APPLICATION NOTE

LuxaPrint Tray

Validated workflow with DMG DentaMile

DMG

Application Note: LuxaPrint Tray

LuxaPrint Tray is a light-curing 3D printing resin for the generative production of custom impression trays. It offers the highest level of precision, outstanding mechanical stability and is certified as a Class I medical device.

New possibilities

With the help of the CAD/CAM manufacturing process, retention holes in impression trays can be conveniently produced in one step without any additional drill holes being required. Rounded edges can also be mapped without the need for time-consuming regrinding of edge areas.

Faster working

LuxaPrint Tray is a certified Class I medical device and suitable for all types of trays in combination with all standard impression materials. The curing depth, which is perfectly aligned to the 3D print process, allows for an optimum resolution even at the highest printing speeds.

A reliable, accurate fit

Very high dimensional stability and flexural strength ensure exact, distortion-free impression-taking from the patient. The exceptionally smooth surfaces of the printed objects provide the basis for an excellent fit.

Validated workflow with DMG DentaMile

In this application guide, we present our validated DentaMile workflow, which you can use to easily and reliably achieve a result that meets the high requirements of dental users in terms of stability, look and precision.

The DentaMile workflow was developed at DMG according to strict criteria, and carefully tested in our digital application centre. Please follow the below process exactly. That way, you can rest assured that you always deliver work of the highest quality.

Table of contents

Required equipment and resources

SCAN

Digital scanner or optical desktop scanner

DESIGN

CAD software for designing custom impression trays (e.g. 3Shape)

PRINT

The following table lists all of the 3D printer and post-process device combinations suitable for printing with **LuxaPrint Tray (DMG)** using our validated workflow. The printers should always be used with the appropriate slicing software with validated printing parameters (e.g. Autodesk Netfabb for DMG DentaMile Lab5 (Pro), 3Demax and 3Delite or DMG DentaMile CAM MC for DMG DentaMile Desk MC-5).

Printer	Cleaning unit	Post-curing
DMG 3Demax DMG 3Delite DMG DentaMile Lab 5 (Pro)	DMG 3Dewash Ultrasonic bath	DMG 3Decure Otoflash G171
DMG DentaMile Desk MC-5	DMG DentaMile Wash MC DMG 3Dewash	DMG DentaMile Cure MC
RapidShape D10+ RapidShape D20+ RapidShape D50+ Straumann P10+ Straumann P20+ Straumann P50+	RS Wash Straumann P Wash Ultrasonic bath	RS cure Straumann P Cure Otoflash G171
Asiga MAX UV	Ultrasonic bath	Otoflash G171
Ackuretta SOL	Ackuretta Cleani	Ackuretta Curie

1. Scan

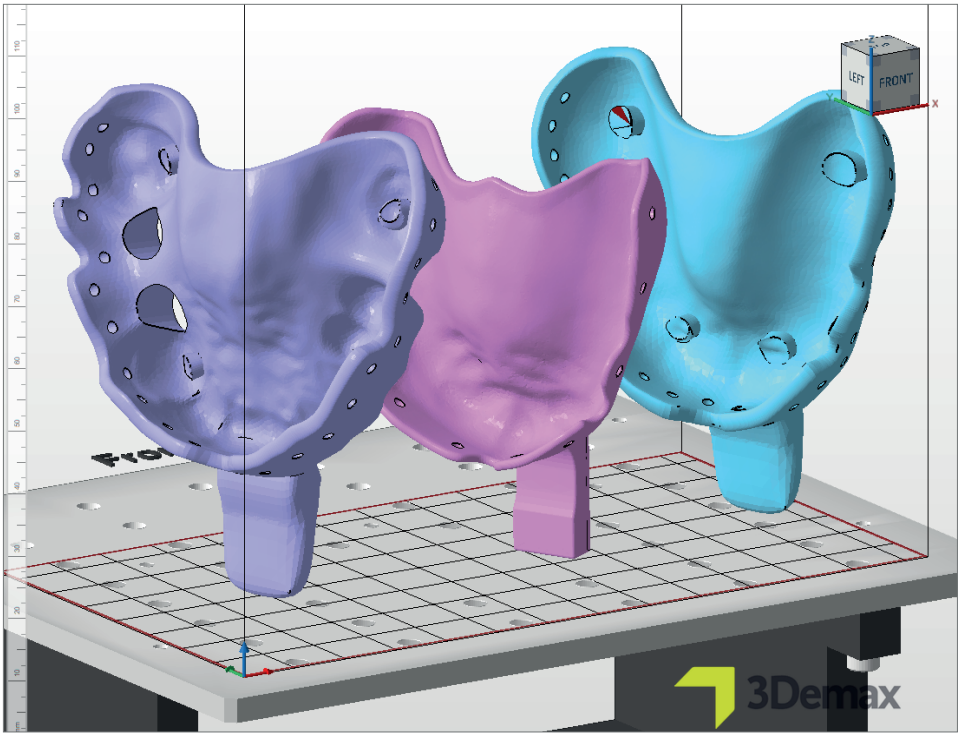
The digital creation of trays requires digital patient data to be generated first. This can be done at the dental clinic with a digital scanner or in the dental laboratory with a laboratory scanner. The laboratory scanner can be used to scan impressions of the patient's dentition or plaster models directly, depending on its design. The digital patient data is then ready to be exported to the design software.

2. Design

The design requirements for custom impression trays can differ from one application to another. Depending on the impression material, the user's preferences and the treatment case, trays may need to be designed with or without retention holes, palatal areas or recesses for implant abutments. Several generally applicable as well as material-specific design guidelines exist for this, details of which are outlined below.

There are various dental software solutions available for the digital design of custom impression trays, including 3Shape Dental System and the free Zirkonzahn.Tray software. Choose the software solution that best suits your personal preferences and requirements. Another option is to commission a service provider to take care of the digital design for you.

The tray needs to be rigid and resilient for a precise impression, as any deformation in the tray can lead to inaccuracies. As well as this, the tray has to be the right thickness so that it is comfortable for the patient to wear. We therefore recommend a material thickness of 1.5 - 3 mm. The edge of the impression tray should be 2 mm shorter than the vestibular depth and should not interfere with lingual, labial, and buccal frenulums. All edge areas should be smooth and rounded, something that can be done directly with digital design software. We recommend a diameter of 2 - 3 mm for retention holes.



Different designs of custom impression trays.

PRACTICAL TIP

Always make sure that the correct machine and material parameters are used. Incorrect settings can lead to misprints and impression trays with a poor fit, as well as inadequate mechanical properties.

3. Print preparation

The digitally designed impression tray now needs to be imported into the printer software to prepare it for 3D printing.

In this step, the impression trays are oriented and arranged in the printer's build area and then provided with support structures.

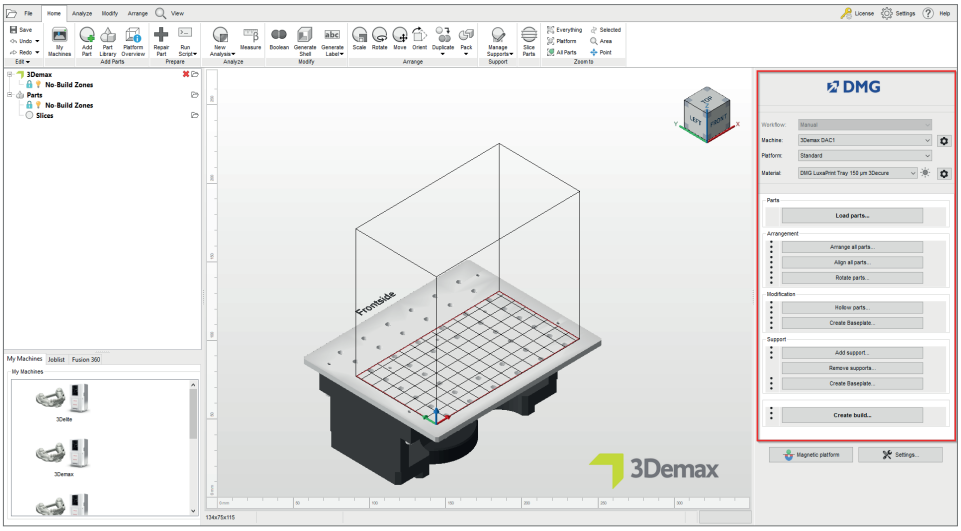
3.1. Autodesk Netfabb for DMG DentaMile Lab5 (Pro), 3Demax and 3Delite (and Rapidshape D series)

3.1.1. Selecting the material and machine

Open Autodesk Netfabb and select your machine environment (e.g. DMG 3Demax).

The DMG workflow area appears on the right-hand side of the screen (marked by the blue DMG logo). Here, you will be guided through all the relevant steps of the software from start to finish.

First select your printer and the material **LuxaPrint Tray (DMG)** with the desired layer thickness and post-curing method. If you haven't worked with the material before, you can add this using the settings wheel next to the material box (see 3Demax/3Delite operating instructions, point 6.7).



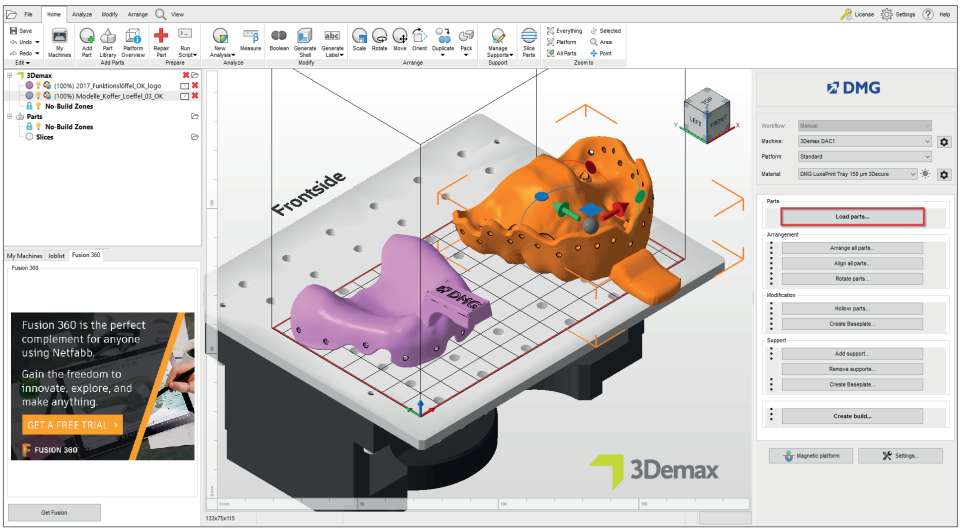
Selection of machine and material parameters in Netfabb.

LAYER THICKNESSES

All available layer thicknesses have been checked in our digital application centre and deliver an exact and reliable printed object. A lower layer thickness leads to a finer surface structure, higher accuracy and longer printing time. Choose the correct layer thickness depending on your specifications regarding available time and desired surface quality. For custom impression trays, we recommend a layer thickness of 150 microns.

3.1.2. Importing STL files

Import the previously designed impression trays into the Netfabb software by simply dragging the files into the software's 3D view or by selecting **Load parts...** in the DMG workflow area and finding your files. The imported objects will then immediately appear in the 3D view.



Import of the digital impression tray into Netfabb.

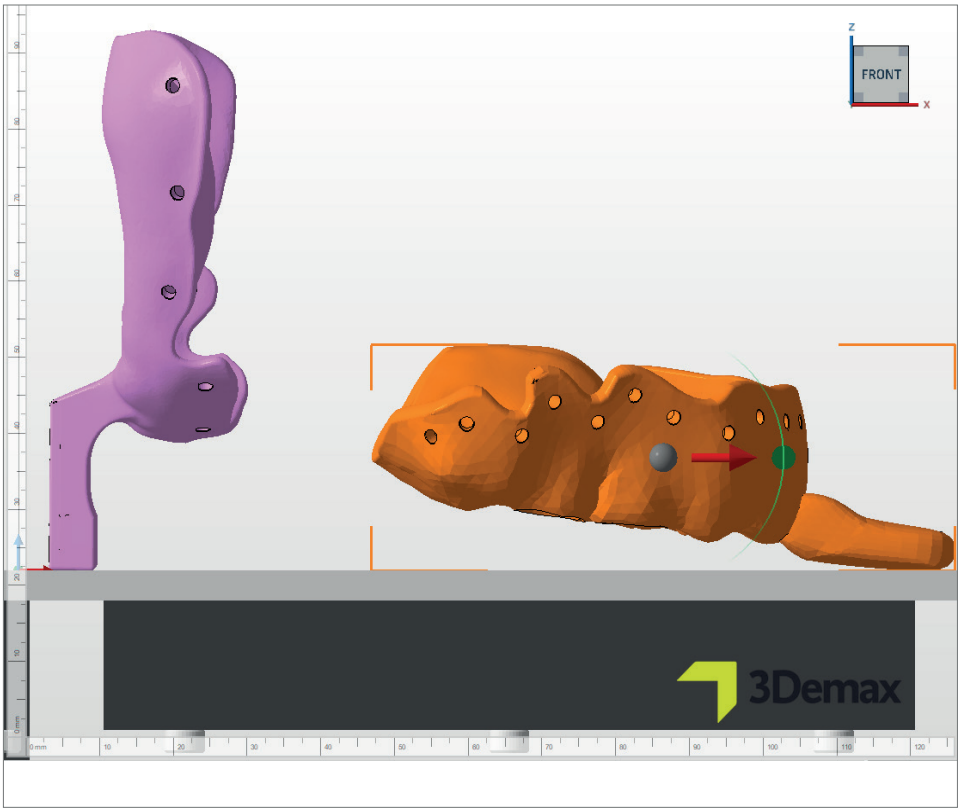
3.1.3. Orienting and aligning trays

Arrange the objects on the build platform. Activate the **Magnetic platform** function in the bottom right-hand section of the window to make sure that the objects stay on the build platform when moving them. To rotate parts, click on an object and drag the circles that now appear.

Impression trays can be printed horizontally or vertically to the build platform, depending on how many parts are to be printed and how much time is available (see diagram).

We recommend printing vertically, as this requires the least amount of support structures and several parts can be printed at the same time. The high printing speed of LuxaPrint Tray means that the build time is kept to a minimum, even when printing vertically, and removing support structures and residues is quicker and easier.

When printing horizontally, the fitting surface of the trays should face away from the build platform, otherwise support structures will be generated on these surfaces that will have to be removed manually during post-processing.

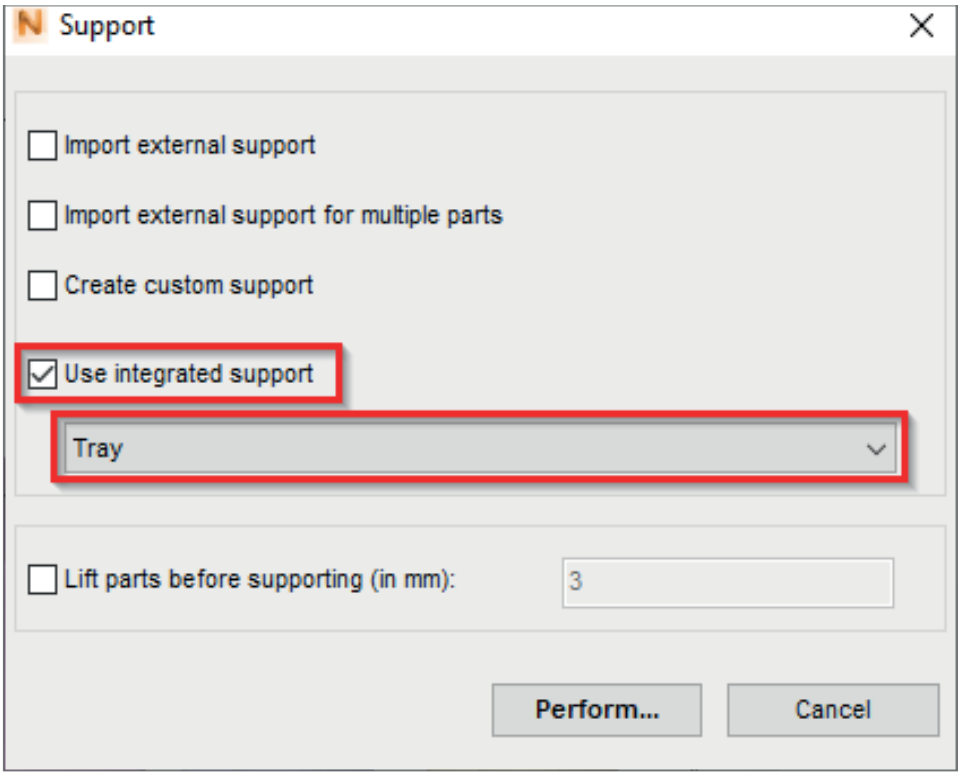


Object orientations for the 3D printing of impression trays. Left: vertical orientation, right: horizontal orientation.

3.1.4. Adding support structures

The objects require support structures to ensure an error-free build process. In the DMG workflow area, select **Add support...**, and then select **Use integrated support** in the next dialogue window. The preset support style **Tray** has been specifically optimised for the printing of impression trays and delivers the best results. If printing horizontally, it is advisable to raise the parts 3 - 4 mm before adding the support. Printing vertically provides a good print result whether the parts are raised or not. Raising makes it slightly easier to remove the support and somewhat increases the printing time due to the greater height involved.

Support dialogue window.



The software automatically calculates the optimal position of the support structures and inserts them between the build platform and the impression tray.

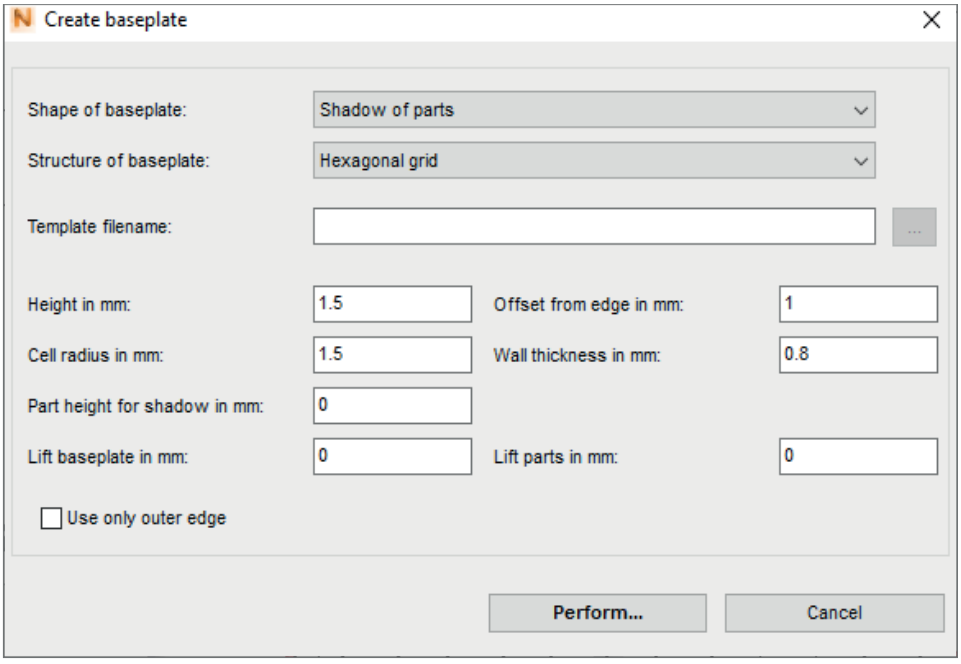
Ensure that there are no support structures on the fitting surface of the impression trays.

3.1.5. Baseplate

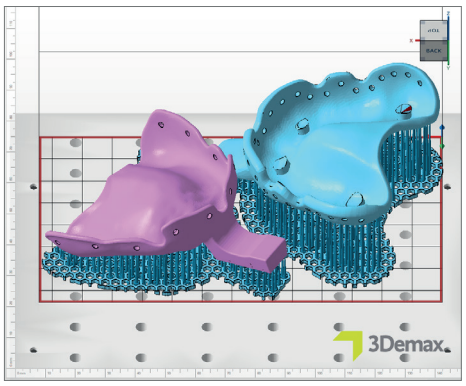
A hexagonal grid baseplate should always be used when printing impression trays. The baseplate ensures better adhesion to the build platform and therefore prevents misprints from occurring. We recommend the following settings for LuxaPrint Tray:

Shadow depending on part, grid with hexagonal cells, height: 0.8 mm, cell size: 1.5 mm, offset from edge: 1 mm, wall thickness: 0.8 mm.

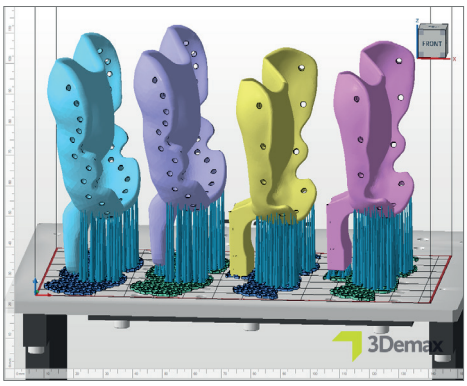
Create baseplate dialogue window.



Your finished project including support structures and baseplates should now look something like this:



Finished build job in Netfabb with horizontal orientation. Two impression trays including supports and baseplate.



Finished build job in Netfabb with vertical orientation. Four impression trays including supports and baseplate. Two of the trays are raised 3 mm from the build platform.

3.1.6. Creating a build job (slicing) and transferring it to the printer

As soon as you are satisfied with the arrangement of the parts on the build platform, the support structures and the baseplates, check the machine and material settings again and create a printer-readable file via **Create build job**.

After the calculation of the individual print layers, also known as slicing, a preview window appears. This allows you to scroll through the layers of the print job and review your work.

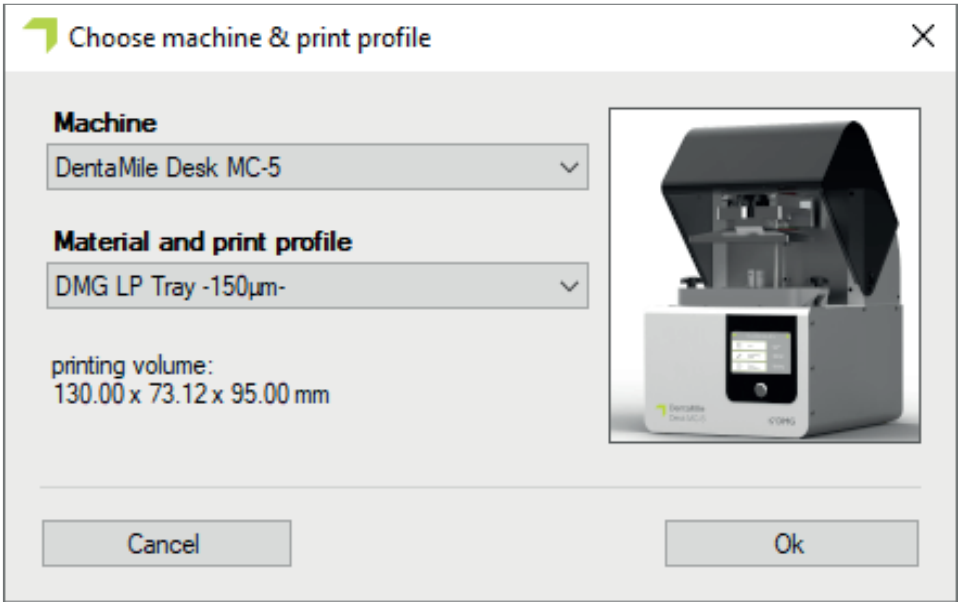
Now, transfer the finished print job to your 3D printer via a network connection or USB stick.

3.2. DentaMile CAM MC for DentaMile Desk MC-5

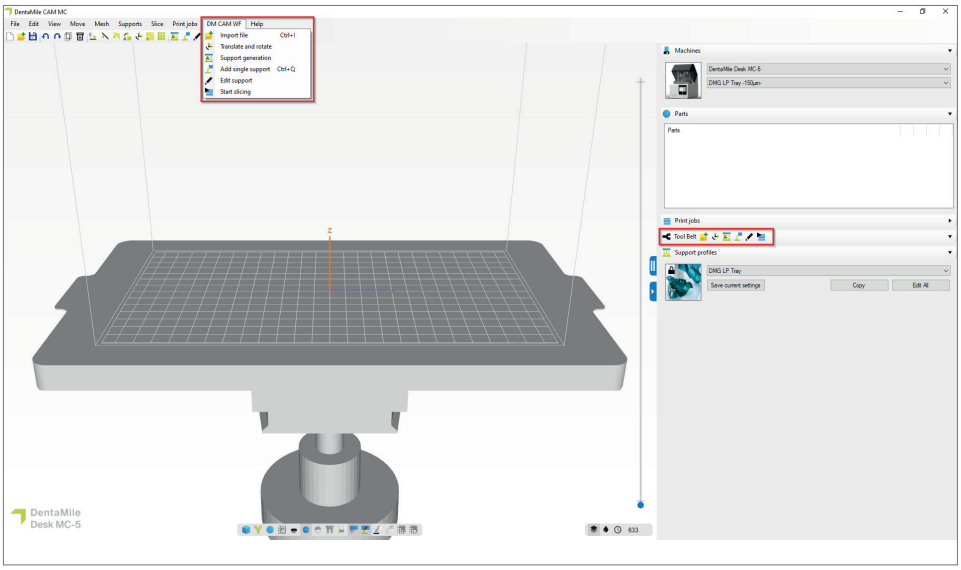
3.2.1. Selecting the printer and material

Open the DentaMile CAM MC software and select your printer (DentaMile Desk MC-5) and the material and print profile for LuxaPrint Tray.

Selection of printer and material parameters.



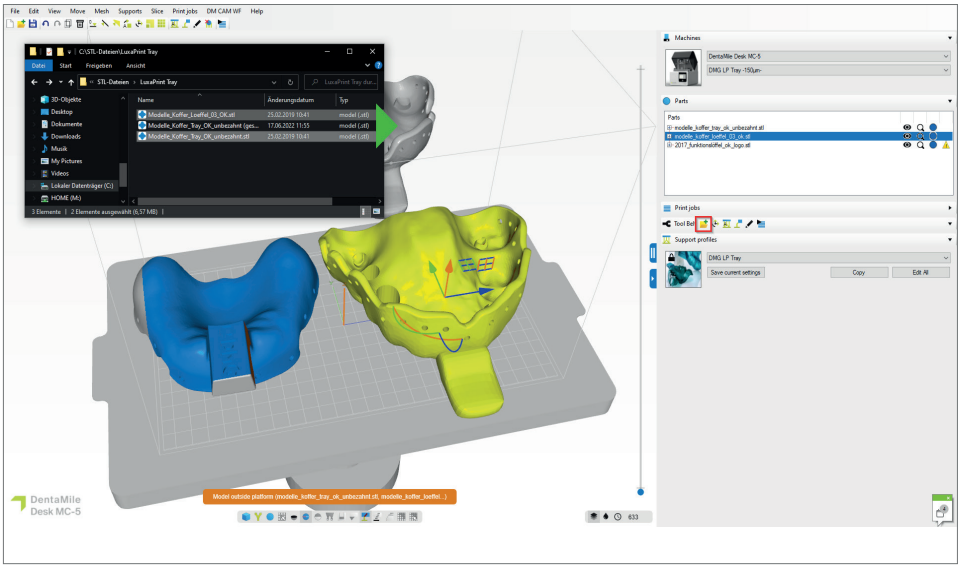
The DentaMile CAM workflow area can be accessed via the **DM CAM WF** tab at the top and from the menu on the right side of the screen. Here, you will be guided through all the relevant steps of the software.



DentaMile CAM MC workflow area with the most important software features.

3.2.2. Importing STL files

Simply import the impression trays from the corresponding folder using drag-and-drop, or select the **Import file** function and find your model files. Both options allow you to select multiple files.



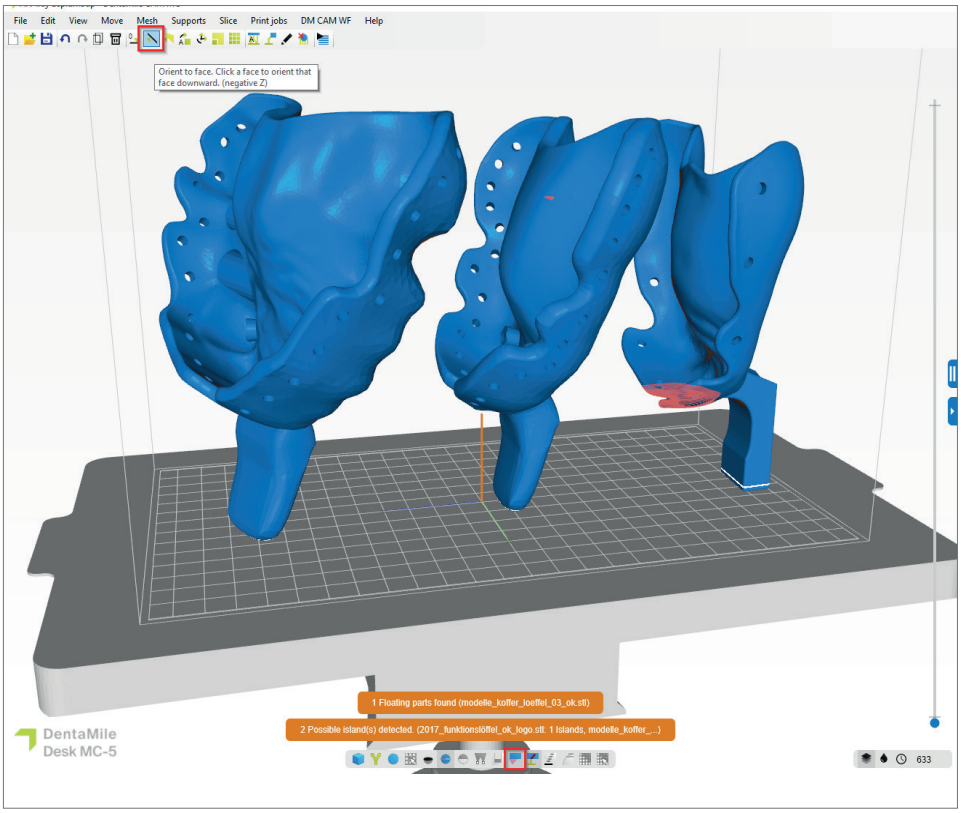
Import of the designed impression trays into DentaMile CAM MC.

3.2.3. Aligning impression trays

The designed impression trays usually appear flat in the software's build area. We recommend printing vertically, as this requires the least amount of support structures and several parts can be printed at the same time.

To orient the trays correctly, select the object and drag the displayed semicircles. For impression trays with a flat handle edge (see image), you have the option of using the function **Select the surface to be used for placing the component on the build platform** to immediately rotate the tray to a vertical position.

Impression trays with occlusal stops should be printed with an inclination of approx. 15° so that the stops can be printed correctly. Activate the function **Show islands** in the menu bar at the bottom of the screen to check the number and position of islands and overhangs. There should be as few islands as possible.



Optimal orientation of different impression trays in DentaMile CAM MC.

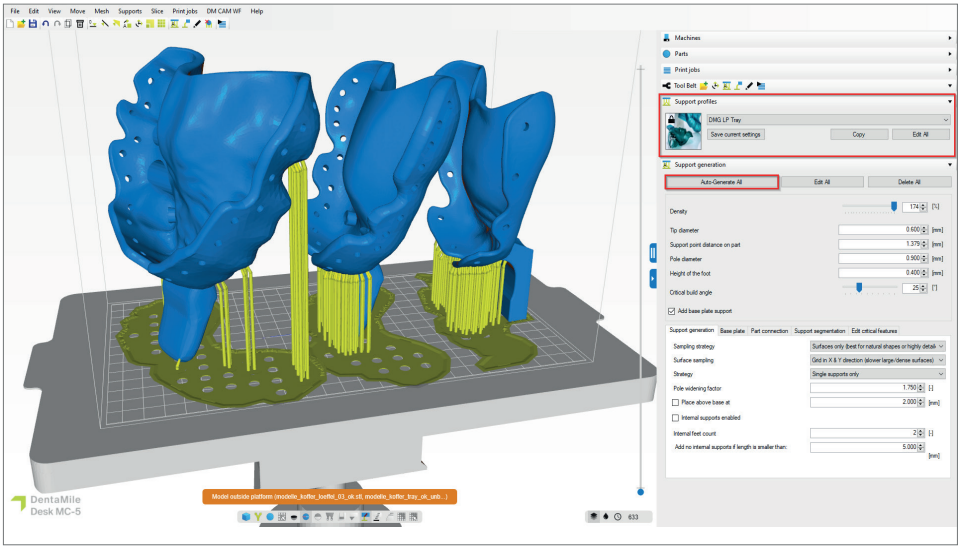
3.2.4. Adding support structures

The impression trays require support structures to ensure an error-free build process. Select **Support generation** in the tool bar. The support profile **DMG LP Tray** has been specifically developed for the material and delivers optimal results. Click on **Auto-generate all** to generate the supports for all objects on the build platform.

It should not be necessary to modify the supports. Nevertheless, check whether supports have been placed in positions that are impractical for you and, if necessary, remove individual supports or place them in a different position.

The objects are not raised automatically using this support profile. This gives them better stability, as the handle also serves as a support. If required, you can go to the support profile and set the marker next to **Place above base at:** Set **2.000 mm** to raise the impression trays slightly.

The baseplate ensures better adhesion to the build platform and is generated automatically along with the supports.



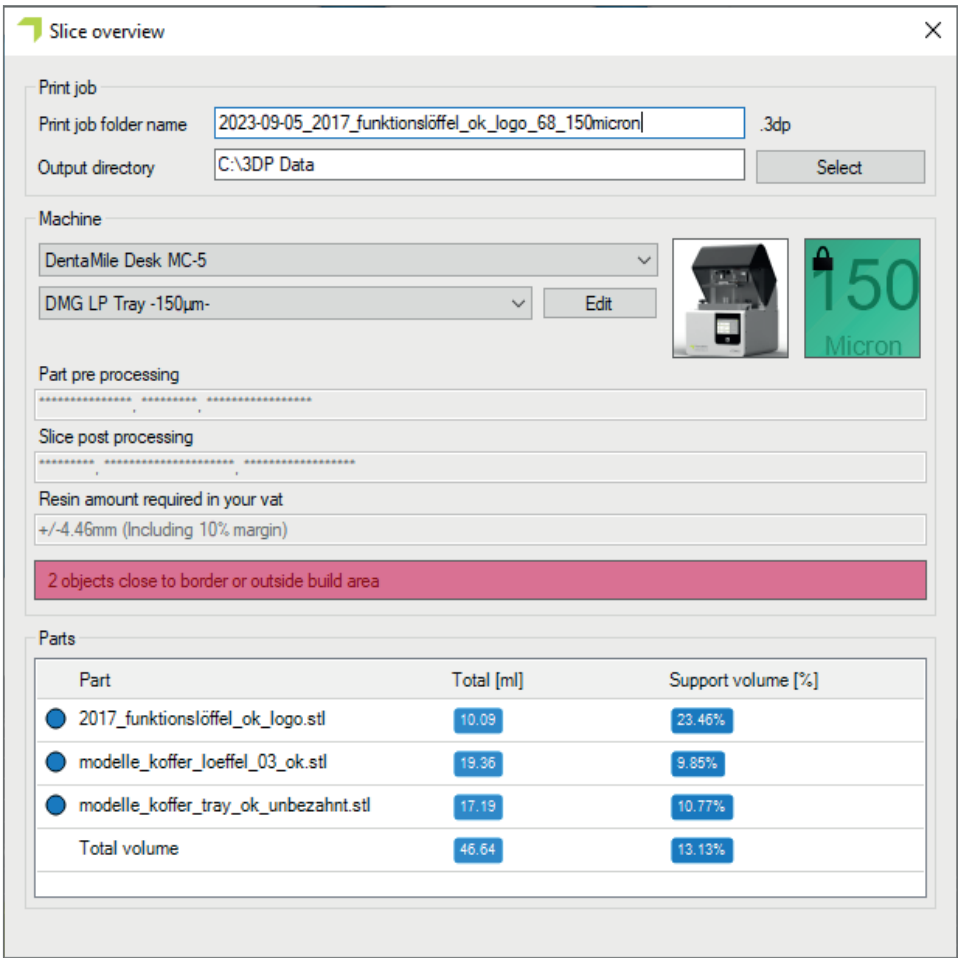
Print-ready build job in DentaMile CAM MC incl. support structures and baseplate.

3.2.5. Creating a build job and transferring it to the printer (slicing)

Once the impression trays have been arranged and supported on the build platform, you can start the slicing process by clicking on **Start slicing**.

In the next dialogue window, you can give your print job a new name or accept the suggested one. Next, select an outgoing directory, which has to be a folder on your computer's local hard drive. This is where the print job will be saved. You can now also check all of the machine and material parameters again and change them. Click on **OK, start slicing** to generate the build job.

Slice overview in DentaMile CAM MC.



If you receive a warning message that objects are close to the edge or outside the build area, check whether this relates to the objects or the baseplates. If it concerns the baseplates (as in this case), you can ignore the warning. If objects are outside the build area, they will need to be reorientated and supported again.

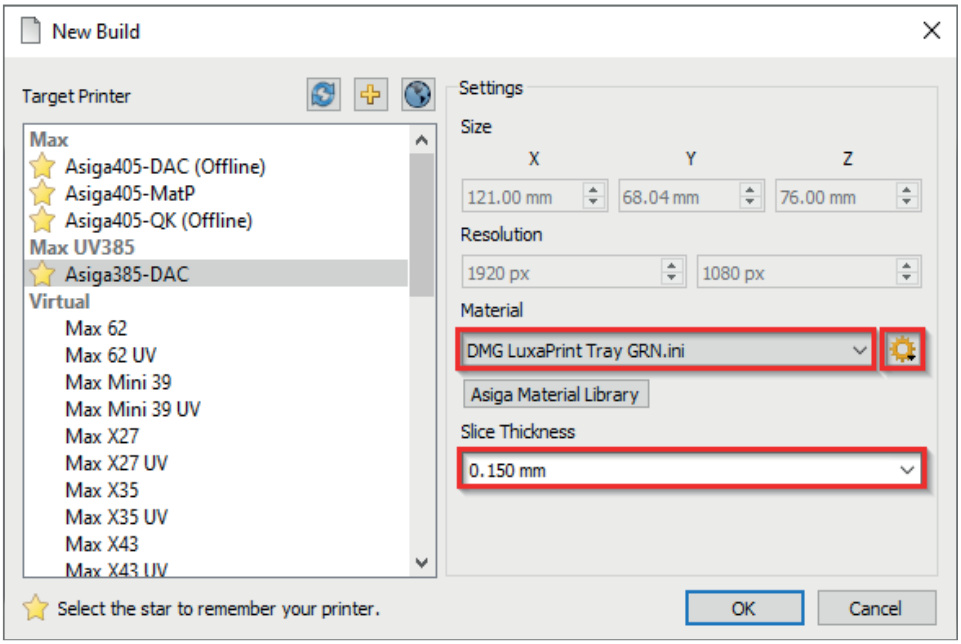
Now transfer the finished print job to your DentaMile Desk MC-5 via the web interface or USB stick.

3.3. Asiga Composer

3.3.1. Selecting the material and machine

Open Asiga Composer and select a new project, or open a previously saved project. Select your printer and the material **LuxaPrint Tray (DMG) Green (GRN)**. The layer thickness validated by DMG is 0.150 mm (= 150 µm) and delivers excellent results at high printing speeds.

If you haven't worked with the material before, you can download the print parameter on the Asiga website in your account area in the material library (asiga.com/accounts/) and import it into the Composer software.



Selection of machine and material parameters in Asiga Composer.

3.3.2. Importing designs

Import the previously created tray design into Asiga Composer. To do so, simply drag-and-drop the file into the software's 3D view area or select **Add objects ...**.

3.3.3. Aligning the impression trays in the build area

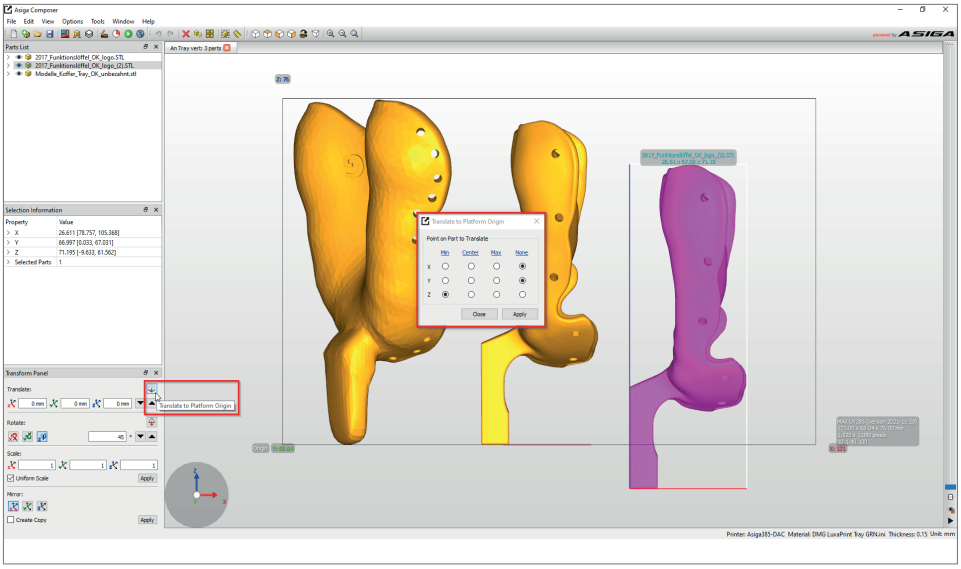
Impression trays can be printed horizontally or vertically. As more support structures are generated when printing horizontally, and these then have to be removed and ground manually during post-processing, we recommend vertical printing.

If printing horizontally, ensure that the fitting surface of the tray faces away from the build platform so that no support structures are placed there.

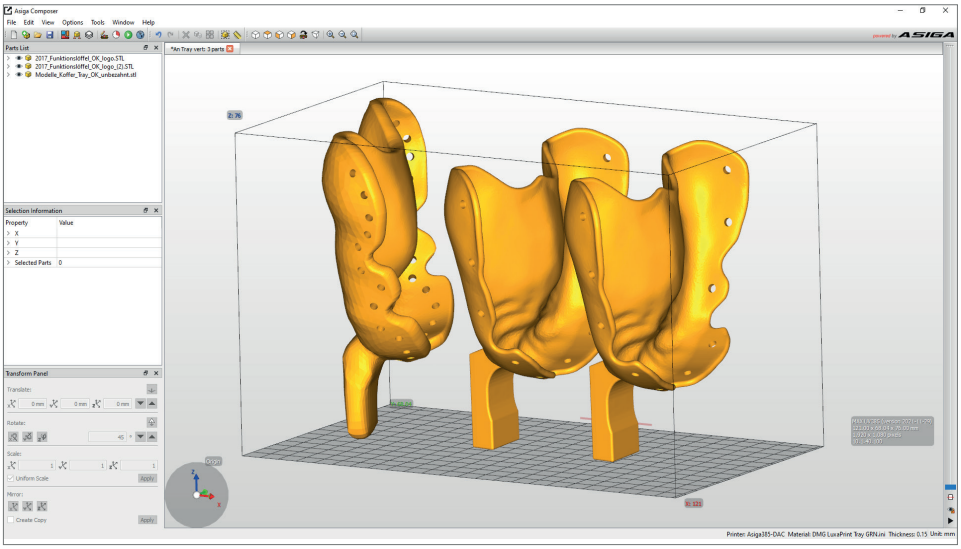
Use the **Rotate** function in the software's Transform panel to rotate your impression trays to the right position.

Now arrange all objects on the build platform. It is advisable to work using the overhead view so that the parts don't move in z axis height. If a tray has moved upwards or downwards during rotation or arrangement, you can use the function **Translate to platform origin** in the Translate area of the Transform panel to place the object in question back on the build platform (z height = 0).

A tray is located outside the build space (pink) and is moved onto the build platform.

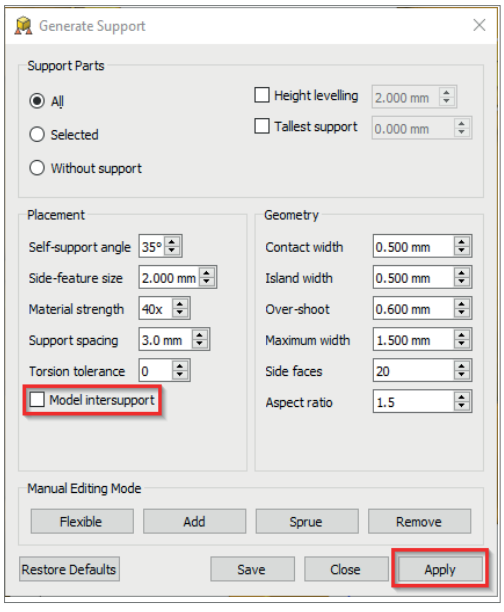


Once you have correctly orientated and arranged all the print objects, they should appear in yellow within the 3D view and therefore be completely within the printer's build area. If an object appears in pink, it isn't yet completely within the build area and needs to be moved and/or rotated accordingly.



Arrangement of three impression trays in the Asiga printer build area.

3.3.4. Adding support structures

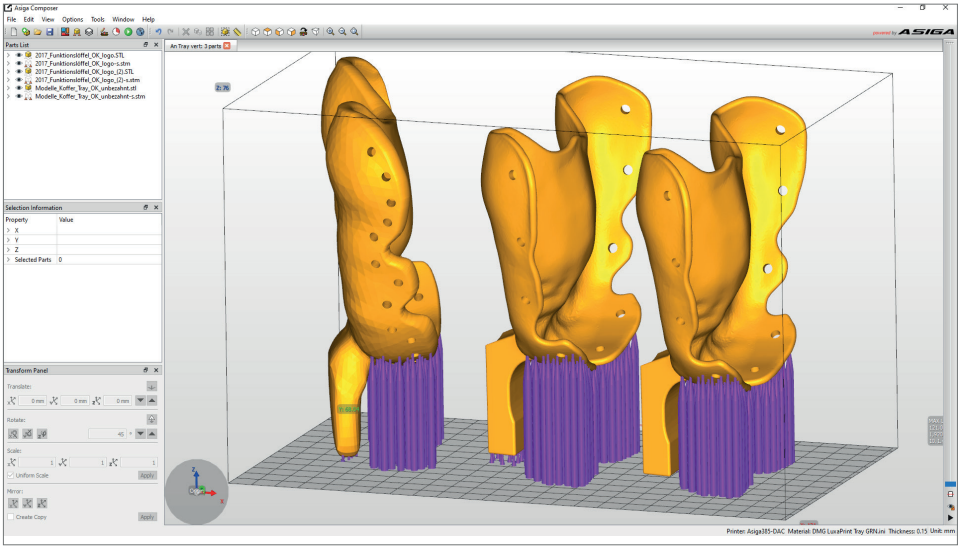


Generate support dialogue window

The objects require support structures to ensure an error-free build process. Select the menu item **Generate support**. The settings suggested in the software have already been optimised for the material, so you can simply start the automatic support generation by clicking on **Apply**. The **Height levelling** function is optional for impression tray printing and raises and supports the objects. The **Model intersupport** checkbox should be also deactivated to prevent the generation of support structures in retention holes.

Once the support has been generated, please check that all objects have been adequately provided with support structures and that there are no supports present on fitting surfaces, in retention holes or in other undesirable areas.

Finished build job including support in Asiga Composer. The baseplate is only generated right before the job is sent to the printer.



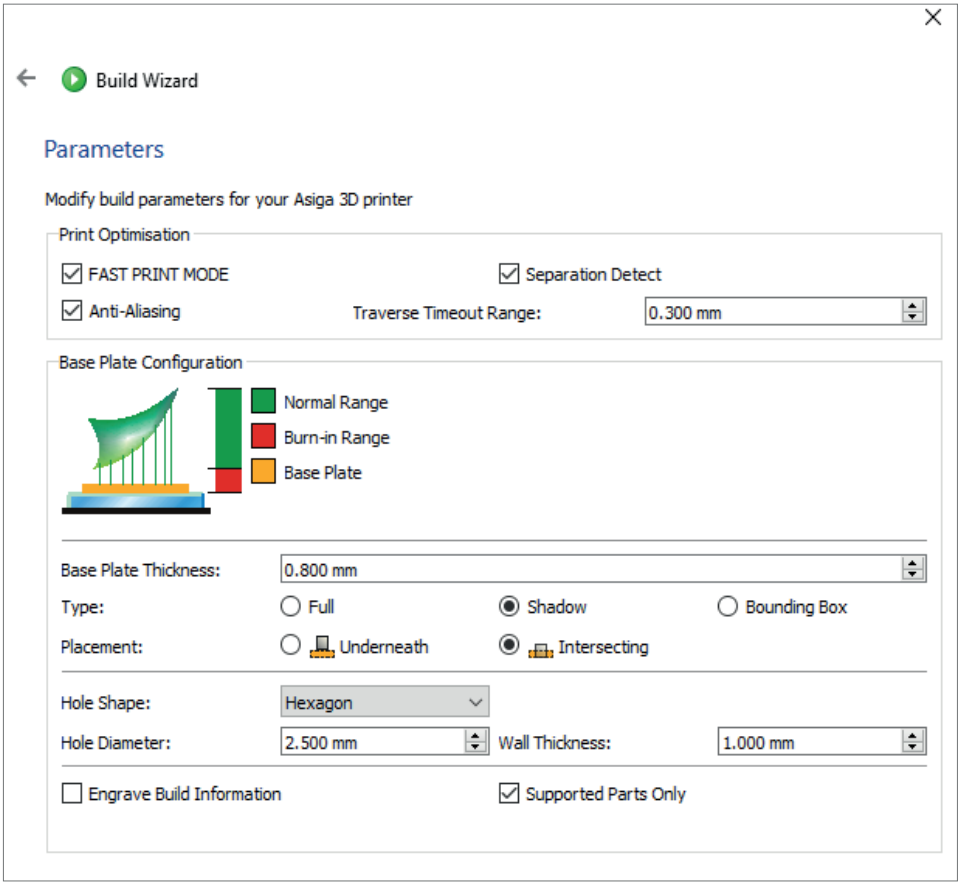
3.3.5. Adding the baseplate and sending the print job to the printer

A baseplate ensures better adhesion to the build platform and therefore prevents misprints from occurring. A baseplate should always be used when printing with LuxaPrint Tray.

In Asiga Composer, the baseplate is generated just before the slicing process. Click on **Build** (the green **Play** icon in the menu bar) to access the build preparation area. This is where you can first of all check all of your settings again. Clicking on **Continue** will then open the screen for generating a baseplate. We recommend the following settings:

Baseplate thickness:	0.800 mm
Type:	Shadow
Placement:	Intersecting
Hole shape:	Hexagon
Hole diameter:	2.500 mm
Wall thickness:	1.000 mm

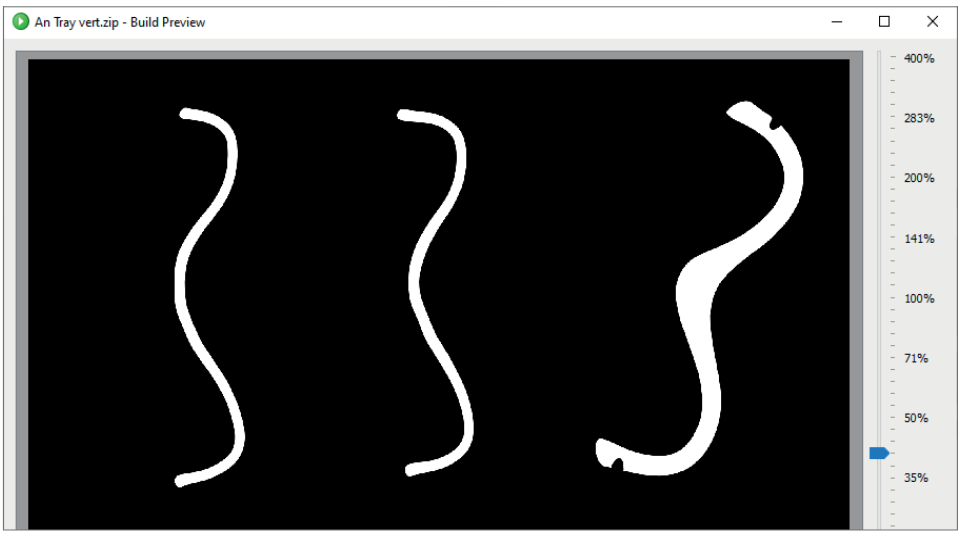
Build preparation dialogue window with recommended baseplate settings.



Further options are available under **Print optimisation**. When printing with LuxaPrint Tray, **Fast print mode**, **Separation detect** and **Anti-aliasing** can be activated to enable a fast and detailed build process.

Clicking on **Continue** allows you to check the advanced parameters and will then take you to the overview screen. Once here, you will need to give your print job a suitable name and then send it to the Asiga 3D printer. This is where you can also view the individual print views in black and white to give your print job a final check.

Build preview in Asiga Composer. Display of print layer 271.



4. Printing

≥ 1 min.

4.1. Shaking the material

LuxaPrint Tray (DMG) should be shaken briefly before use.

This ensures that you always achieve a homogeneous product and therefore consistently high-quality results.

4.2. Scanning RFID tags

Scan the printing resin's RFID tag by holding it in front of the integrated reader on the 3D printer. The printer will recognise the LuxaPrint material being used and compare it with the information stored in the print job. This means that accidental incorrect entries in the software can be identified early on and any manufacturing errors avoided. The system thereby supports you in complying with the validated DentaMile workflow (supported by DMG DentaMile Lab 5 (Pro), 3Demax, 3Delite and Rapidshape 3D printers).

4.3. Adding material

Add LuxaPrint Tray to the resin tray of your 3D printer. Make sure that the tray is filled far enough, so that the resin can continue to flow even if the build platform is fully occupied. Never fill the tray to the brim, as the resin may overflow and contaminate your printer.

4.4. Starting a 3D printing job

Start the print job on your 3D printer.

5. Post-processing

PRACTICAL TIP

Avoid direct skin contact with the liquid printing resin and parts prior to post-curing. Always wear suitable protective gloves when working.

INTELLIGENT CONNECTIVITY

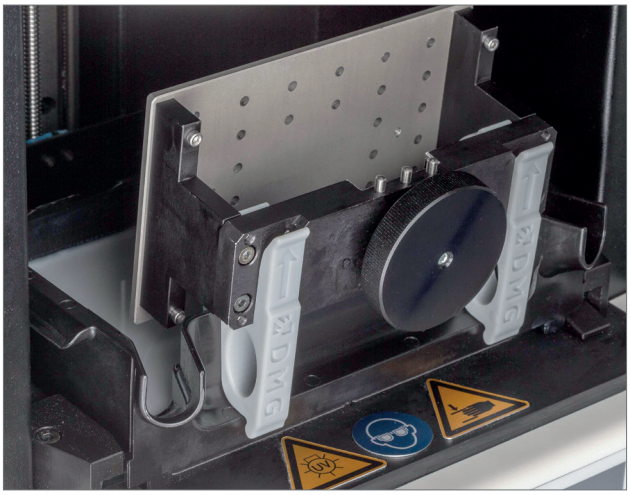
As a user of a DMG 3D printing system, consisting of the 3D printers DMG 3Delite, 3Demax and Lab5/Lab5 Pro, and the post-processing units 3Dewash and 3Decure, you can benefit from the intelligent linking of these devices. As soon as the print job is finished on the printer, all relevant information is transferred to the post-processing units, where you only have to select the appropriate print job to start the individual post-processing.

5.1. Drip-drying

After completing the printing process, let the impression trays hang in the 3D printer for about 10 minutes, so that any liquid resin can drip off. This saves material and cleaning.

PRACTICAL TIP

Use the drip aid (dripping rabbit) to enable the liquid resin to drip even faster and more effectively off your print objects. This saves print material and will reduce the number of times the isopropyl alcohol of your cleaning unit will need changing.



The print data for printing the drip aid can be downloaded directly from the DentaMile website at:https://www.dentamile.com/de/news/detail/ostern-ist-vorbei-aber-der-abtropfhase-leistet-immer-gute-hilfe

Removal of the printed impression trays from the 3Demax.

5.2. Detaching parts from the build platform

Carefully detach the printed objects from the build platform. Use a spatula, utility knife, razor scraper or similar tool to do so. Push the tool under the baseplate and loosen the parts using gentle lever movements. If the adhesion to the build platform is too strong, you can apply the spatula to the baseplate and carefully tap the handle of the spatula with a hammer to loosen the parts.

If you are using a DMG 3Delite or Rapidshape D10+, leave the objects on the build platform and hang the entire platform in the 3Dewash (or RS wash) cleaning unit.

Detaching of the impression trays from the build platform.

5.3. Removing the support structures

With LuxaPrint Tray, the supports can be removed before or immediately after cleaning. As the parts are less firm before post-curing, removing the supports is easier. Use a plaster knife or remove the supports directly by hand (use gloves!).

Check the parts for cracks as well as any other damage. Damaged parts should be discarded and reprinted.

Removal of support structures.

5.4. Cleaning

The impression trays must be cleaned after printing. We recommend using the 3Dewash cleaning unit to ensure thorough, automatic cleaning that is optimised for the application.

PRACTICAL TIP

Prolonged contact with cleaning agents can affect the accuracy of the objects as well as their mechanical properties. Please keep to the times stated here and remove the parts from the units as promptly as possible after cleaning.

Cleaning of custom impression trays in the 3Dewash.

5.4.1. DMG 3Dewash (or RS wash / P wash)

Simply place the printed parts in the cleaning chamber of the 3Dewash and select the programme for LuxaPrint Tray or the appropriate print job (requires intelligent connectivity). The cleaning should be carried out using isopropyl alcohol (approx. 99 %).

5.4.2. DMG DentaMile Wash MC

Place the printed parts into the cleaning chamber of the DentaMile Wash MC. Select the cleaning programme **Low** and set the timer to 5 minutes for thorough cleaning of the printed objects. The cleaning should be carried out using isopropyl alcohol (approx. 99 %).

5.4.3. Ultrasonic bath

If you don't have any of the cleaning units listed above, you can clean the printed impression trays in an ultrasonic bath with isopropyl alcohol (99 %). To do so, we recommend using two separate cleaning containers. The first for a prewash (max. 3 minutes) for removing most of the resin from the parts. This container will quickly become contaminated with resin, but can still be used for prewashing other parts. The second container needs to be clean or only minimally contaminated and is used to completely remove the remaining resin residues (max. 2 minutes).

Step 1 (Prewash)	Ultrasound	Isopropyl alcohol	3 min
Step 2 (Main wash)	Ultrasound	Isopropyl alcohol (fresh)	2 min
Drying	Compressed air/air		10 - 60 s / 10 min

PRACTICAL TIP

The **fresh** cleaning container will start showing signs of contamination after a number of cleaning processes. Once this happens, you can use it to replace the now more heavily contaminated container used for the prewash, which requires proper disposal. A container with fresh isopropyl alcohol can then be reused as a **fresh** cleaning container for the main wash.

5.5. Drying and visual inspection

Ensure the impression trays have completely dried before you proceed with post-curing. Use compressed air for this, or let the parts air dry for about 10 minutes.

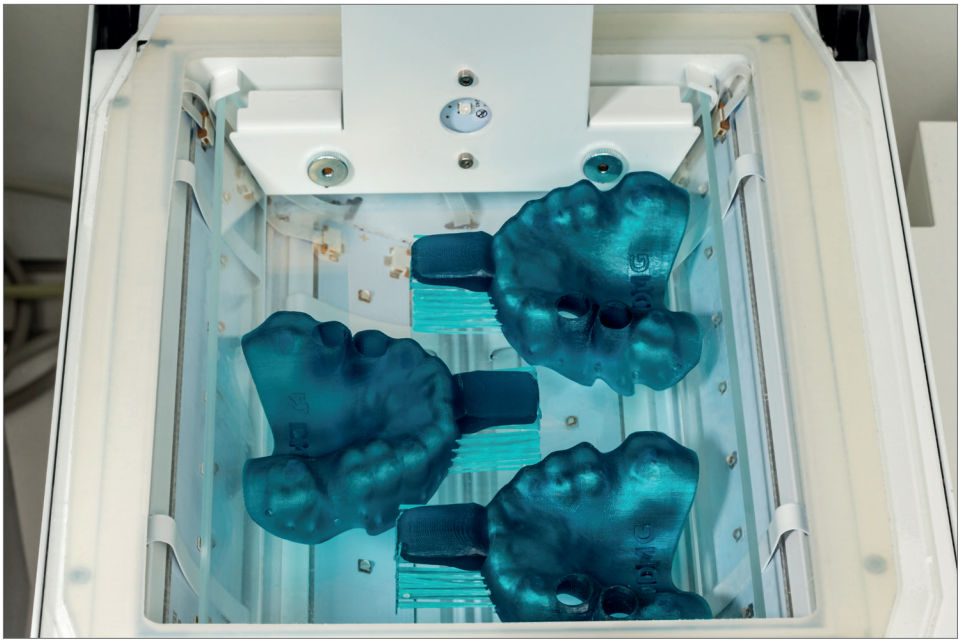
Inspect the parts thoroughly after drying and ensure that:

- The trays are clean and completely dry,
- No cleaning fluid or resin residues remain on the surface (indicated by a shiny object surface),
- No imperfections, cracks or solid resin particles are evident on the surface.

If there are still liquid resin residues on the objects, they can be removed e.g. with a spray bottle containing isopropyl alcohol or a cloth soaked in isopropyl alcohol. Then dry your trays completely as described above.

5.6. Post-curing

Correct post-curing is essential for achieving biocompatible objects with optimal mechanical properties and a perfect fit. Therefore, make sure that the specified process conditions are always observed. Do not place impression trays on top of each other in the light-curing chamber and make sure that the pieces receive light from all sides.



Post-curing in the 3Decure.

5.6.1. DMG 3Decure

Place your printed objects in the designated chamber of the light-curing unit and select the programme for LuxaPrint Tray or the appropriate print job via intelligent connectivity. The parts should not be placed on top of each other and must be able to receive sufficient light from all sides.

5.6.2. DMG DentaMile Cure MC

Place your printed objects inside the light-curing chamber of the DentaMile Cure MC and select the programme for LuxaPrint Tray (DMG). Make sure that the objects are not stacked on top of each other and that they receive sufficient light from all sides.

5.6.3. Otoflash / Heraflash / HiLite power 3D

Place the objects in the chamber of the light-curing unit and cure using the settings given:

Light-curing unit	Light-curing time	Tips
Otoflash G171 (N360 bath)	2 x 2,000 flashes	After the first 2'000 flashes, let the printed object cool down and turn it over
Heraeus Heraflash/ Kulzer HiLite power 3D	2 x 180 seconds	After the first 180 seconds, let the printed object cool down and turn it over

PRACTICAL TIP

Once finished, please check your objects for any cracks or other damage. Damaged impression trays are not to be used with patients.

5.7. Finish and polish

LuxaPrint Tray is quick and easy to grind. Make sure that you use low speeds when grinding to avoid defects on the tray surface. The objects should be finished under active suction due to the resulting dust exposure.

- A tungsten carbide bur can be used to remove coarse support residues.
- Use a soft rubber polisher to polish over finished areas and deburr any sharp edges.
- The trays do not usually require polishing. If so desired, polishing can be carried out using the conventional instruments and materials.

Rotating instruments for manual post-processing.

Custom impression trays after completion of the validated workflow.

6. Disinfection

DMG has tested the following disinfectants for use with custom impression trays made from LuxaPrint Tray: they are suitable for use as per the manufacturer's instructions:

- PrintoSept-ID (based on quaternary ammonium salts)
- SprayActiv, alcohol-based disinfectant spray (also contains didecyldimethylammonium chloride)
- Dentavon (solution prepared from granulate; contains pentapotassium bis(peroxymonosulfate) bis(sulfate), anionic surfactants, non-ionic surfactants, soap, phosphonate)

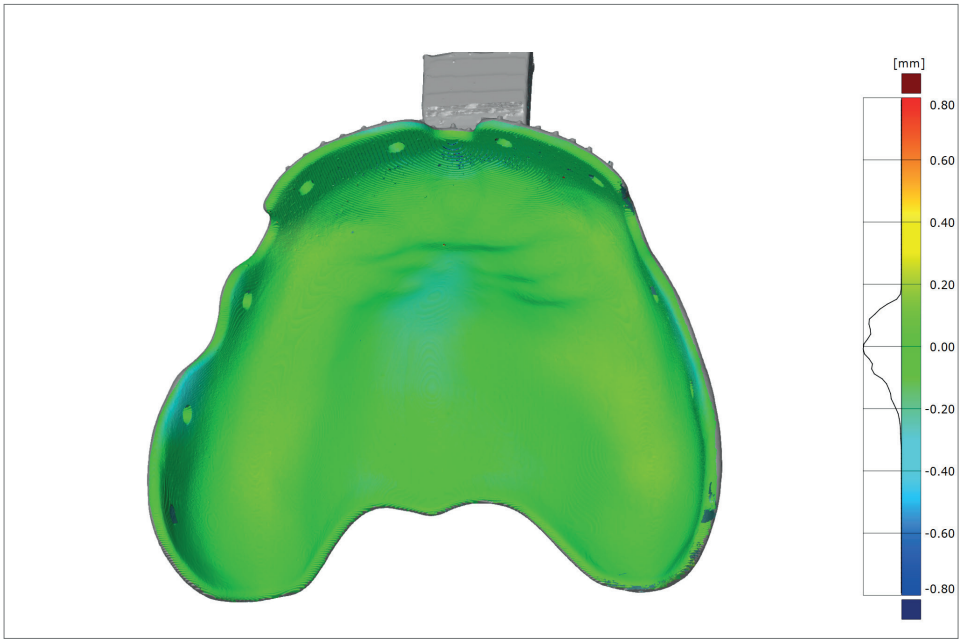
NOTE:

Do not use heat-based disinfection or sterilisation methods as these can cause deformation of the workpiece.

7. Validated fit accuracy

The main purpose of a custom impression tray is to provide a more accurate reproduction of the impression compared to impressions made with conventional, non-personalised impression trays, which are consequently less accurate. Accurate reproduction is achieved through a consistent material thickness of the impression material, whereby the dimensional changes in the impression material during curing are proportional to the material thickness [1, 2]. A tray with consistent material thickness requires the tray contour to follow the patient's individual tooth contour. It should be noted that the trays do not take smaller contours and details of the teeth into account during waxing up. This means that the impression material will exhibit and tolerate slight differences in material thickness despite customisation. The optimal material thickness for the used impression material is 2 - 4 mm.

Taking this into consideration, it becomes clear that the 3D-printed, custom trays will also tolerate minor deviations. Tolerance will therefore fall within at least a tenth of the material thickness, i.e. 0.4 mm.



Comparison of the fitting surface of a custom impression tray made using the validated DentaMile workflow with the initial digital data.

The fitting surface of a custom impression tray produced using the validated DentaMile workflow with LuxaPrint Tray (DMG) printing resin, DMG 3Demax 3D printer (150 µm layer thickness), DMG 3Dewash cleaning unit and DMG 3Decure post-curing unit shows deviations in the range of +/- 0.2 mm and is therefore within the optimal range for clinical use. The average deviation is 82 µm.

7.1. References

[1] Bomberg TJ, Hatch RA, Hoffmann WJ. Impression material thickness in stock and custom trays. J Prosthet Dent 1985; 54: 170–173.

[2] Wirz J. Materialien für individuelle Abformlöffel. Dtsch Zahnärztl Z 1982; 92: 207–211.