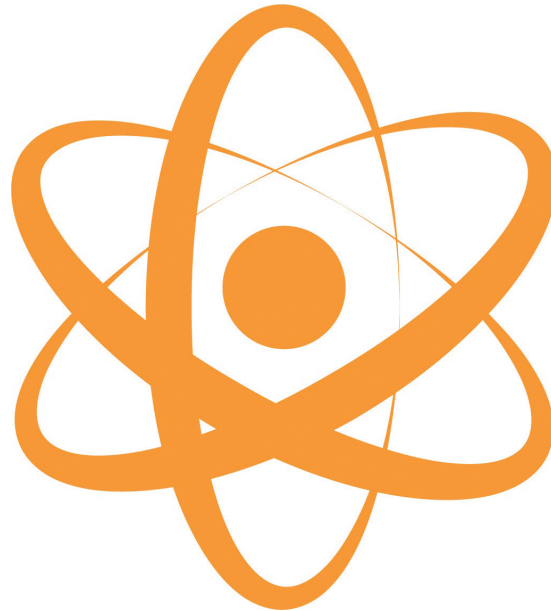


Renishaw Material Editor V5.3



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This quick start guide covers the Material Editor build parameter file editing software version 5.3.

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Patents

Features of the Renishaw Material Editor software are the subject of one or more of the following patents and/or patent applications:

CN 105102160	CN 105228775	CN 105492188	CN105492981	CN 107206484
CN 107206493	CN107771123	CN108189390	CN108515182	CN108829942
EP 2956261	EP 2956262	EP3007879	EP 3014369	EP 3221075
EP3302939	EP3323534	EP3357606	EP3415254	JP2019/166841
JP6482476	JP6571638	JP6581079	US 9669583	US10191476
US10335901	US10493562	US10500641	US10639879	WO 2014/125258
WO 2014/125280	WO 2014/199134	WO 2016/079496	WO 2019/211587	

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2 Setup

3

2.1 Install and activate

1. After you have purchased Material Editor, you will receive an email from Renishaw.
2. Follow the instructions in the email to install and activate Material Editor.

2.2 Configure

1. The Material Editor software is preconfigured for Renishaw additive manufacturing systems.

2.3 Recommended PC specification

- Processor CPU – 3.2 GHz (or better) multi-core CPU Intel Core i5 to i7 or higher.
- Operating system – Windows 7 SP1 64-bit Professional, Enterprise or Ultimate (32-bit is not supported) or Windows 10 64-bit.
- Memory – 16 GB RAM or better.
- Hard drive – internal Solid State Drive (SSD) with 128 GB of free space for processing.
- Storage drive – as required by the number and size of material files you want to store.
- Monitor/display – minimum resolution 1280 x 1024. For HD 1920 x 1080.
- Graphics card – NVIDIA GeForce GT 710 2 GB RAM or higher (any graphics card supporting DirectX 9 and above).
- You will need sufficient local administrator privileges to enable you to install software.

Note: The Material Editor user interface can be used with a regular Windows compatible mouse and a space mouse.

3 The build preparation process

5

3.1 Introduction

Using QuantAM and Material Editor to prepare your 3D data for an AM build is a very simple process, with only a few steps required to create a build file. If you are preparing a build file for a single laser Renishaw AM system, there are four stages of build preparation. For a multi-laser AM system, there are five stages.

**1 – Orientation****2 – Support****3 – Layout****4 – Review****5 – Build file viewer**

A material file can be selected during the **Orientation**, **Support** or **Layout** stages, but **MUST** be selected before you enter the **Review** stage of build file preparation.

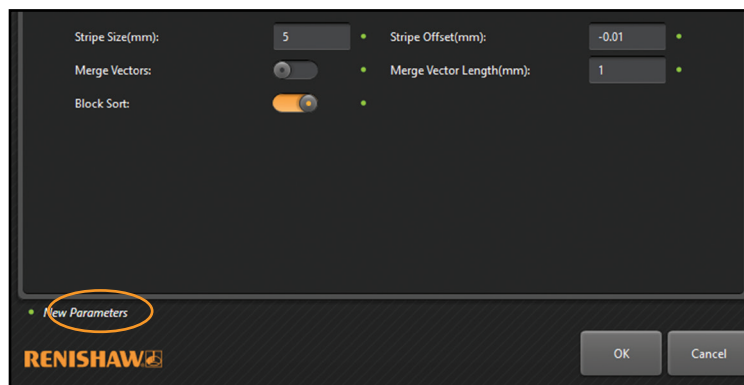
Optional fifth stage if using a multi-laser AM system.

3.2 Training

Renishaw can provide a range of training courses, from basic through to advanced, to assist you in getting the best out of Material Editor. Use the contact details information in Section 5 to contact Renishaw and discuss the range of options available.

3.3 New Parameters

If you are an existing user of Material Editor, you will be familiar with the features and functions of the user interface. Where new parameters have been added to the interface, these will be marked with a small green dot next to the parameter as shown in the illustration below.



4 User interface

4.1 Introduction

Material Editor is an application that enables the user to copy, edit and create new material files. The completed material files can be exported from Material Editor, imported into the QuantAM build preparation software and then linked to a build file during build preparation.

Material files allow the user to fully customise how their build preparation software slices parts and generates vector paths, and how the Renishaw AM system scans each hatch line. Editing these files allows vast control over material development and fine-tuning of each and every build. Slicing, hatching and scanning aside, Material Editor also provides access to other tools such as fine-tuning costs and build estimations.

Note: If you change any values of existing material files, you will overwrite the master data. If you wish to make variations to a material file, it is best to copy and rename the material file so that the master data is not lost.

4.2 Material Editor

The user interface of Material Editor is described in the following sections:

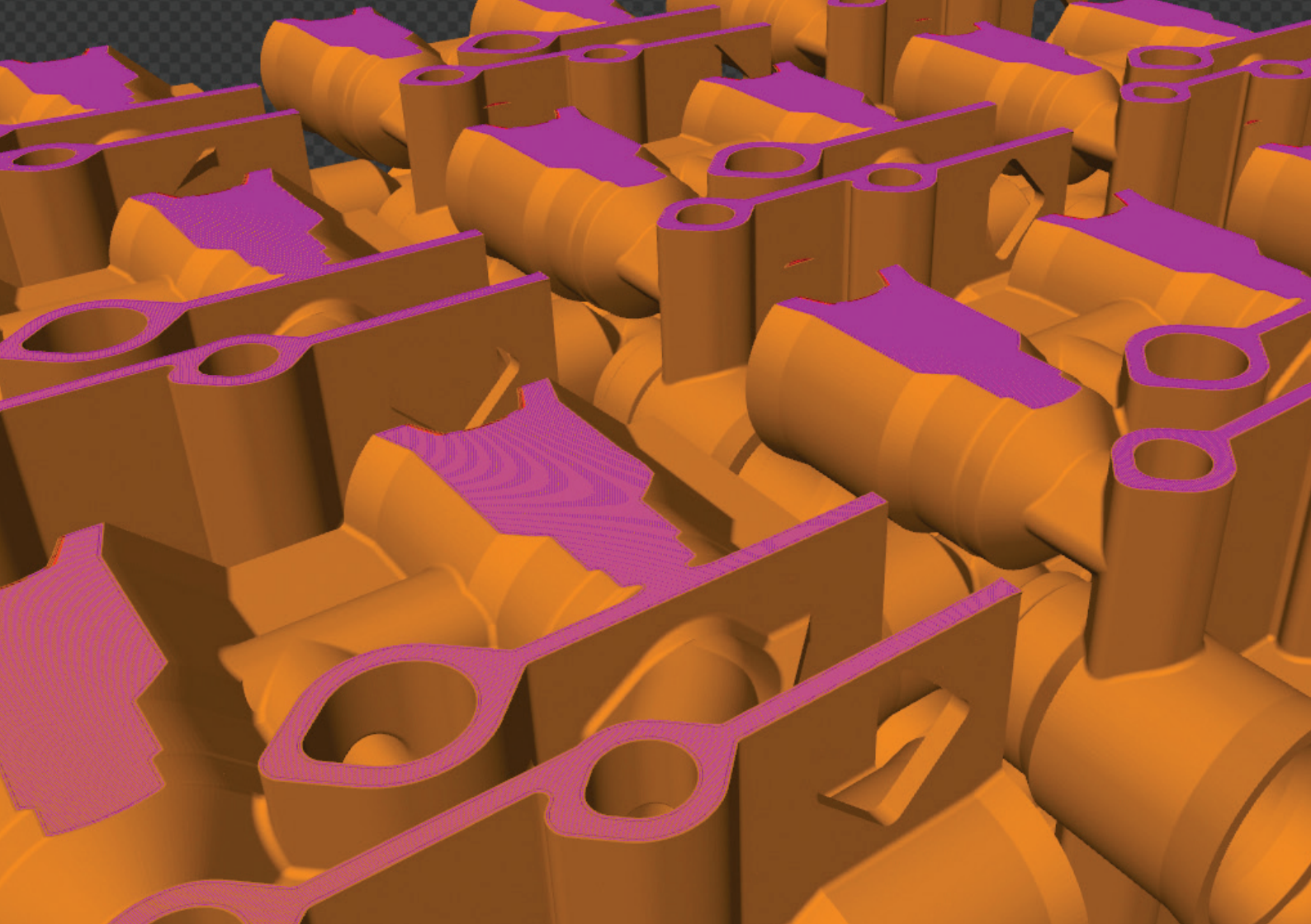
- 4.3 To launch Editor
- 4.4 Start page
- 4.5 Add New Material
- 4.6 Edit Material
- 4.7 Copy Material
- 4.8 Import Material File
- 4.9 About Renishaw Material Editor
- 4.10 Help
- 4.11 Export Material File

4.3 To launch Material Editor

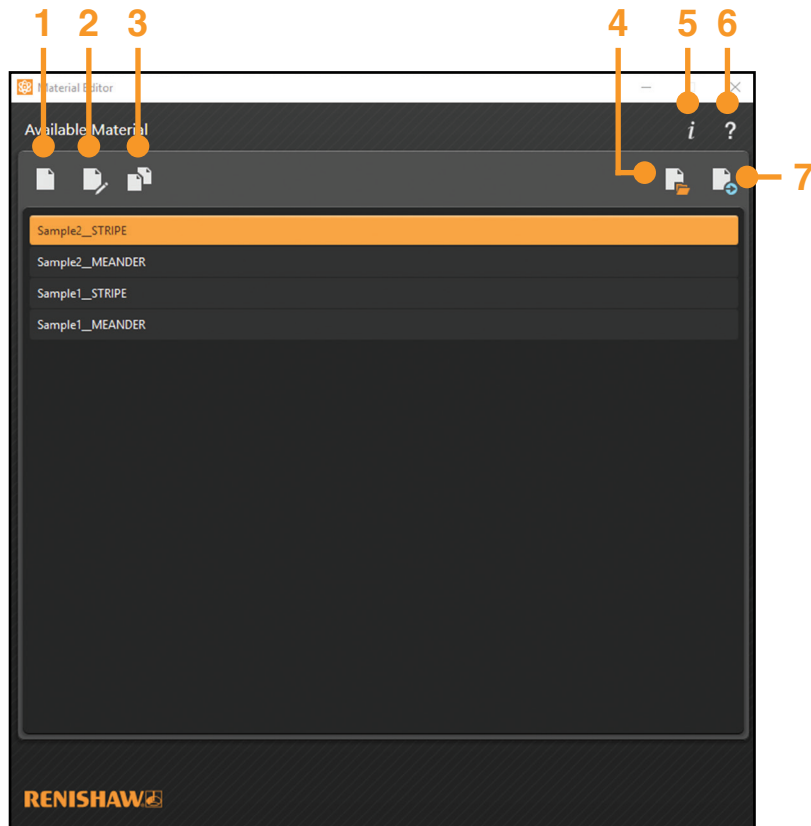
1



To open Material Editor by double-clicking on the programme icon. This will open the 'Start' page.



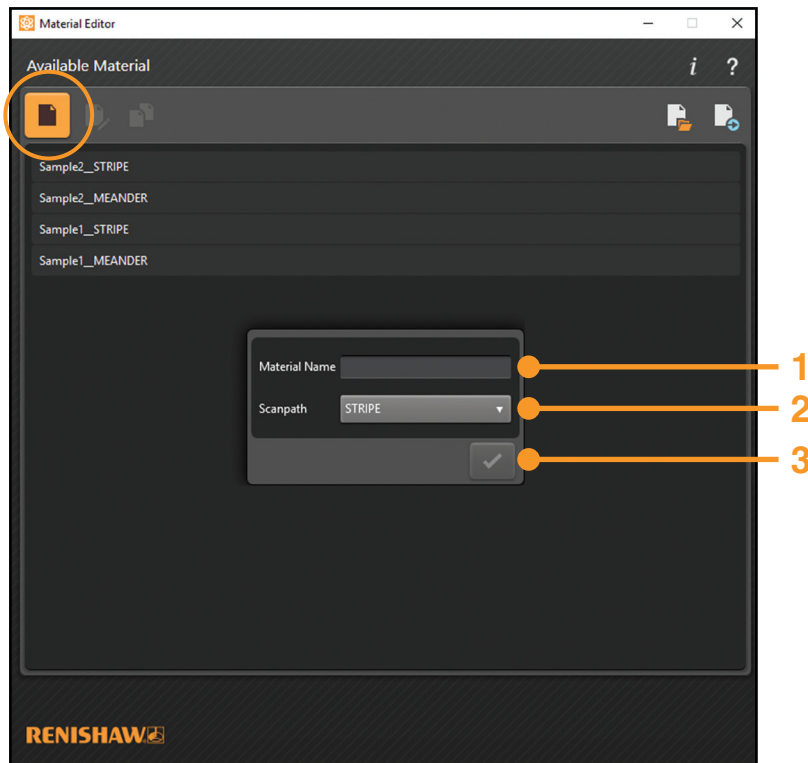
4.4 Start page



From the 'Start' page, you will see the following seven options.

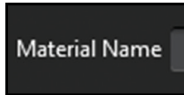
- 1  **Add New Material**
Selecting 'Add New Material' enables you to create a new material file. See Section 4.5 for details.
- 2  **Edit Material**
Selecting 'Edit Material' enables you edit any of the parameters within a material file. See Section 4.6 for details.
- 3  **Copy Material**
Selecting 'Copy Material' enables you to take a copy of an existing material file. See Section 4.7 for details.
- 4  **Import Material File**
Selecting 'Import Material File' enables you to import a material file. See Section 4.8 for details.
- 5  **About Material Editor**
Displays product licence and trademark information about the Material Editor software. Can be launched at any time. See Section 4.9 for details.
- 6  **Help**
Launches the Material Editor quick start guide from the Renishaw website. Can be launched at any time. See Section 4.10 for details.
- 7  **Export Material File**
Selecting 'Export Material File' enables you to export a material file. See Section 4.11 for details.

4.5 Add New Material



From the 'Start' page, select 'Add New Material'. This will open a dialogue with the following two options.

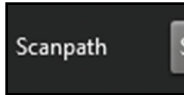
1



Material Name

Selecting 'Add New Material' opens a dialogue where you can give your new material file a name. Enter a suitable name as required.

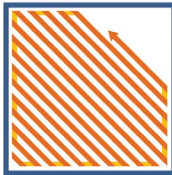
2



Scanpath

Selecting 'New Material' opens a dialogue where you can choose the scanpath type you want for your new material file. Open the dropdown and choose from 'Meander', 'Stripe' or 'Chessboard'.

2a



Meander

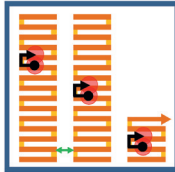
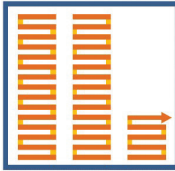
Straight line vector path from each side of the border.



As the laser moves, residual heat is left in its wake. In the bottom left-hand corner and the top right-hand corner, the beam passes the preceding tracks in quick succession (point A). This will have a higher temperature than the larger middle sections, where there is more time before passing the successive track (point B).

- Quick and efficient.
- Ideal for parts with a small X and Y cross section.
- Inconsistent heat distribution throughout each layer.

2b



Stripe

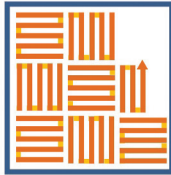
The area within the border is split into stripes and a meander technique is used within each stripe. Typically, stripes of 5 mm to 10 mm wide are used.

The layer is cut into stripes at a user-defined width. The stripe size is commonly 5 mm. This allows constant time between each successive track, maintaining a more consistent temperature throughout.

A stripe offset is used to overlap the stripes to prevent porosity. Use a negative offset for an overlap. A positive value will leave a space, as shown opposite. A stripe offset of -0.2 mm is typically used.

- Consistent heat distribution throughout the layer.
- Ideal for parts with a large X and Y cross section.
- Slower than 'Meander', as more jumps are required.

2c



Chessboard

Similar to 'Stripe', except the area is split into squares like a chessboard. Due to the complexity, which adds another variable, 'Chessboard' is rarely used.

Each layer is cut into square fields, like a chessboard. The field size is commonly 25 mm² (5 mm side length). Each field is rotated successively by 90°. Squares are scanned in rows. In each row, the squares with black arrows are scanned first. When all the squares with black arrows have been scanned, the squares with white arrows are scanned. A field offset is used to overlap the fields.

- Little improvement over stripes.
- Significantly slower to scan.
- This method is not commonly used.

Note: Each of the three scanpaths has three types of coloured line. A blue line represents a bounding box, an orange line represents a hatch path with the laser on and a yellow line represents a hatch path with the laser off.

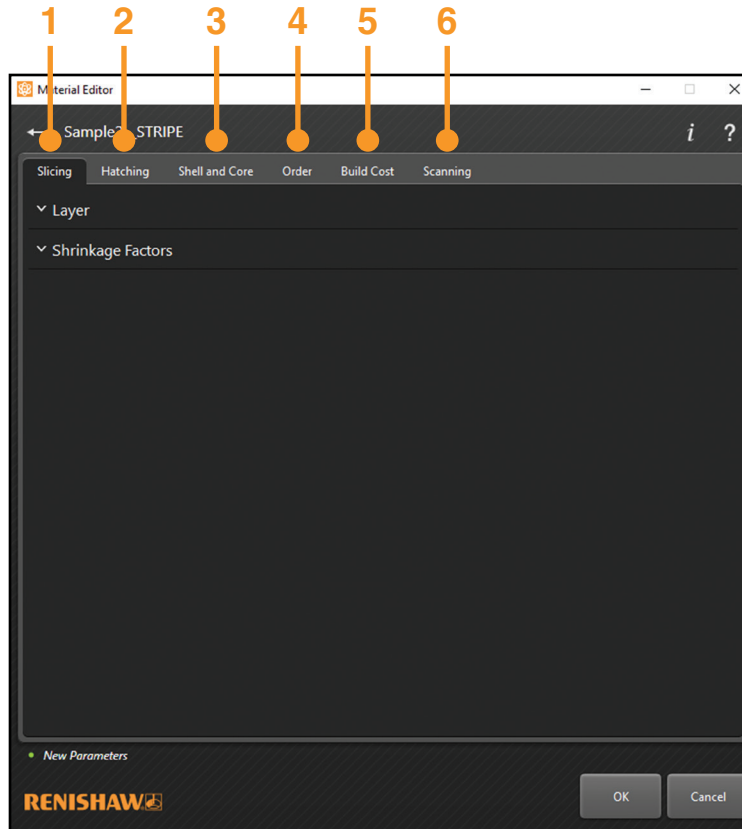
3



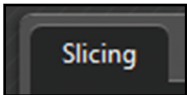
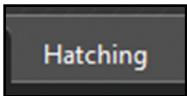
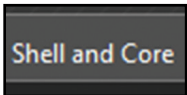
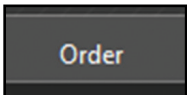
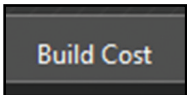
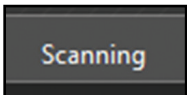
Confirm

When you have given your copied material a name and selected a suitable scanpath, select the green tick to confirm your selections.

4.6 Edit Material

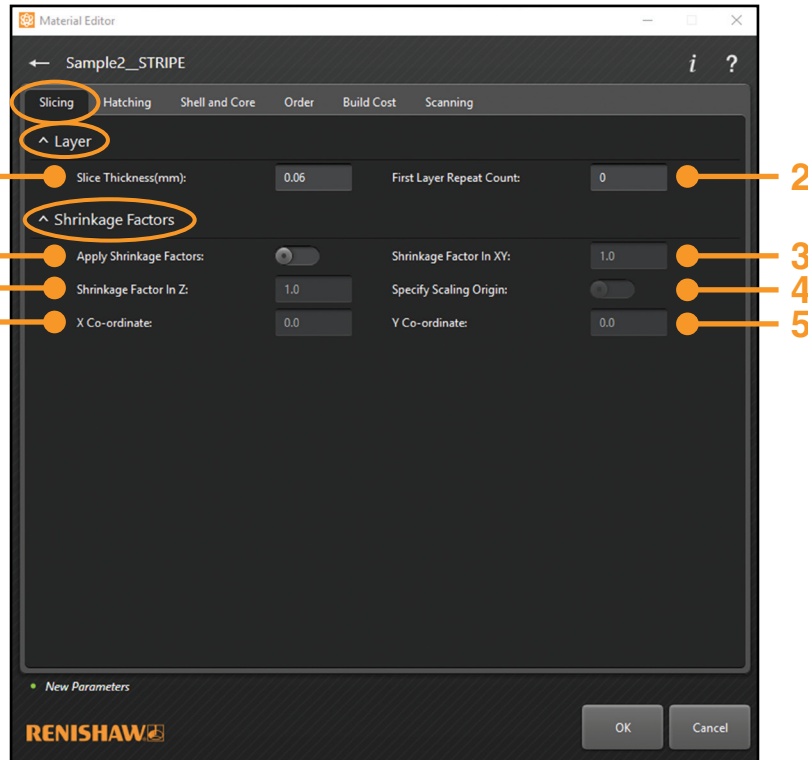


From the 'Start' page, select one of the listed materials. Select 'Edit Material' and the following six tabs will display.

- 1  **Slicing**
Selecting this enables you to edit the 'Slicing' parameters of material files. See Section 4.6.1 for details.
- 2  **Hatching**
Selecting this enables you to edit the 'Hatching' parameters of material files. See Section 4.6.2 for details.
- 3  **Shell and Core**
Selecting this enables you to edit the 'Shell and Core' parameters of material files. See Section 4.6.3 for details.
- 4  **Order**
Selecting this enables you to edit the 'Order' parameters of material files. See Section 4.6.4 for details.
- 5  **Build Cost**
Selecting this enables you to edit the 'Build Cost' parameters of material files. See Section 4.6.5 for details.
- 6  **Scanning**
Selecting this enables you to edit the 'Scanning' parameters of material files. See Section 4.6.6 for details.

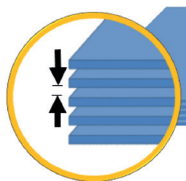
4.6.1 Slicing

From the 'Edit Material' page, select the 'Slicing' tab and the dropdowns 'Layer' and 'Shrinkage Factors' will display. Open the 'Layer' and 'Shrinkage Factors' dropdowns and the following will display.



4.6.1.1 Layer

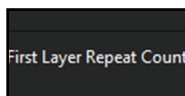
1



Slice Thickness (mm)

The slice thickness is the height of each slice in the Z direction. The field requires a decimal value in millimetres.

2

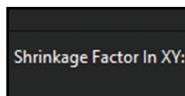


First Layer Repeat Count

This will re-scan the first layer multiple times, without re-dosing or Z axis movement.

4.6.1.2 Shrinkage Factors

3

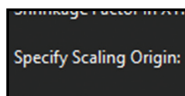


Shrinkage Factor In XY

The shrinkage factor to be applied in the X and Y directions of the bounding box. Shrinkage is only applied at the review stage and will also be applied to supports. Typically, shrinkage factors are within the order of < 1% to allow for thermal expansion.

If 'Specify Scaling Origin' is selected, the shrinkage will be applied to the whole build relative to the XY origin provided.

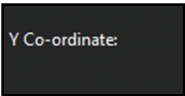
4



Specify Scaling Option

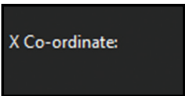
Shrinkage will be applied to the whole build relative to the XY origin provided. Specify the points about which shrinkage to take place.

5

A dark rectangular input field with the text "Y Co-ordinate:" in a light gray font.**Y Co-ordinate**

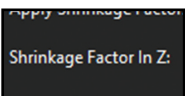
Shrinkage will be applied to the whole build relative to the XY origin provided. Specify the points about which shrinkage to take place.

6

A dark rectangular input field with the text "X Co-ordinate:" in a light gray font.**X Co-ordinate**

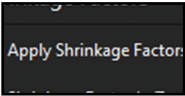
Shrinkage will be applied to the whole build relative to the XY origin provided. Specify the points about which shrinkage to take place.

7

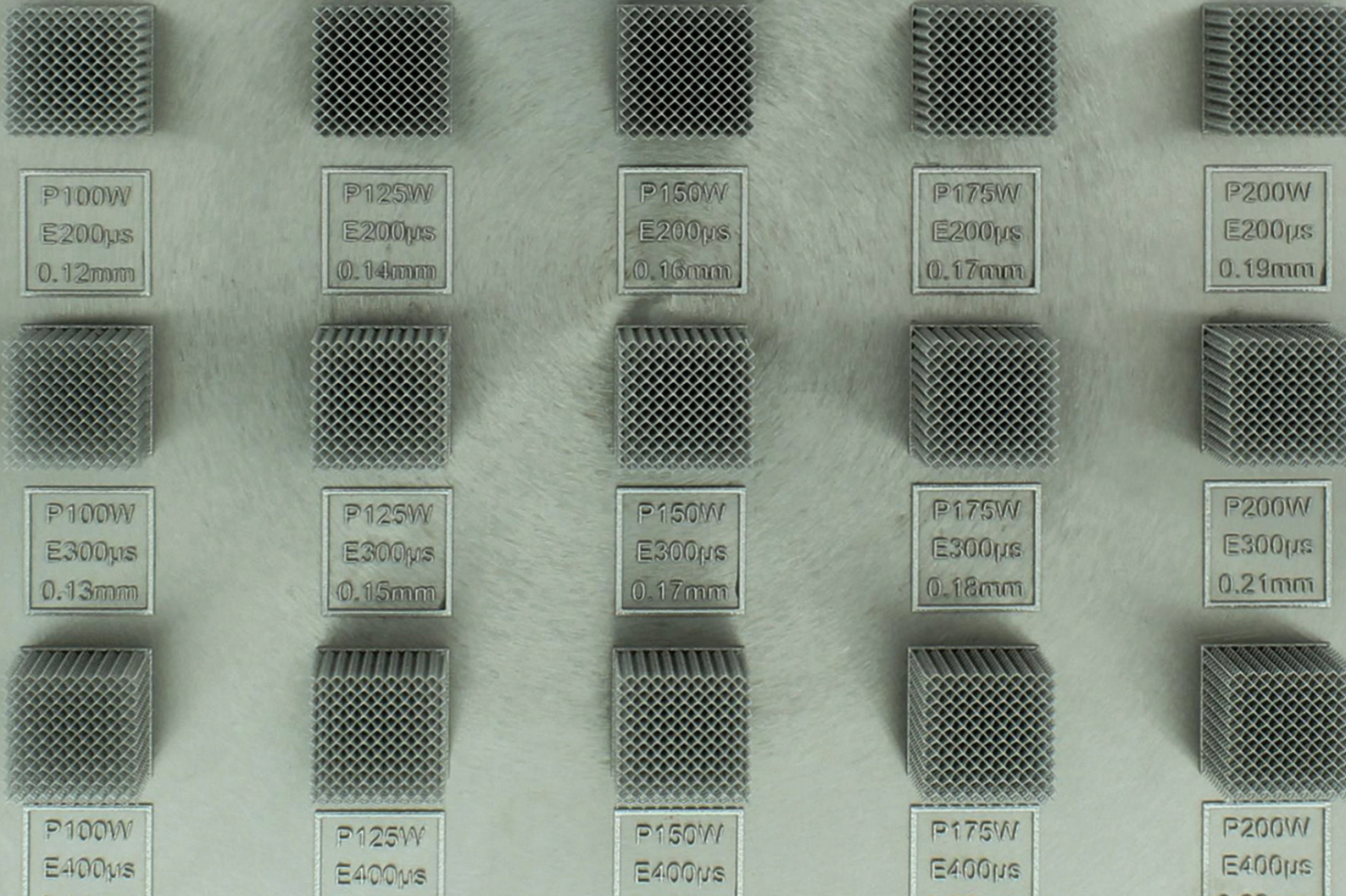
A dark rectangular input field with the text "Shrinkage Factor In Z:" in a light gray font.**Shrinkage Factor In Z**

The shrinkage factor to be applied in the Z direction.

8

A dark rectangular button with the text "Apply Shrinkage Factors:" in a light gray font.**Apply Shrinkage Factors**

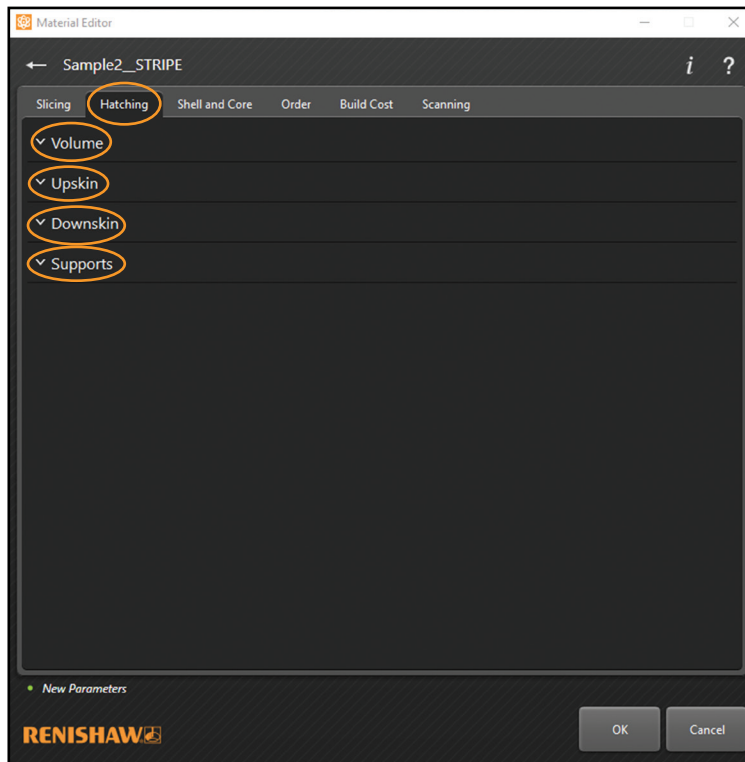
A toggle that enables or disables 'Apply Shrinkage Factors'. The shrinkage factor will apply a shrinkage rate to the CAD file in the direction of the axis that it is assigned to. This rate will be applied in the 'Review stage' in QuantAM.



Test builds of mesh, built in titanium, in varying thicknesses and using a variety of parameter settings.

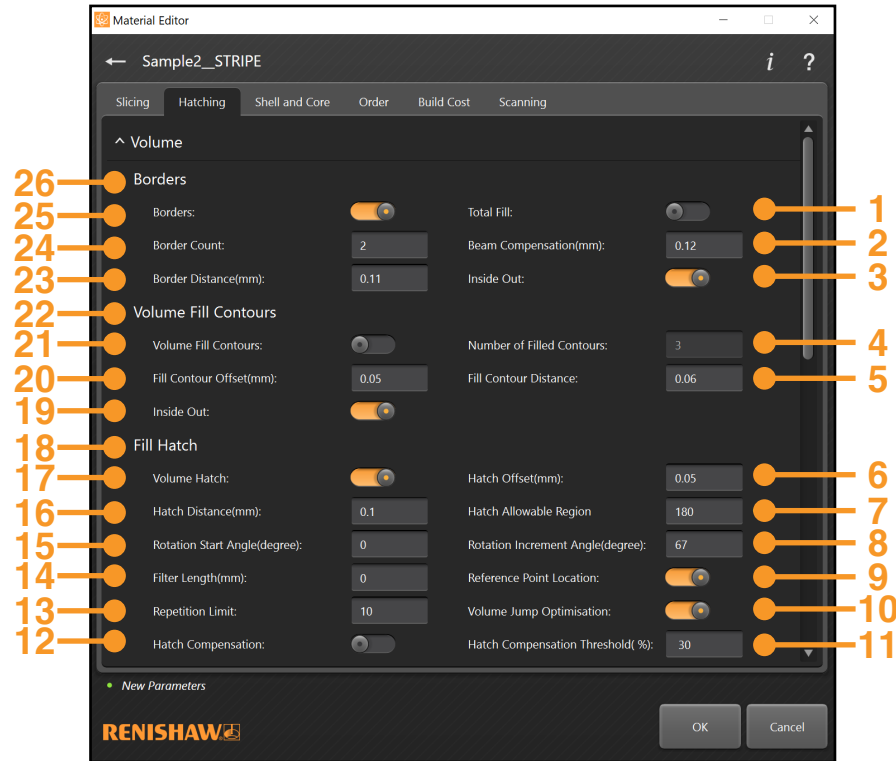
4.6.2 Hatching

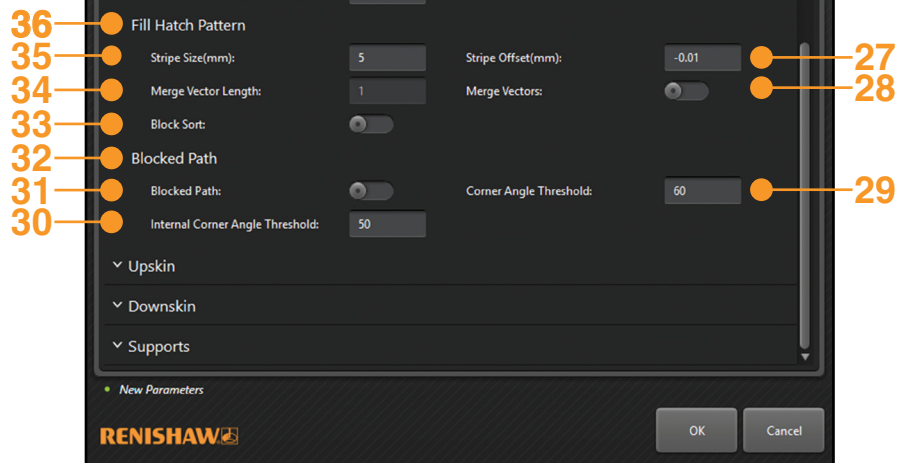
From the 'Edit Material' page, select the 'Hatching' tab. The 'Volume', 'Upskin', 'Downskin' and 'Supports' dropdowns will display.



4.6.2.1 Volume

Open the 'Volume' dropdown and the following will display.



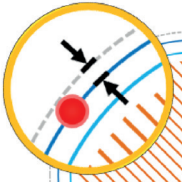


1

**Total Fill**

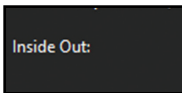
This enables or disables the number of borders option. Enabling this fills the layer with additional border lines only without any hatch fill.

2

**Beam compensation**

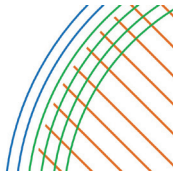
Beam compensation is used to offset the laser from the edge of the stl boundary. This is principally the same as cutter compensation used in traditional subtractive machining. Beam compensation is used to offset the beam from the real edge of the slice, shown with a dashed line. A beam compensation offset is typically the approximate radius of the melt pool.

3

**Inside Out**

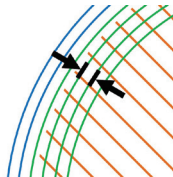
This enables the order of scan inside out (4, 3, 2 and 1). Deselection will result in the scan order of outside in (1, 2, 3 and 4).

4

**Number of filled contours**

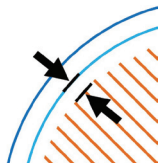
The number of fill contours to be generated. In the illustration, four are shown in green. Fill contours will be generated inwards and will overlap with the fill hatch.

5

**Fill contour distance**

The distance between each fill contour.

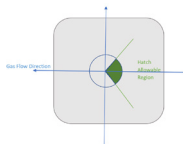
6



Hatch Offset

The distance between the hatch boundary and the innermost border or STL contour if 'Borders' are disabled.

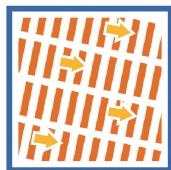
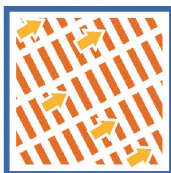
7



Hatch Allowable Region

The hatch allowable region represents a cone of allowed angles for the hatch normal, distributed symmetrically about the X-axis, opposite to the gas-flow direction. This causes hatching to move against the gas-flow to improve part quality.

8



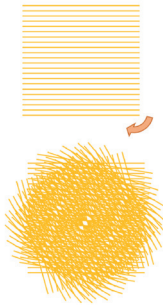
Gas flow



Rotation Increment Angle (degree)

It is recommended that a rotation is applied to the generation of fill hatch lines every layer. This eliminates the chance of scan lines repeating themselves directly on top of each other, creating poor material properties. Hatching will always work against the flow of gas. If a fill hatch rotation is generated outside the 'Hatch Allowable Region', it will be incremented by '360 - Hatch Allowable Region' to keep scanning against the flow of gas. A rotation increment angle of 67° is recommended as it will take 180 slices before another layer will be generated with the same scan direction.

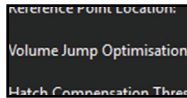
9



Reference Point Location

For each layer, QuantAM rotates the hatches around a reference point (X and Y). As the hatches are rotated, a natural centre point can be observed. This centre point might cause negative melting behaviour and affect the part quality in that region. Turning on reference point relocation will randomly align the centre of rotation for each layer and therefore remove the chance for a centre point to form.

10

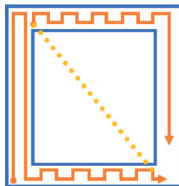


Volume Jump Optimisation

If 'Volume Jump Optimisation' is enabled, gas flow is not considered.

'Volume Jump Optimisation' tries to find the shortest path, minimising the total jump distance. Scanning still moves against the gas flow, but the order of each scanning block might not be optimal.

10a



Jump optimisation on

The laser path for the part area is broken up into scanning blocks to minimise jumps. If the part has a low part area to gap area ratio, such as a thin walled cylinder with a large bore, it can be much more efficient to not make jumps over the gap. Instead, melt each side individually in separate blocks with limited jumps to move between blocks. The disadvantage of having jump optimisation on is when there are many small gaps, as a nonhomogenous layer will be produced with the part area broken up into many blocks with visible cold weld lines.

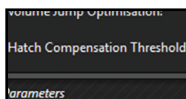
10b



Jump optimisation off

The laser path scans a whole part area in one block and jumps over holes. The laser is off during the jump and switched back on at the other side. However, if the part has a low part area to gap area ratio, such as a thin walled cylinder with a large bore, this can result in more time spent making the jump over the gap than melting the part area. This can dramatically increase scanning time. The advantage of having jump optimisation turned off is when there are many small gaps. It is therefore more efficient to jump over all the gaps than to break the area into many blocks, thus creating a very nonhomogenous scan layer.

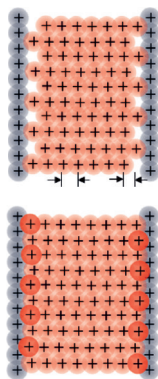
11



Hatch compensation threshold

The threshold specifies the percentage of the point distance which is allowed to create the extra end points.

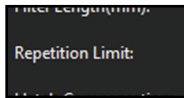
12



Hatch Compensation

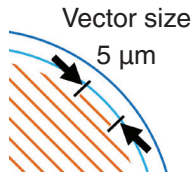
Vector lines are constructed by numbers of point exposures. When the length of the vector is not divisible by the point distance, missing points will occur. Hatch compensation can be used to create these extra points. With hatch compensation off, if the point distance is 60 μm , and the remainder at the end of a vector is 59 μm , a point will not be added. Turning on hatch compensation will produce an extra point in this space. If the threshold is set to 50%, an additional point will be added if the remainder is as small as 30 μm .

13

**Repetition Limit**

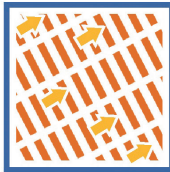
The shift factor will result in a shift of the entire pattern in the Y direction; the original pattern position will be reached after x iterations, with x being the value entered. The shift factor can be used in combination with the rotation increment angle in order to perform a reference point relocation.

14

**Filter Length (mm)**

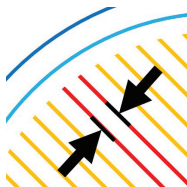
Vectors smaller than this threshold should not be generated. There is no need to generate vectors that are a fraction of the spot size.

15



Gas flow
←

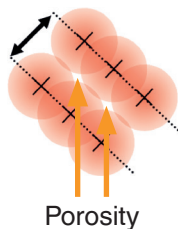
16



Hatch Distance (mm)

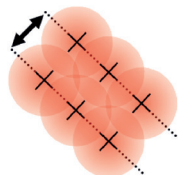
Hatch lines consist of point exposures. The distance between each line of point exposures is called the hatch distance.

16a



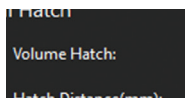
'Hatch Distance' aims to achieve an overlap of successive melt tracks. By making the hatch distance too large, porosity can occur between the hatch lines as shown in the illustration opposite.

16b



It is best practice to keep the hatch distance similar to, or the same as, the point distance by overlapping the spots by about one third as shown in the illustration opposite.

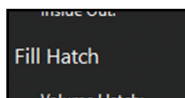
17



Volume Hatch

This makes up the volume of the inside of the part. This toggle enables and disables the 'Fill Hatch' functionality.

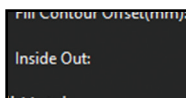
18



Fill Hatch

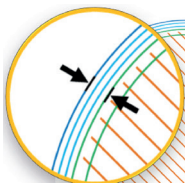
The 'Fill Hatch' group of functions. Fill hatching uses either the meander, stripes or chessboard pattern to make up the rest of the part. See Section 4.5.

19

**Inside Out**

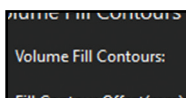
This enables the order of scan 'Inside Out' (4, 3, 2 & 1). Deselection will result in the scan order of 'Outside In' (1, 2, 3 & 4).

20

**Fill Contour Offset (mm)**

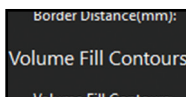
The distance the fill contour is placed from the outermost border. In this illustration the border is dark blue, the additional borders are pale blue and the fill contours are green.

21

**Volume Fill Contours**

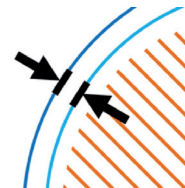
'Volume Fill Contours' are similar to borders. The purpose of volume fill contours are to reduce porosity and strengthen the bond between fill hatching and the borders. Toggle on the 'Volume Fill Contours' feature to enable fill contours.

22

**Volume Fill Contours**

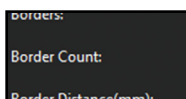
A set of controls for the 'Volume Fill Contours' functionality.

23

**Border Distance (mm)**

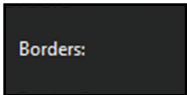
The distance between each border.

24

**Border Count**

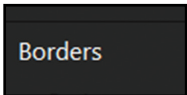
The number of Borders.

25

A dark rectangular button with the text "Borders:" in white.**Borders**

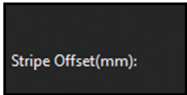
A toggle that enables and disables the 'Borders' functions.

26

A dark rectangular button with the text "Borders" in white.**Borders**

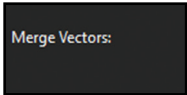
The 'Border' group of functions.

27

A dark rectangular button with the text "Stripe Offset(mm):" in white.**Stripe Offset (mm)**

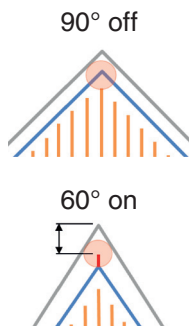
'Stripe Offset' is used to overlap stripes to prevent porosity. Use a negative offset for an overlap and a positive value to leave a space. A stripe offset of -0.2 mm is typically used. For a chessboard scan strategy, the equivalent parameter is 'Field Offset'.

28

A dark rectangular button with the text "Merge Vectors:" in white.**Merge Vectors**

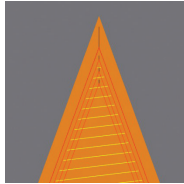
Enables and disables 'Merge Vectors'. One of the limitations of stripe is that lots of small scan vectors can be generated as the stripe pattern dissects the part geometry. To prevent this, merge vectors can be switched on to merge any scan vectors smaller than the distance specified in the 'Merge Vector Length' into the adjacent stripe.

29

**Corner Angle Threshold**

Corners under the specified angle threshold will generate a blocked path, for example at 80° .

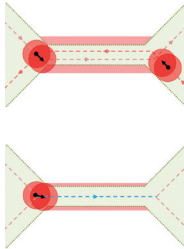
30



Internal Corner Angle Threshold

As well as the first border, additional borders can have blocked path vectors added. This will be activated where the angle is less than the internal corner angle threshold.

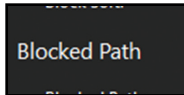
31



Blocked Path

This enables and disables the 'Blocked Path' functions. Blocked paths are used to reduce the number of scans in thin wall sections to a single scan. The illustration opposite shows an example of a 2D area, the path of which is shaded in green. The red areas show the exaggeration in thickness caused by the contour paths of the laser. In the second illustration the blocked path allows the two contour lines to be merged into one scan, resulting in a wall thickness which is less exaggerated.

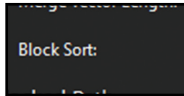
32



Blocked Path

The 'Blocked Path' group of functions.

33

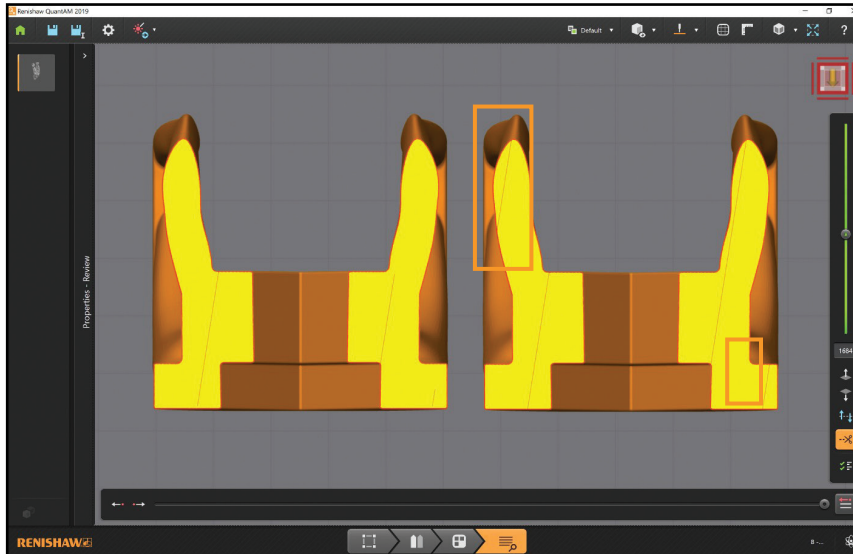


Block Sort

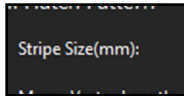
The 'Block Sort' function optimises stripe order in the same manner that 'Jump Optimisation' works for hatch scan order.

Merge Vector Length

This defines the distance of overlap for vector lines. One of the limitations of stripe is that lots of small scan vectors can be generated as the stripe pattern dissects the part geometry. To prevent this, merge vectors can be enabled. This will merge any scan vectors smaller than the distance specified in 'Merge Vector Length' into the adjacent stripe. In the illustration, in the left-hand image, the 'Merge Vector Length' parameter is set to 2 mm, which results in smaller regions merging into the adjacent stripes. In the right-hand image, stripes are fixed at a width of 10 mm irrespective of part geometry and vector length. For a chessboard scan strategy, the equivalent parameter is 'Minimal Field Size'.



35



Stripe Size (mm)

The width of the stripe section. The stripe size is commonly 5 mm. For a chessboard strategy, the equivalent parameter is 'Field Size'.

36

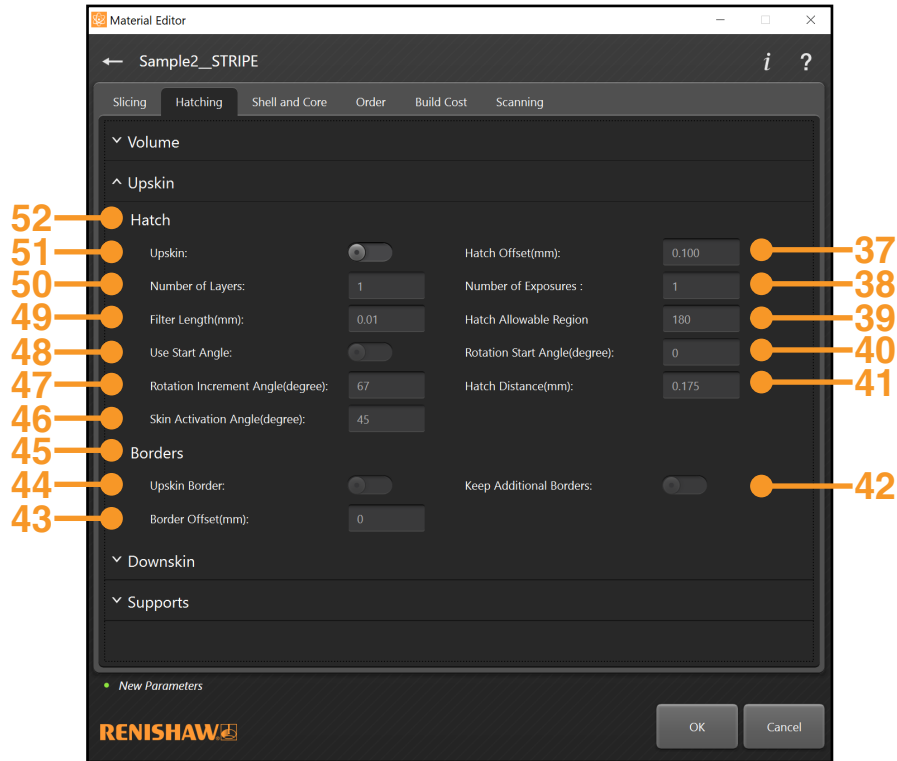


Fill Hatch Pattern

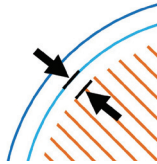
The 'Fill Hatch Pattern' group of functions.

4.6.2.2 Upskin

Open the 'Upskin' dropdown and the following will display.



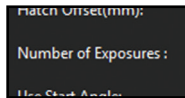
37



Hatch Offset (mm)

The distance between the hatch boundary and the innermost border or stl contour if 'Borders' are disabled.

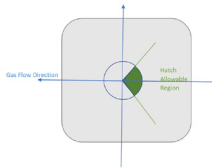
38



Number of Exposures

The number of times the skin layer is exposed is specified by the number of exposures.

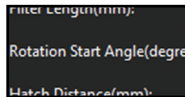
39



Hatch Allowable Region

The 'Hatch Allowable Region' represents a cone of allowed angles for the hatch normal, distributed symmetrically about the X-axis, opposite to the gas-flow direction. This causes hatching to move against the gas-flow, to improve part quality.

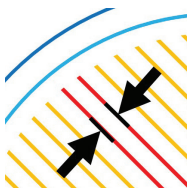
40



Rotation Start Angle (degree)

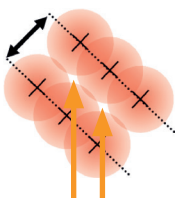
This is the angle that the layer will start at normal to the last volume layer.

41

**Hatch Distance (mm)**

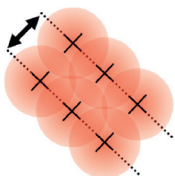
Hatch lines consist of point exposures. The distance between each line vector of point exposures is called the 'Hatch Distance'.

41a



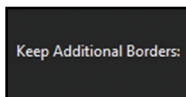
'Hatch Distance' aims to achieve an overlap of successive melt tracks. By making the hatch distance too large, porosity can occur between the hatch lines (see illustration opposite).

41b



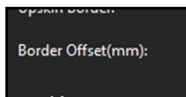
It is best practice to keep the hatch distance similar, or the same as, the point distance and overlapping the spots by about one third (see illustration opposite).

42

**Keep Additional Borders**

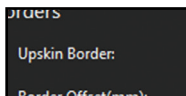
The function keeps additional borders. This will only activate if enable upskin borders is active.

43

**Border Offset (mm)**

This is the offset between the borders if the additional borders are enabled.

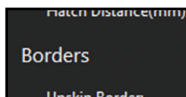
44



Upskin Border

This toggle enables border to be added to the upskin layers.

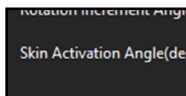
45



Borders

The 'Borders' group of functions. Borders are the scans that outline the 2D areas of each layer. They help improve the surface structure and surface finish. A border is the first and outermost layer. Additional borders are optional and are used to allow the fill hatch to be offset further from the edge of the part. This has been shown to improve surface finish.

46



Skin Activation Angle (degree)

Upskins will be applied to upward facing surfaces that are at an angle below the 'Skin Activation Angle'. Upskins are shown in purple in QuantAM.

47



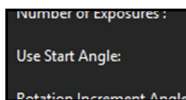
Gas flow



Rotation Increment Angle (degree)

This is the angle that the layer will rotate by if more than one layer is opted for. An angle of 67° is the optimum value as this gives the maximum rotation allowance between layers in the same orientation.

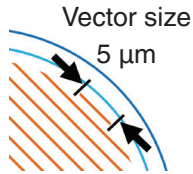
48



Use Start Angle

If 'Use Start Angle' is active, the first layer will be placed at the angle specified in 'Rotation Start Angle (degree)'.

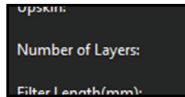
49



Filter Length (mm)

A vector smaller than this threshold will not be generated. There is no need to generate vectors that are a fraction of the spot size.

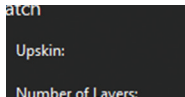
50



Number of Layers

The number of layers on which hatching can be applied.

51



Upskin

This enables and disables the 'Upskin' functions. Without 'Upskin' enabled, track patterns are visible on the top surface of each part. These patterns are usually caused by overlapping scanpaths and weld lines. These are common when using both stripe and chessboard strategies and when jump optimisation is enabled.

'Upskin' re-scans the top surface to remove the marks left by scan strategies. 'Upskin' generally uses the meander strategy with jump optimisation off, as this gives the most uniform finish. The number of layers or exposures for 'Upskin' is variable. The following show how a combination of the parameters available in Material Editor can be used to produce different results. Unlike normal layers, where the fill type is offset from the border, it is possible for 'Upskin' to have no border, so the hatch offset is instead measured from the STL boundary.

51a

**Option 1 – re-melted**

Normal exposures are used up to the final layer 'f'. On the final layer, this layer is re-exposed to upskin parameters without dosing, number of layers: one and number of exposures: one.

51b

**Option 2 – multiple re-melts**

Build up to the final layer 'f'. On the final layer, this is exposed x number of times. In the example the final layer is exposed three times, number of layers: one and number of exposures: two.

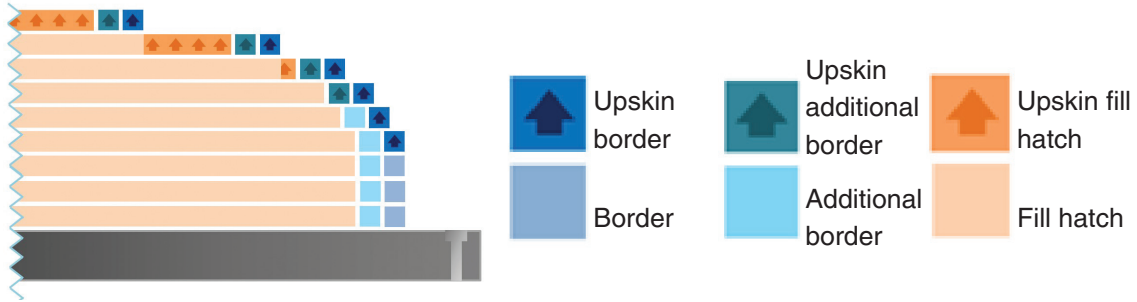
51c

**Option 3 – multiple re-melts of multiple layers**

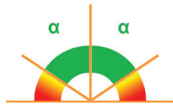
Multiple final 'f' layers are exposed x times. In this example the final three layers are all exposed three times each, number of layers: three and number of exposures: two.

51d

'Upskin' is applied to any section of a layer that is not covered vertically by another layer. The illustration below shows how upskin generation adapts to a change in build angle, when both upskin border and upskin additional borders are activated.



51e

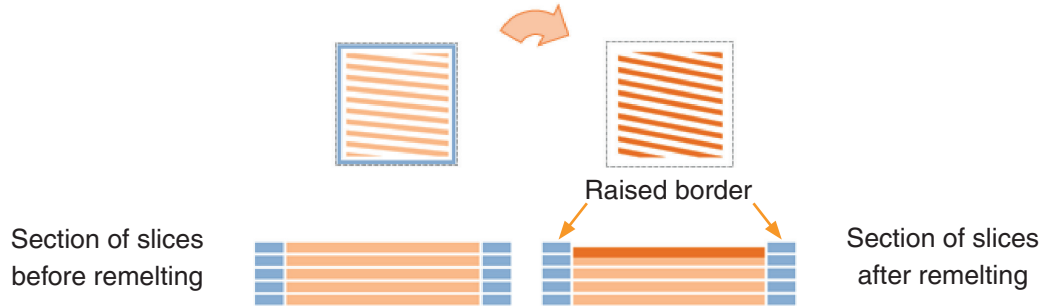
**Skin angle threshold**

The angle, relative to vertical, when skin is activated.

51f

Upskin raised borders issue

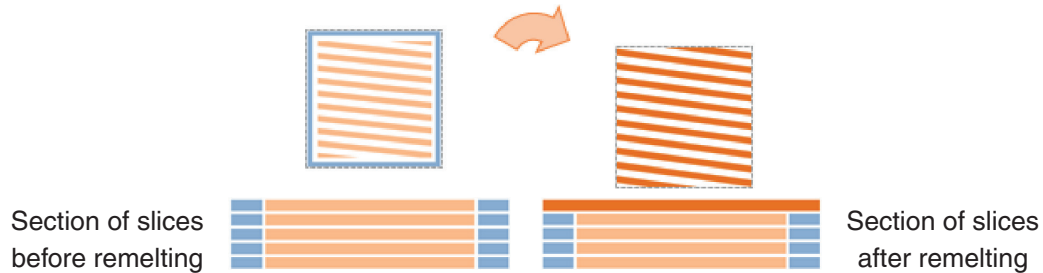
Re-melting the final layer with upskin hatching can sink the fill hatch and leave raised borders.



51g

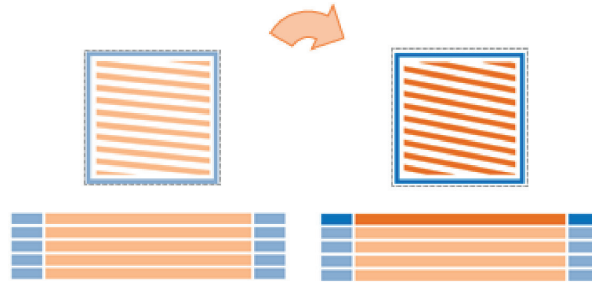
Option 1

'Upskin Border' toggled off (default). Remove the hatch offset.

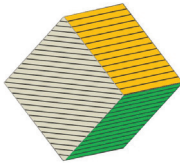


Option 2

Enable 'Upskin Border'.



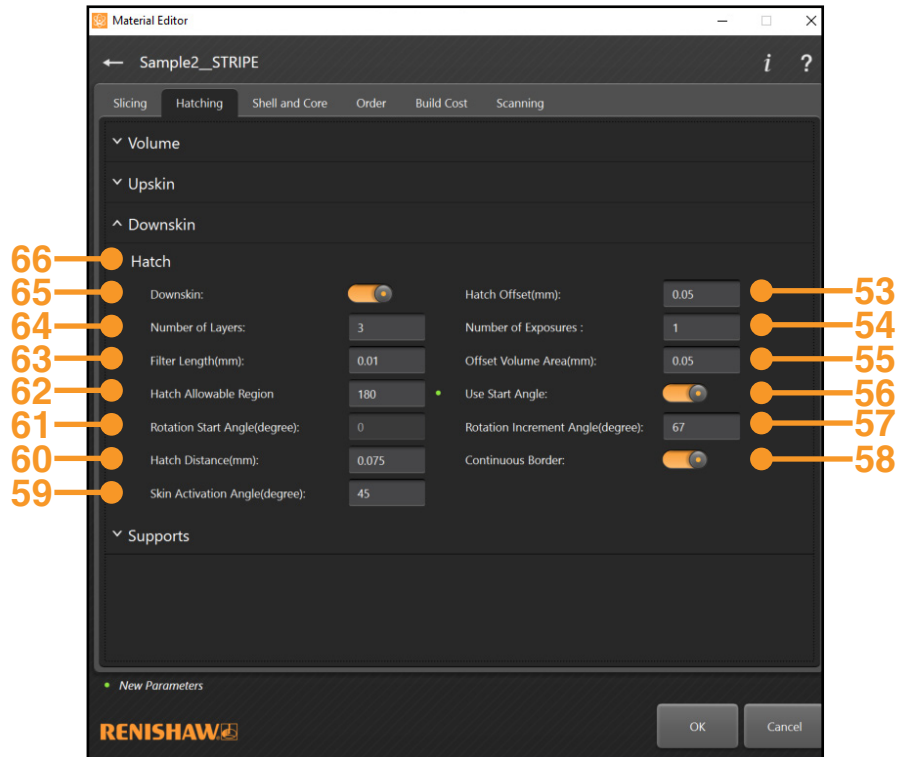
Note: When 'Upskin Boder' is toggled on, there is a further option to toggle 'Keep Additional Borders' on. 'Border Offset' can then be used to set the offset distance between the border and additional border.

**Hatch**

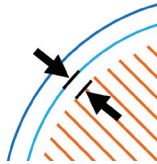
The 'Hatch' group of functions. Hatching is the process by which the 2D slices are converted into toolpath scan lines. Each layer can have its hatching split into three main regions: 'Volume', 'Upskin' and 'Downskin'. 'Upskin' is an area of layers that are not covered by another layer. 'Downskin' is a surface area facing down without any volume in the previous layer. 'Volume' is simply the inner core of the part which is not on any of the edges. Splitting each layer into these sections means that different parameters can be set for each region. In this illustration 'Volume' is grey, 'Upskin' is yellow and 'Downskin' is green.

4.6.2.3 Downskin

Open the 'Downskin' dropdown and the following will display.



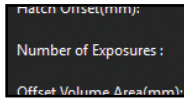
53



Hatch Offset (mm)

The distance between the hatch boundary and the innermost border or still contour if 'Borders' are disabled.

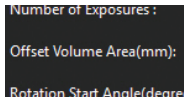
54



Number of Exposures

The number of times the 'Skin' layer is exposed is specified by the number of exposures.

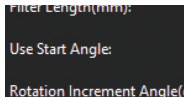
55



Offset Volume Area (mm)

The offset of the volume area from the 'Downskin' layer.

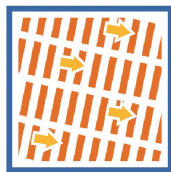
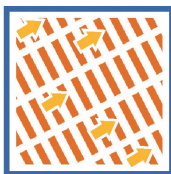
56



Use Start Angle

If the 'Use Start Angle' toggle is enabled, the first layer will be placed at the angle specified in 'Rotation Start Angle (degree)'.

57

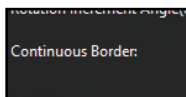


Gas flow
←

Rotation Increment Angle (degree)

It is recommended that a rotation is applied to the generation of fill hatch lines every layer. This eliminates the chance of scan lines repeating themselves directly on top of each other, creating poor material properties. Hatching will always work against the flow of gas. If a fill hatch rotation is generated outside the 'Hatch Allowable Region', it will be incremented by '360 - Hatch Allowable Region' to keep scanning against the flow of gas. An angle of 67° is recommended as it will take 180 slices before another layer will be generated with the same scan direction.

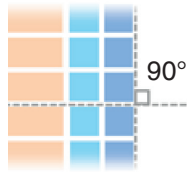
58



Continuous Border

Scans volumes and downskin borders as a continuous border.

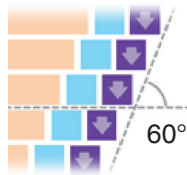
58a



At 90°

The hatch is always on top of the previous hatch, therefore no downskin is produced and normal parameters are used.

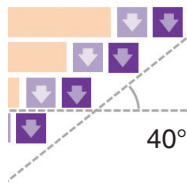
58b



At 60°

As the angle decreases, some of the border region begins to protrude. This activates border downskin. Notice only the downskin border activates, as this is the only area overhanging.

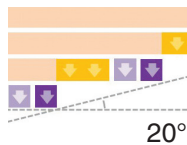
58c



At 40°

As the angle decreases, more of the hatching protrudes and more downskin is activated.

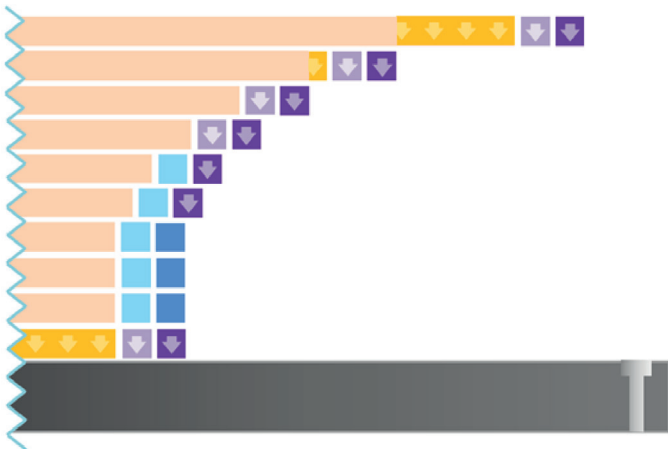
58d



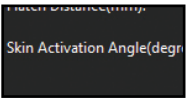
At 20°

As the angle approaches horizontal, the fill hatch will start to protrude. The fill hatch for that layer will be split into standard parameters and downskin parameters.

Note: Depending upon geometry, one or more hatch regions may switch to downskin.



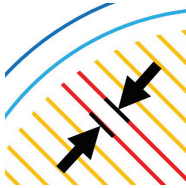
59



Skin Activation Angle (degree)

Downskins will be applied to downward facing surfaces that are at an angle below the skin activation angle, Downskins are shown in blue in QuantAM.

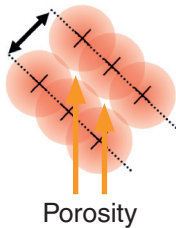
60



Hatch Distance (mm)

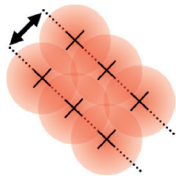
Hatch lines consist of point exposures. The distance between each line of point exposures is called the hatch distance.

60a



'Hatch Distance' aims to achieve an overlap of successive melt tracks. By making the hatch distance too large, porosity can occur between the hatch lines as shown in the illustration opposite.

60b



It is best practice to keep the hatch distance similar or the same as the point distance, overlapping the spots by about one third as shown in the illustration opposite.

61



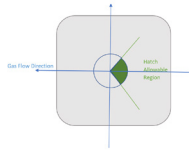
Gas flow



Rotation Start Angle (degree)

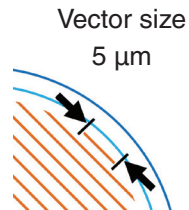
This is the angle that the layer will start at, normal to the last volume layer.

62

**Hatch Allowable Region**

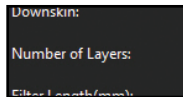
The 'Hatch Allowable Region' represents a cone of allowed angles for the hatch normal, distributed symmetrically about the X-axis, opposite to the gas-flow direction. This causes hatching to move against the gas-flow, to improve part quality.

63

**Filter Length (mm)**

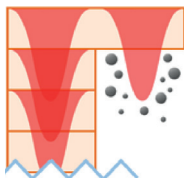
Vectors smaller than this threshold should not be generated. There is no need to generate vectors that are a fraction of the spot size.

64

**Number of Layers**

The number of layers on which hatching can be applied.

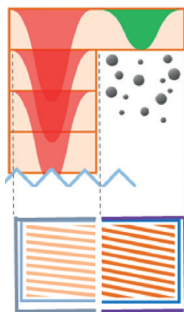
65



Downskin

This toggle enables and disables 'Downskin'. Normal energy allows penetration into the layer below and welds layers together. On downward faces, this energy is not conducted away as quickly as powder insulates more than solid material. This results in the melt pool penetrating further into the powder creating a poor surface finish.

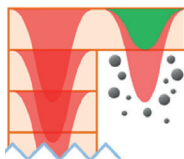
65a



The objective

To reduce the energy or increase speed at overhangs to reduce penetration and obtain better surface finish. Meanwhile all borders and fill contour distances should remain uniform.

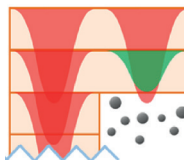
65b



Option 1 – Remelt

Allow a normal exposure, and then a separate downskin exposure. The damage is done with the first exposure. A downskin exposure will not rectify the issue.

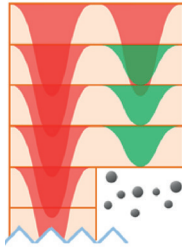
65c



Option 2 – Replace for one layer

Replaces the normal exposure with a downskin melt. This offers some improvement. However layer two penetrates layer one and some of the powder below, which again creates a poor downskin finish.

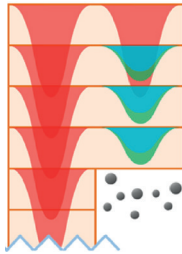
65d



Option 3 – Replace “n” layer

Replaces “n” normal melt layer with downskin melts. Good, three layers above the powder are replaced with downskin melts and a good surface finish is preserved. The melt pool from layer n+1 will not reach the powder.

65e



Option 4 – Replace and re-melt

When downskin is enabled, it can be scanned multiple times. Best, not only has the normal melt layer been distanced from the powder bed, but also a more refined way of scanning downskin is being used to improve surface finish.

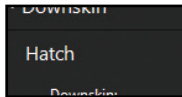


Downskin
repeat



Downskin

66

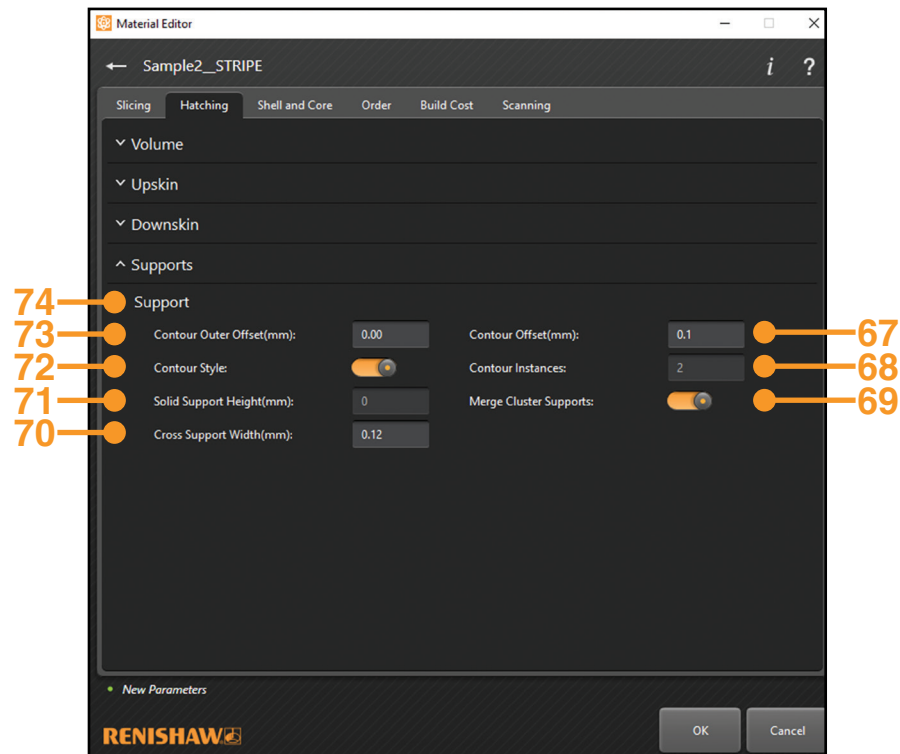


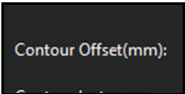
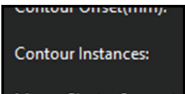
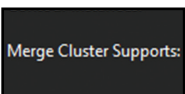
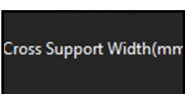
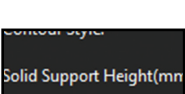
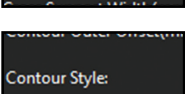
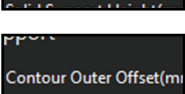
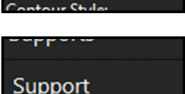
Hatch

The ‘Fill Hatch Pattern’ group of functions.

4.6.2.4 Supports

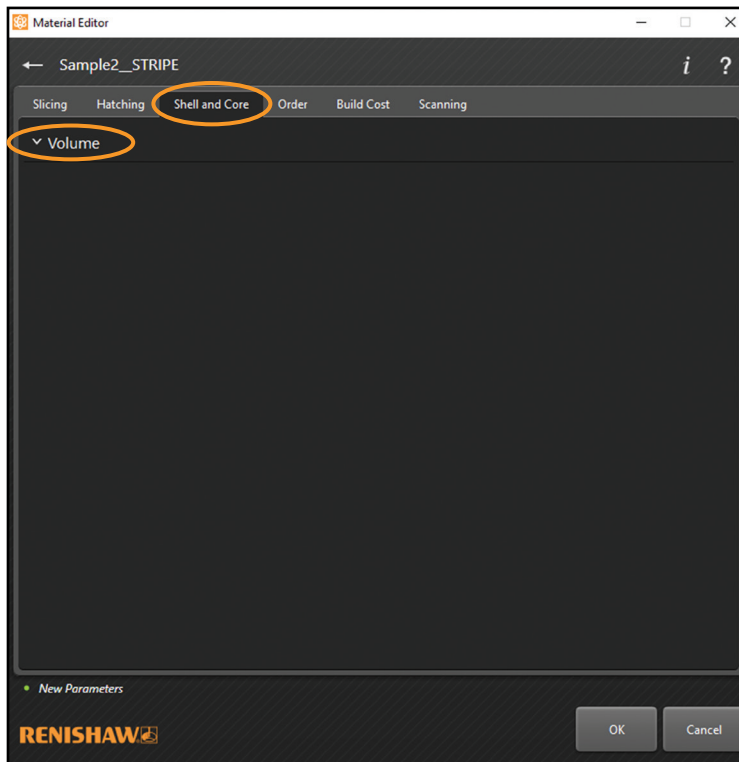
Open the 'Supports' dropdown and the following will display.

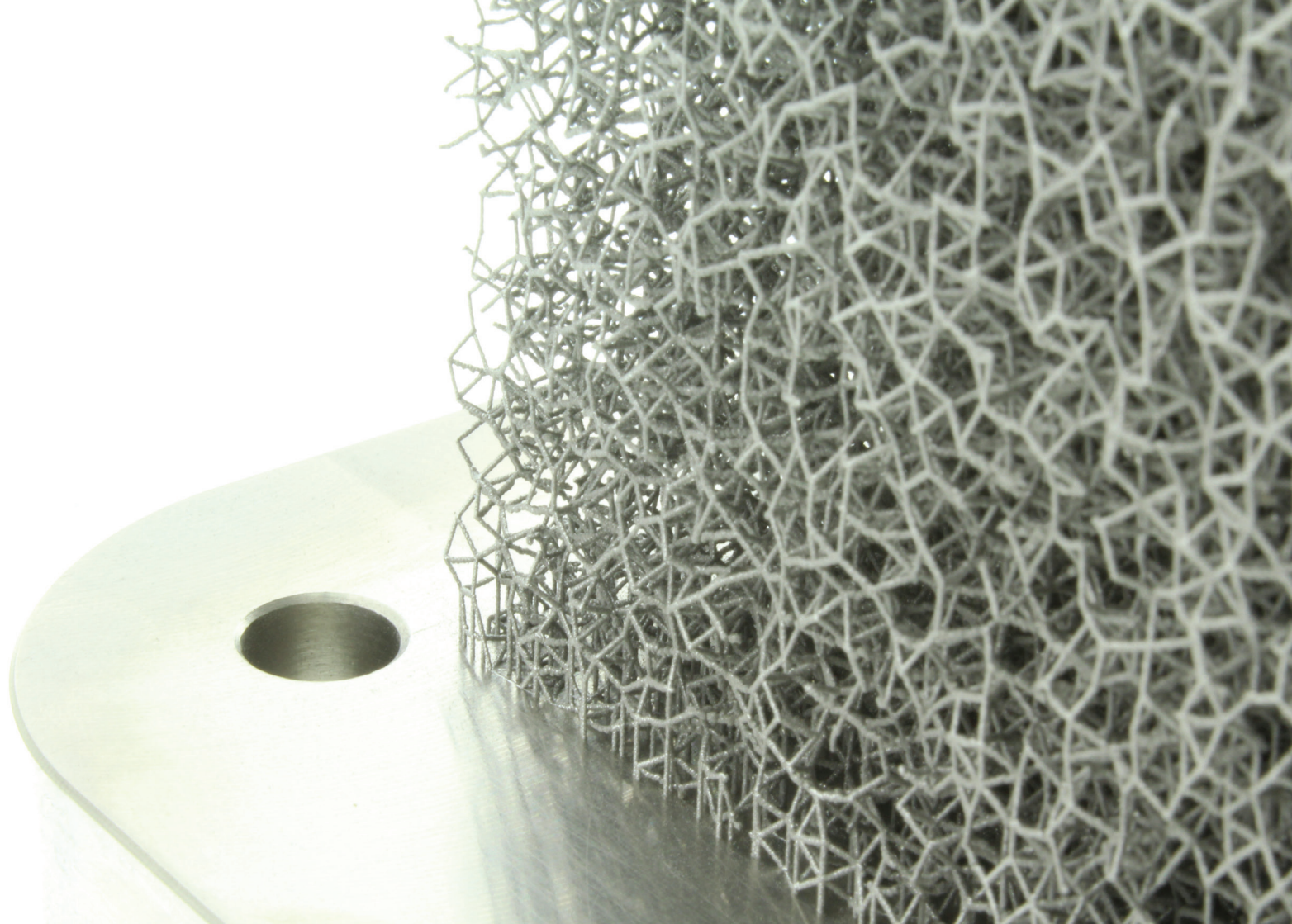


- 67  **Contour Offset (mm)**
The spacing between contours.
- 68  **Contour Instances**
Defines the number of contours to be generated.
- 69  **Merge Cluster Supports**
A toggle to enable or disable 'Merges Slices of Cluster Support'.
- 70  **Cross Support Width (mm)**
Nominal width of cross supports used for calculating support volume. In practice, the vector width will depend on the laser parameters used.
- 71  **Solid Support Height (mm)**
The height up to which supports are filled using total fill.
- 72  **Contour Style**
Fill the slice with concentric contour scans.
- 73  **Contour Outer Offset (mm)**
The offset between model contour and outermost scanned contour.
- 74  **Support**
The 'Support' group of functions.

4.6.3 Shell and Core

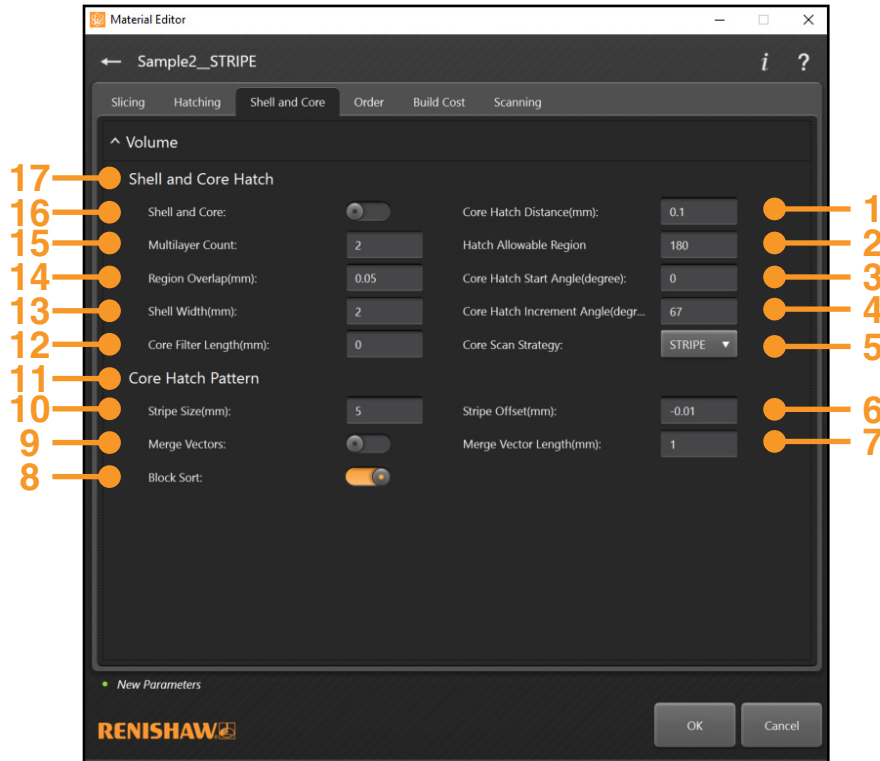
From the 'Edit Material' page, select the 'Shell and Core' tab and the 'Volume' dropdown will display.



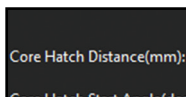


4.6.3.1 Shell and Core Hatch

Open the 'Shell and Core Hatch' dropdown and the following will display.



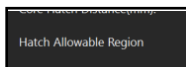
1



Core Hatch Distance (mm)

Hatch lines consist of point exposures. The distance between each line vector of point exposures is called the core hatch distance.

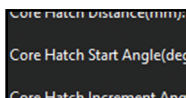
2



Hatch Allowable Region

The allowed angles for the hatch normal, distributed symmetrically about the X-axis, opposite to the gas-flow direction.

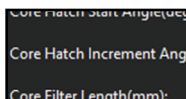
3



Core Hatch Start Angle (degree)

This is the angle that the 'Core Hatch' will start at.

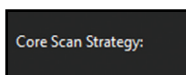
4



Core Hatch Increment Angle (degree)

The angle that each layer will rotate by.

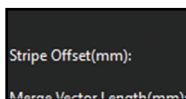
5



Core Scan Strategy

A dropdown enables you to choose from 'Stripe', 'Meander' or 'Chessboard'.

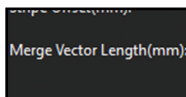
6



Stripe Offset (mm)

'Stripe Offset' is used to overlap the stripes to prevent porosity.

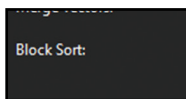
7



Merge Vector Length (mm)

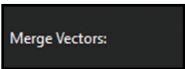
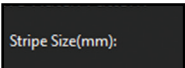
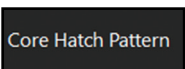
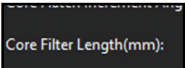
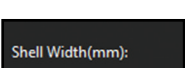
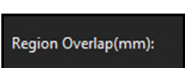
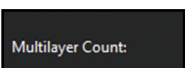
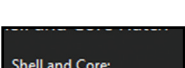
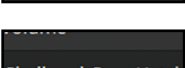
This will merge any scan vectors smaller than the distance specified in the 'Merge Vector Length' into the adjacent stripe.

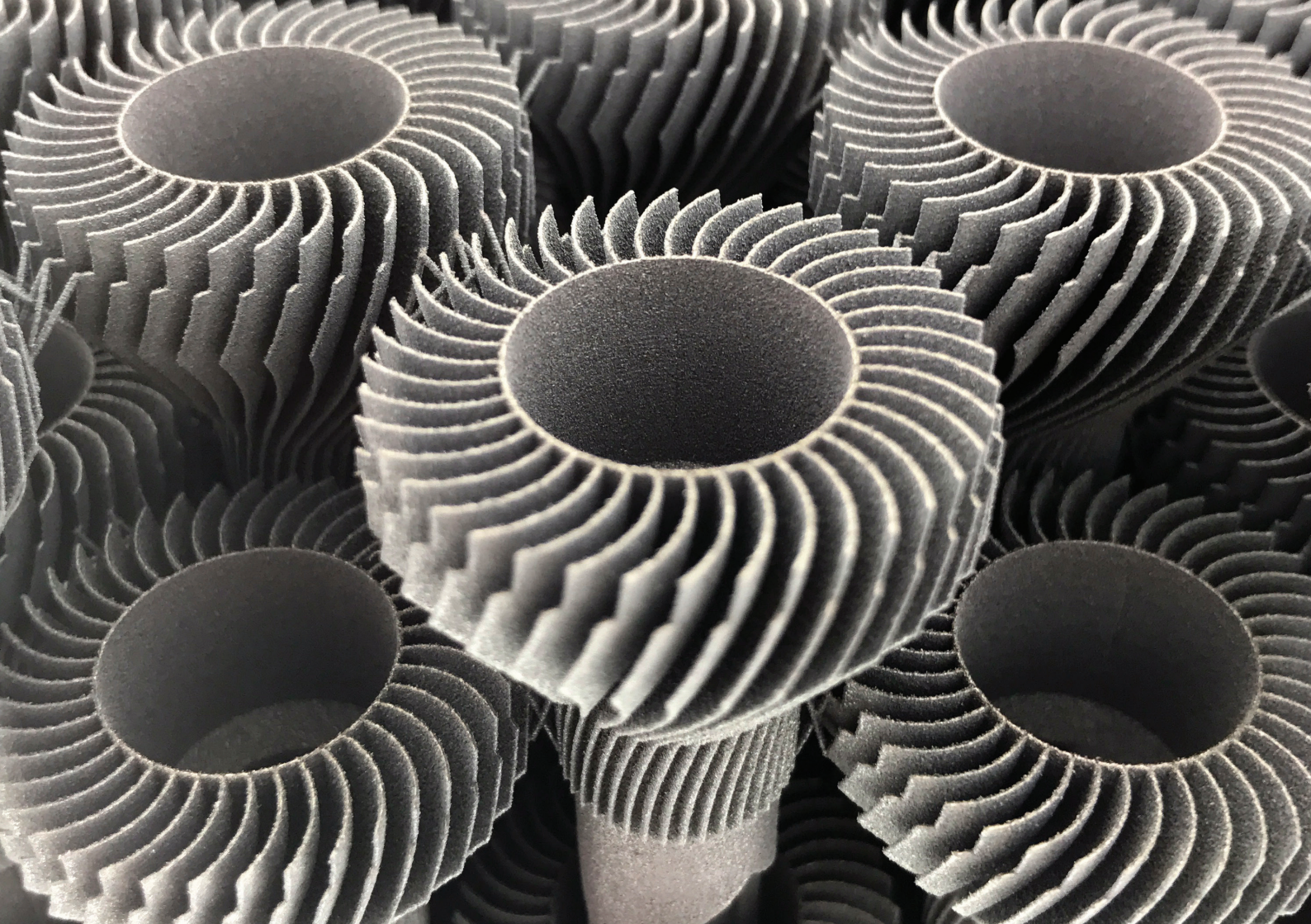
8



Block Sort

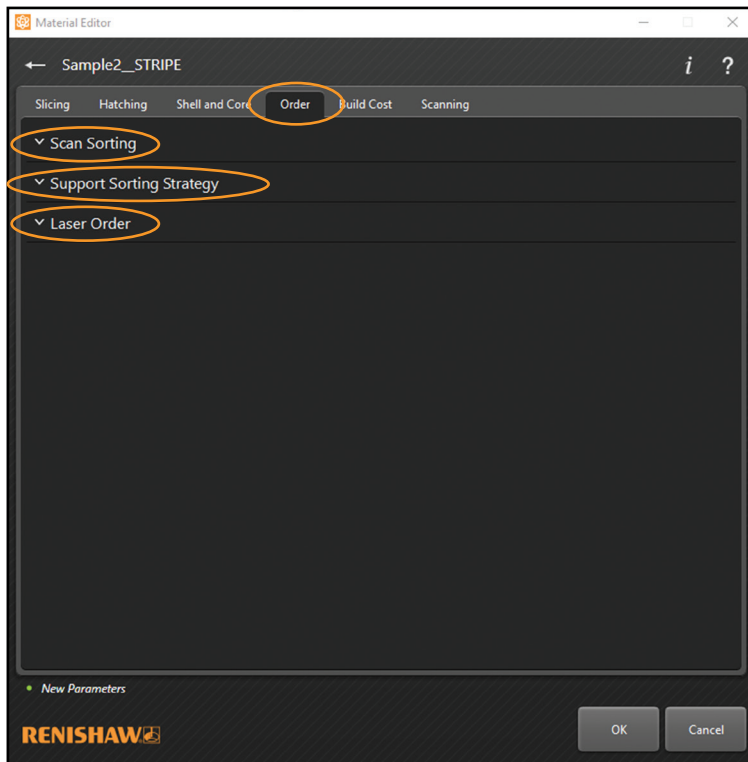
A toggle that enables or disables sorting across blocks.

- | | | |
|----|---|--|
| 9 |  | Merge Vectors
A toggle that enables or disables merging of vectors. |
| 10 |  | Stripe Size (mm)
The length of the stripe section. |
| 11 |  | Core Hatch Pattern
The 'Core Hatch Pattern' group of functions. |
| 12 |  | Core Filter Length (mm)
The 'Core Filter Length'. See the 'Filter Length' explanation in Section 4.6.2.1. |
| 13 |  | Shell Width (mm)
The width of the shell. |
| 14 |  | Region Overlap (mm)
The overlap of the 'Core' and 'Shell' regions. |
| 15 |  | Multilayer Count
Multiplied by the layer thickness of the material file to dictate the layer thickness of the core |
| 16 |  | Shell and Core
A toggle that enables or disables the 'Shell and Core' functions. |
| 17 |  | Shell and Core Hatch
The 'Shell and Core Hatch' group of functions. |



4.6.4 Order

From the 'Edit Material' page, select the 'Order' tab and the 'Scan Sorting', 'Support Sorting Strategy' and 'Laser Order' dropdowns will display.

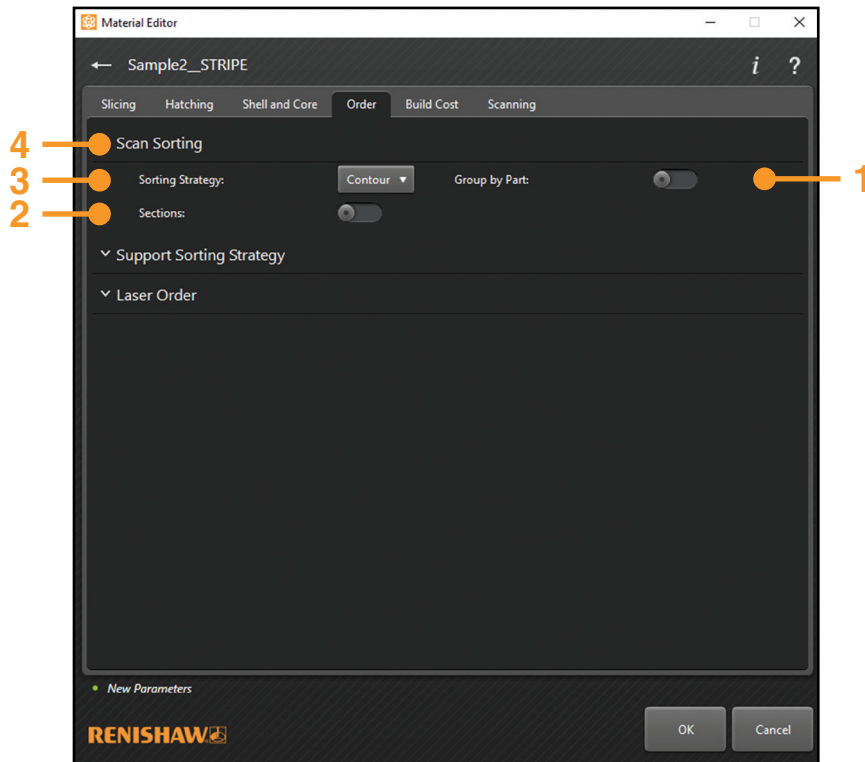




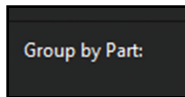
Central Titanium Support (CTS) from the ARION4 project run by the University of Liverpool Velocipede Team (ULV Team), in which Karen Darke and Ken Talbot set world speed records for hand cyclists at the World Human Powered Speed Challenge at Battle Mountain, Nevada, USA.

4.6.4.1 Scan Sorting

Open the 'Scan Sorting' dropdown and the following will display.



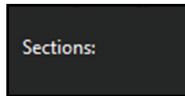
1



Group by Part

A toggle to enable or disable 'Group by Part'. Enabling this will apply the scan sorting strategy to each part separately from left to right.

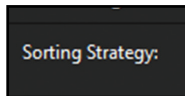
2



Sections

A toggle to enable or disable sorting based on sections. Enabling 'Sections' will sort the stripe scan order for the entire build, from left to right, based on the right most exposure point of each stripe. This can result in scans jumping islands, seemingly midway through, since the right most stripe exposure point from an island below is further left than the current.

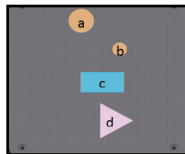
3



Sorting Strategy

This parameter has two options available. You can choose from 'Build' or 'Contour'.

3a



Build

The 'Build' platform will be treated as a whole and all vector types will be scanned in the order: a hatch, c hatch, d hatch, b hatch, a border, c border, d border and b border.

3b

Contour

Prioritises left most islands. All vector types will be scanned in the order: a hatch, a border, c hatch, c border, d hatch, d border, b hatch and b border.

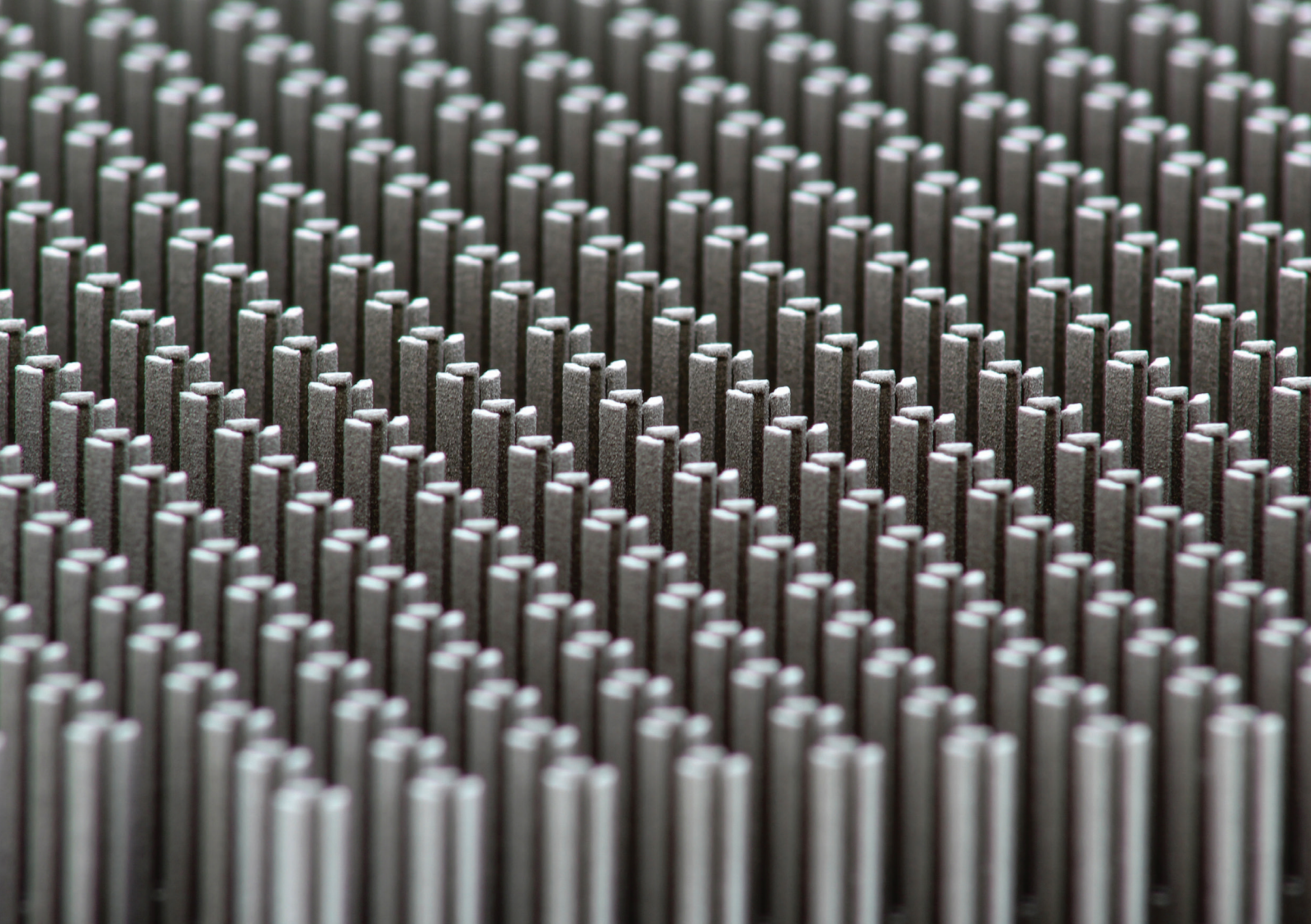
3c

Part

Each part is scanned, based in order from left to right: a hatch, b hatch, a border, b border, c hatch, c border, d hatch and d border.

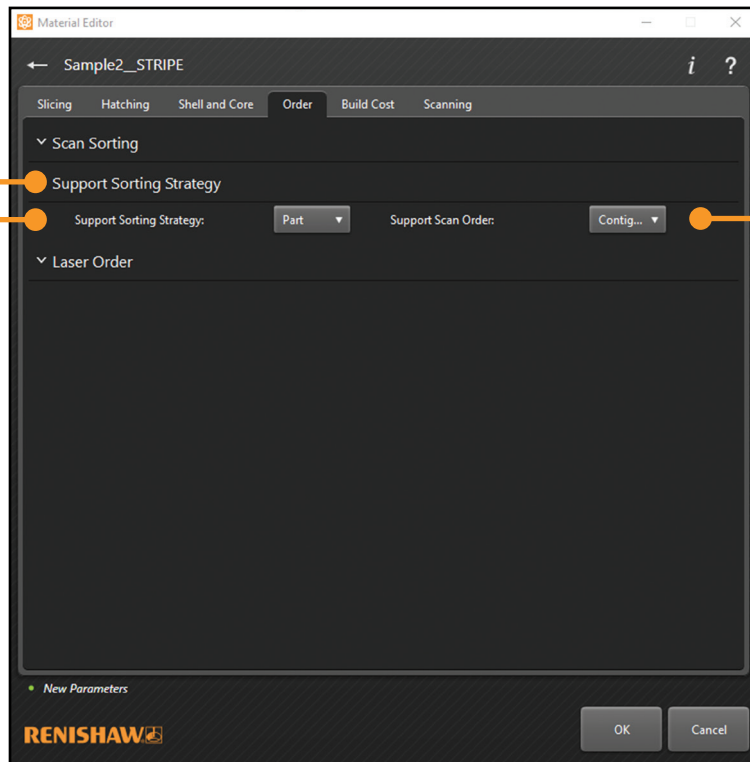
Scan Sorting

The 'Scan Sorting' group of functions. Scan sorting enables the user to control the order in which the laser(s) scan across the build plate. The laser will naturally scan from top left to bottom right. However, the three strategies described below further control the order in which this is carried out.

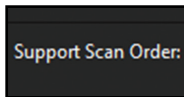


4.6.4.2 Support Sorting Strategy

Open the 'Support Sorting Strategy' dropdown and the following will display.



1



Support Scan Order

There is a dropdown with three choices. Choose from 'Contiguous', 'First' or 'Last'.

1a

Contiguous

Scans sequentially with all other part profiles

1b

First

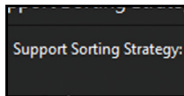
Supports are scanned first, followed by the part

1c

Last

Supports are scanned after the part

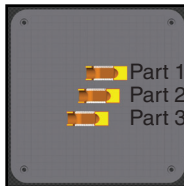
2



Support Sorting Strategy

Sets sorting strategies for support scans. There is a dropdown with two choices, choose from 'Part' or 'Build'.

2a



Part

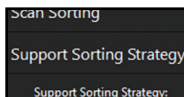
Fully scans the supports in part order, in the illustration this would be 3, 2 and 1.

2b

Build

Scans the supports sequentially from left to right regardless of part number.

3

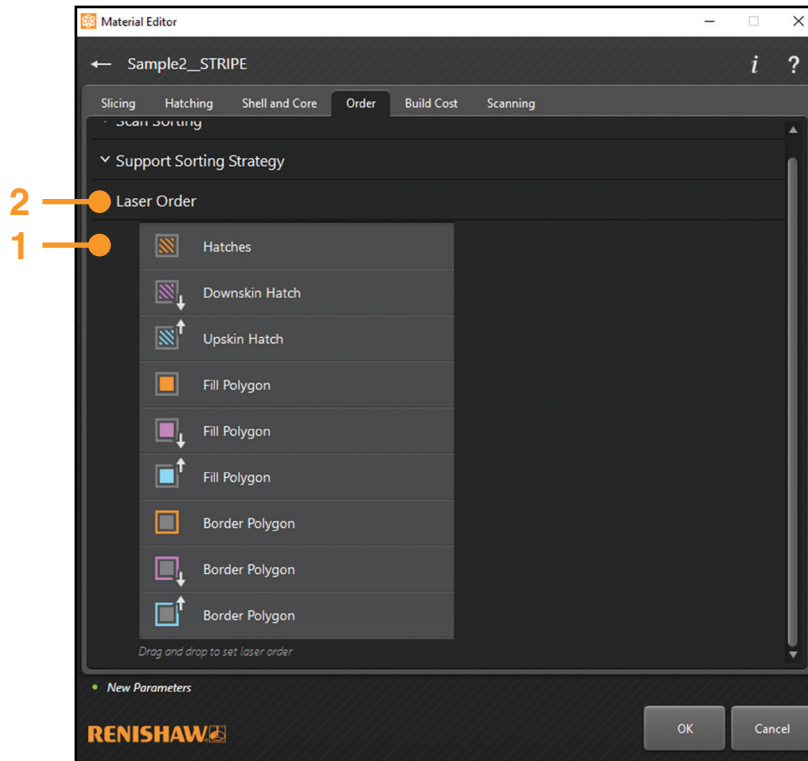


Support Sorting Strategy

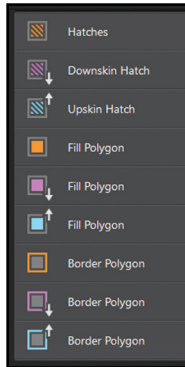
Support sorting strategies are based either by 'Part' or by 'Build'. 'Support Scan' order can be set as 'Contiguous', 'First' or 'Last'. You can select any combination of support sorting strategies and support scan order to suit your requirements.

4.6.4.3 Laser Order

Open the 'Laser Order' dropdown and the following will display.



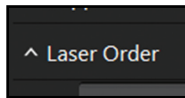
1



Laser Order Dropdown

Drag and drop to set the laser order. Select the vector types that require sorting by dragging and dropping them into the desired order in the list.

2



Laser Order

A dropdown enables you to choose the laser order for your build. This setting gives the ability to change the scan order of each type of hatch. This is changed by selecting from the list as shown in the illustration.

4.6.5 Build Cost

From the 'Edit Material' page, select the 'Build Cost' tab and the following parameters will display.

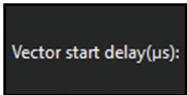
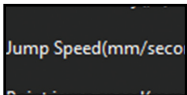
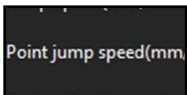
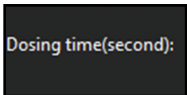
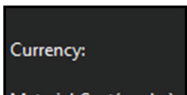
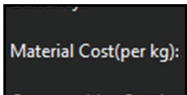
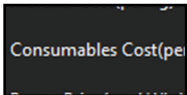
User interface

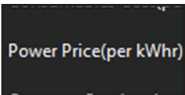
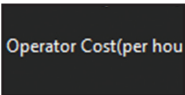
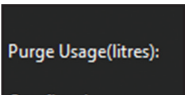
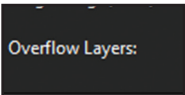
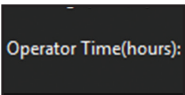
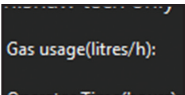
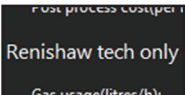
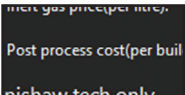
74

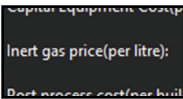
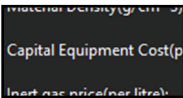
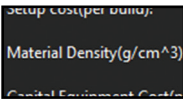
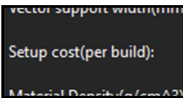
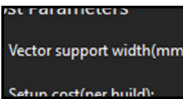
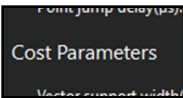
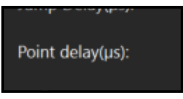
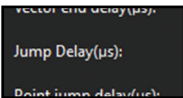
The screenshot shows the 'Material Editor' window for 'Sample2_STRIPE'. The 'Build Cost' tab is selected, displaying a grid of parameters. Numbered callouts (1-26) point to specific fields:

- 26: Build parameters (header)
- 25: Dynamic jump delay distance(mm): 0.0
- 24: Vector end delay(μs): 400
- 23: Jump Delay(μs): 500
- 22: Point jump delay(μs): 0
- 21: Cost Parameters (header)
- 20: Vector support width(mm): 0.15
- 19: Setup cost(per build): 100.0
- 18: Material Density(g/cm³): 7.8
- 17: Capital Equipment Cost(per hour): 18.70
- 16: Inert gas price(per litre): 0.004
- 15: Post process cost(per build): 160.00
- 14: Renishaw tech only (header)
- 13: Gas usage(litres/h): 10.0
- 12: Operator Time(hours): 0.250
- 1: Vector start delay(μs): 0
- 2: Jump Speed(mm/second): 5000.00
- 3: Point jump speed(mm/second): 5000.00
- 4: Dosing time(second): 8.0
- 5: Currency: GBP
- 6: Material Cost(per kg): 80.0
- 7: Consumables Cost(per build): 54.60
- 8: Power Price(per kWh): 0.120
- 9: Operator Cost(per hour): 30.00
- 10: Purge Usage(litres): 1000.00
- 11: Overflow Layers: 2000

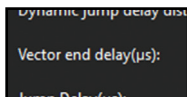
At the bottom, there is a 'New Parameters' link, the 'RENISHAW' logo, and 'OK' and 'Cancel' buttons.

- 1  **Vector start delay (μ s)**
The delay accrued before the start of the vector hatch. These values are required in microseconds.
- 2  **Jump Speed (mm/second)**
The speed at which the mirrors move when performing the next jump operation. This is usually from the end of one contour to the start of the next. This value is required in millimetres per second.
- 3  **Point jump speed (mm/second)**
This is the speed at which the mirrors move between point exposures. This value is required in millimetres per second.
- 4  **Dosing time (second)**
This is the average time it takes for the wiper to move from the forward position to the back of the chamber, dose the required amount of powder, and move to the front of the chamber again.
- 5  **Currency**
Select the currency you want to see your build estimate in.
- 6  **Material Cost (per kg)**
The cost of metal powder per kilogram.
- 7  **Consumables Cost (per build)**
The cost of any other consumables used during a build.

- | | | |
|----|---|--|
| 8 |  | Power price (per kWh)
The cost of running an entire machine. |
| 9 |  | Operator cost (per hour)
The cost in labour for operation of the machine while it is running. |
| 10 |  | Purge Usage (litres)
Cost of purge to prepare inert atmosphere.
This can only be configured by a Renishaw Service Engineer. |
| 11 |  | Overflow Layers
The number of overflow layers.
This can only be configured by a Renishaw Service Engineer. |
| 12 |  | Operator Time (hours)
The working time of operators.
This can only be configured by a Renishaw Service Engineer. |
| 13 |  | Gas Usage (litres/h)
The amount of inert gas used.
This can only be configured by a Renishaw Service Engineer. |
| 14 |  | Renishaw tech only
This section displays values that can only be configured by a Renishaw Service Engineer. |
| 15 |  | Post process cost (per hour)
The cost of post processing the build. |

- 16  **Inert gas price (per litre)**
The price of inert gas.
- 17  **Capital Equipment Cost (per hour)**
The cost for the use of any equipment.
- 18  **Material Density (per g/cm³)**
The density of the laser melted powder.
- 19  **Setup cost (per build)**
The cost of setting up a machine ready for a build.
- 20  **Vector support width (mm)**
Vector supports have no volume therefore a real width for these supports must be input.
- 21  **Cost Parameters**
This section gives the ability to provide cost estimations for each component of a build.
- 22  **Point delay (µs)**
This is the delay accrued when the laser jumps between point exposures. This value is required in microseconds.
- 23  **Jump Delay (µs)**
This is the delay accrued when performing a jump. This is usually from the end of one contour to the start of the next. This value is required in microseconds.

24

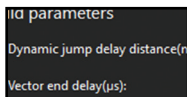


Dynamic jump delay (ms)
Vector end delay(μs):
Vector end delay(μs):

Vector end delay (μs)

The delay accrued at the end of a vector path. These values are required in microseconds.

25

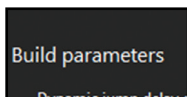


Build parameters
Dynamic jump delay distance(mm)
Vector end delay(μs):

Dynamic jump delay distance (mm)

This is the distance travelled when performing a jump. This is usually from the end of one contour to the start of the next. This value is required in millimetres.

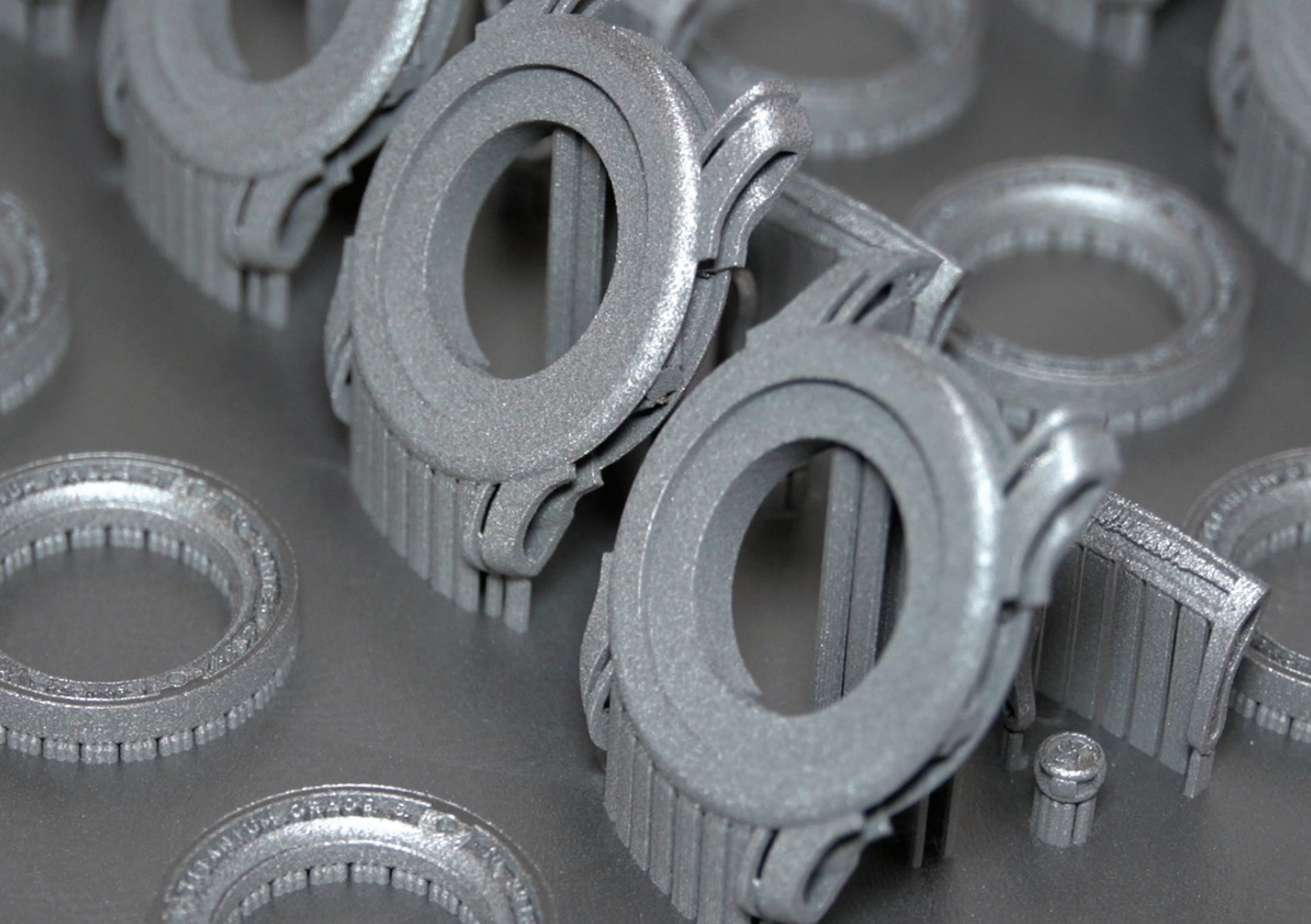
26



Build parameters
Dynamic jump delay(μs):

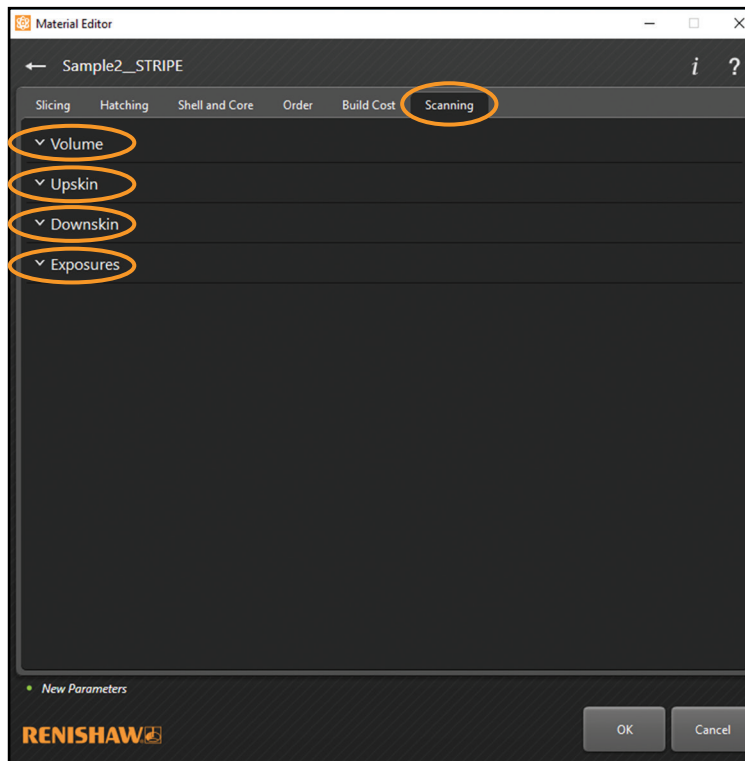
Build parameters

The 'Build parameters' group of functions.



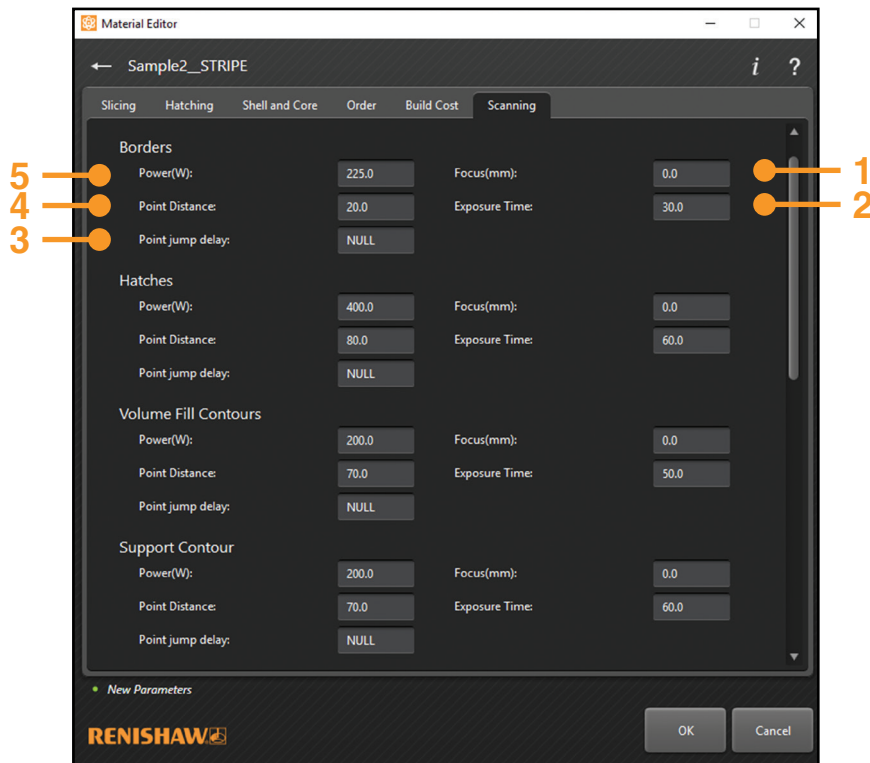
4.6.6 Scanning

From the 'Edit Material' page, select the 'Scanning' tab and the 'Volume', 'Upskin', 'Downskin' and 'Supports' dropdowns will display. This tab is used to set the laser parameters applied to each of the build styles described in the 'Hatching' tab, as well as parameters for single point exposures.



4.6.6.1 Volume

Open the 'Volume' dropdown and the following will display.



- 1

Focus(mm):

Focus (mm)

Changing the focal lens position will result in an increased beam diameter. For AM systems, the minimum value is -30 mm and the maximum value is +30 mm. For RenAM systems, the minimum value is -10 mm and the maximum value is +10 mm. Values can be incremented in units of 1 mm.
- 2

Exposure Time:

Exposure Time

Exposure time controls how long the laser remains on for each point exposure. The minimum value is 20 μ s and the maximum value is 10 s. Values can be incremented in units of 10 μ s.
- 3

Point jump delay:

Point jump delay (μ s)

The delay applied between each point exposure. RenAM systems can be set to 0 to run in continuous mode. Values can be incremented in units of 10 μ s.
- 4

Point Distance:

Point Distance (μ m)

The distance the laser moves between each point exposure. The minimum value is 5 μ m and maximum value is 1 mm. Values can be incremented in units of 1 μ m.
- 5

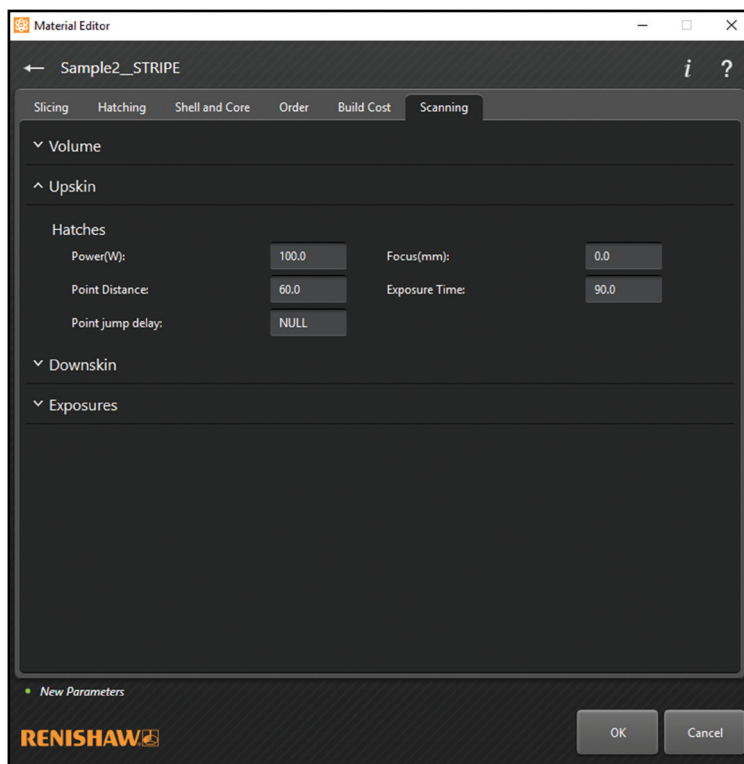
Power(W):

Power (W)

Relates to the power of the laser. The minimum is 5% of the total laser power. The maximum is laser dependent. Values can be incremented in units of 0.1 W.

4.6.6.2 Upskin

Open the 'Upskin' dropdown and the following will display. The laser parameters are the same as for the 'Volume' build styles.



4.6.6.3 Downskin

Open the 'Downskin' dropdown and the following will display. The laser parameters are the same as for the 'Volume' build styles.

Material Editor

← Sample2_STRIPE i ?

Slicing Hatching Shell and Core Order Build Cost Scanning

Borders

Power(W):	200.0	Focus(mm):	0.0
Point Distance:	40.0	Exposure Time:	40.0
Point jump delay:	NULL		

Hatches

Power(W):	200.0	Focus(mm):	0.0
Point Distance:	80.0	Exposure Time:	50.0
Point jump delay:	NULL		

Volume Fill Contours

Power(W):	100.0	Focus(mm):	0.0
Point Distance:	60.0	Exposure Time:	90.0
Point jump delay:	NULL		

Additional Borders

Power(W):	200.0	Focus(mm):	0.0
Point Distance:	80.0	Exposure Time:	50.0
Point jump delay:	NULL		

* New Parameters

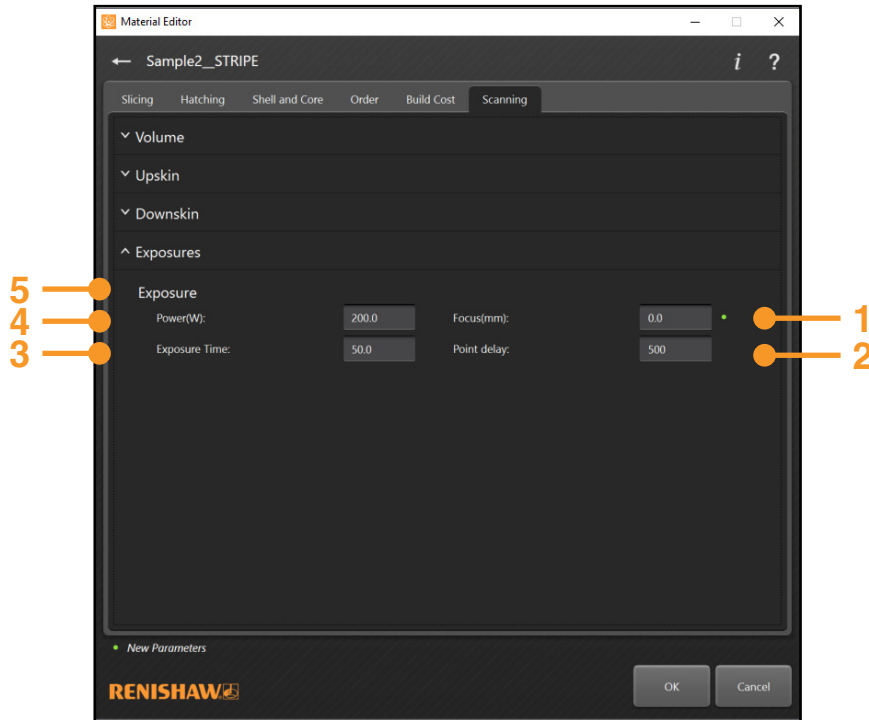
RENISHAW

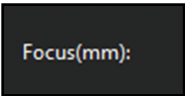
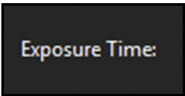
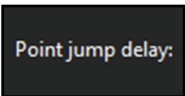
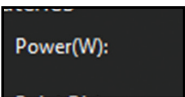
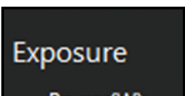
OK Cancel

4.6.6.4 Exposures

Open the 'Exposures' dropdown and the following will display.

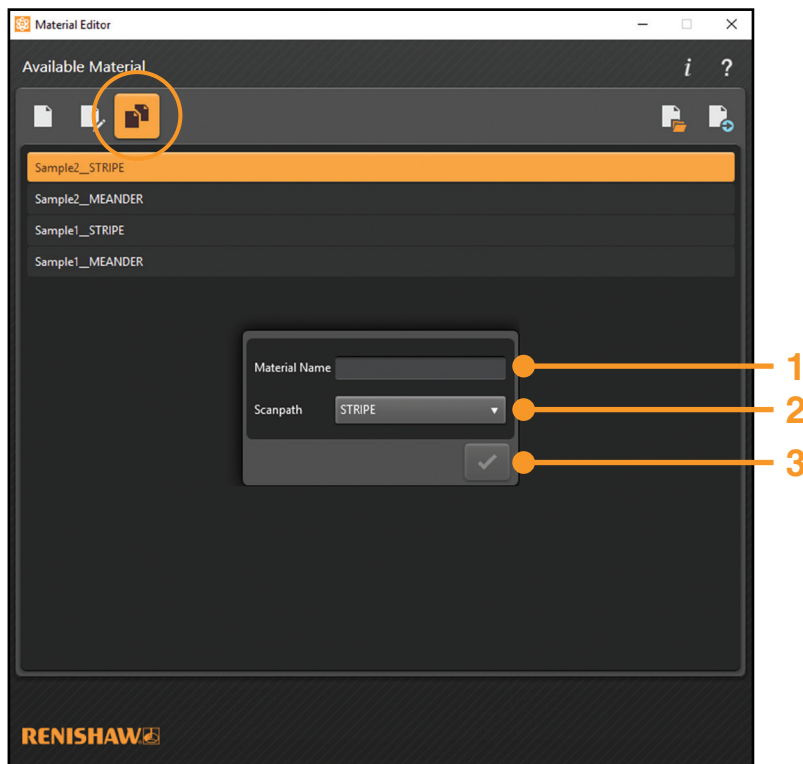
Note: The 'Exposures' build style does not have a 'Point Distance' parameter because each point's location is defined explicitly in this style.



- 1  **Focus (mm)**
Changing the focal lens position will result in an increased beam diameter. For AM systems, the minimum value is -30 mm and the maximum value is +30 mm. For RenAM systems, the minimum value is -10 mm and the maximum value is +10 mm. Values can be incremented in units of 1 mm.
- 2  **Exposure Time**
Exposure time controls how long the laser remains on for each point exposure. The minimum value 20 μ s and the maximum value is 10 s. Values can be incremented in units of 10 μ s.
- 3  **Point jump delay (μ s)**
The delay applied between each point exposure. RenAM systems can be set to 0 to run in continuous mode. Values can be incremented in units of 10 μ s.
- 4  **Power (W)**
This relates to the power of the laser. The minimum is 5% of the total laser power. The maximum is laser dependent. Values can be incremented in units of 0.1 W.
- 5  **Exposure**
Displays a summary of the parameters for 'Exposures'.



4.7 Copy Material



From the 'Start Page', select one of the listed materials. Select 'Copy Material' and the dialogue will display.

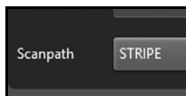
1



Material Name

Selecting 'Copy Material' opens a dialogue where you can give your new material file a name. Enter a suitable name as required.

2



Scanpath

Selecting 'Copy Material' opens a dialogue where you can choose the scanpath type you want for your new material file. Open the dropdown and choose from 'Meander', 'Stripe' or 'Chessboard'.

3

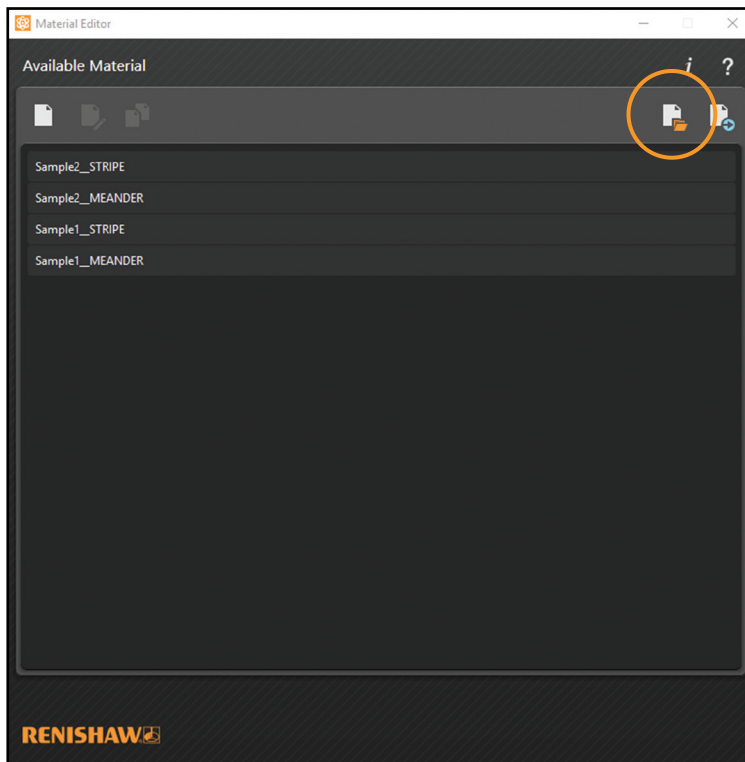


Confirm

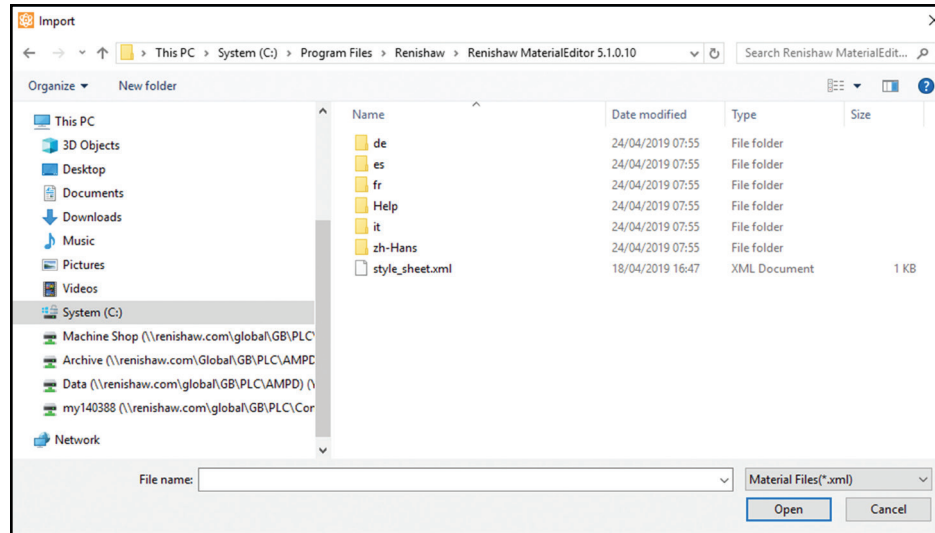
When you have given your copied material a name, and selected a suitable scanpath, select the green tick to confirm your selections.

Note: When you have copied your material, you can edit the material parameters. See Section 4.6 for details.

4.8 Import Material File

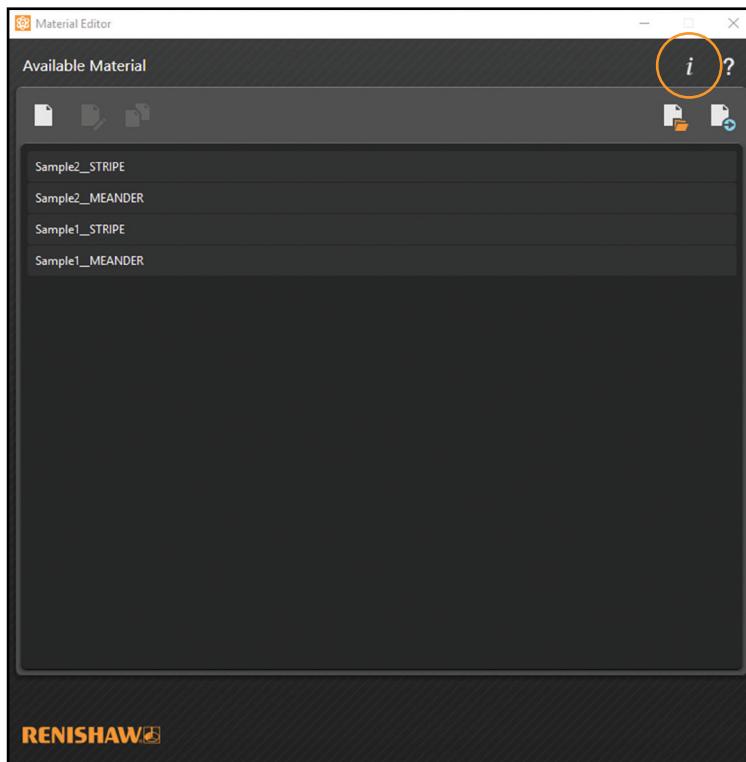


From the 'Start Page', select 'Import Material File'. A dialogue will open which will enable you to navigate to, select and open your material file.

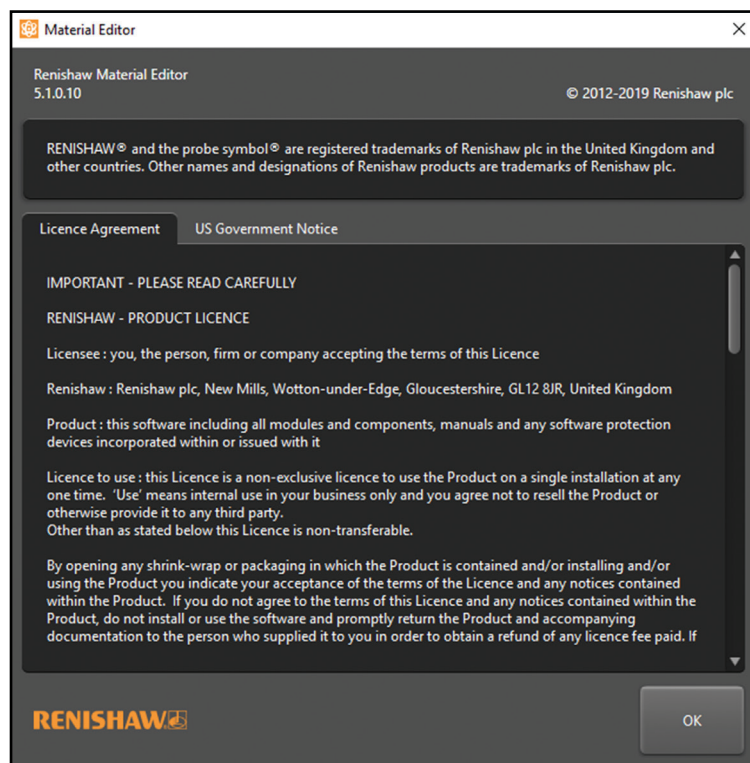


Note: Material files created in earlier versions of QuantAM will need to be imported, checked and exported in the relevant version of Material Editor before they can be opened in QuantAM.

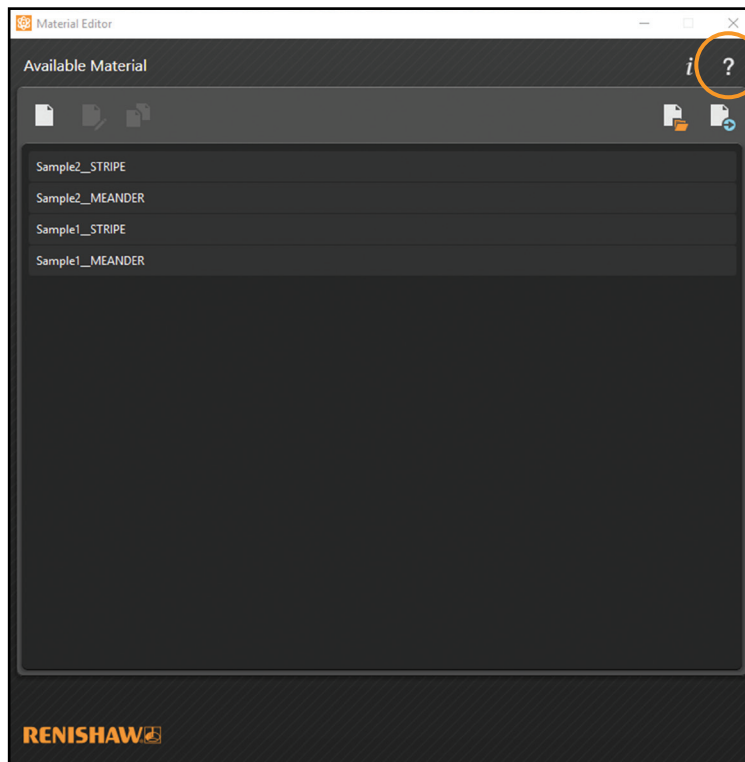
4.9 About Renishaw Material Editor



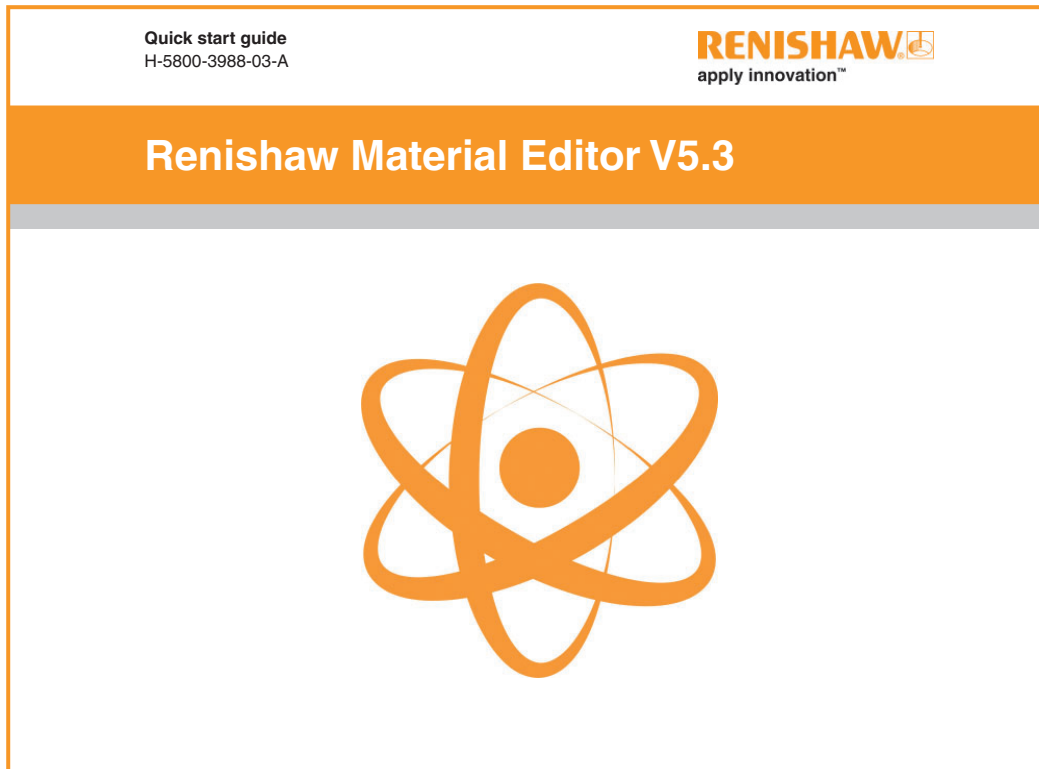
Displays product licence and trademark information about the Renishaw Material Editor software. Also launches from all screens within the software.



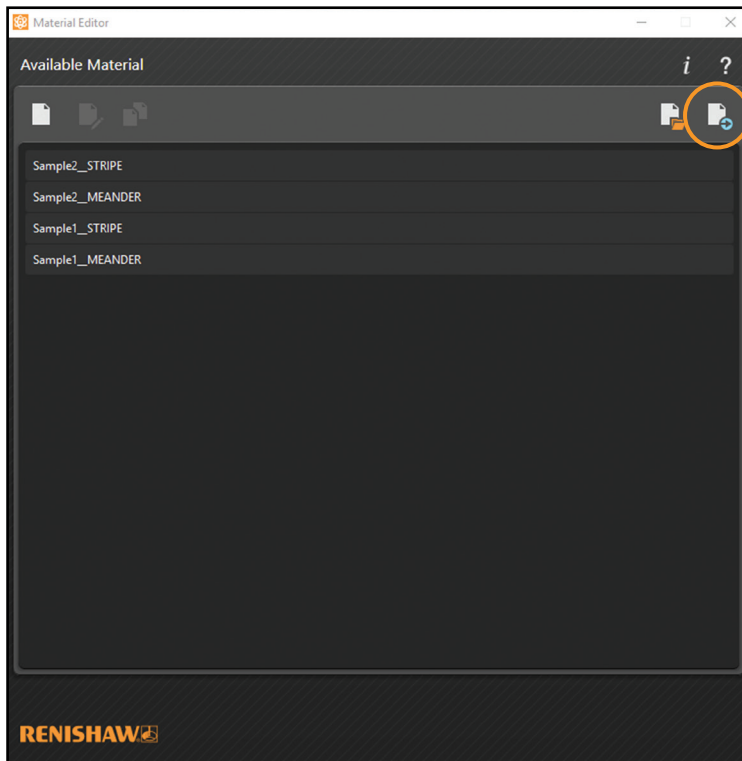
4.10 Help



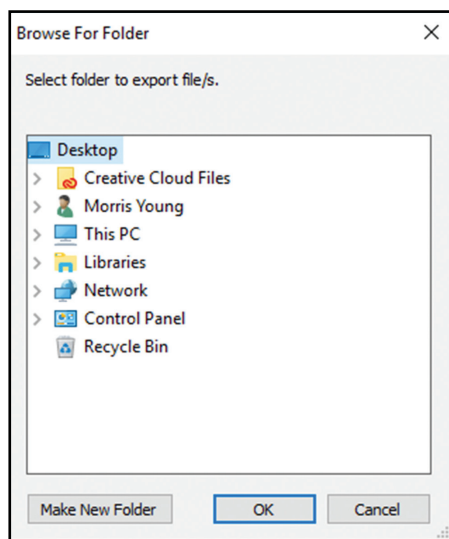
Launches the Renishaw Material Editor quick start guide. Also launches from all screens within the software. You can browse or search for the information you want.

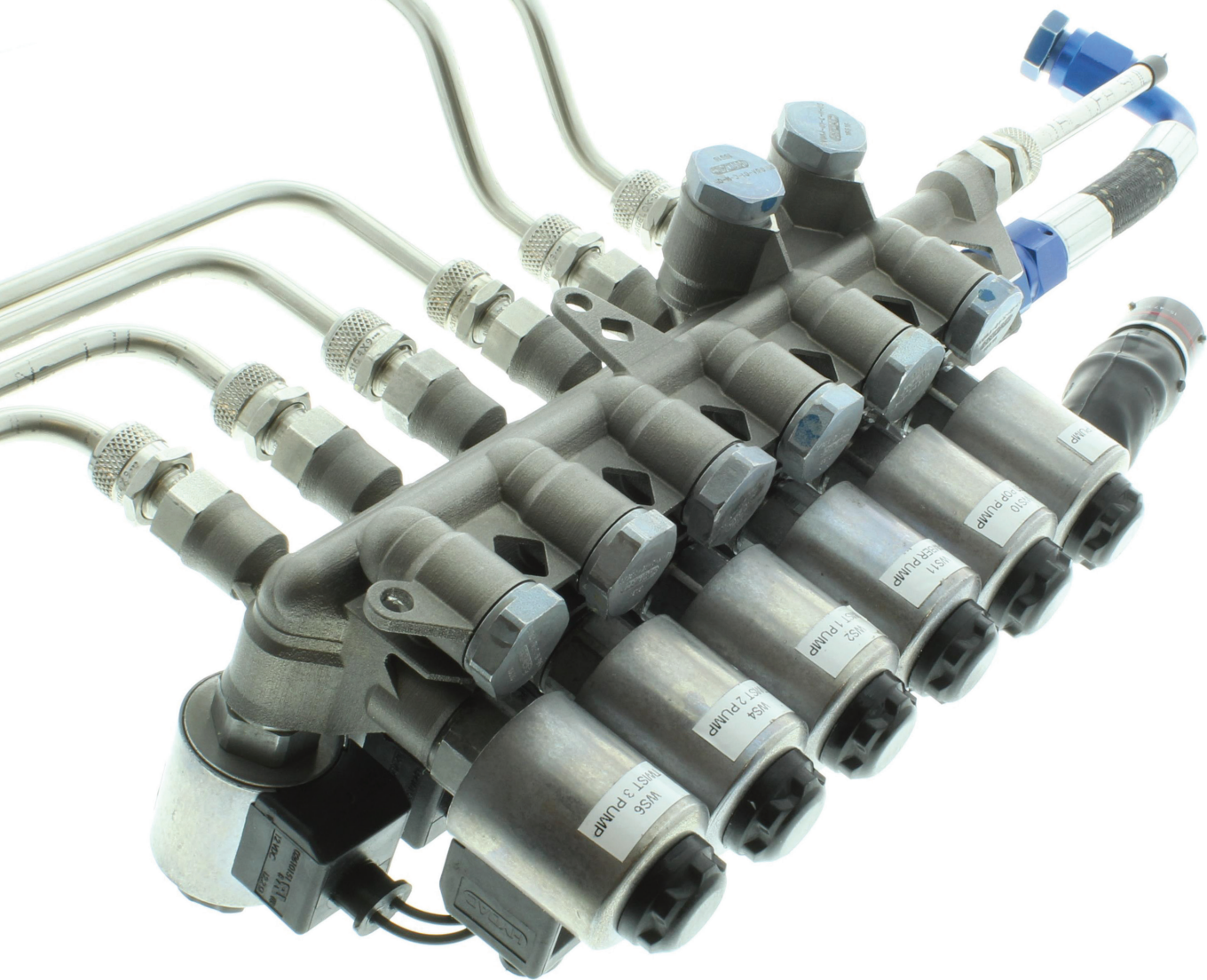


4.11 Export Material File



From the 'Start Page', select one of the listed materials and select 'Export Material File'. A dialogue will display which will enable you to navigate to a suitable location and export your material file.





5 Contact details

If you need support or assistance with QuantAM software please contact Renishaw:

Phone number	+44 (0) 1453 524 524 Hours of work: Monday to Friday 08:00 to 17:00 hr (UTC and DST)
Email	quantam.support@renishaw.com
Service address	Renishaw plc New Mills Wotton-under-Edge Gloucestershire United Kingdom GL12 8JR

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www.renishaw.com/contact

