



3D Printing MULTI HEAD LASER USAGE RECOMMENDATIONS FOR USERS OF DMP F500 SERIES

Tutorial - Updated: 16,0000,1824,245

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Preface

This document describes in detail the usage recommendations for preparing for print in 3DXpert, when working with 3D Systems Multi Laser Head printers.

Specifically, these recommendations cover the main scenarios for placing parts on the tray and slicing them for the **3D Systems DMP 500 Series** printer.

Before we begin, let's discuss 3DXpert product versions, as you should pay attention to the 3DXpert version that you are using.

Recommendations for multi head usage (on DMP 500 Series) were first published for 3DXpert 14, so if you are still using this version, look for the original Multi Head Recommendations guide.

3DXpert 16 includes all the functionality that is available with the original, official release of 3DXpert 15, and in addition, it introduces a new process flow, which is specifically relevant only for the DMP F500 Series printers, and therefore the usage recommendations are updated as well.

Briefly, this workflow enables the use of Automatic Balancing for multiple components, without the need for Part Consolidation.

While this is the main change, an additional improvement is that the **2D Nesting** functionality that assigns laser heads, has been incorporated into the Manual Assignment tool, for ease of use.

To sum up:

The workflow discussed in this document is relevant for 3DXpert 16, only for DMP F500 Series printers.

* With **Automatic Balancing**, the system calculates the operation of each laser head of the printer, scanpath elements are assigned to heads to optimize the print time of each layer, so the scan is distributed between heads as evenly as possible. This calculation takes into account numerous elements, such as the printer type, number of heads, material, objects selected, parameter values, etc.

The Process Flow - Multi Laser Head (DMP F500 Series)

As explained in the preface, the target of 3DXpert 16 is to enable Automatic Balancing of multiple parts without the need of Part Consolidation.

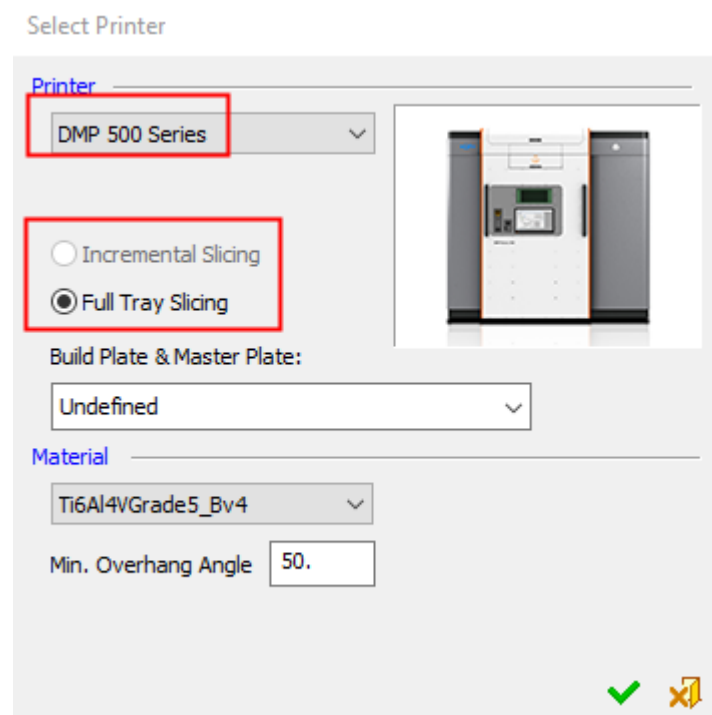
In other words, it is no longer required to combine the geometry of all parts into a single part in order to achieve Automatic Balancing of all parts on the tray.

This is a major change of behavior, which makes the process flow simpler. The user places the parts or instances on the tray, assigns lasers (if needed) and runs slicing.

An additional advantage is that the instances are kept as instances, thus reducing file size and calculation time.

This is an enhanced behavior, and a simpler user experience of managing the multi head slicing, compared with 3DXpert 15 (and of course 3DXpert 14).

In 3DXpert 16, the slicer always considers the entire tray when using DMP 500 printers. With other printers, the user may choose whether to slice each part separately on the tray (Incremental Slicing) or slice the entire tray as a whole.



When you click the Calculate Slices icon, the system picks all the parts and instances that are currently placed on the tray. This sounds straightforward, but this approach does have implications on the workflow, because it is recommended to complete the preparations of the tray before starting the slice calculations of the scanpath (Calculate Slicing).

As a result of this change, the process workflow is simpler for the users.

So if the previous guidelines were different for different scenarios (a single large part, multiple instances, nesting of different parts, etc.) the process flow is now practically similar for all scenarios, since the entire tray is considered for the slicing execution.

The following chapters of this document will therefore consider typical scenarios to explain the new workflow.

Considerations for Full Tray Slicing Calculation

At this point, it is necessary to explain why the fact that the entire tray is considered for calculation means that the process is simpler on the one hand, but also means that the user is advised to finish preparing the tray for printing before starting the calculation.

Since the slicer picks the whole tray, any change after slicing, which is related to the tray arrangement (such as adding a part (or instance) to the sliced result or moving a part) will require a new slicing calculation of the entire tray.

You can delete a part or an instance of a part (remove from tray), without any need for recalculation. Its slicing is deleted from the scanpath, and the slicing of the rest of the tray, including auto balancing is kept unchanged. However, the removal of a part means that the balancing that took that part into consideration is less optimal than it was, and the system will notify you of that.

The fact that the entire tray is considered does not mean that you must include all parts for slicing. As before, the editing of tray content before slicing calculation is possible (through the optional step), but clearly, if you unpick specific parts that are located on the tray, this is exactly as if you changed the content of the parts on the tray*.

An additional tool, which is relevant to this discussion, is the **Scanpath Manager**.

Whereas so far the Scanpath Manager saved the results of the picked parts for slicing within each part, it now saves the previous executions for the entire tray, and not of the specific parts.

Note: Changing the tray layout in downstream applications, such as DMP Control, should not be done since the slicing is made for the entire tray.

*Parts that were not picked for slicing cannot be added later. Adding parts means reselecting all the parts that will be printed, all over again, and calculating a new slicing.

Typical Scenarios

The new behavior discussed above leads to changes in the working methodology.

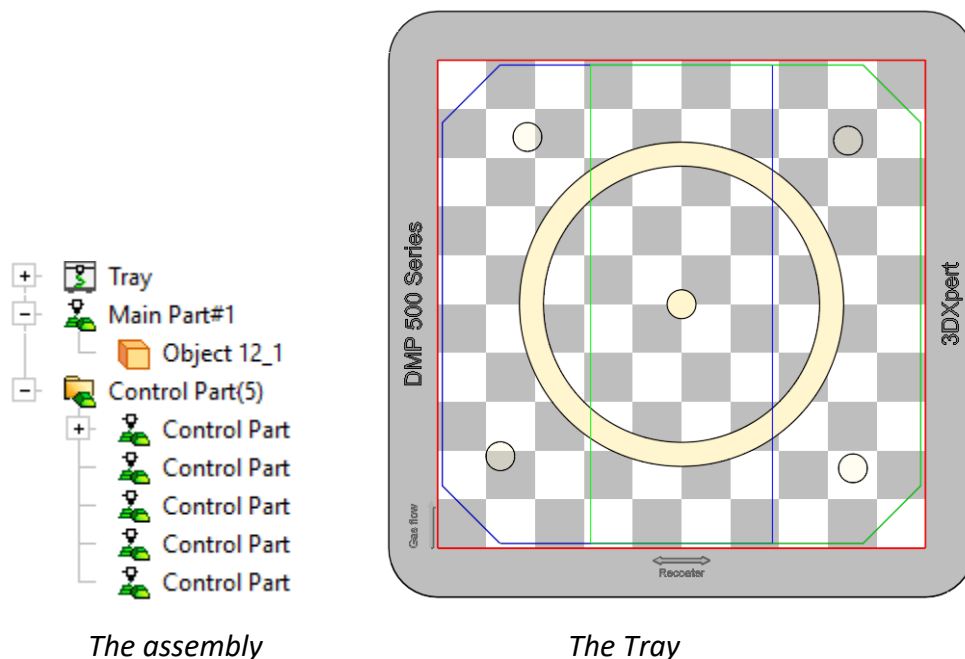
Overall, you should find the new behavior easier to work with. Clearly, as part consolidation is no longer required, there is no need to differentiate between parts added in the assembly environment or in the part environment – for auto balancing. As a result, most of the scenarios described in the Multi Head Recommendation document for 3DXpert 15 now share the same working methodology; place the parts on the tray, if required assign laser heads and calculate the slicing.

Still, it may be useful to look at the common scenarios and review the suggested working methodology for each of them.

Scenario 1: Printing a Large Part

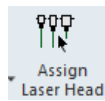
An example of tray contains a single part to be printed by all lasers and additional individual control parts (bars, boxes) are added on the tray at specific locations (laser or tray boundaries). Each of the control parts are usually printed with a single laser (or with more than one laser when using virtual objects).

The assembly shown below includes one bigger part that is located within the reach of 3 laser heads and 5 additional control parts, each located within the reach of a single laser head or more:

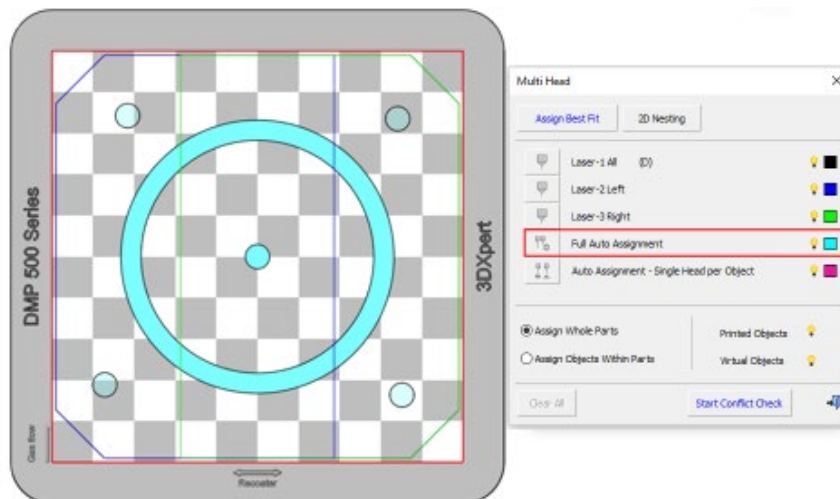


The requirement is that the large part is automatically balanced.

Click the Assign Laser Head icon and set the Laser Head Assignment to **Automatic Head Assignment**.



See that by default, all the parts are set as Full Auto Assignments.



Review the assignments and assign the control parts to a single head (if required).

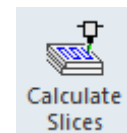
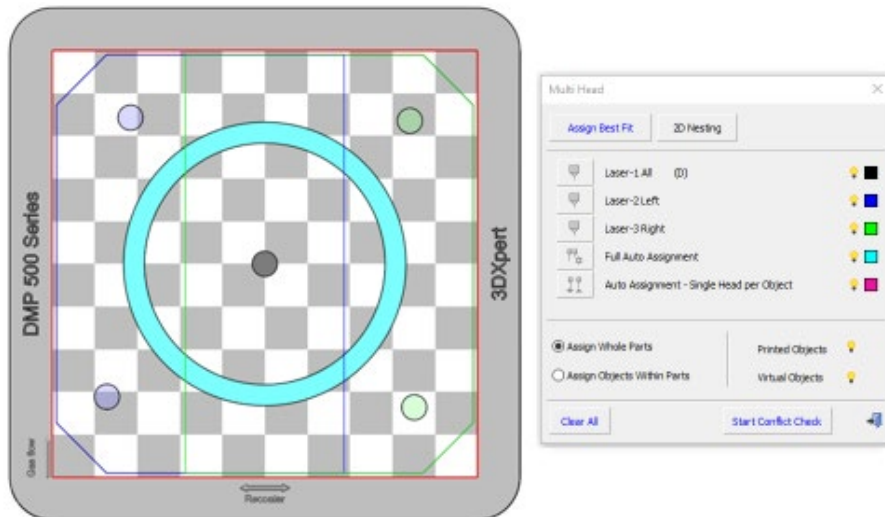
In the example shown here, each of the control parts gets assigned to the relevant laser heads.

Manual Assignment of Instances:

Note, that when Full Auto Assignment is assigned to the original part, it is not possible to assign a laser head to a specific instance.

In order to assign an instance to a laser head, the original part must be assigned first to a single laser head.

Therefore, in this case, first assign the original part to a laser head, and then the rest of the instances.



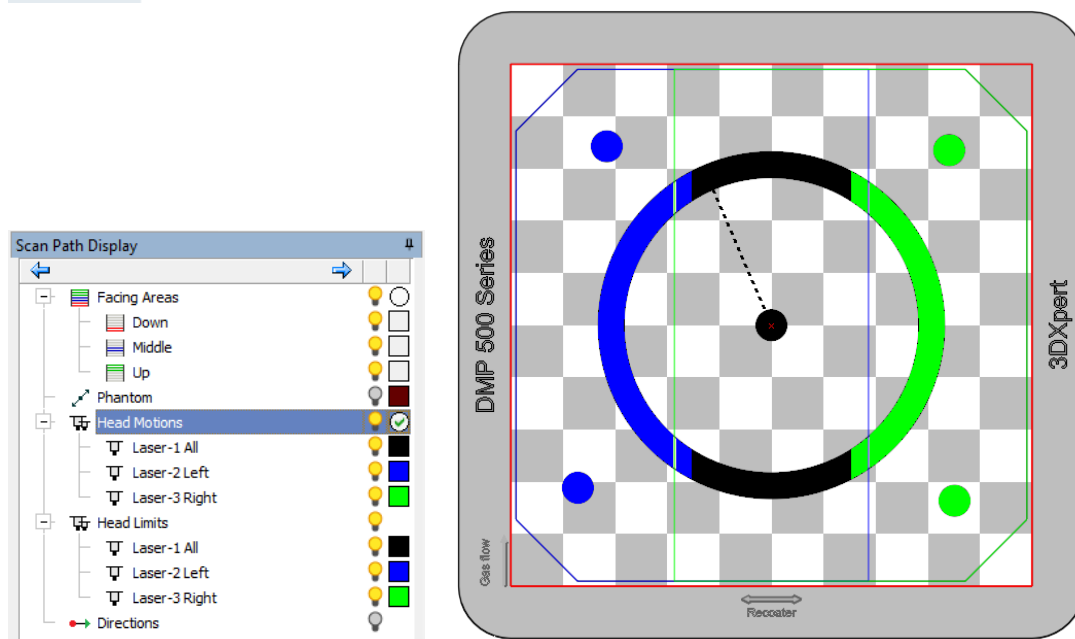
Click the Calculate Slices icon and press OK to launch slicing.

When slicing finishes, enter the Slice Viewer to see the result.

Notice that the main part is balanced and each of the control parts is assigned to a single laser head, as shown here:

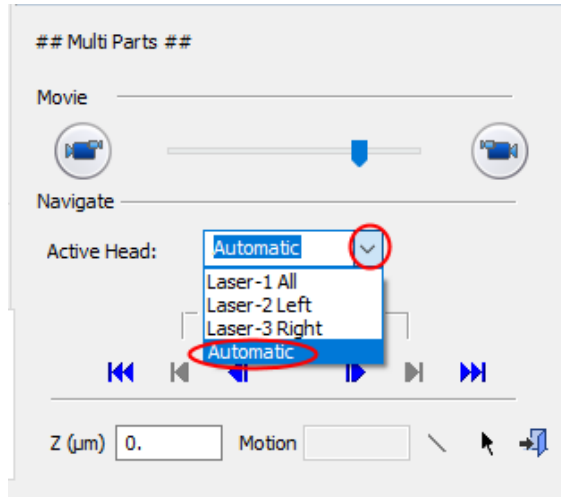


Slice Viewer

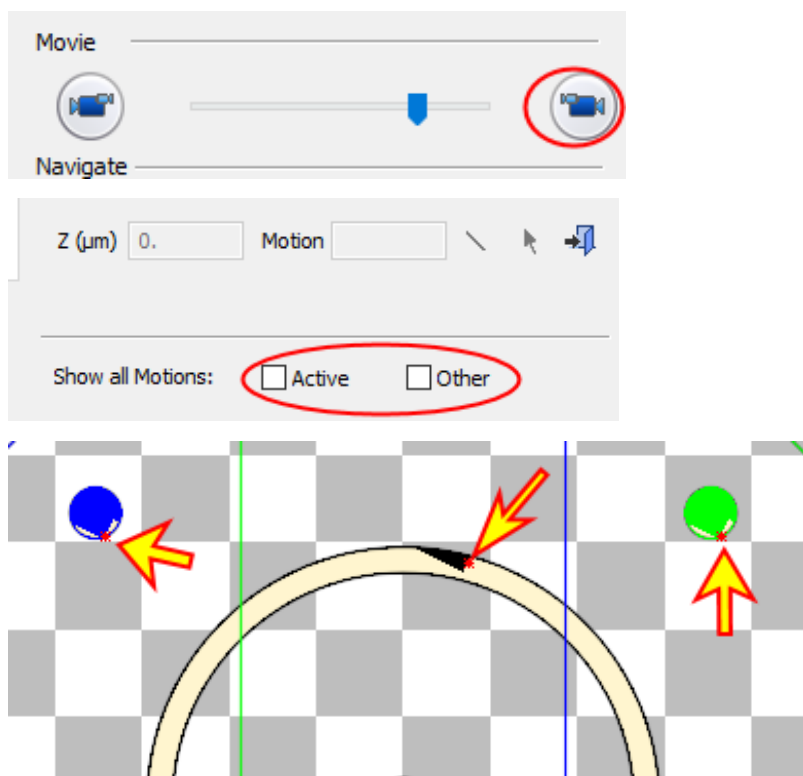


Note that in version 3DXpert 15, the movie option of the navigator displayed the motions of the active head only.

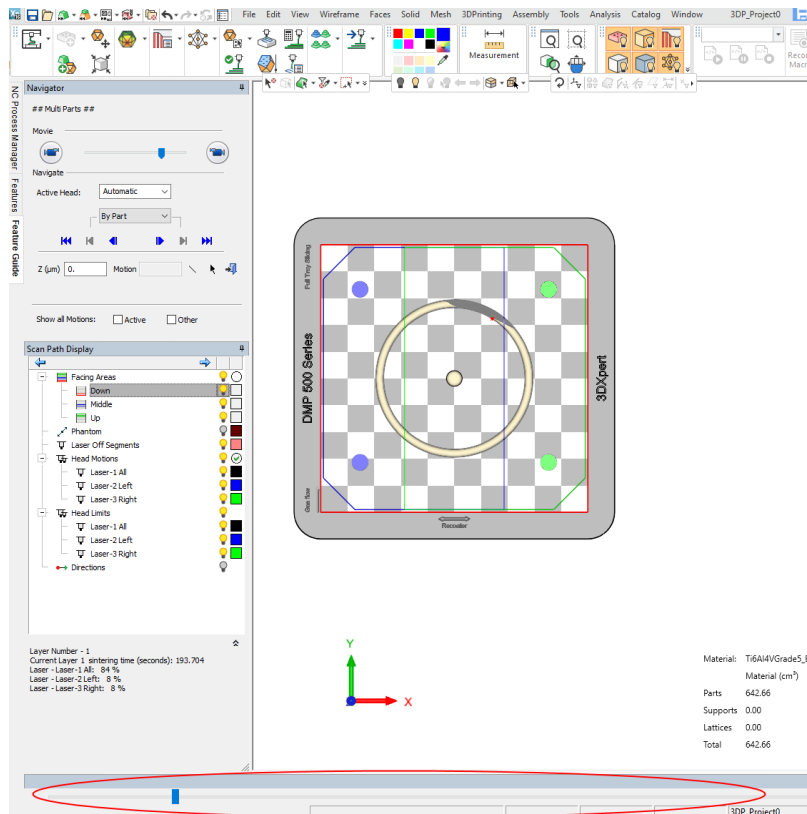
In 3DXpert 16, using the automatic option in the Navigator, the system shows the motions of all printer's heads simultaneously.



While running the movie, uncheck the Show all Motions (Active & Other) for a clearer display of the current position of all heads, and the motions performed until the current position in the layer. As mention before, with **Automatic Balancing**, the system calculates the operation of each laser head of the printer, scanpath elements are assigned to heads to optimize the print time of each layer, so the scan is distributed between heads as evenly as possible



The bar in the lowest part of the window, shows the relative time left to finish the current layer printing.



Scenario 2: Printing Several Parts or Instances

In this scenario, we prepare several parts for printing and assign them different laser heads.

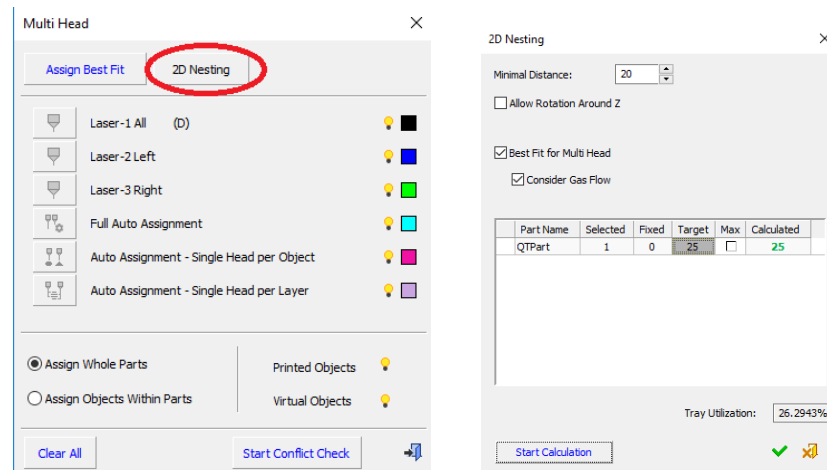
When working with a single laser assignment, adding instances (also known as 'clones') is preferable.

There are various ways to arrange multiple instances on the tray, such as **Copy Array** and then **Assign Laser Head** to each part by **Assign Best Fit**, or use **2D Nesting**, which is now available also from within the **Assign Laser Head** tool (see images later on, below).

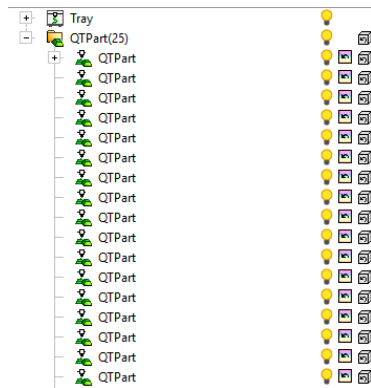
First, load the part then prepare it for printing - orientation, supports, etc.

Then, use **2D Nesting**, to either fully utilize the area of the tray (Max), or enter a specific number of instances on the tray. Either way, use the options **Best Fit for Multi Head** and **Consider Gas Flow**.

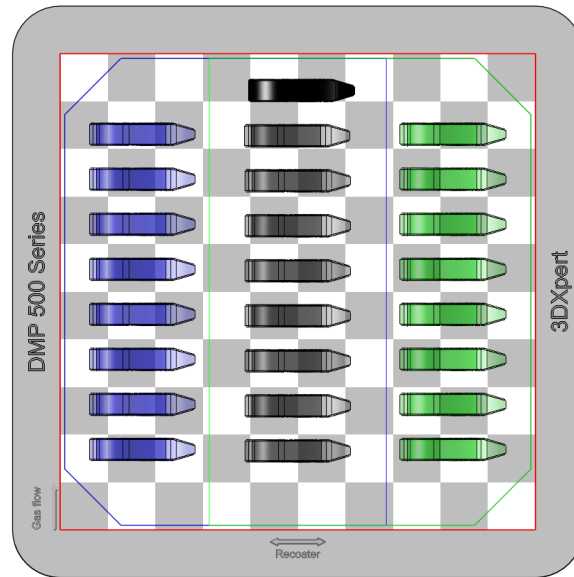
In Assign Laser Head, click the 2D Nesting button and set the nesting parameters:



Result: Instances of part nested on the tray:



The instances on the tree

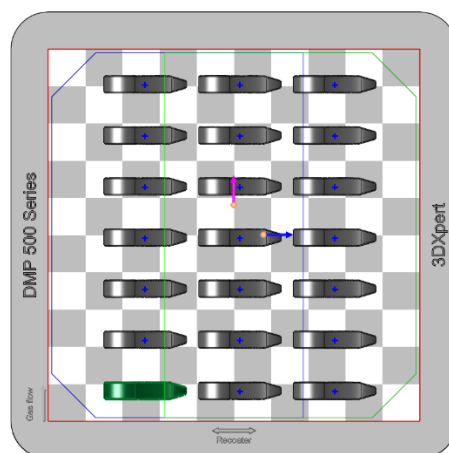
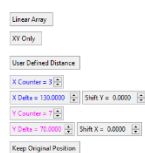
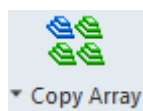


The instances on the tray

As can be seen through the above image, **2D Nesting** automatically assigns the laser heads to the instances (as in previous versions).

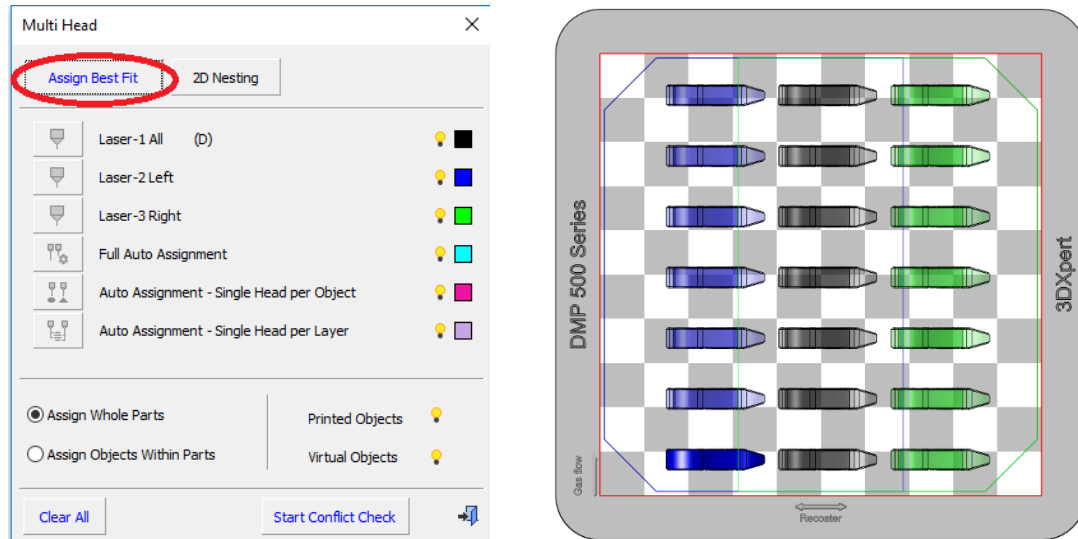
Before exiting '**Assign Laser Head**', make sure that all the laser head assignments are as required (either to the specific head or that the parts are auto balanced).

Alternatively, use **Copy Array** to put several instances of the same part on the tray.

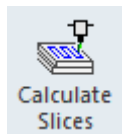


If the position of the copies is suitable for an automatic head assignment, use the

Best Fit option. So next, enter Assign Laser Heads and click the **Assign Best Fit** button.



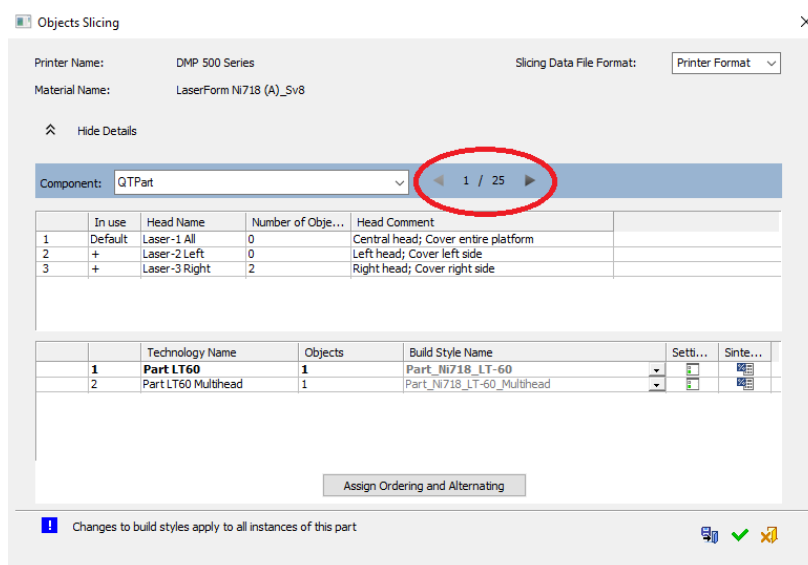
Once the tray is ready for slicing, click the **Calculate Slices** icon to launch slicing.



While you are in the Object Slicing dialog, note the number of components to slice.

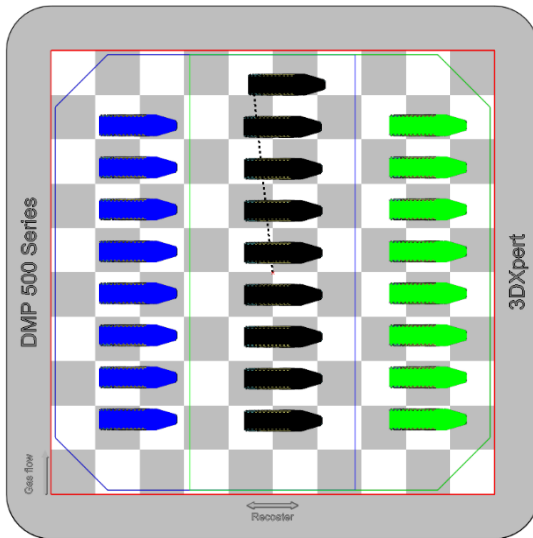
This number is marked in the image below.

The number of components equals the number of the instances on the tray:



- 1 See the note at the bottom of the dialog, indicating that any changes to build styles are applied to all instances. This note appears if slicing a part with more than one instance.
Press OK to start slicing; wait for it to finish.

Once Slicing has finished, enter the Slicer Viewer to see the result:

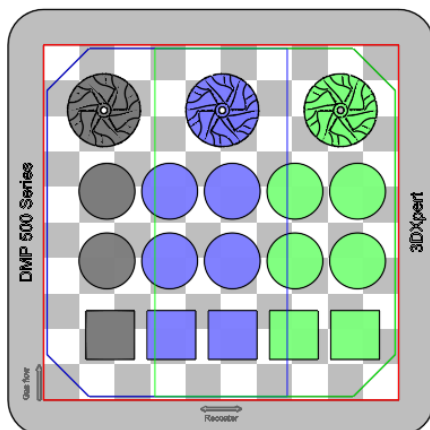


In the example above, each instance will be printed by a single laser, based on its position on the tray, and considering the gas flow.

Note on calculation time:

The calculation of instances takes into account the fact that the parts have the same geometrical shape, therefore most slicer operations are not duplicated per each instance, in order to reduce the calculation time, and still, some additional calculation time is required, in order to optimize/balance the tray.

In the example above and in the following image, the parts are placed so that the lasers can work in parallel.

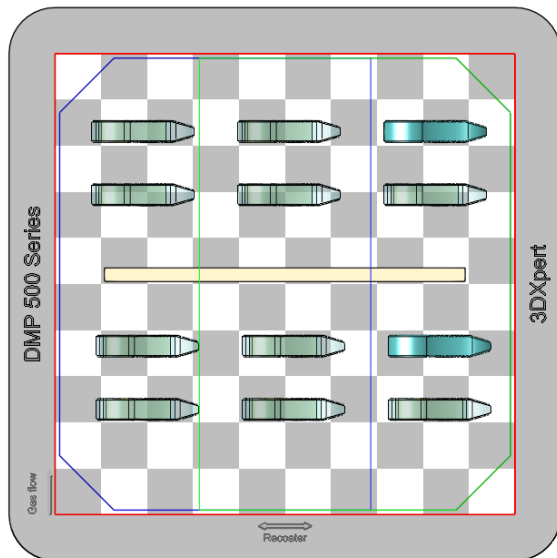


In this case, 3DXpert can assign the heads accordingly, as seen here.

In other cases, where parts are placed differently, this would not be possible due to the gas flow. The fumes coming from one part may interfere with the scanning of another. Therefore, in this case the head assignments will be less optimal.

If full tray balancing is required, clear all head assignments (note that unlike previous versions, there is no longer any need for part consolidation).

Consider the following example:



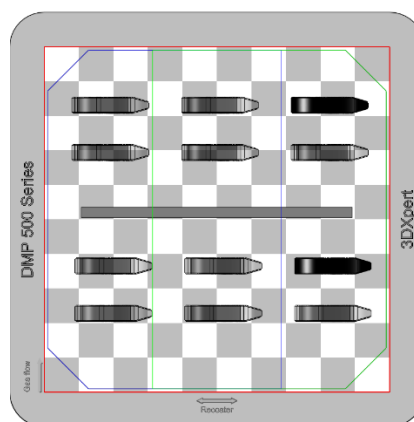
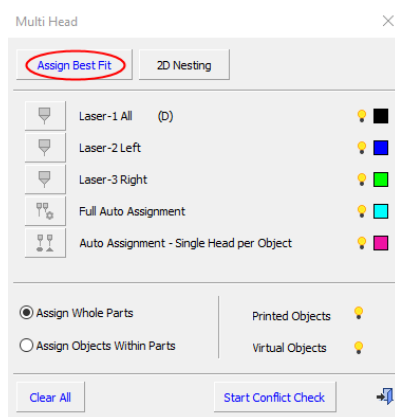
The tray includes two groups of parts, and in between a long part that crosses the boundaries of two laser heads (green and blue). Clearly, if one laser is assigned for this part, this will be the main laser head (black).

Here, the user wishes to assign the laser heads to each part, by **Best Fit**.

The result: all the parts are assigned with the main laser head (black).

This happens due to gas flow considerations, once the long part is included.

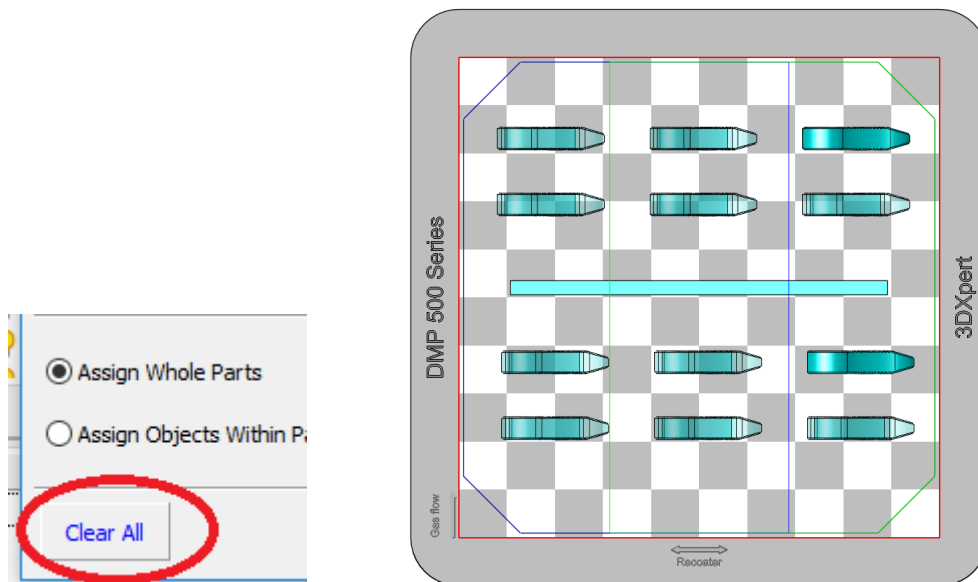
It is not possible to apply the different laser heads without them interfering with each another.



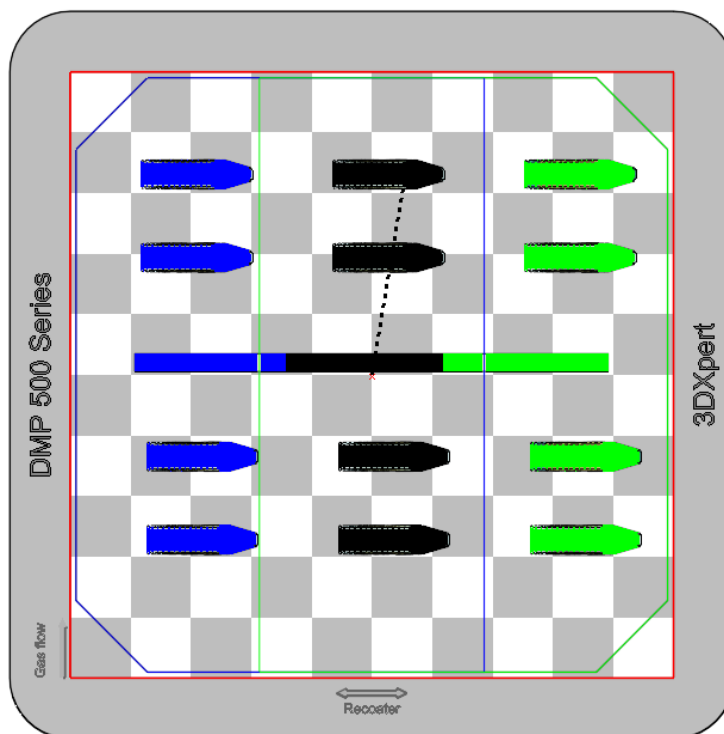
For a better, balanced, result, we will need to reassign the parts.

Press the **Clear All** button located at the bottom of the Multi Head dialog.

The nested parts are re-assigned as '**Full Automatic**'.



Calculate the slicing and enter the navigator to see the result:



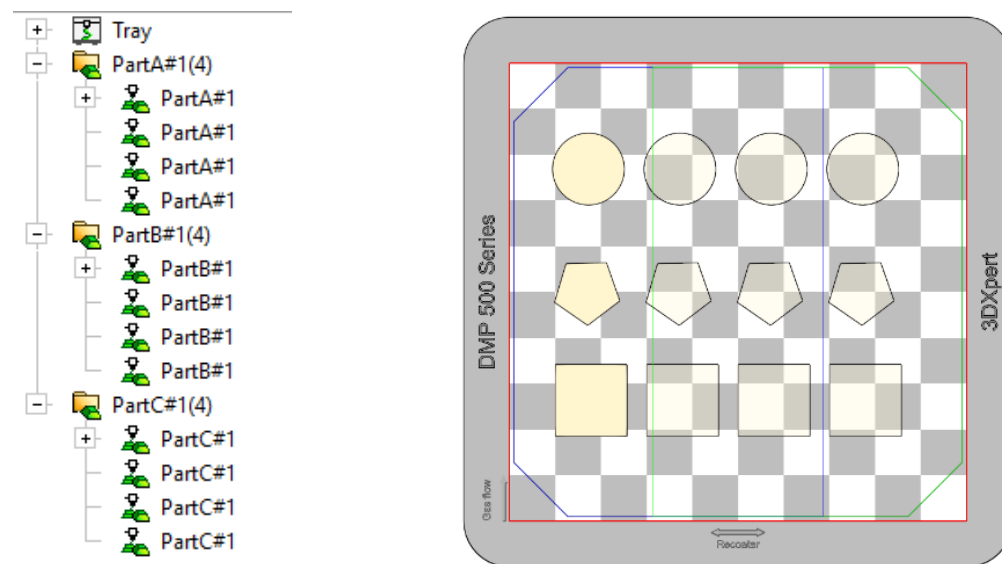
As can be seen here, the tray is now balanced and there is no gas flow related interference. The system calculates the slicing of each layer, so the scan is distributed between heads as evenly as possible per each layer.

Scenario 3: Placing Several, Different, Parts

This case represents the scenario of placing several different parts (each several times) on the tray.

Working with multi laser head printers, we may wish to use Auto Balancing.

This example shows a tray, on which 3 different parts were placed, each with several instances:

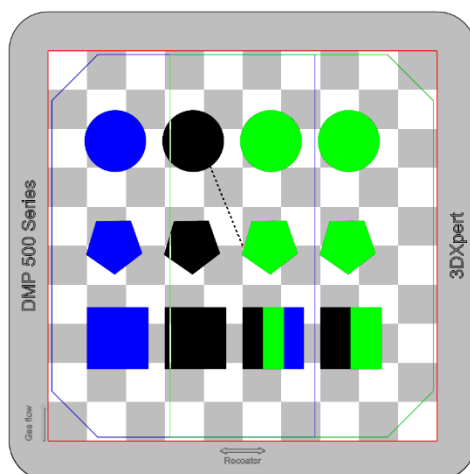


Parts & Instances on Tree

Parts and Instances on Tray

All the parts and instances are Auto Assigned for balancing.

Run Calculate Slices and after it finishes, enter the Navigator:

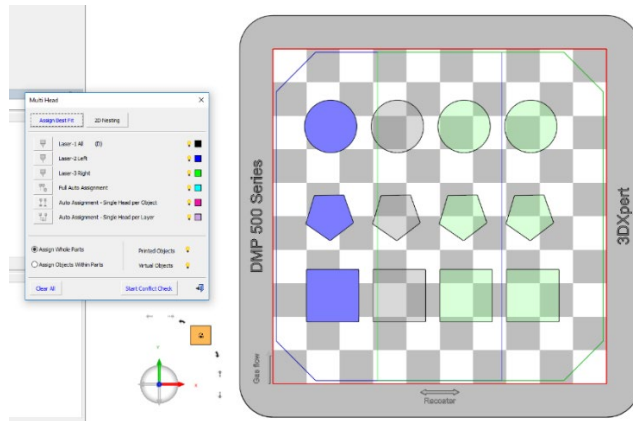


As can be seen here, the tray has been balanced, so that the three lasers can work in parallel, to reduce printing time.

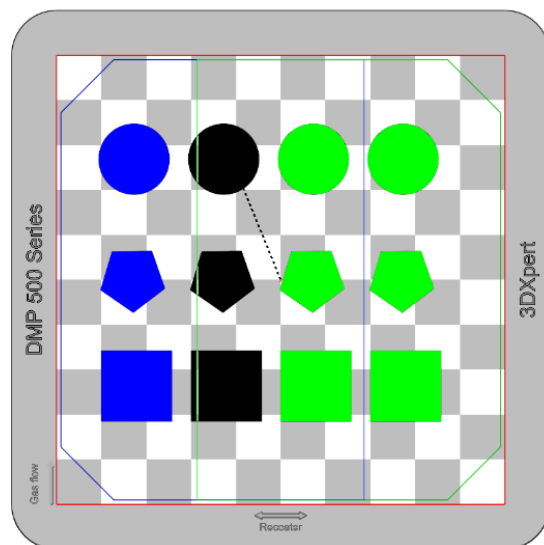
Due to the different areas of the models, some parts were split and assigned to different laser heads. This enables to minimize delays between the laser heads, so that they work in parallel as much as possible. Each laser works within its boundary.

Alternatively, assign specific laser heads to the parts:

Enter Assign Laser Heads and use the option **Assign Best Fit**.



Run Calculate Slices and after it finishes, enter the Navigator:



In this case, each laser head works on specific parts, however the tray is not balanced. This means that some lasers may wait for other laser(s) to finish working, in order to resume.

As explained earlier, since this is an array of instances, the slice calculation will be performed once for each different part that is nested on the tray.

Additional Notes

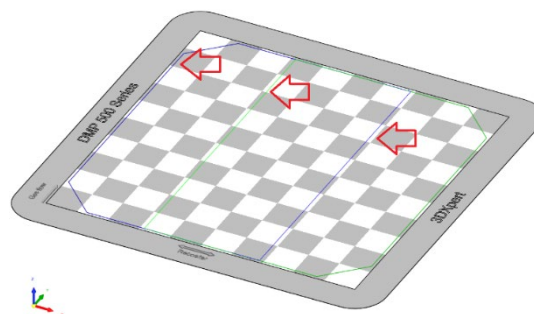
Following are some further notes and clarifications, which are relevant for the work process explained here. This section has additional details, concerning the process, such as what happens when making changes to parts after slicing, adding instances, the Operator environment and more.

General:

- Support of existing projects: This is relevant for 3DXpert files that use the DMP F500 Series printer and saved on previous versions of 3DXpert (including 3DXpert 15).
If these files contain slicing data, this slicing data will be removed when loading the project on this version. Re-slicing is required.
- The slicing data will also be removed from parts that were sliced in previous versions and are added to the tray.

Work Flow:

- After slice calculation, making changes such as rotation of parts or copying of parts will lead to the deletion of existing slicing and will require slicing the entire tray again, due to the resultant balancing considerations.
- You may add parts and instances. However, in order to have them printed, you must slice the entire tray again. Note that when adding instances of sliced parts, the slicing data is not copied from the original part into the added instance. Re-slicing is required.
- When there are several instances of the same part, every operation or a change, which is performed on a single instance (for example, a change to the build style in use), affects all the other instances.
- If after slicing, the user re-assigns lasers heads to parts or instances, re-slicing will also be required.
- Parts should be placed within the laser heads' boundaries. If parts exceed the boundaries, the slicer will issue a warning to the user and slicing will not be executed.



Laser head boundaries of the DMP F500 Series

In such a case, move the parts exceeding the laser heads' boundaries using Position Body or the Copy Array/Nesting tools.

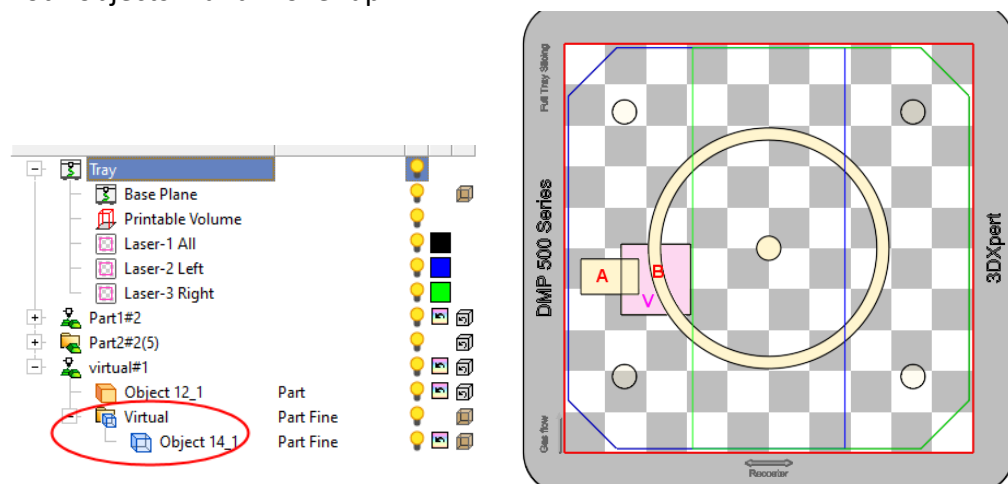
- Relations between different parts (models) – Consider a tray on which several parts are positioned and virtual objects from the two parts overlap (for example, when a virtual object created in one part (Part A), overlaps another part (Part B)).

Virtual objects from one part do not affect other parts. In other words, the virtual object in part A does not influence the scanpath of Part B.

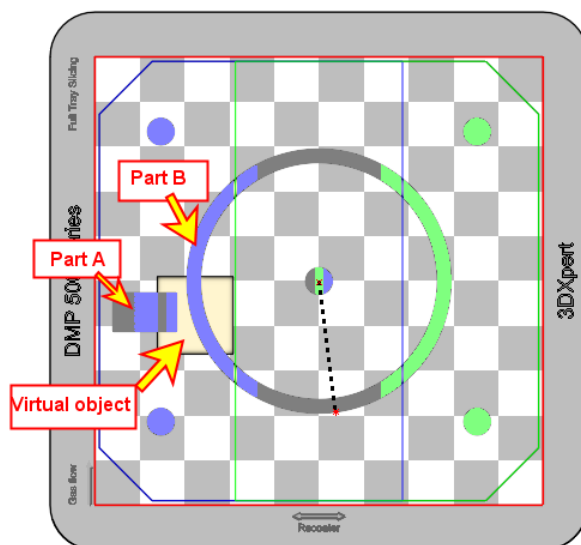
To have an effect, the virtual object should be placed in the same part.

This example shows a few parts, one of them is defined as a Virtual object (V object belongs to part A).

Both objects V and B overlap:



The sliced result of part B is not influenced by a virtual object, which is located in another part (Part A).



Additional Information

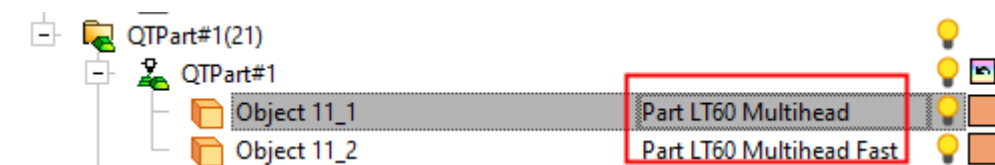
MH special technologies of Validated Materials:

A Technology specifies the printing technology to be used to create a specific part. For example, a part to be printed may have a **Part** printing technology and each Support type may have its own printing technology (**Cone Support** technology, **Wall Support** technology, etc.).

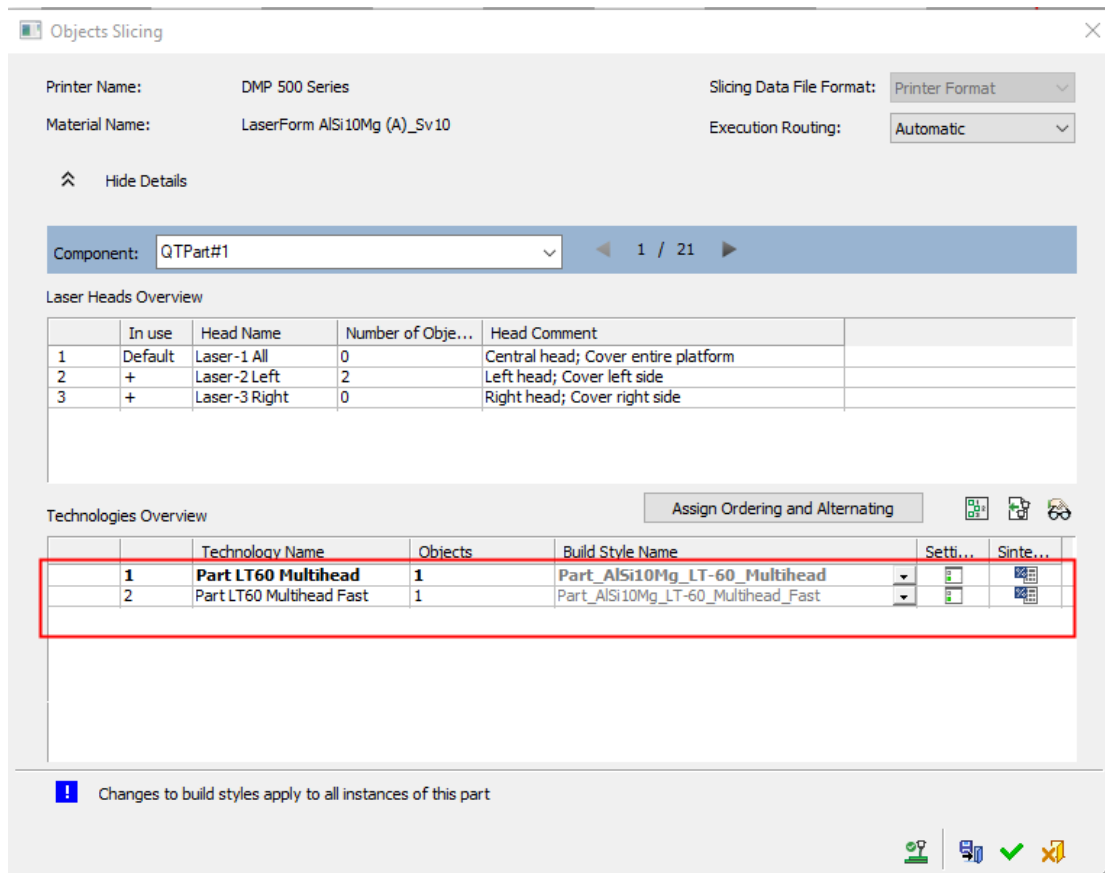
Each Technology contains its own specific set of printing parameters, consisting of the following:

1. **A Build Style** - is a group of material configuration parameters, saved in a file as preset printing parameter settings.
2. **Laser Parameters** - a specific group of laser parameter settings.
3. **Scanning Order** (if defined) - the order in which elements are scanned, within each layer.

Technologies such as **Part LT60 Multihead** and **Part LT60 Multihead Fast** are specific technologies for Multi Head printers.



These technologies are originated from the regular **Part LT60** technology, however with several adaptations to best fit the Multi Head requirements and advantages.



The surface quality is much better when using Multihead technology rather than Multihead Fast technology.

For example, in Multihead Fast, setting hatching is applied only to the Middle Area (not to Down or Up facing areas).

The User may choose to apply a fast technology for example to supports, in these cases, the surface quality is less important.

Printing order by groups:

While using “Full Tray Slicing” it is possible to significantly reduce printing time and achieve excellent part quality (print the Part regions on clean powder) by instructing the slicer to treat and order each layer by groups.

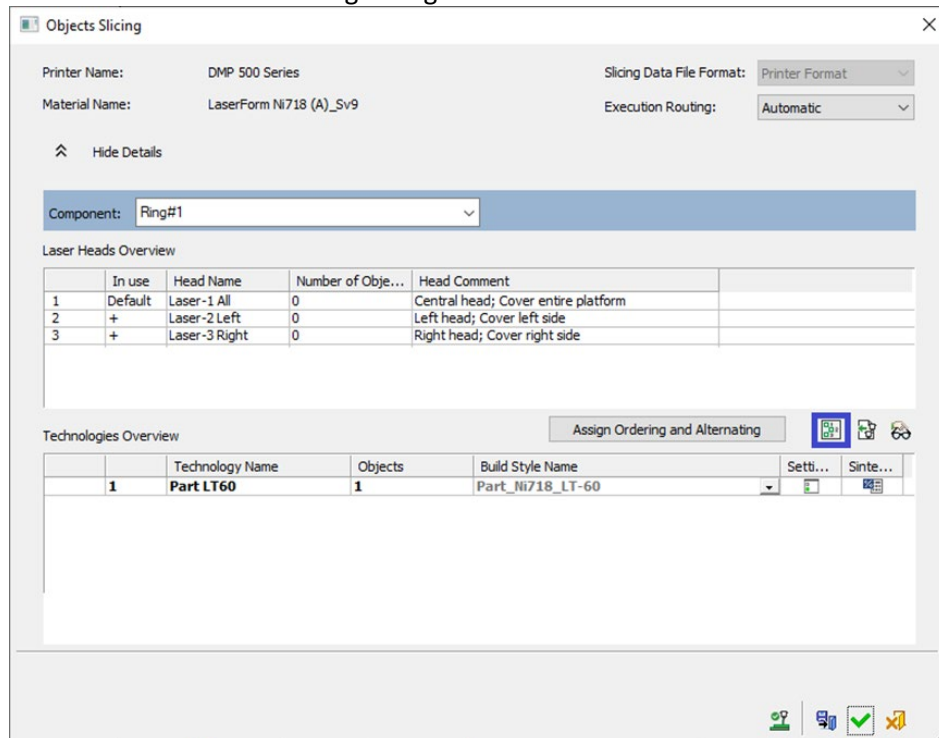
A group for all the support regions, a group for all the Lattice regions and a group for all the rest.

The group of all support regions will be printed together as the last thing to print in each layer, furthermore it will be ordered internally without the restrictions created by the Gas Flow awareness.

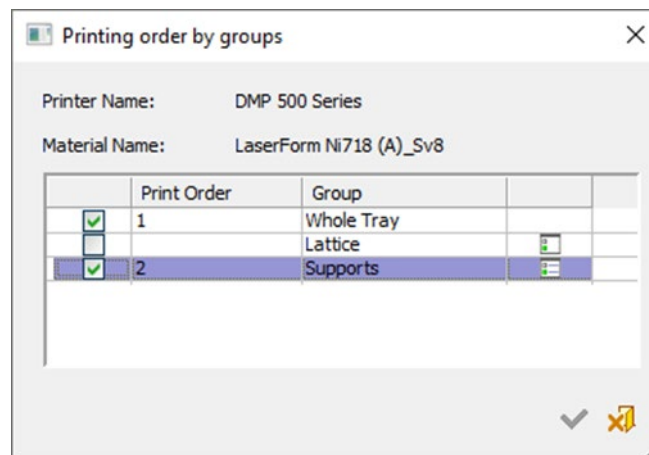
The group for all the Lattice regions will be printed after the group of all the rest; internally it will be ordered while considering all restrictions (including Gas Flow awareness).

The group of all the rest (which is mainly Part regions) will be printed as the first thing in the layer, while internally considering all the active restrictions.

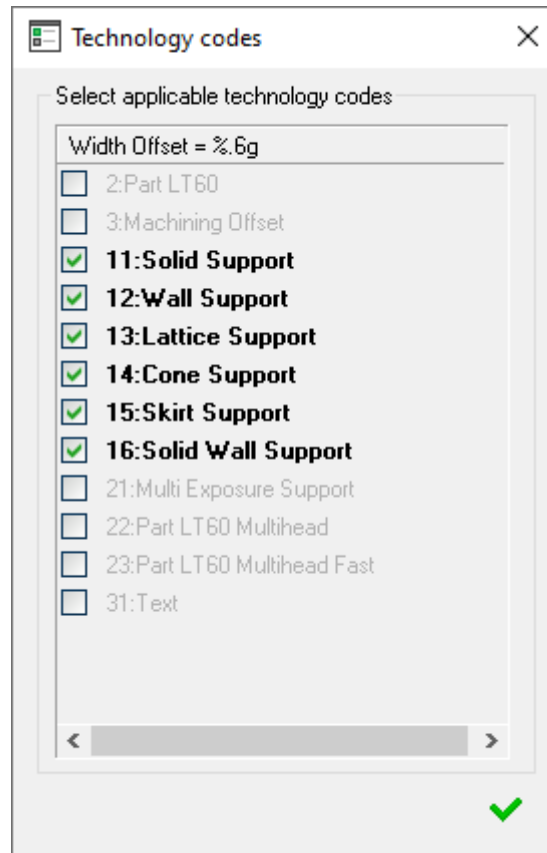
For each Scanpath calculation, you can define the Printing order by group settings by clicking the Print Order button on the slicing dialog.



Define which groups will be created



When clicking on the button next to each group, you will be able to define which technology types will be assigned to that group.

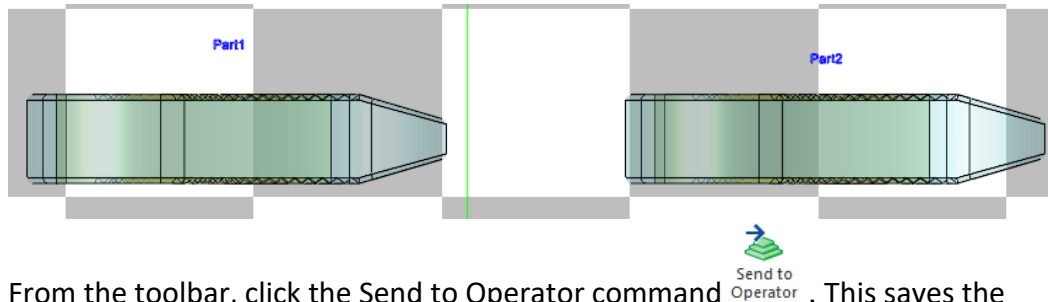



Scenario 4: Working with the Operator Environment

The Operator Environment enables to add serial labels on the tray and to calculate the slicing data for these labels. The work flow is much the same as before, there are some options which are not available when using the DMP F500 Series, as explained here (see step #3).

The process flow is the following:

1. Position the part(s) on the tray and prepare for printing. Add Labels and assign them with the Technology. Calculate slicing.




2. From the toolbar, click the Send to Operator command . This saves the project and launches the Operator project.

3. Notice that in 3DXpert 16 Operator, the changing laser head assignment, adding parts, positioning and nesting functions are disabled (as the entire tray is taken into account in the calculation).

This is because such changes require re-slicing, and as slicing in Operator is only relevant for the labels, these cannot be carried out in the Operator environment.

It is possible, however, to delete a component.

The **Assign Laser Head** tool is available for viewing purposes only.

4. Use the Label Manager to edit serial labels and to create label objects. 

5. Slice the Labels. 

6. Send to Print. 

Finally, note that files, which were saved in the Operator Environment in previous versions (including 3DXpert 15) can be loaded also on 3DXpert 16, however, these files cannot be sent to the printer through this version.

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