Viscosity Monitoring Procedure

Maintaining proper resin viscosity in your stereolithography machine is very important. The viscosity can increase over time, and this can cause problems in building parts. If the viscosity increase is severe enough, the resin may have to be replaced, resulting in significant expense and lost production time.. If increasing viscosity is identified early, the resin can be saved in most cases. Early detection of the problem can be accomplished by regularly measuring the resin viscosity. This must be done even if the machine is not used often, as resin viscosity can change even if the machine is not used.

Contact your technical support representative for instructions on sending resin samples to Elgin, IL to test viscosity.

Appendix B

Vat Installation Procedure

For the SLA 3500, 500, 5000 and 7000, please follow these instructions for installing a new vat:

- Remove front cover of the SLA and drip pan if present
- Verify that the vat pads on the new vat are the same type and same position as the pads of the original vat.
- Apply a thin coat of grease to the vat pad where contact is made with the vat jacks (channels).
- Unload old vat using machine software.
- With old vat removed, resin removed from all surfaces, SLA chamber floor clean, elevator at its upper limit and vat jacks in the unload position, roll the empty new vat into the chamber for fitting.
- Using the machine software, raise the vat jacks until they contact the vat pads. Verify that the jack posts are seated in the vat pad channels.
- Continue to raise the jacks (which are now raising the vat) to a point just below the bottom of the rim.
- Lower the elevator slowly until the unit is in the rim.
- Check the clearance between the:
 - Vat walls and rim
 - Vat walls and blade
 - Vat walls and elevator arms
 - Vat walls and leveling system
- If vat is full, lower the vat until its weight is on the wheels.
- Adjust the front and back clearances by moving the vat pads within the slotted mounting holes where they bolt into the vat.

Appendix B: Vat Installation Procedure

- Adjust side-to-side clearances by adding shims to the needed side to move the vat pad away from the vat.
- After the clearance adjustments are correct, raise the vent to its upper limits, verifying that the vat walls do not come into contact with any object in the rim area.



Remember!

- Make sure blade is pulled slightly back so the vat does not hit it and lift the rim.
- When the vat has been fully loaded and the proper amount of resin has been added, verify that the resin level in the Zephyr blade is about half way up the viewing window. If it is not, remove the black cover of the SLA and adjust the vacuum until the resin is the correct height.

Appendix B: Vat Installation Procedure

For the SLA 250/30, please follow these instructions for installing a new vat:

- Remove cover from leveling plunger area.
- Remove the old resin from the vat and clean the vat until the resin is removed from all surfaces, including the leveling plunger and leveling reservoir.
- Clean the blade.
- Clean the elevator arms.
- Clean the resin from all surfaces inside the build chamber.
- Fill the vat to 1/2 inch below the fill line. (This will allow plenty of room for the resin to expand as it warms)
- Replace the cover on leveling plunger area.
- If the resin file does not exist, create one for the new resin. (The resin files are in the **c:/resin** directory)
- Load the resin file in the Change Resin Utility and verify that the Ec and Dp are correct.
- In the Recoater Utility, start the Adjust Resin Level utility and add resin if necessary.
- Verify the build start position is correct. (The platform should be 1/2 out of the resin)
- Using the software, move the elevator below the recoat bar.
- Exit the menu program. At the DOS prompt, enter "recoater/zoff".
- Using the software, verify that the sweep works correctly then exit the Recoater Utility
- Enter "menu" at the DOS prompt to enter back into the menu program. Verify that the heater is on and set to 30°C. Before starting a run, verify that the lase is on and up to full power.

Appendix B: Vat Installation Procedure

For the SLA 250/30, please follow these instructions for installing a new vat:

- From the recoater utility of the menu program unload the vat.
- Once the vat unload is complete open the chamber door and slowly pull the vat drawer all the way out till it stops.
- Put the lid on the vat and fasten it on with the four clips.
- Lift the vat out of the drawer and place it on paper towels on the floor. (This is a 2 person job)
- Remove the old resin from the vat and clean the vat till the resin is removed from all surfaces of the vat.
- Clean the zephyr blade inside and out.
- Clean the elevator arms.
- Clean resin from all surfaces inside the build chamber.
- Place the empty and clean vat back in the vat drawer. Fill the vat to 1/2 inch below the fill line. (This will allow plenty of room for the resin to expand as it warms and prevent spills when pushing the vat drawer back in.)
- Push the vat drawer in till it stops. (If the chamber door will not close the vat is not in far enough).
- Load the vat with the menu software.
- If the resin file does not exist create one for the new resin. (The resin files are in the **c:/resin** directory.)
- Load the resin file in the Change Resin Utility and verify that the Ec and Dp are correct.
- In the Recoater Utility start the Adjust Resin Level utility and add resin if necessary.
- Verify that resin is about 1/2 way up the window in the zephyr blade. If it is not, use the vacuum adjustment on the lower left wall of the build chamber to set it properly. (2 screws need to be removed to access the adjustment knob)
- Verify the build start position is correct. (The platform should be 1/2 out of the resin)
- Using the software move the elevator below the recoat bar.

Appendix B: Vat Installation Procedure

- Exit the menu program.
- At the DOS prompt type “recoater/zoff”.
- Using the software verify that the sweep works correctly then exit the Recoater Utility.
- Type “menu” at the DOS prompt to enter back into the menu program.
- Verify that the heater is on and set to 30°C.
- Before starting a run verify the laser is on and up to full power.

Contact Information

Ordering and Customer Service

U.S. & Canada

Tel: 800-222-7189 (within the U.S. and Canada)
+1-847-468-7809 (outside the U.S. and Canada)

Fax: +1-847-695-1748

DSM Somos
1122 St. Charles St.
Elgin, IL 60120

Europe (Hoek van Holland, The Netherlands)

Tel: 011-31-174-315530
Fax: 011-31-174-315391

DSM Somos
Slachthuisweg 30
3151 XN Hoek van Holland, The Netherlands

Asia (Shanghai, China)

Tel: +86-21-61418188
Fax: +86-21-61417008

DSM Somos
11F The Headquarters Building
No. 168 Middle Xi Zang Road
Shanghai 200001 China

Contact Information

Technical Service

U.S. & Canada

Brian Bauman
Technical Service & Product Manager
+847-608-2555
brian.bauman@dsm.com

Jonathan Spragg
Technical Service Specialist
+1-847-214-3840
jonathan.spragg@dsm.com

John Schaefer
Technical Service Specialist
(512) 848-0570
john.schaefer@dsm.com

Rick Thomas
Technical Service Specialist
+1-847-468-7783
richard.thomas@dsm.com

Gregg Renshaw
Technical Service Specialist
+1-248-819-9432
gregg.renshaw@dsm.com

Europe (Hoek van Holland, The Netherlands)

Philippe Barcet
Technical Service Specialist
+33-6734-77482
philippe.barcet@dsm.com

Bert Grispen
Technical Service Specialist
+847 468-7742
bert.grispen@dsm.com

Asia (Shanghai, China)

Yuri Chen
Technical Service Specialist
+86 21-6141-8068
jun.chen@dsm.com

Technical Service information is also available through our website. Please refer to page 2 of this guide, or...

Log on to www.dsmsomos.com for more information.

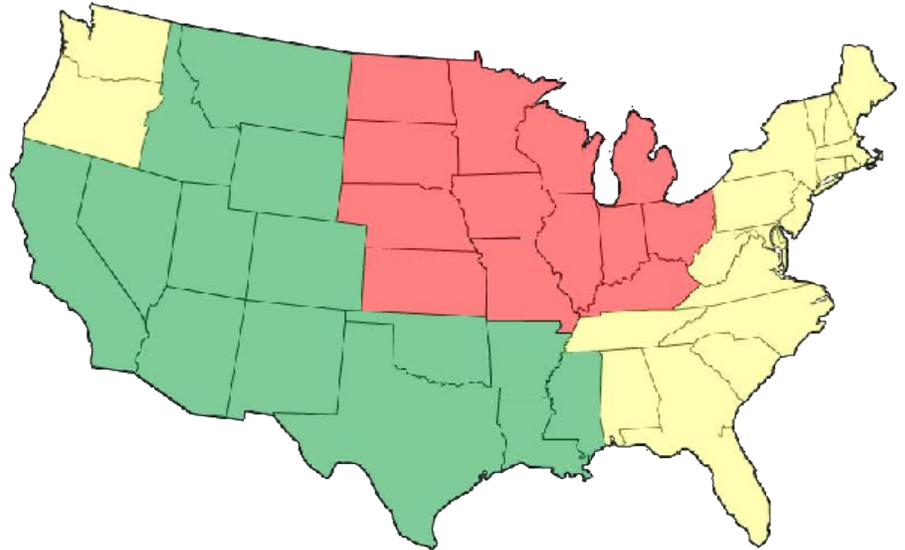
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Contact Information

Sales

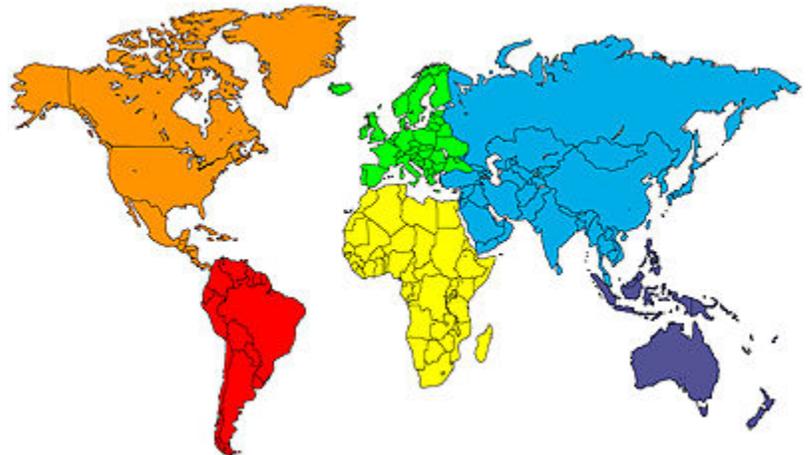
U.S. & Canada

- Myron Bezdicek
(847) 468-7722
myron.bezdicek@dsm.com
- Charlie Kaufmann
(302) 897-4658
charlie.kaufmann@dsm.com
- Scott Nordlund
(847)468-7808
scott.nordlund@dsm.com



Europe (Hoek van Holland, The Netherlands)

- Arnaud Guedou
+33-60-84-10-663
arnaud.guedou@dsm.com
- Anna Hoiss
+49 8065 906740
anna.hoiss@dsm.com



Asia (Shanghai, China)

- Li Ji-Hong
+86 21-6141-8188
ji-hong.li@dsm.com