Delcam Advanced Manufacturing Solutions

What's New in PowerMILL 2011

PowerMILL 2011

What's New

Release Issue 1

PowerMILL

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Acknowledgements

Patents

The Raceline smoothing functionality is subject to patent applications.

Patent granted: GB 2374562 Improvements Relating to Machine Tools

Patent granted: US 6,832,876 Machine Tools

Some of the functionality of the ViewMill and Simulation modules of PowerMILL is subject to patent applications.

Patent granted: GB 2 423 592 Surface Finish Prediction

Licenses

Intelligent cursor licensed under U.S. patent numbers 5,123,087 and 5,371,845 (Ashlar Inc.)

PowerMILL 2011. Published on 23 November 2010

Contents

Summary of new features

PowerMILL is the leading specialist NC CAM software for manufacturing complex shapes typically found in the toolmaking, automotive, and aerospace industries. PowerMILL 2011 offers all of the original features of PowerMILL 2010, but with numerous improvements. The most significant improvements are described in this document.

Toolpath preparation

There is an additional option on the **Create Boundary** dialogs which determines whether the tool, and therefore the boundary, is allowed outside the block (see page 4).

There are improvements to shallow boundaries (see page 4).

There are several improvements to the **Curve Editor** toolbar (see page 6).

- You can now create an arc which is tangential to existing lines and arcs as well as at specific points using the **Arc 3 Items**  button (see page 12).
- Fillets can now be modified in two ways (see page 13).
- You can now create a line which is tangential to a curve (see page 6).
- There are four new options on the **Transformation** toolbar.
  -  **Offset** (see page 16) - offsets curve by a specified distance.
  -  **Multiple transformation** (see page 23) - an easier method of performing multiple **Moves**  or **Rotations**  .
  -  **Transform to workplane** (see page 6) - moves the curves so they are in the same place relative to the active workplane as they were to the global transform.

-  **Transform to world** (see page 6) - moves the curves so they are in the same place relative to the global transform as they were to the active workplane.

- There is an additional limit option on the **Limit** toolbar of  **Limit to intersection** which limits the curve to the nearest intersection point (see page 33).
- Many of the curve editor options, such as creating a continuous line, are much faster. This is particularly noticeable when the view contains a large model, toolpath, or stock model.
- There is now a **Properties** option which displays the extents of the curves and specifies the number of segments in the entity (see page 6).
- **Insert Point**  has an additional option of **Between points** (see page 34).

There are no longer any restrictions on tool holder and shank component geometry (see page 34).

The **Tool Database Search** dialog now displays the name of the current tool database (see page 38).

There are two new options on the **Block** dialog which allow you to:

- Include a reference model when calculating the extents of the block (see page 39).
- Save a block (see page 38).

There is a new option which determines how to align a workplane (see page 42).

Toolpath generation

There is a new page on the finishing strategy dialogs of **Stock Engagement** that avoids machining too far into the stock material and removes toolpath segments that don't machine the stock (see page 43).

Limiting toolpaths to a 3D boundary uses a new algorithm and produces much better results (see page 52).

There is a new **Fixed Angle** frame on the **Tool Axis** dialog  (see page 53).

Using the new **Lead feed rates** page, you can specify the **Ramp lead in**, **Lead in**, and **Lead out** feed rates for lead moves as a factor of the cutting feed rate (see page 56).

The toolpath transformation functionality is improved to make it easier to use (see page 57).

There is an additional option of **Draw Cutting Moves**  on the drawing and viewing options on the **Toolpath** toolbar (see page 81).

Profile area clearance strategies have an additional option of **Additional profiles** on the **Cut direction** frame (see page 82).

Blisk machining can now machine hubs that bend upwards at their ends (see page 83).

There are several general toolpath enhancements (see page 84).

Toolpath verification

Some new parameters are displayed in the **Post-Creation Verification** part of the toolpath tree (see page 86).

User interface

The new **Selection** dialog makes it easier to select individual model components by **Model**, **Colour**, and **Levels and Sets**. The selection settings are stored in the toolpath template, allowing you to export and import the selection settings into a different PowerMILL project (see page 87).

You can now display the tool shank and holder as well as the tool tip. This improves the ability to do a visual check of the tool against the part (see page 88).

To avoid duplication, options available on the **Curve editor** toolbar are no longer available on the explorer context menus (see page 88).

To make it easier to visualise the principal editing plane, the normal is displayed in a different colour on the active axes (see page 89).

General enhancements

You can now change the **Orientation Vector Length** (see page 90).

Toolpath preparation

Boundary improvements

There are a few enhancements to boundaries:

- There is a new option on the **Create Boundary** dialogs which determines whether the tool, and therefore the boundary, is allowed outside the block (see page 4).
- Faster creation of shallow boundaries.
- You can now create a shallow boundary on a surface which has a negative thickness.

Boundaries outside block

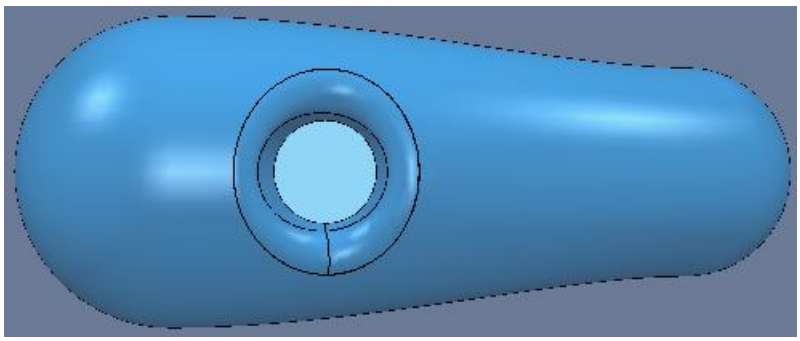
There is an additional option on the **Create Boundary** dialogs (which are created using a tool) of **Block Limit**. This determines whether the tool, and therefore the boundary, is allowed outside the block. Previously all boundaries were contained within the block. This enhancement improves consistency between boundary and toolpath creation.

 - allows the tool outside the confines of the block. It can only extend outside the block by up to one tool radius.

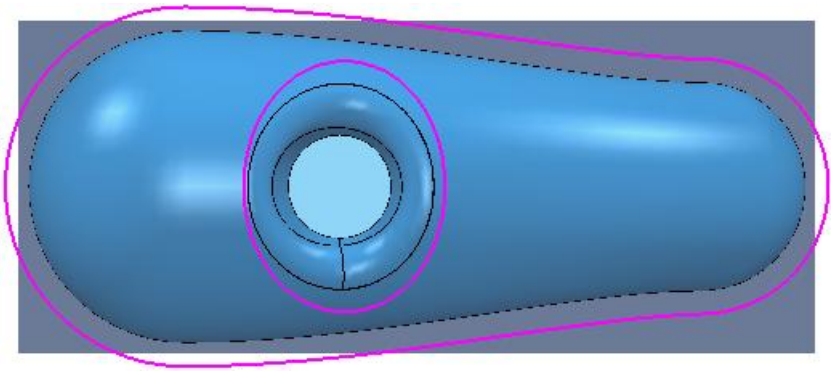
 - the tool tip is contained within the block.

If there is an active toolpath, then when you create a new boundary, the boundary block limit is set to the same value (centre  *or periphery*  *) as the toolpath block limit. The two values are not locked though, so you can set one to tool centre and the other to tool periphery.*

This example uses a selected surface boundary, but other boundaries work in the same way. It uses the **cowling.dgk** model in the **Examples** folder.

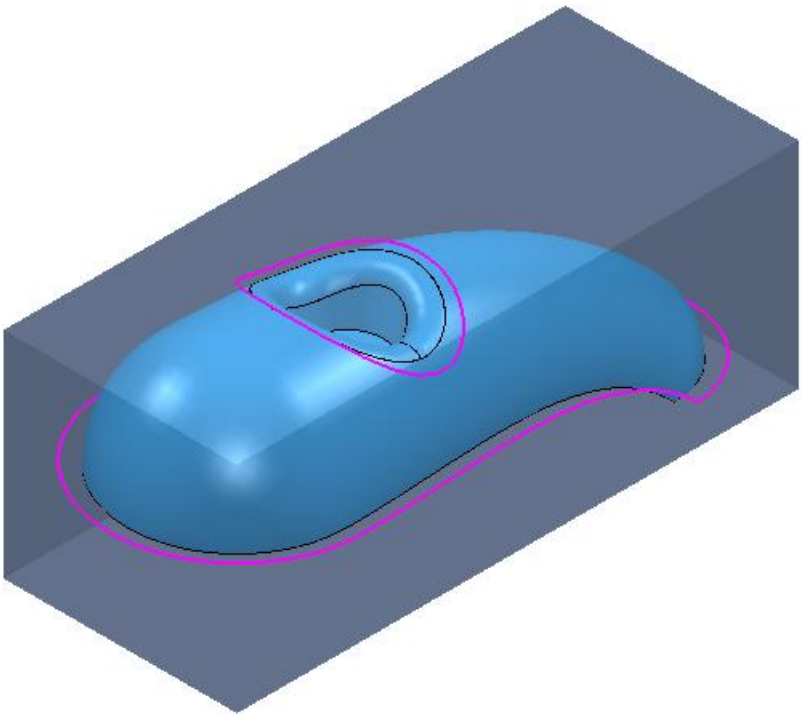


Creating a selected surface boundary with a **Block Limit** of  gives:

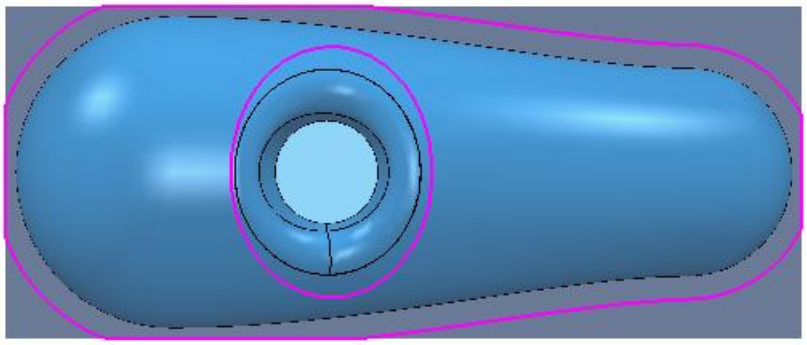


You can see the boundary extends beyond the edge of the block.

Looking at the ISO view:

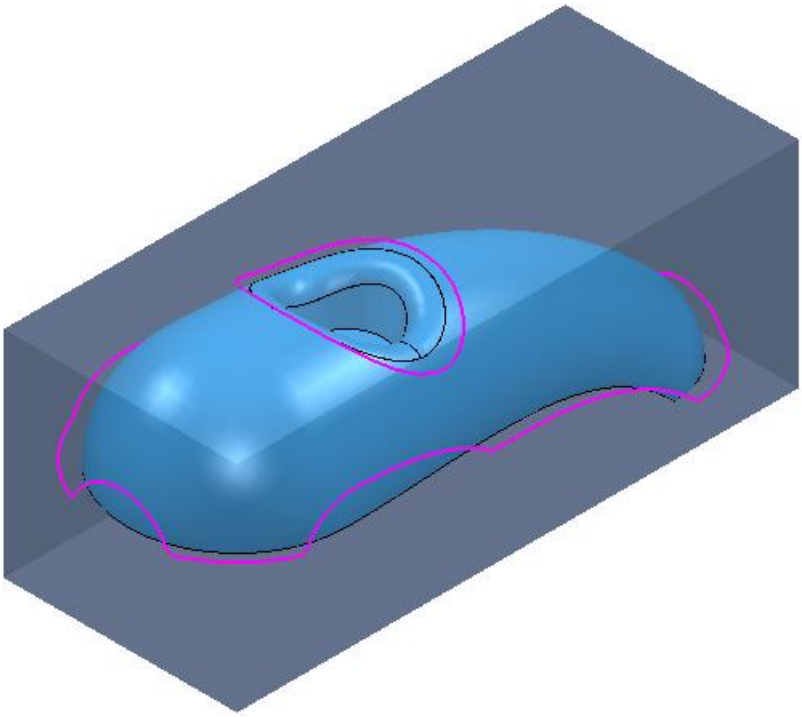


Creating a selected surface boundary with a **Block Limit** of gives:



You can see the boundary never goes outside the block.

Looking at the ISO view:



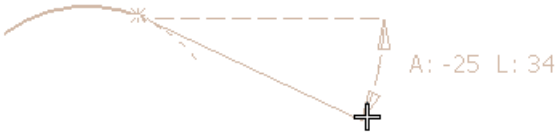
You can see the boundary rises up the model to ensure the tool is contained within the block.

Curve editor improvements

There are several improvements to the **Curve Editor** toolbar. These reduce the need to use PowerSHAPE or other third party CAD systems to generate complex wireframe geometry for machining.

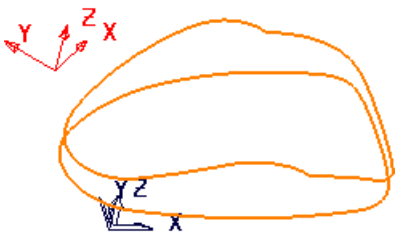
- You can now create an arc which is tangential to existing lines and arcs as well as at specific points using the **Arc 3 Items** button (see page 12).

- Fillets (see page 13) can now be modified in two ways:
  1. As a fillet - Changing the radius of the fillet and re-trimming the entities at either end of the fillet.
  2. As an arc - Moving the origin of the fillet, but maintaining the radius. The trimmed entities remain unchanged. This was the only option in previous versions.
- You can now create a line which is tangential to a curve. The first point snaps to the arc tangent. The length and angle of the line are displayed as you move the cursor to select the second point. The resulting line is always tangent to the arc.

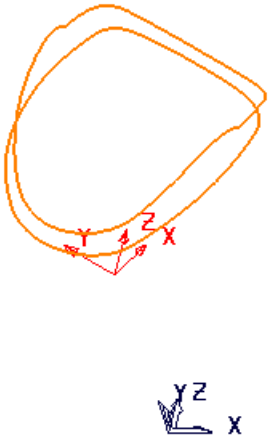


- There are four new options on the **Transformation** toolbar .
  - **Offset** (see page 16) - offsets the curve by a specified distance.
  - **Multiple transformation** (see page 23) - an easier method of performing multiple **Moves** or **Rotations** . This is similar to Multiple transformations of toolpaths (see page 63).
  - **Transform to workplane** - moves the curves so they are in the same place relative to the active workplane as they were to the global transform.

    Converts this:

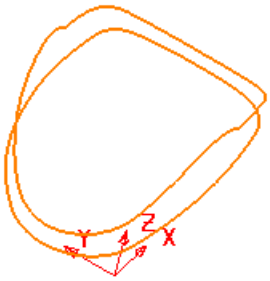


to this:

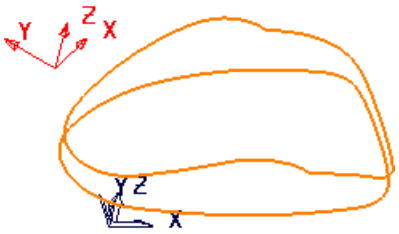


- **Transform to world** - moves the curves so they are in the same place relative to the global transform as they were to the active workplane.

  Converts this:

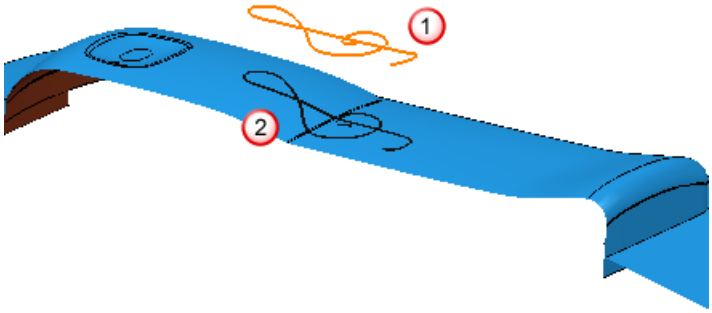


  to this:



- There is an additional limit option on the **Limit** toolbar  .
  - **Limit to intersection** (see page 33) - limits the curve to the nearest intersection point. The portion of the curve you select is the portion of the curve that is removed.

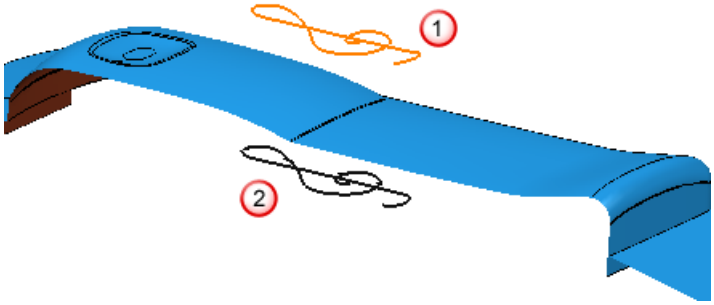
- The pattern projections options are now available on the **Curve Editor** toolbar  as well as from the individual pattern context menu.
  - **Drop** - the selected pattern is projected down the tool axis (or dropped) onto the part. The whole pattern must be contained within the part when viewed down the tool axis.



1 - original pattern.

2 - pattern dropped on to the part.

  - **Flatten** - the selected pattern is projected (or flattened) onto the XY plane at Z = 0. In this case the pattern need not be entirely contained within the part.

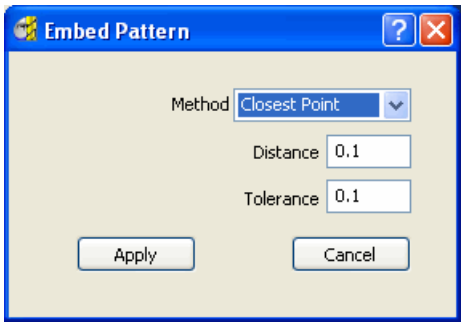


1 - original pattern.

2 - patten flattened onto Z=0.

  - **Embed** - links the pattern lying on the model to its associated surface (or surfaces).

This displays the following dialog:



Method - defines how the pattern is associated to the surfaces.

Closest Point - the points on the curve are associated to the closest point on the surfaces provided it is within the **Embedded Distance**.

Drop - the curve is projected down Z Axis of the active workplane (or dropped) onto the part. The whole curve must be contained within the part when viewed down Z. If the **Closest Point** method doesn't work you may find that this option does.

Embedded Distance - defines the maximum distance the curve can be to the surface to enable embedding to take place. If the **Embedded Distance** is exceeded you get the following error message:

In this case you may find choosing a **Method** of **Drop** cures the problem.

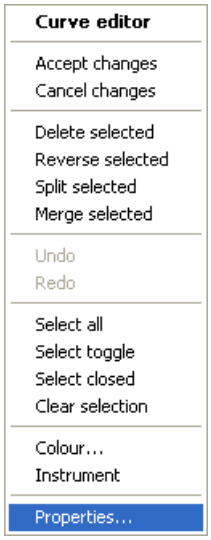
Tolerance - defines the tolerance used when **Embedding Patterns**.

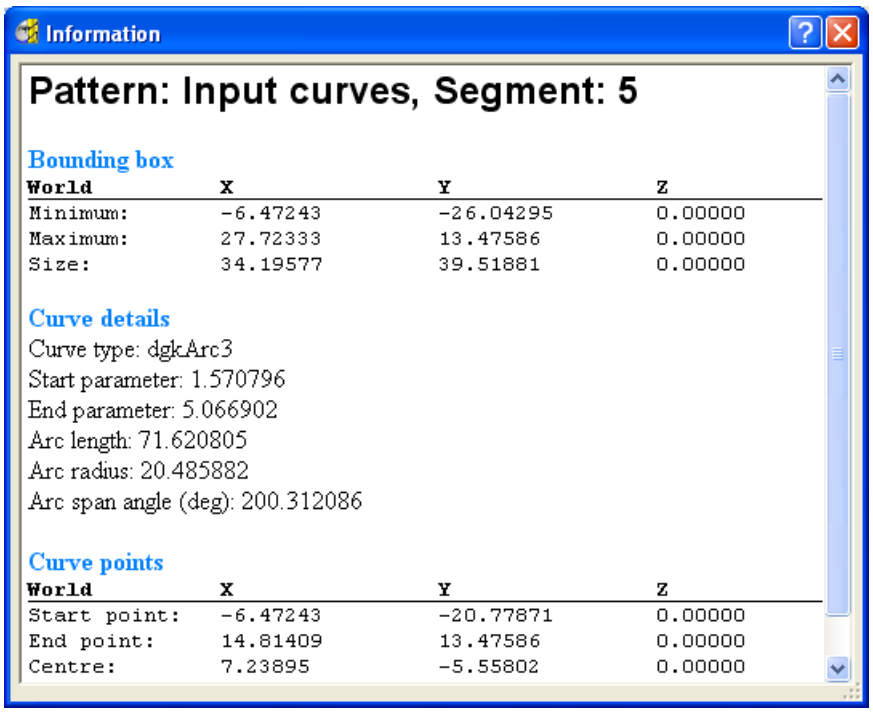
For more information on embedded patterns see the Example Creating an Embedded Pattern.

By default the pattern is embedded onto all the surfaces in the model. However, if you select one or more surfaces, then the curve will only be embedded onto the selected surfaces.

- Many of the curve editor options, such as creating a continuous line, are much faster. This is particularly noticeable when the view contains a large model, toolpath, or stock model.

- There is a **Properties** option on the **Curve editor** menu which displays the extents of the curves and specifies the number of segments in the entity.





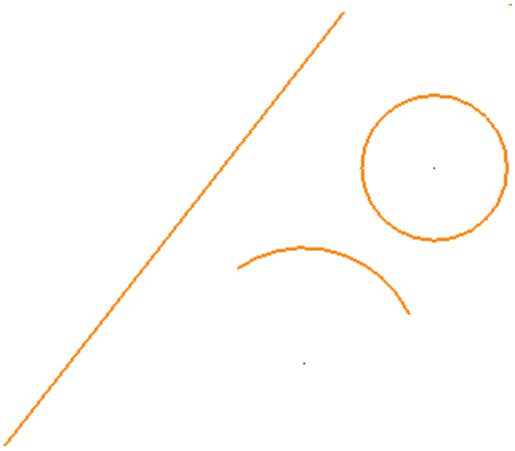
Pattern - the name of the pattern, in this case **Input curves**.

Segment - displays the properties of the segment listed here, in this case the fifth segment.

- **Insert Point**  has an additional option of **Between points** (see page 34).

Creating an arc using three items example

This example shows you how to create an arc tangential to other items. It starts with a simple line, arc, and circle.



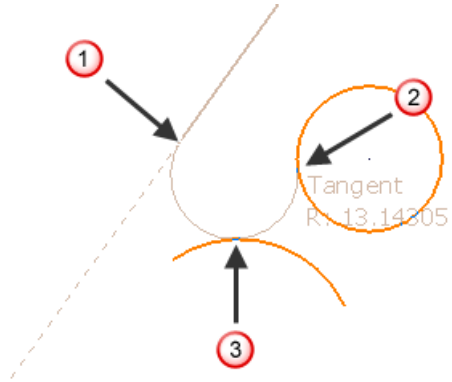
1 Click the **Arc 3 Item** button from the **Circles** pull-out toolbar

.

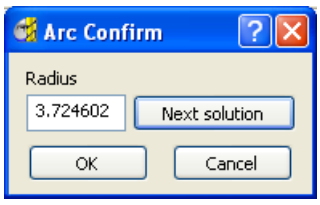
2 Select the line to indicate the start point of the arc (point 1).

3 Select the circle to indicate the end point of the arc (point 2).

4 Select the arc to indicate a mid-point of the arc (point 3).

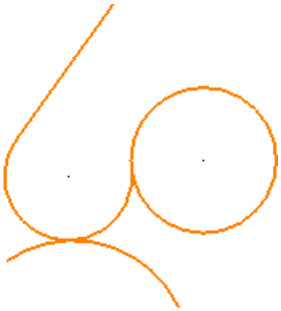


PowerMILL creates an arc which is tangential to all three items. and displays the **Arc Confirm** dialog.



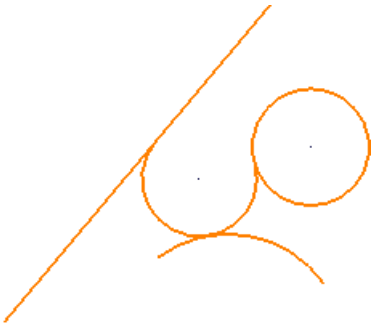
5 Since there are many solutions, PowerMILL supplies one, but allows you to choose another by clicking **Next solution**.

6 When you are happy with the solution, click **OK**.



Only items at the start or end are trimmed (or extended), the middle item is never trimmed (or extended). Open curves (arcs and lines) can be trimmed, but closed curves (circles) are never trimmed.

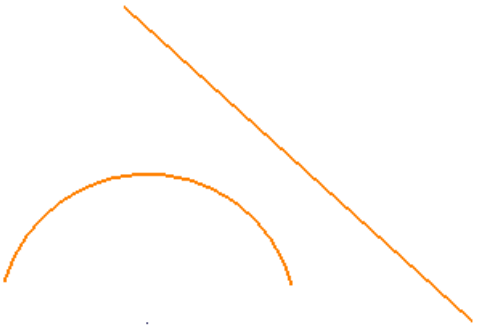
*Pressing the **Shift** key whilst selecting the third item suppresses trimming (or extending) of the start and end item.*



For more information, see the creating an arc with three points and creating circles and arcs examples.

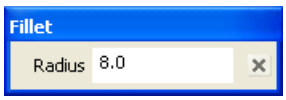
Changing the radius of a fillet example

This example shows you how to edit a fillet. It starts with a simple line and fillet.

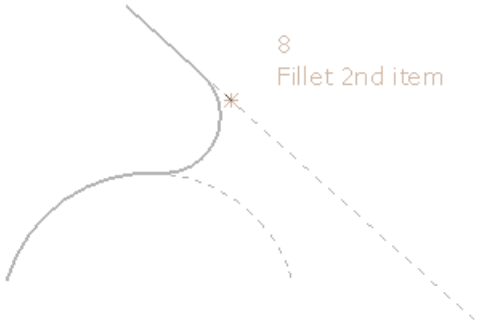


1 Click the **Fillet** button from the **Circles** pull-out toolbar  .

2 In the **Fillet** toolbar, enter a **Radius** of **8**.

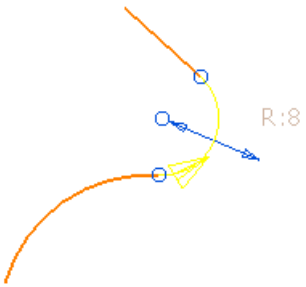


3 Select the arc and the line to indicate the location of the fillet.

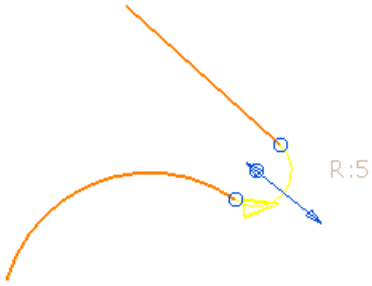


4 Click to close the **Fillet** toolbar.

5 Select the fillet to edit it.

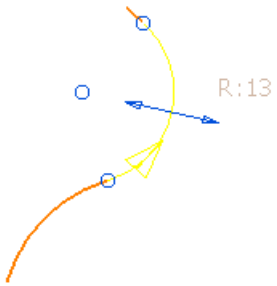


6 Select the blue arrow and drag it to the right.



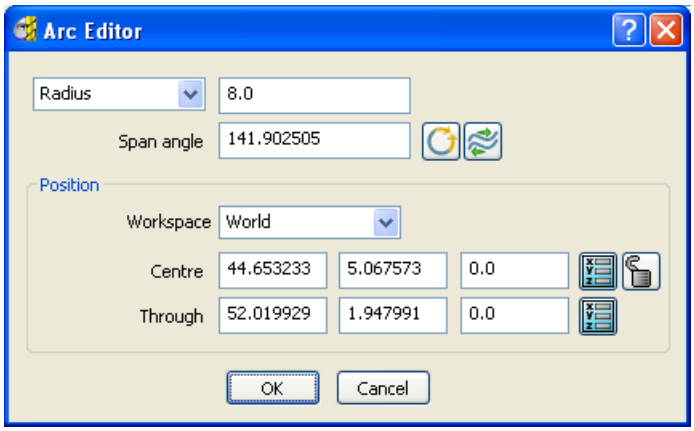
The fillet radius is reduced and the line and arc next to the fillet are re-trimmed.

7 Select the blue arrow and drag it to the left.

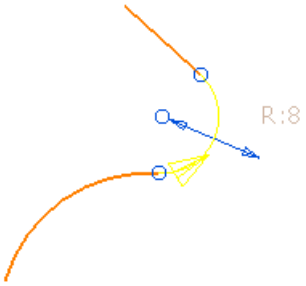


The fillet radius increases, the location of the centre of the fillet moves, and the line and arc next to the fillet are re-trimmed.

8 Double click on the fillet to display the **Arc Editor** dialog.

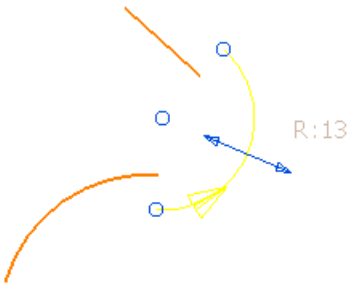


9 In the **Arc Editor** dialog enter a **Radius** of 8.



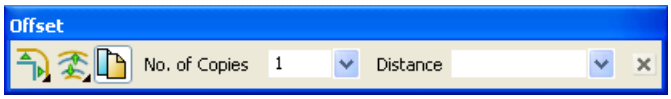
10 In the **Arc Editor** dialog, **Lock**  the **Centre**.

11 Select the blue arrow and drag it to the right.



The fillet radius increases, the location of the centre of the fillet stays in the same place, and the line and arc next to the fillet remain unchanged.

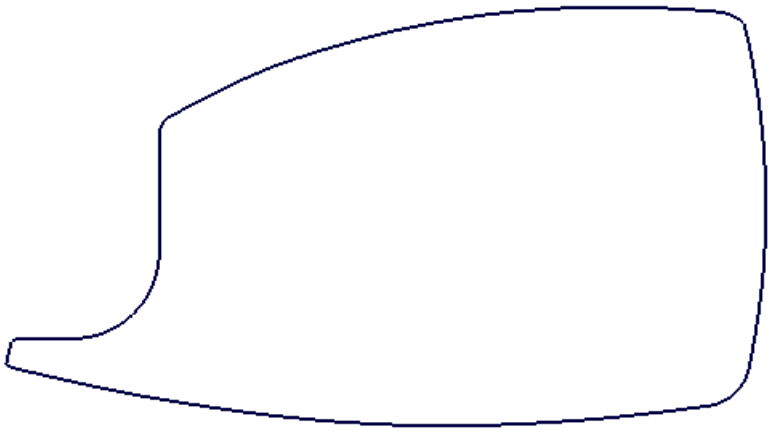
Offset curve



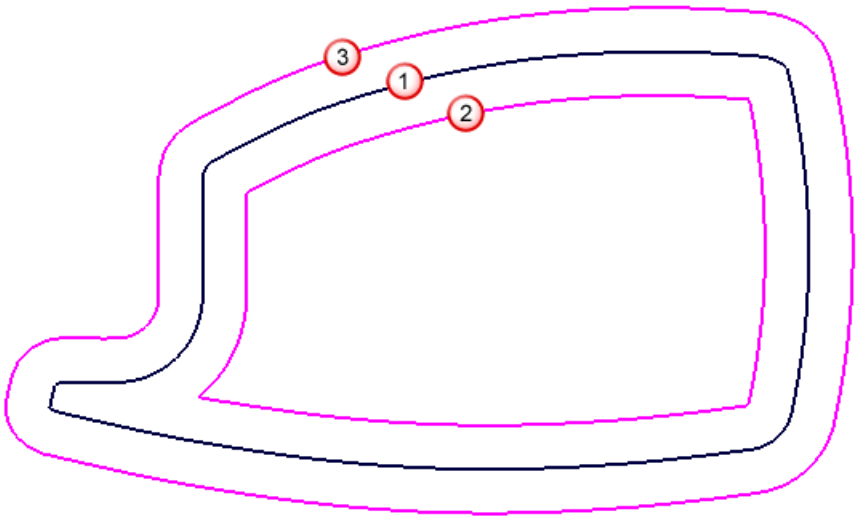
Offset type - determines the offset type. A positive value offsets the curve outwards, a negative value offsets the curve inwards.

2D round - offsets a 2D curve by a specified distance. This creates smooth offsets when offsetting outwards and sharp offsets on internal corners when offsetting inwards. This is the same as **Edit > Offset 2D (Round corners)** on the individual boundary context menu.

If you start with this curve:



Selecting **2D round** gives you:



1 - original curve.

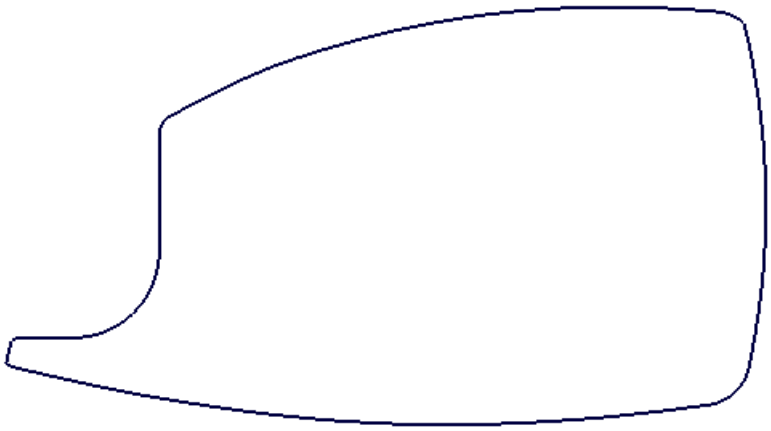
2 - curve offset inwards.

3 - curve offset outwards.

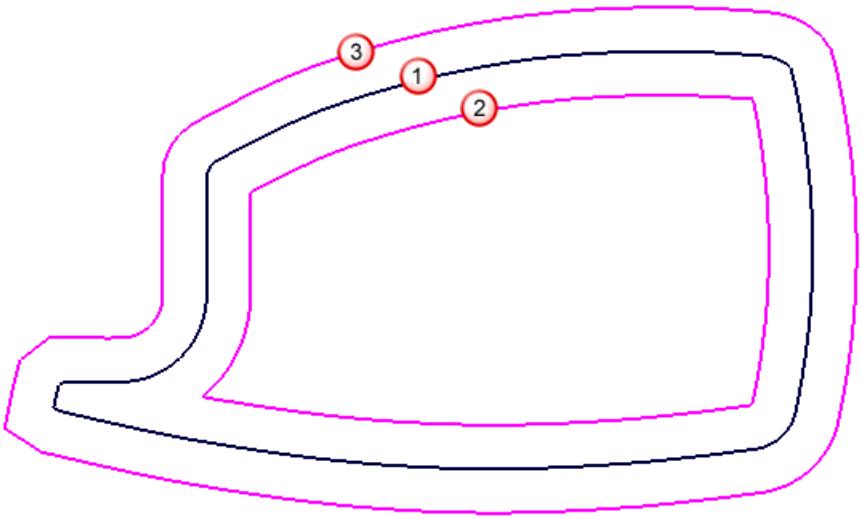
This creates smooth offsets when offsetting outwards and sharp offsets on internal corners when offsetting inwards.

2D Sharp - this is similar to **2D Round** except the offset curve has sharp offsets on external corners when offsetting outwards and sharp offsets on internal corners when offsetting inwards. This replaces **Edit > Offset 2D (Sharp)** on the individual boundary context menu.

If you start with this curve:



Selecting the **2D Sharp** gives you:



1 - original curve.

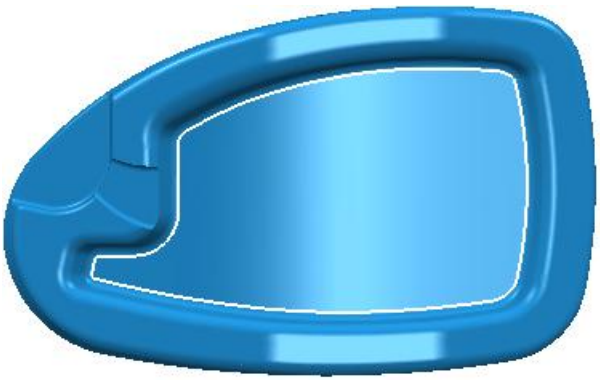
2 - curve offset inwards.

3 - curve offset outwards.

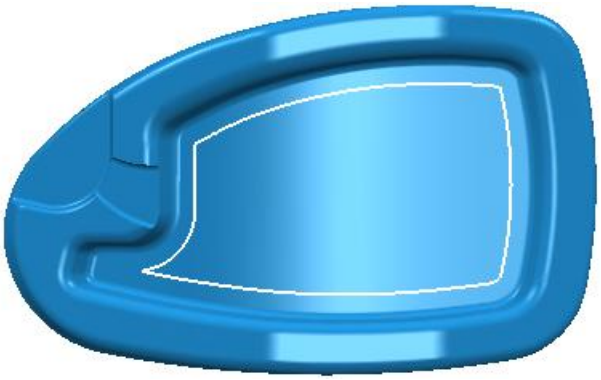
This option creates sharp offsets on external corners when offsetting outwards and sharp offsets on internal corners when offsetting inwards.

3D Round - this is similar to **3D Smooth** except the offset curve isn't necessarily smoothed. This creates smooth offsets when offsetting outwards and sharp offsets on internal corners when offsetting inwards. This replaces **Edit > Offset 3D (Round corners)** on the individual boundary context menu.

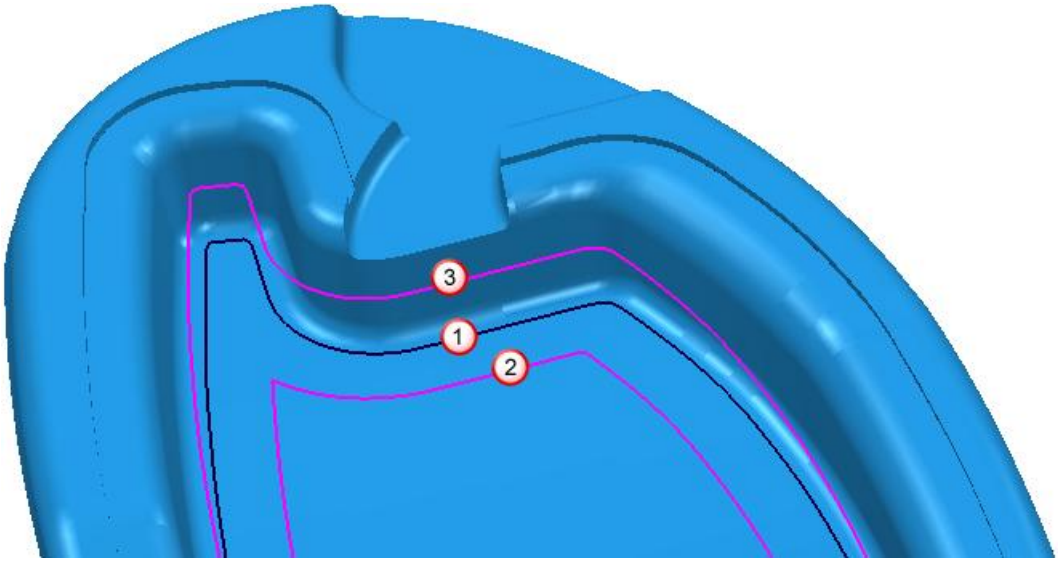
Starting with **5axisModel.dgk** in the examples file with a selected surface boundary:



Selecting **3D Round** and a **Distance** of **-10** gives you:



This creates smooth offsets when offsetting outwards and sharp offsets on internal corners when offsetting inwards.



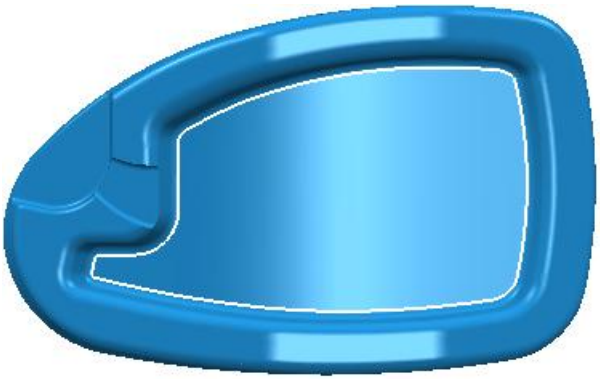
1 - original curve.

2 - curve offset inwards.

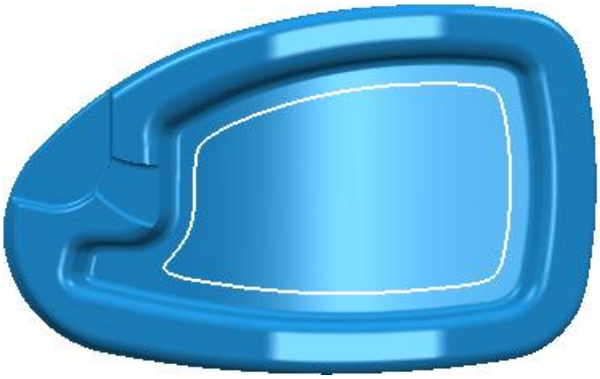
3 - curve offset outwards.

3D Smooth - offsets a 3D curve by a specified distance. This always creates smooth offsets. This replaces **Edit > Offset 3D (Smooth)** on the individual boundary context menu.

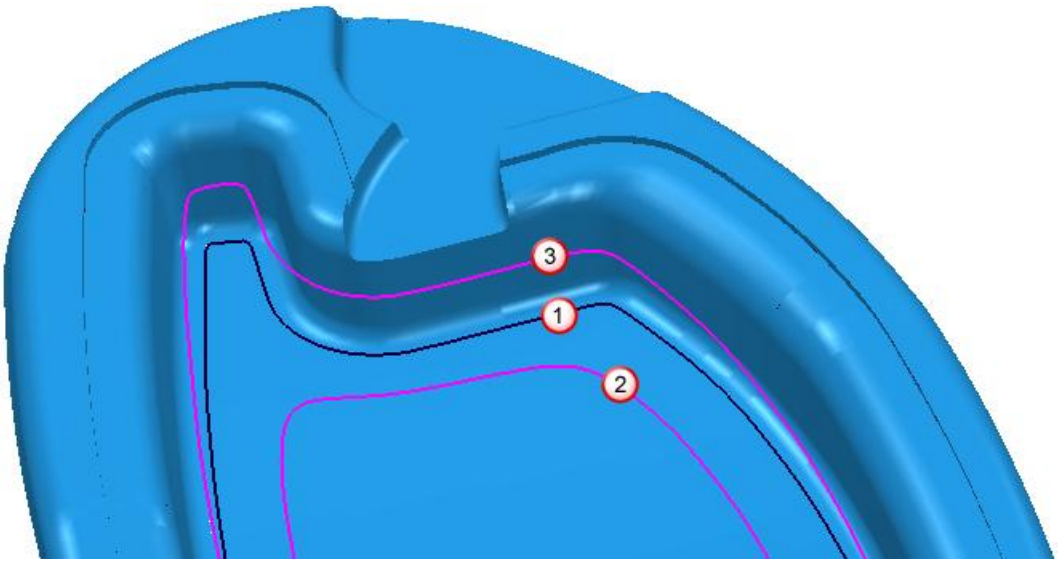
Starting with **5axisModel.dgk** in the examples file with a selected surface boundary:



Selecting **3D Smooth** and a **Distance** of **-10** gives you:



This option always creates smooth offsets.



1 - original curve.

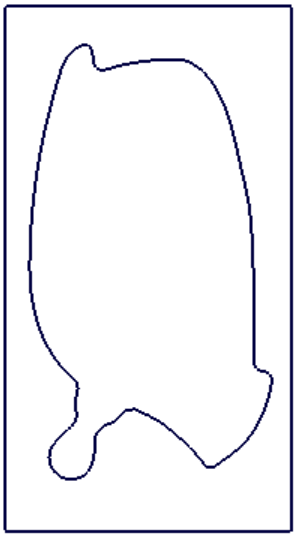
2 - curve offset inwards.

3 - curve offset outwards.

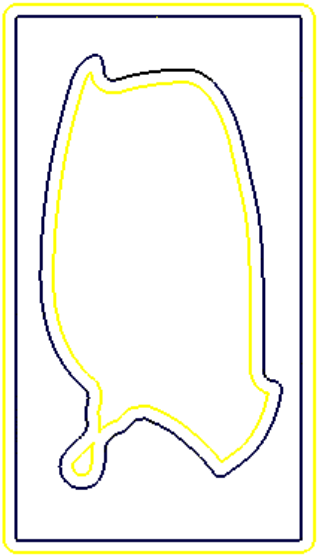
Concentric curves - determines whether concentric curves are offset by region or as individual curves.

Offset concentric curves by region - concentric curves are treated as regions and are offset outside, or inside the region.

Starting with this:

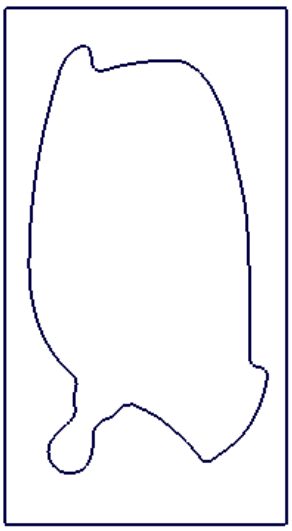


Selecting offsets the curve outside the region:

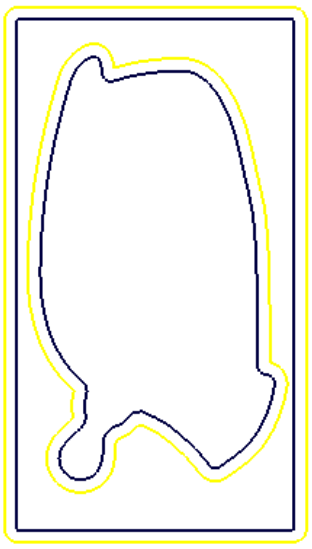


 **Offset curves individually -** concentric curves are treated as individuals and are offset individually.

Starting with this:



Selecting  offsets each curve outwards:



 **Keep Original -** determines whether the entities are copied or replaced when transformed.

 **Replace Original -** the original entities are replaced with the transformed ones.

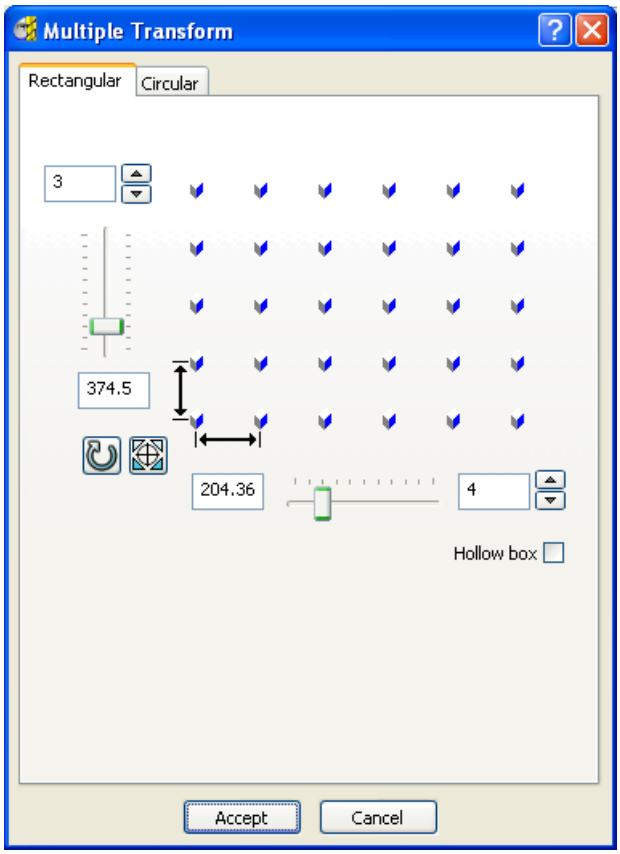
 **Keep Original -** keeps both the original and transformed entities.

No. of Copies - the number of copies you want.

Distance - the offset distance.

Multiple transform (curve)

Multiple transform is an easier method of performing multiple **Moves** or **Rotations** of curves. It is available from the **Curve Editor** toolbar.



This works in the same way as **Multiple transform** on the **Toolpath** toolbar except it works on curves rather than toolpaths (see page 63).

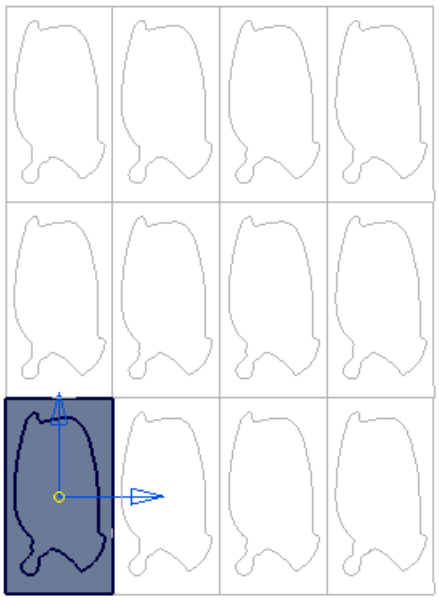
The orientation of the transform is determined by the principal working plane , , or , set in the **Information** toolbar.

For information on the **Circular** tab, see **Multiple transform - Circular** (see page 27).

The examples use the **chainsaw.ige** model in the examples file with a selected surface boundary.

3 **Number of rows** - either enter a value or use .

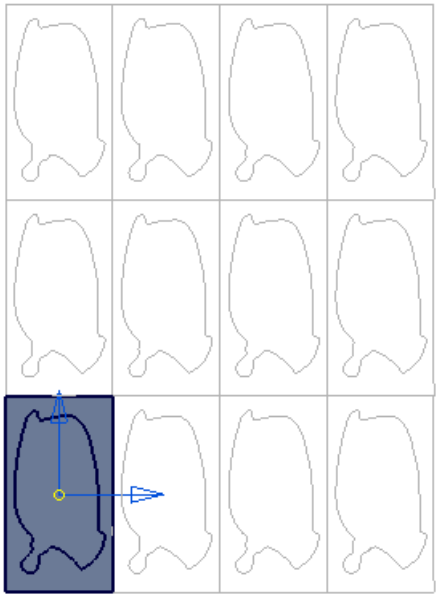
This curve transform has 3 rows and 4 columns:



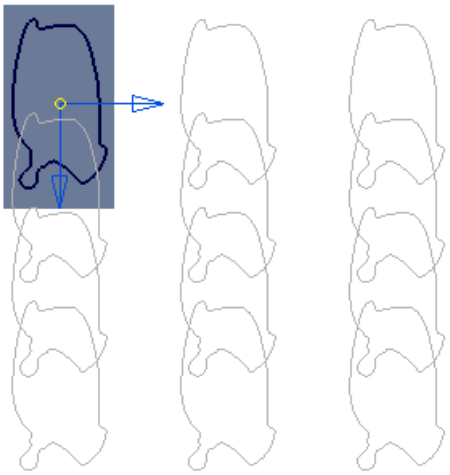
Distance between rows - by default, this specifies the extents of the curve.

 **Rotate axis -** rotates the transform by 90° in a clockwise direction in the principal working plane.

Converts this:



to this:

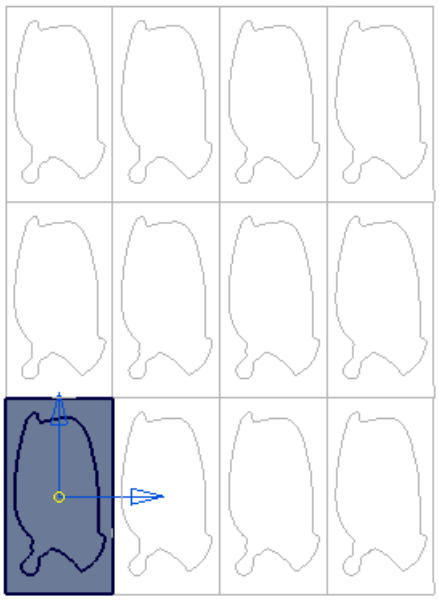


Move Origin - when selected, enables you to move the origin graphically, by dragging, or by entering coordinates using , , or and in the **Status** bar.

204.36 **Distance between columns -** by default, this specifies the extents of the curve.

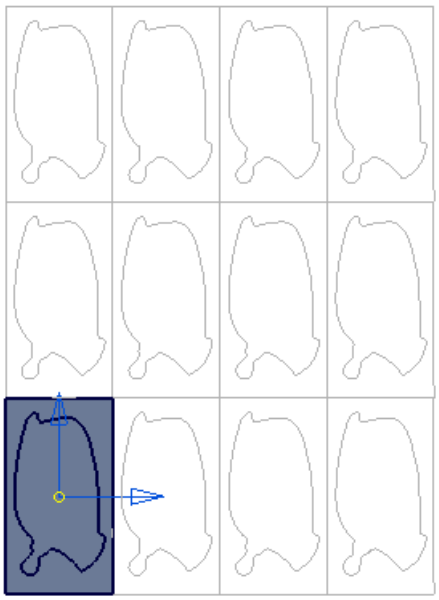
4 **Number of columns -** either enter a value or use .

This curve transform has 3 rows and 4 columns:

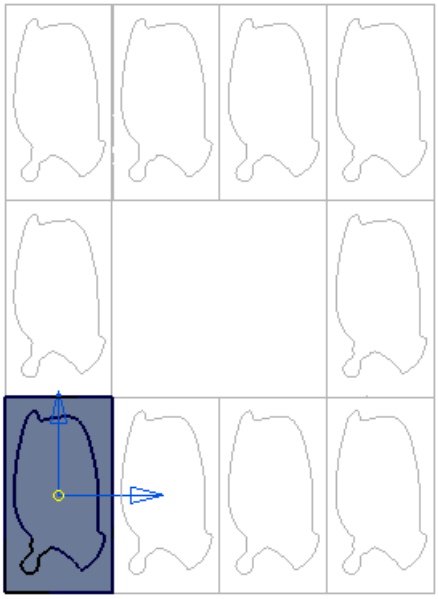


Hollow box - places the duplicated curves around the perimeter of the transform and removes the central ones.

Converts this:



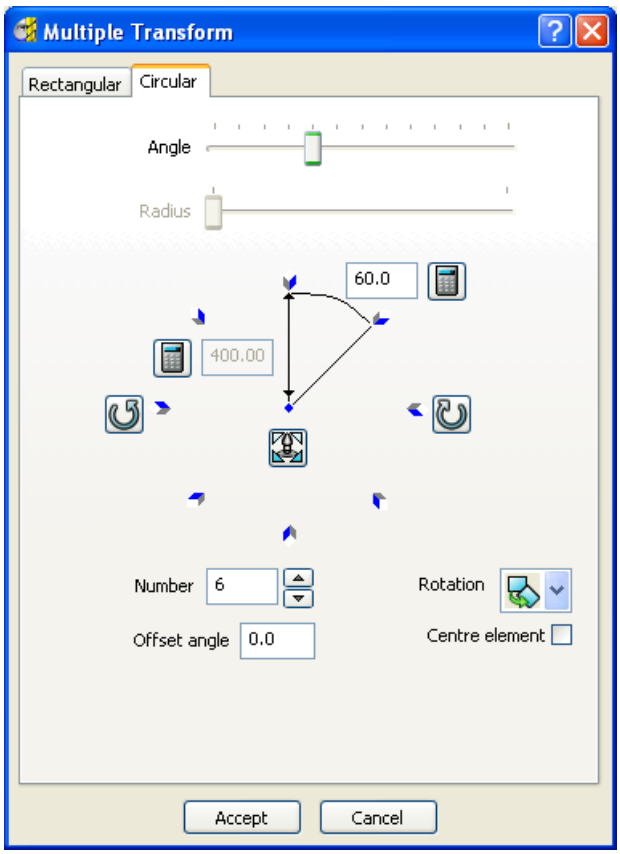
to this:



For more information, see Rectangular transform example (see page 78); this example shows you how to create multiple moves on a toolpath using a rectangular pattern, but the principle is the same for curves.

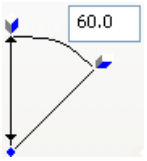
Multiple Transform - Circular (curve)

The **Circular** tab on the **Multiple Transform** dialog creates multiple **Rotations** of curves.



This works in the same way as the **Circular** tab (see page 68) on the **Multiple transform** on the **Toolpath** toolbar (see page 63) except it works on curves rather than toolpaths.

The orientation of the transform is determined by the principal working plane  ,  , or  , set in the **Information** toolbar.



Angle - the angle between elements in the transform. You can also use the slider, or specify the **Number** of elements to determine the angle.

 **Angle lock -** determines whether the rotation angle is calculated automatically or not.

Calculated - the values are calculated automatically by PowerMILL. This assumes that you want a full circular pattern (**Angle** = 360/**Number**).

Edited - the value is entered by you (or another user). The **Angle** and **Number** values operate independently. This enables you to create a partial circle rather than a full circular pattern.

and *work as a toggle.*

Radius - the radius of the pattern. You can also use the slider to determine the radius.

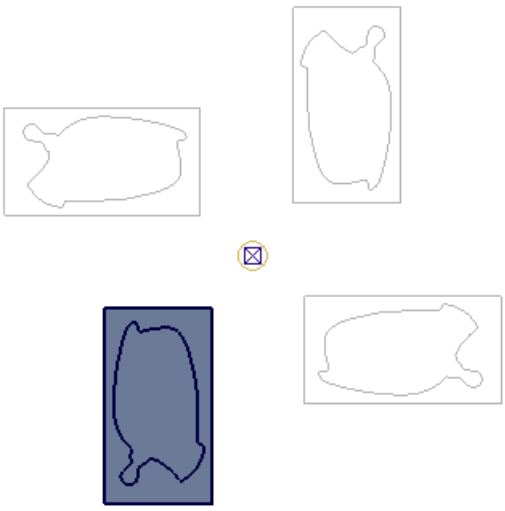
Radius lock - determines whether the rotation radius is defined automatically or not.

Calculated - the values are calculated automatically by PowerMILL. The radius is the distance from the centre of the rotation (defined by) to the centre of the set of curves.

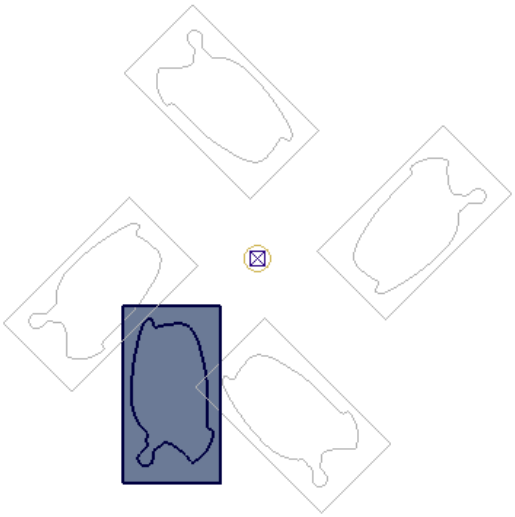
Edited - the value is entered by you (or another user).

Clockwise - rotates the transform clockwise by half of the **Angle**. Clicking this updates the **Offset angle**.

Original transform:



Clicking  changes it to:



and updates **Offset angle** to **-45°**.

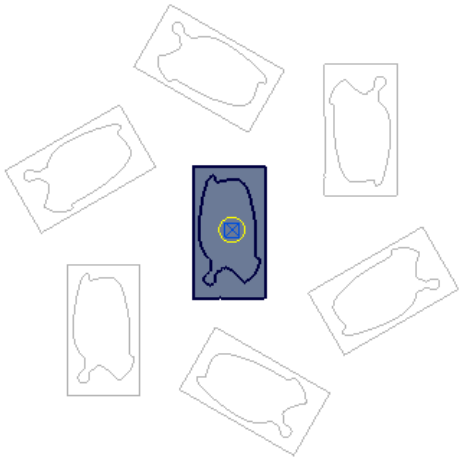
 **Anticlockwise -** rotates the transform anticlockwise by half of the **Angle**. Clicking this updates the **Offset angle**.

 **Number -** the number of entities in the circular pattern. If the angle lock is  , then editing this field edits the angle. If the angle lock is  then **Angle** and **Number** work independently.

It is best to see how these fields interact by example. If you have:

- An **Angle** of **60°**
-  selected.

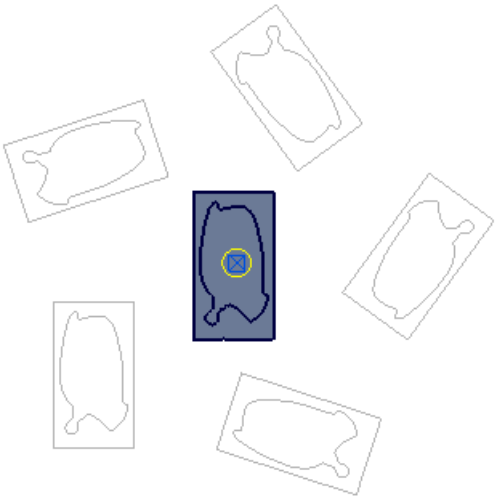
PowerMILL calculates the **Number** automatically (it is 6).



If you have:

- A **Number** of **5**
-  selected.

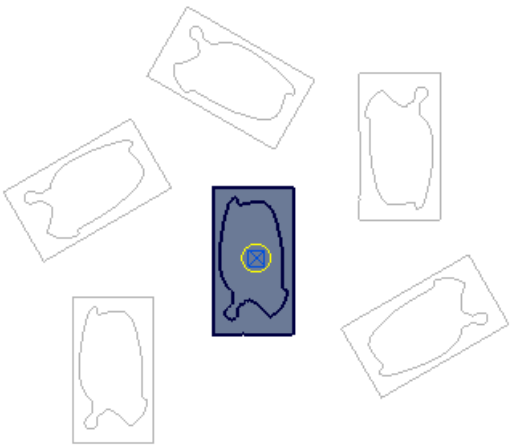
PowerMILL calculates the **Angle** automatically (it is 72°).



If you have:

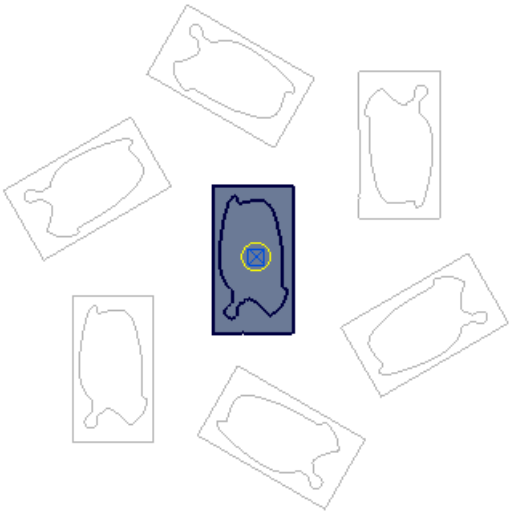
- An **Angle** of 60°
-  selected
- A **Number** of 5.

PowerMILL calculates a partial circular pattern.

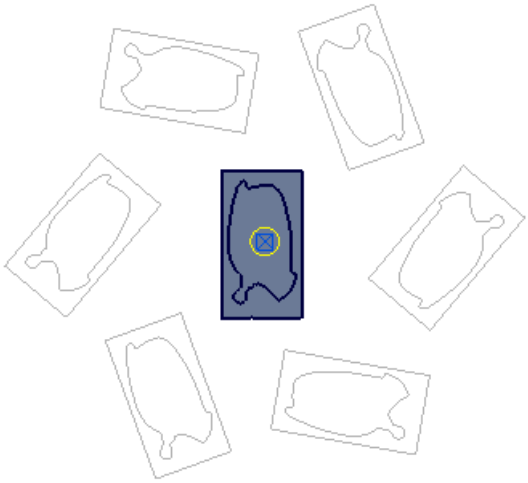


Offset angle - determines the start angle of the transform.

Offset angle of **0°**:

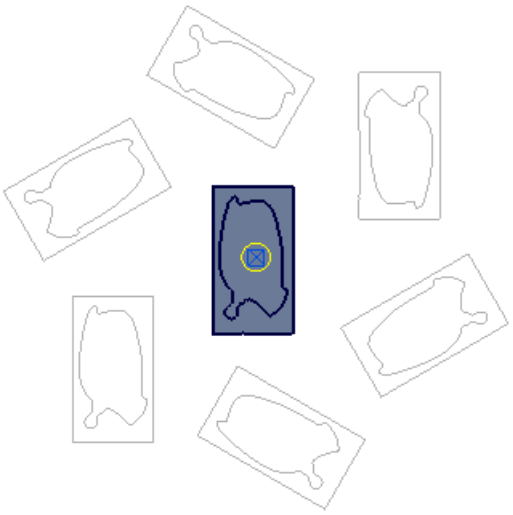


Offset Angle of **20°**:

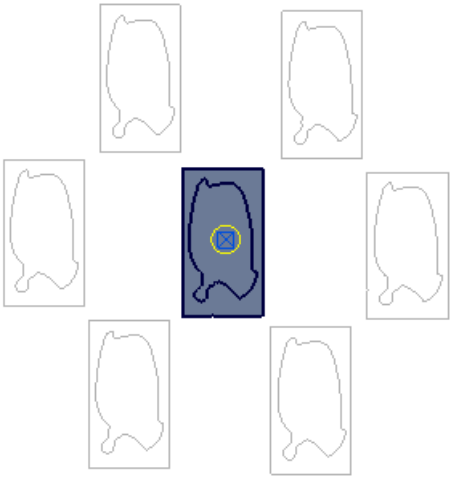


Rotation - determines whether you rotate or move the curves around the transform.

 Rotate and copy:

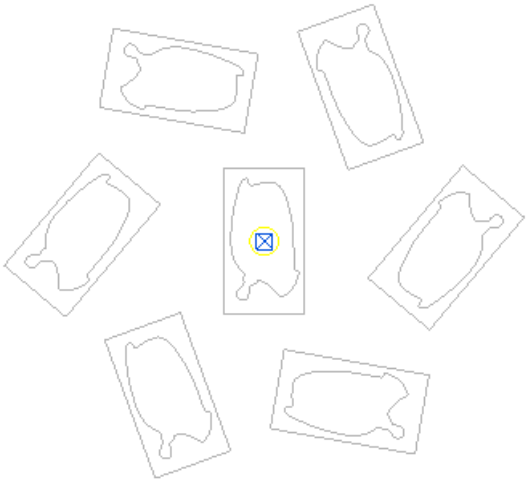


 Rotate and move:

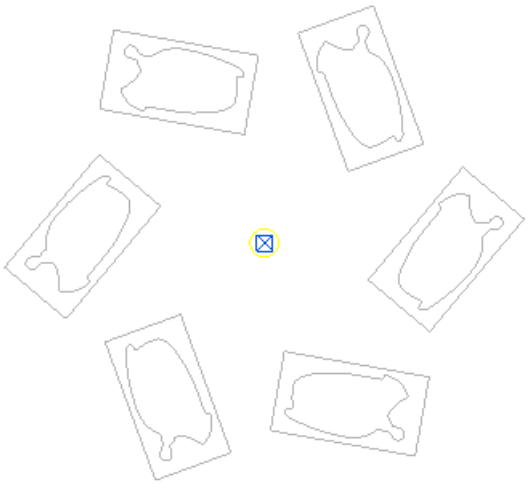


Centre element - creates an additional copy of curves at the centre of the circle.

Centre element selected:



Centre element deselected:



For more information, see Circular transform example (see page 80). This shows how to create multiple rotations on a toolpath using a circular pattern, but the principle is the same for curves.

Limit to intersection example

This example shows you how to limit two intersection curves. It assumes that you have created two intersecting curves, using the **Curve Editor** toolbar.

1 Click the **Limit to Intersection** button from the **Limit** pull-out toolbar  .

2 Select the portion of the curve you want to remove.

The curve you hover over turns red.

Selecting the curve limits it back to the nearest intersection point.

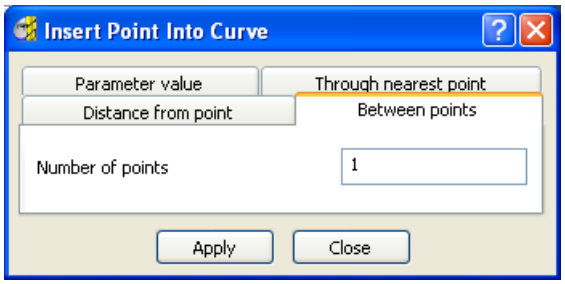
3 Select the second portion of the curve you want to remove.

Selecting the curve limits it back to the nearest intersection point.

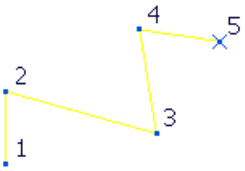
4 Repeat for the remaining two "tails".

Insert Point into Curve dialog

There is an additional way of inserting points into a curve using **Insert Point** on the **Curve Editor** dialog of equispaced between two consecutive points.

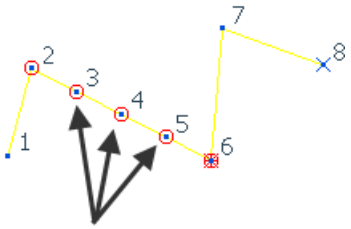


For example, to insert points in to this curve:



1. Select the curve.
2. On the **Curve Editor** toolbar, click to display the **Insert Point Into Curve** dialog.
3. Select the **Between points** tab and enter a **Number of points** of 3.
4. On the curve, select points 2 and 3.

   Press the Shift key on your keyboard to select multiple points.
5. Click **Apply** and **Close**.



The additional points are inserted into the curve.

Tool component geometry

The introduction of the tool holder profile functionality in PowerMILL 2010 has made the restrictions on tool profile, tool holder, and shank component geometry unnecessary. Now you have fast and easy construction of accurate and complex tool assemblies using either the curve editor or importing profiles.

- Tool profiles with any shape may be loaded with any type of file format.
- You can create a tool profiles using the curve editor.
- You can create tool profiles from arcs, curves, lines, or other dgk curves.
- You can create tool profiles from patterns.
- The resulting curve doesn't have to be one single composite curve.
- As long as the geometry contains a valid profile, PowerMILL will import the components.
- Tool profiles containing negative Y moves are imported, but the negative moves are ignored.
- Gaps between curves in the tool profile must be less that 10^{-5} mm.
- The tool profile is a polygonised approximation of the input profile.

In previous versions, imported tool shank and tool holder geometry suffered from the same restrictions as form tools:

- Only .dgk files could be imported.
- The curve could only contain lines or arc spans.
- All lines and arc spans had to be concatenated to form one composite curve.

These restrictions were in place so as not to impact on collision checking performance. The tool holder profile functionality supersedes this requirement.

Creating a tool shank from a pattern

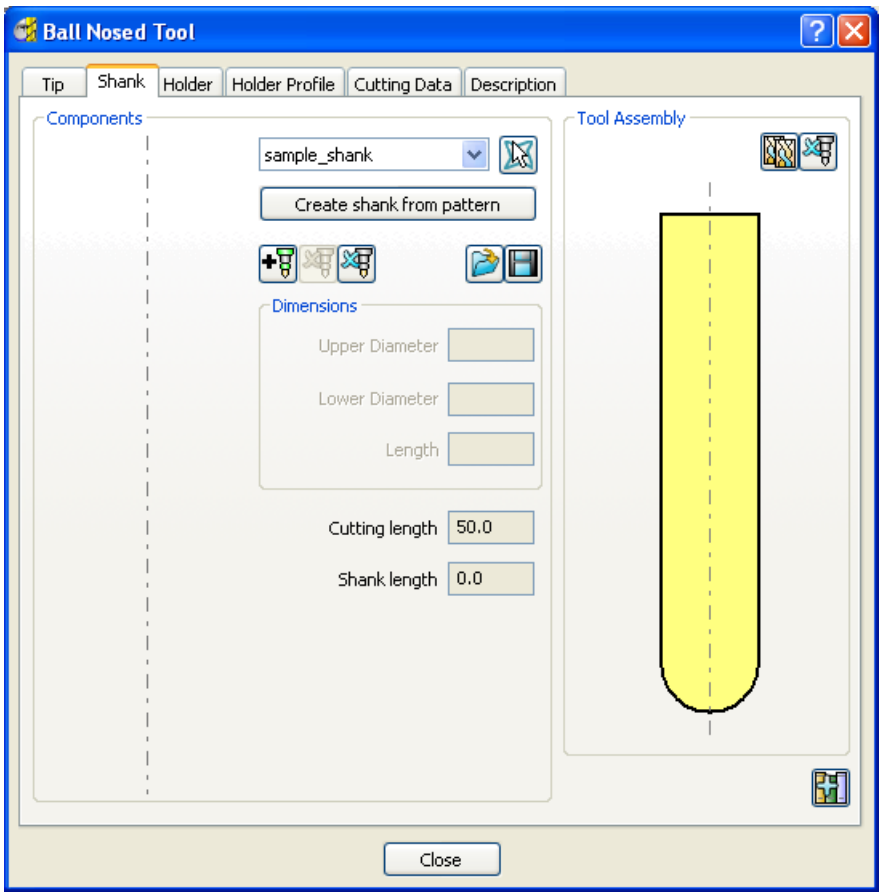
This example shows you how to create a shank for a specific tool. The shank profile is generated outside PowerMILL and imported as a pattern. You can create a form tool profile, routing tool profile, and tool holder in the same way.

Creating a pattern

1. Click **Create Pattern** on the **Pattern** toolbar to create a new pattern.
2. Click **Insert File into Active Pattern** on the **Pattern** toolbar. this displays the **Open Pattern** dialog.
3. Click  to display the **Examples** file and then click on the **Patterns** folder.
4. Select **sample_shank.dgk** and click **Open**.

Creating the shank

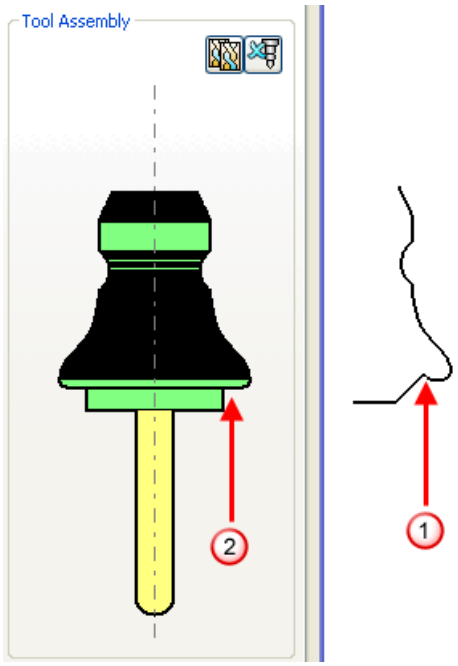
1. From the individual tool context menu, select **Settings**.
2. Select the **Shank** tab from the **Tool** dialog.



3 Click **Pick a Pattern** and then select the pattern you have just created.

4 Click the **Create shank from pattern** button. The shank is added to the tool tip.

Since tool shanks can't contain negative Y moves, PowerMILL removes them from the pattern when creating the shank.



1 *Pattern with negative Y move.*

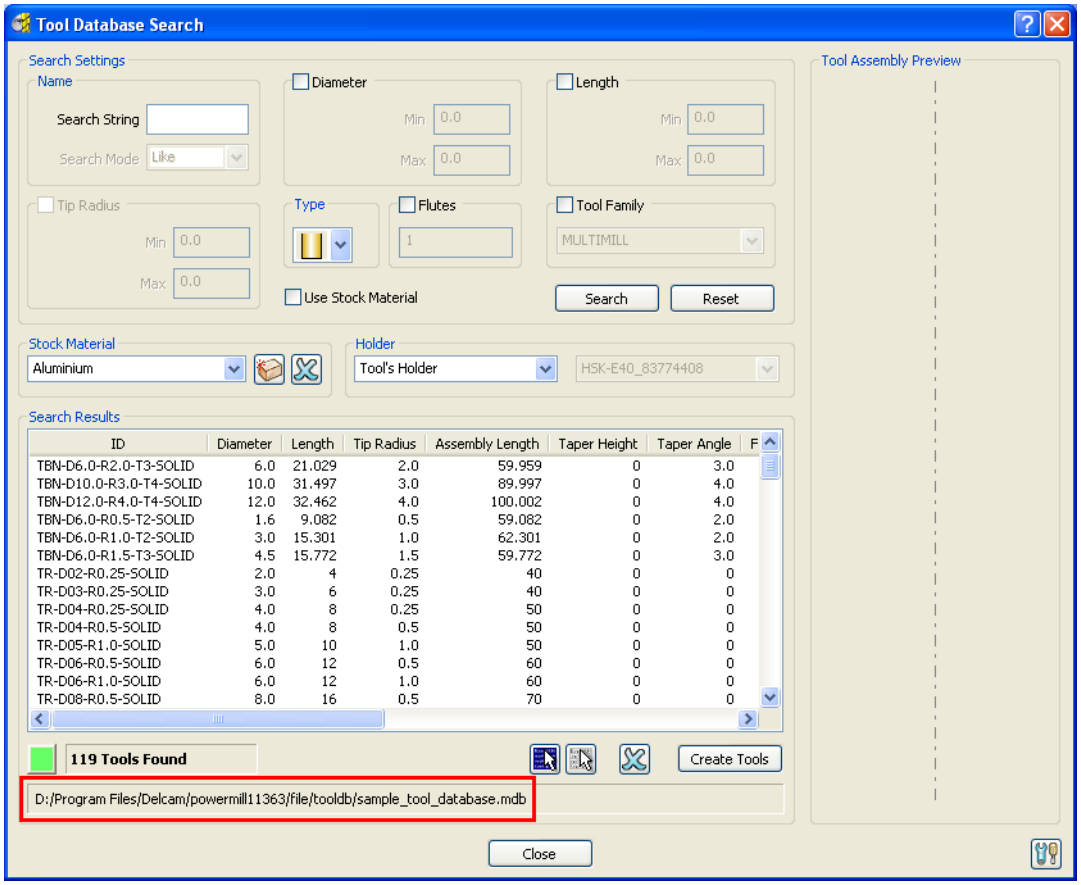
2 *Shank created from the pattern with only positive Y moves.*

Tool database enhancements

Searching the database for tools which use stock materials is much faster.

The **Restore Defaults** button on the **Options** dialog (available from the **Tool > Options** menu) restores the default tool database.

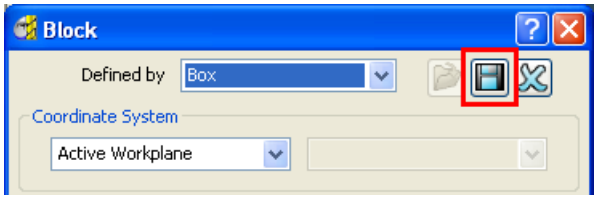
The **Tool Database Search** dialog now displays the name of the current tool database. This makes it easier to see the current tool database and so minimise errors from using the wrong tool database. Previously, this was only available if you hovered the mouse on the title of the **Tool Database Search** dialog.



Block enhancements

There are two new options on the **Block** dialog which allow you to:

- Include a reference model when calculating the extents of the block (see page 39).
- Save a block.

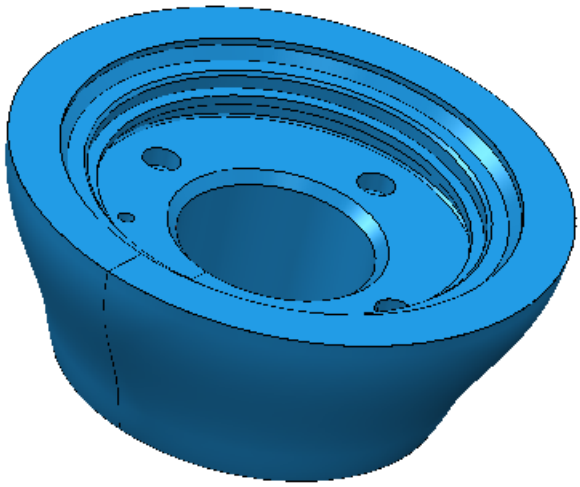


Save Block enables you to export the block as a ***.dmt** or ***.stl** file.

Creating a block using a reference surface

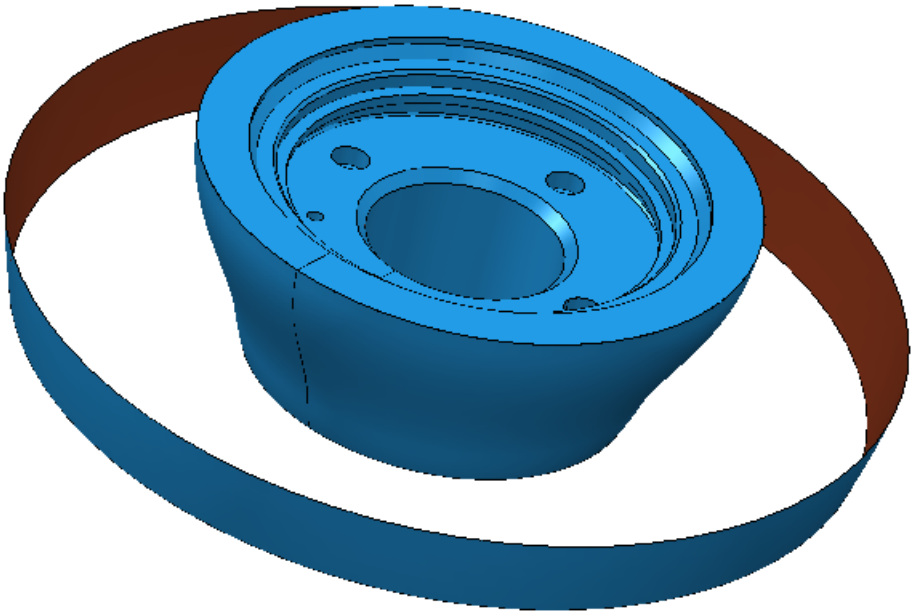
There is a new option on the **Block** dialog, which allows you to include a reference model when calculating the extents of the block. This is particularly useful when creating a surface projection toolpath where the reference surface is larger than the model.

This example shows the effect of using a reference surface when creating a block. It uses the **Hub.dgk** example in the **Examples** file.

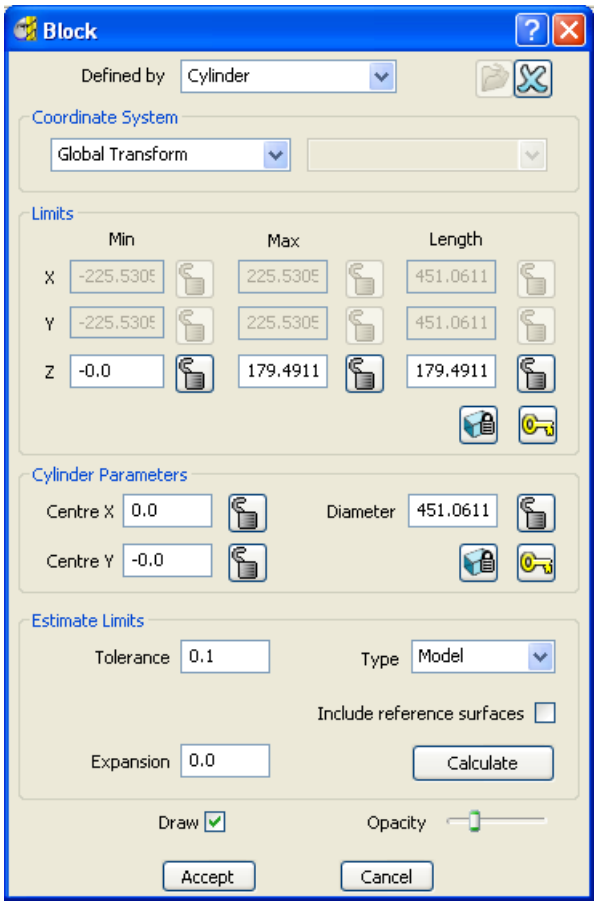


1 From the **Models** context menu, select **Import Reference Surfaces**.

2 Open the **RefSurface.dgk** model in the **Examples** file.



3 Click  on the **Main** toolbar to open the **Block** dialog.

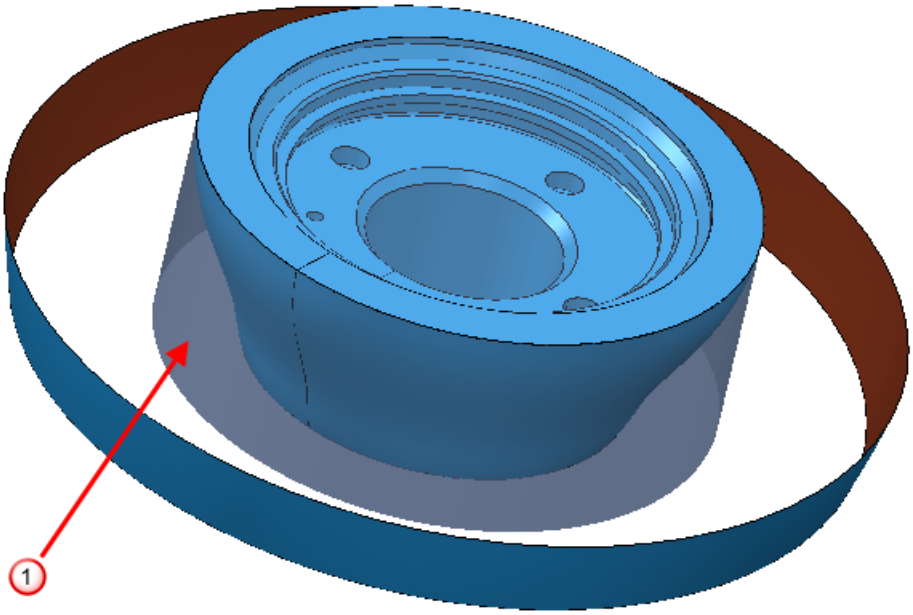


a Set **Defined by** to **Cylinder**.

b Deselect **Include reference surfaces**.

c Select **Draw**.

d Click **Calculate**.

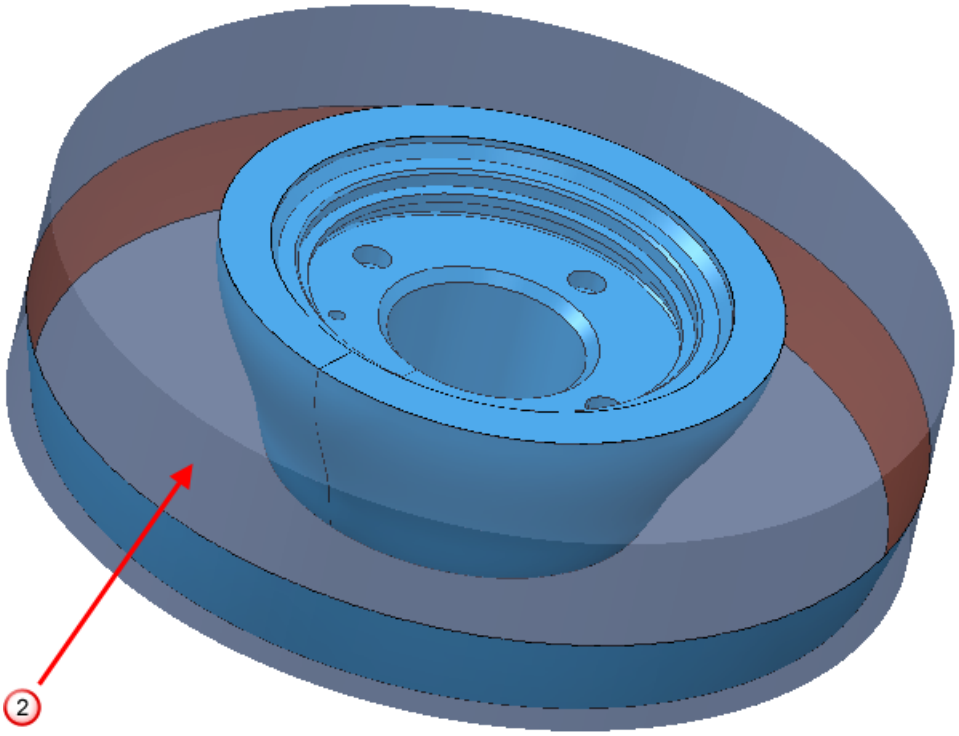


1 - block excluding reference surface.

4 In the **Block** dialog:

a Select **Include reference surfaces**.

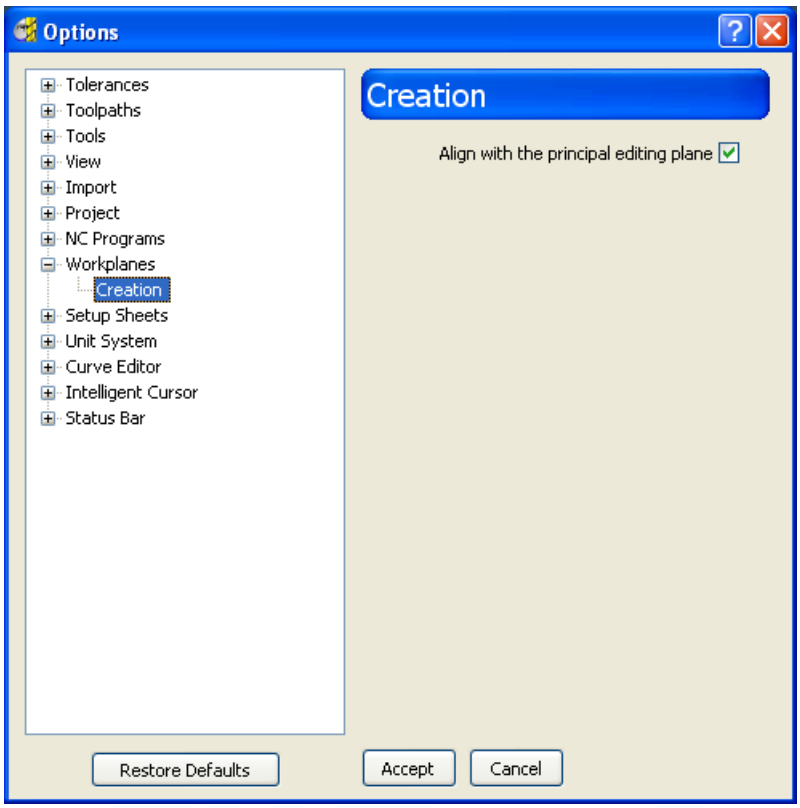
b Click **Calculate**.



2 - block including reference surface.

Workplane alignment

There is a new **Tools > Options > Workplane > Creation** option, which determines how to align a workplane.

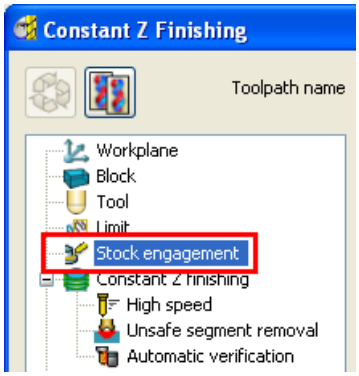


When selected, **Align with the principal editing plane** uses the principal editing plane when aligning a workplane. When deselected, the principal editing plane is ignored when aligning the workplane.

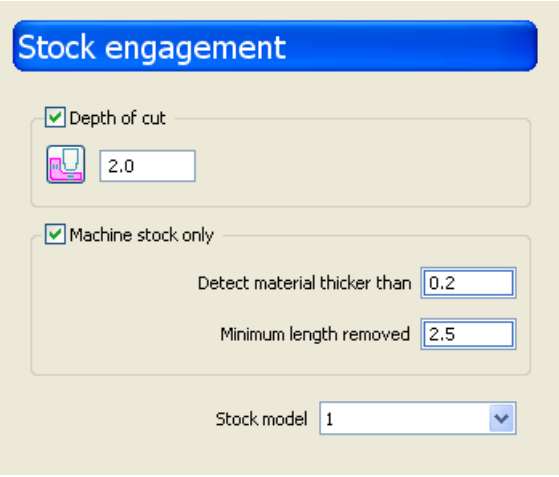
Toolpath generation

Stock model engagement

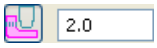
There is a new page on the finishing strategy dialogs of **Stock engagement**.



Stock engagement avoids the tool damage that occurs when machining excess stock and improves surface finish. It also enables you to use higher feed rates as excessive tool engagement is eliminated. Machining times are improved as this avoids air cutting by removing toolpath segments which machine very little, or no material. This uses a stock model and is particularly useful when semi-finishing. This option is available for finishing strategies.



Depth of cut - specifies the maximum allowable depth of cut into the stock material.



- clicking the **Stock depth of cut** button changes the **Stock depth of cut** field to **Stock radial depth of cut** and the **Stock axial depth of cut** field appears. Now you can specify separate **Stock radial** and **Stock axial depth of cut** values 

.

- **Stock depth of cut -** specifies the depth of cut in all directions.
- **Stock radial depth of cut -** specifies a radial depth of cut.
- **Stock axial depth of cut -** specifies an axial depth of cut.

Machine stock only - only machines the rest material. Segments of the toolpath which cut the rest material are kept. Segments of the toolpath which don't cut the rest material are removed.

Detect material thicker than - the calculation ignores stock material thinner than the threshold specified here. This helps to avoid thin regions being machined, where the benefit of a second cut is negligible. These thin regions can be caused by cusps from the previous toolpath.

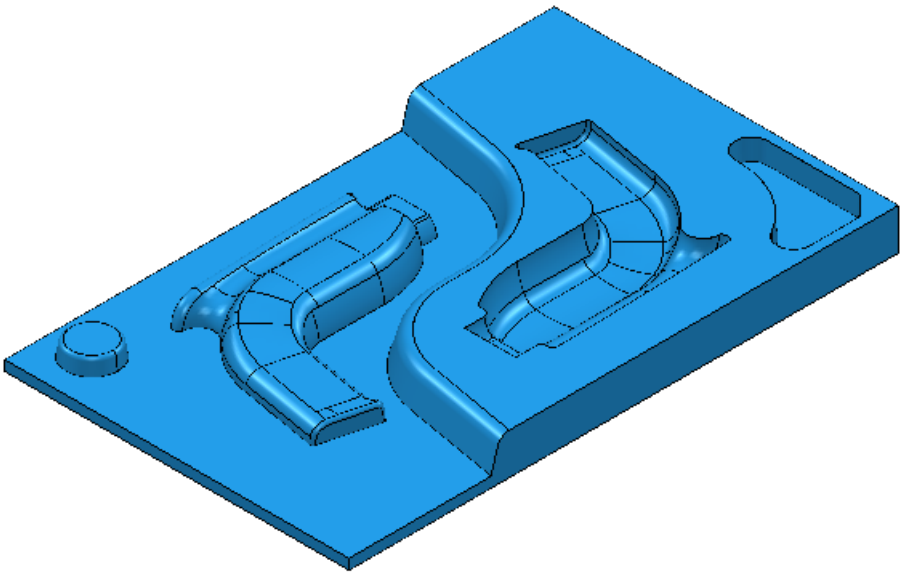
Minimum length removed - segments of the toolpath which don't cut the rest material and are longer than this value are removed. Short segments which don't cut the rest material aren't removed. This avoids the generation of fragmented toolpaths and associated air moves which would join these segments.

Stock model - the stock model used to check the **Depth of cut** (or engagement) or **Machine stock only**. If no stock model is selected, then stock model engagement isn't considered. By default, no stock is selected.

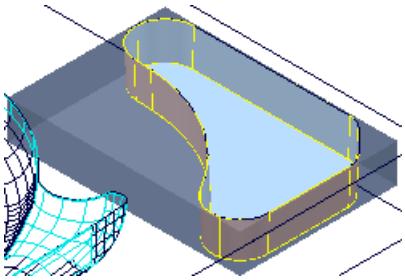
For more information see Avoiding machining into unmachined stock (see page 45) and Machining stock only (see page 49).

Avoiding machining into unmachined stock

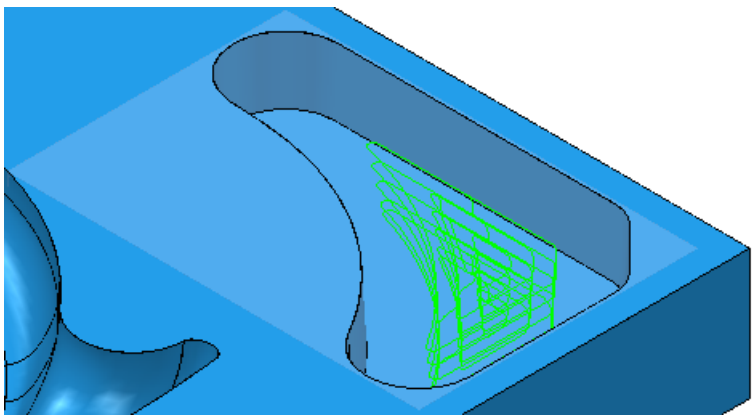
This example shows you how to avoid machining too far into the stock material. This prevents tool damage by controlling the depth of cut into the stock model. This uses the **powerdrill.dgk** model in the **Examples** file.



1 Create a block around the pocket.



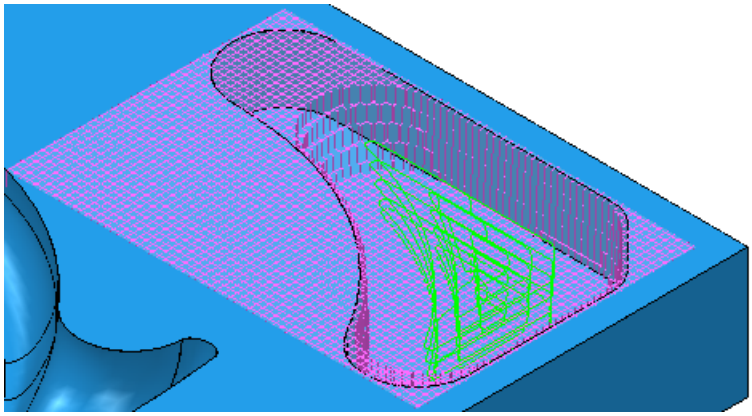
2 Create a model area clearance toolpath using a 30mm end mill.



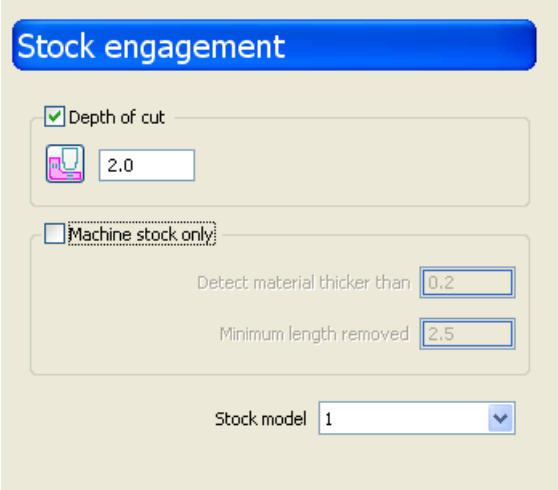
3 From the **Stock Models** context menu, select **Create Stock Model**.

4 From the individual stock model context menu, select **Apply > Active Toolpath Last**.

5 From the individual stock model context menu, select **Calculate**.



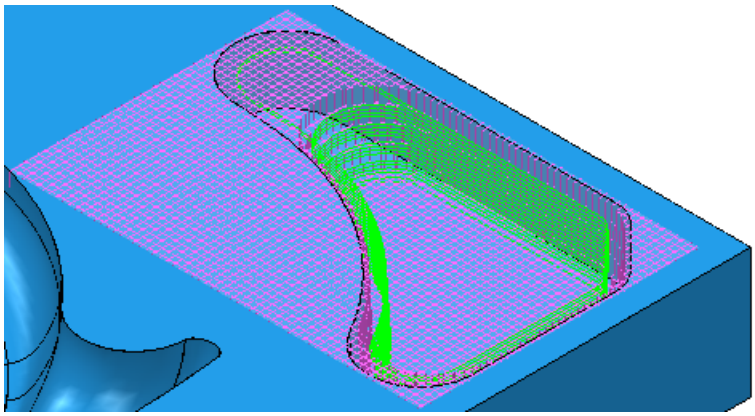
6 Create a constant Z toolpath with a 10mm end mill. On the **Stock Engagement** page:



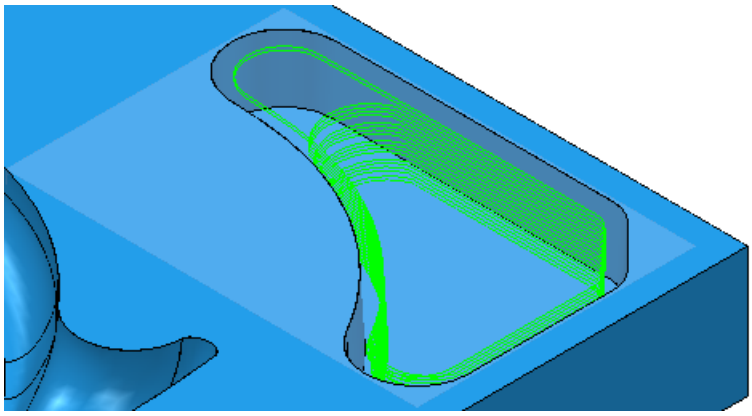
a Select a **Depth of cut** and enter a  of **2.0**.

b Select the **Stock Model** you have just created.

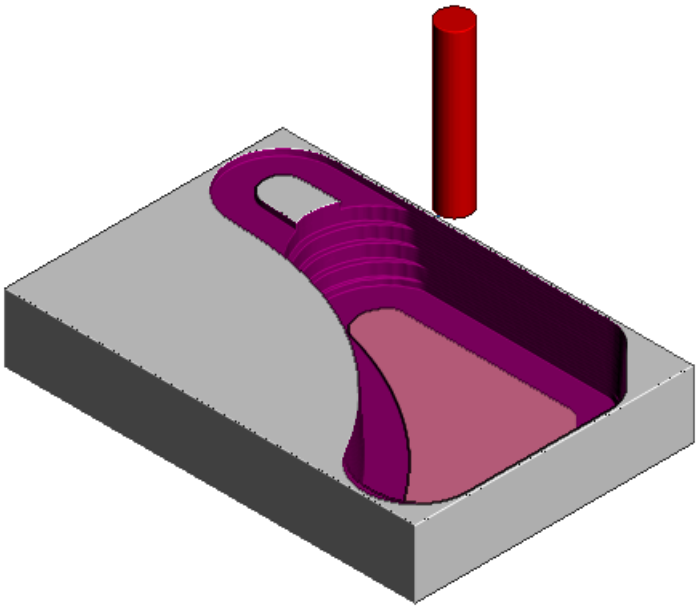
c Click **Calculate**.



It is easier to see the toolpath without the stock model.



Looking at the ViewMill simulation:



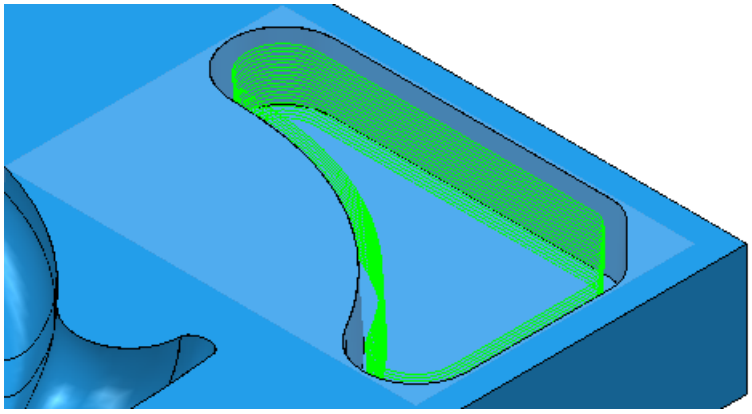
You can see how the toolpath follows the stock model rather than the model.

If you don't control the stock engagement, the toolpath follows the model rather than the stock.

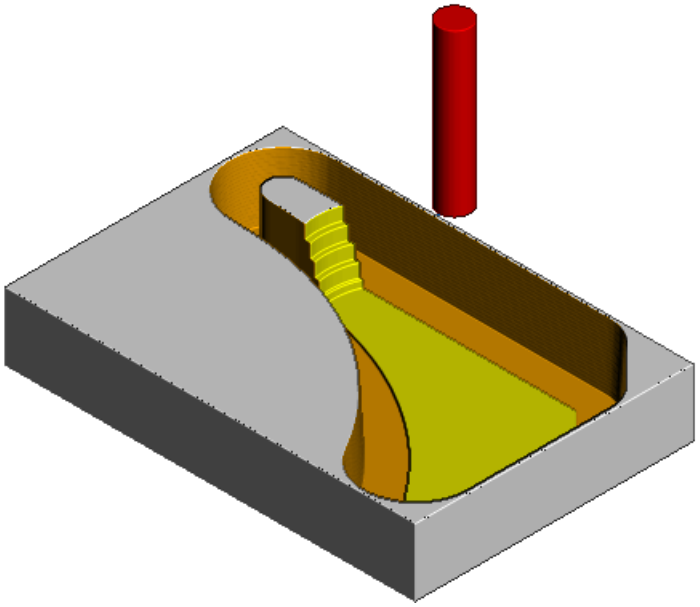
1 Create a second constant Z toolpath based on this one by clicking on  . On the **Stock Engagement** page:

   a Select a **Stock Model** of none.

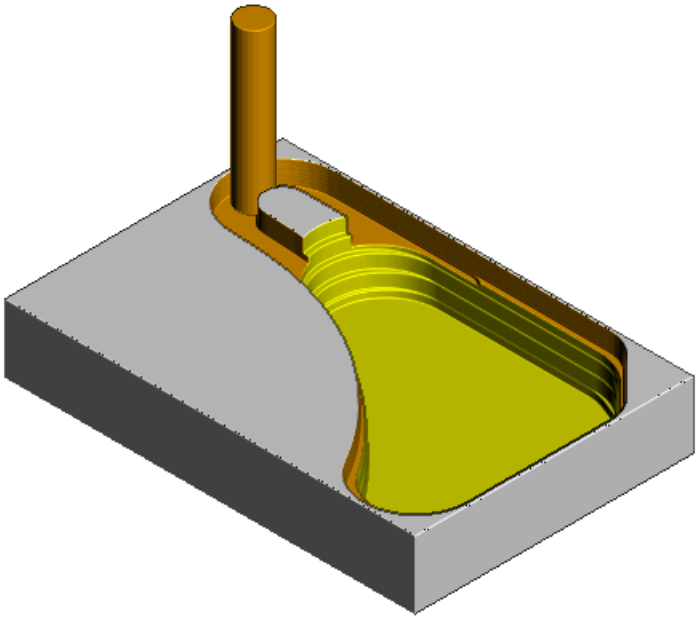
b Click **Calculate**.



Looking at the ViewMill simulation:

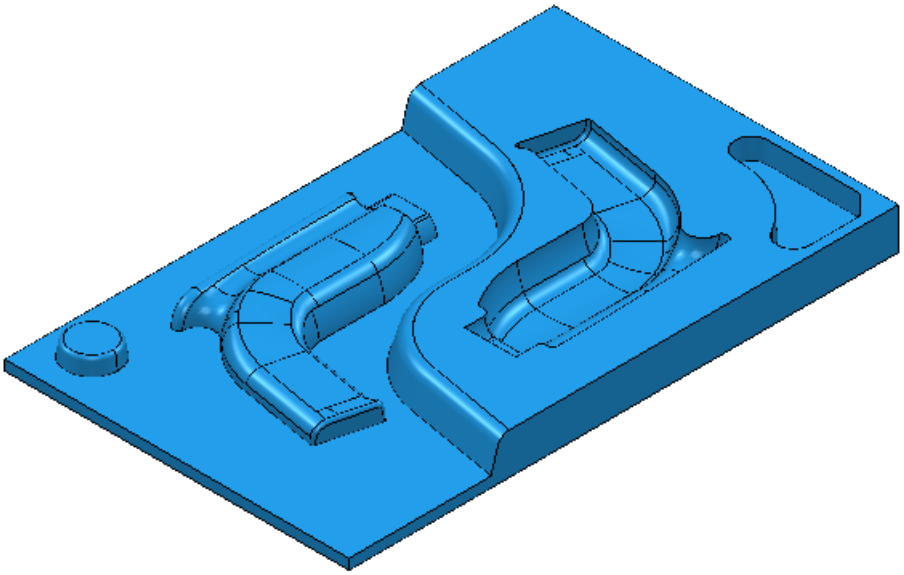


This toolpath generates an excessive depth of cut and tool load as it machines around the tight corner leaving the upstand in the middle.

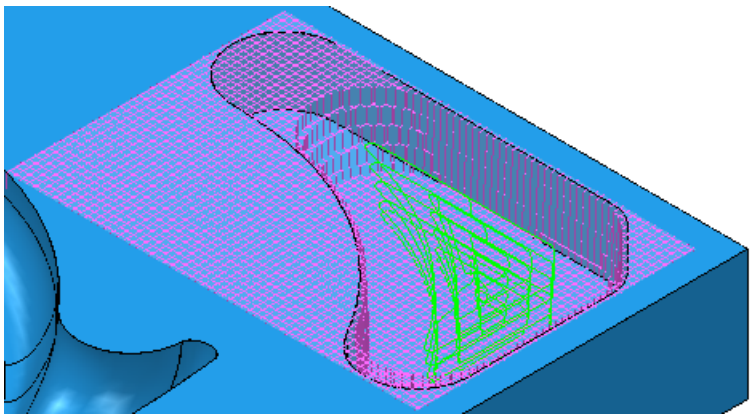


Machining stock only

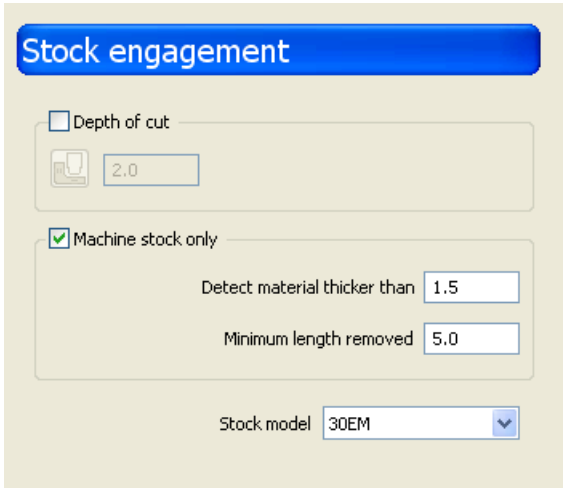
This example shows you how to machine stock only and remove all segments that don't remove stock. This minimises cutting time by removing unnecessary toolpath segments. It uses the **powerdrill.dgk** model in the **Examples** file.



1 Create a model area clearance toolpath and stock model as explained in steps 1 - 5 in Avoiding machining into unmachined stock (see page 45).



2 Create a constant Z toolpath with a 20mm end mill. On the **Stock Engagement** page:



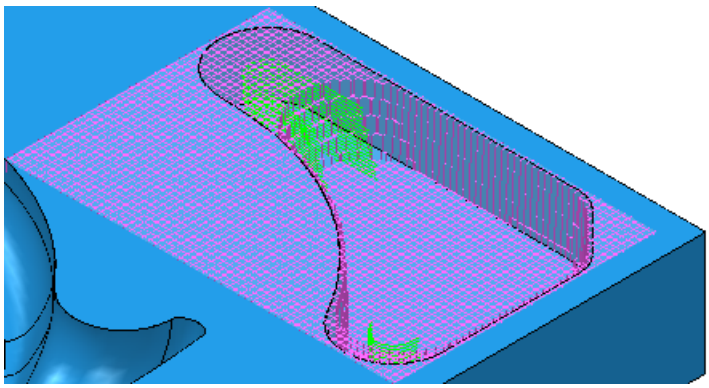
a Select **Machine stock only**.

b Enter a **Detect material thicker than** of 1.5.

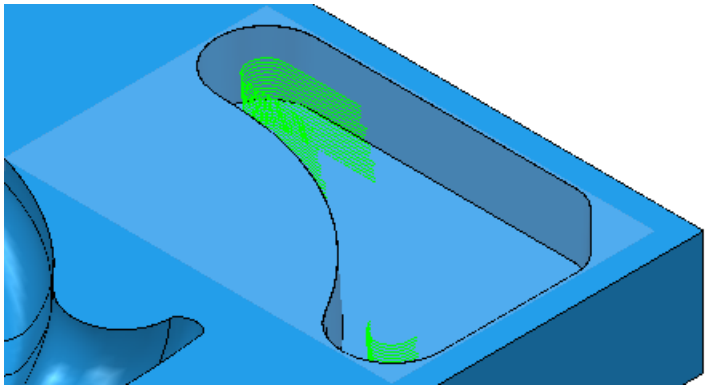
c Enter a **Minimum length removed** of 5.0.

d Select the **Stock Model** you have just created.

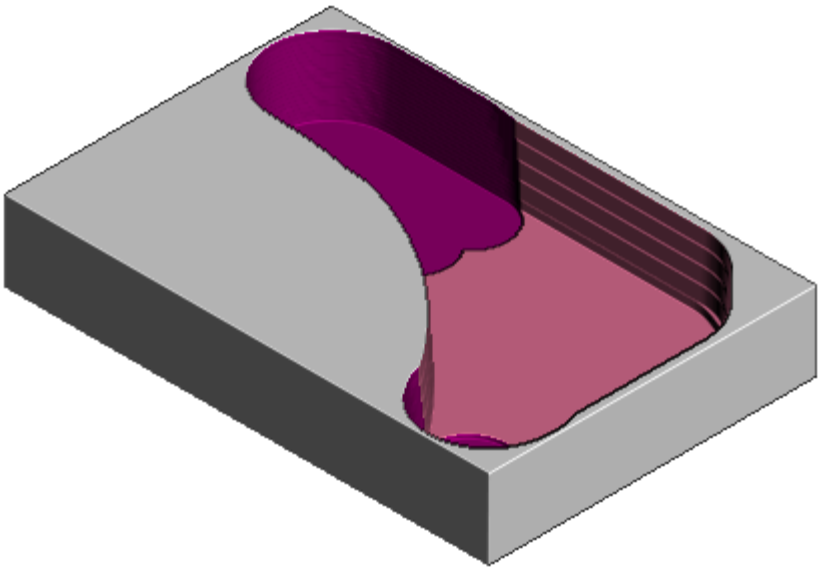
e Click **Calculate**.



It is easier to see the toolpath without the stock model.



Looking at the ViewMill simulation:



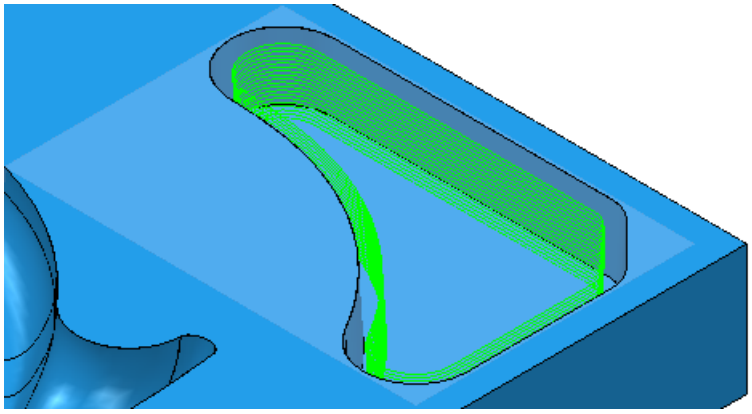
You can see how the toolpath only machines areas where there was stock rather than the whole model.

If you don't control the stock engagement, the toolpath follows the model rather than the stock.

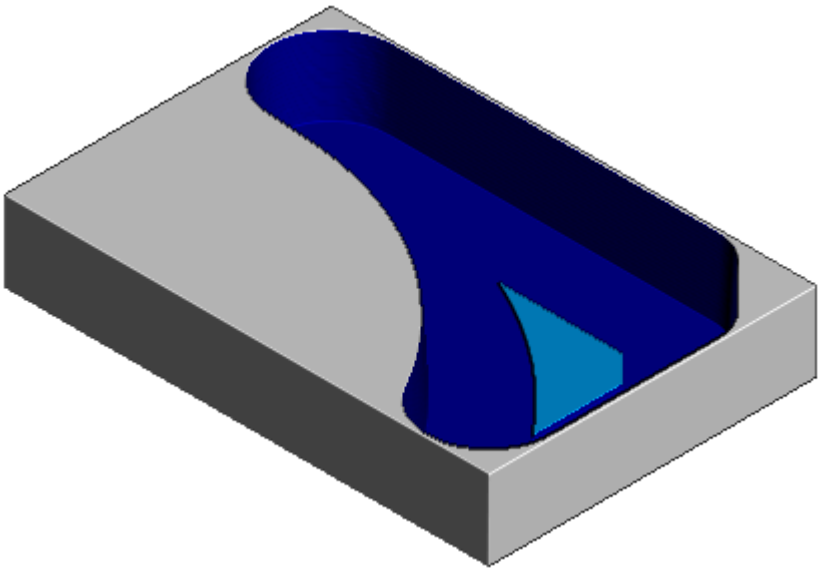
1 Create a second constant Z toolpath based on this one by clicking on  . On the **Stock Engagement** page:

   a Select a **Stock Model** of none.

b Click **Calculate**.



Looking at the ViewMill simulation:



This toolpath machines areas that aren't really necessary and therefore elongates machining times.

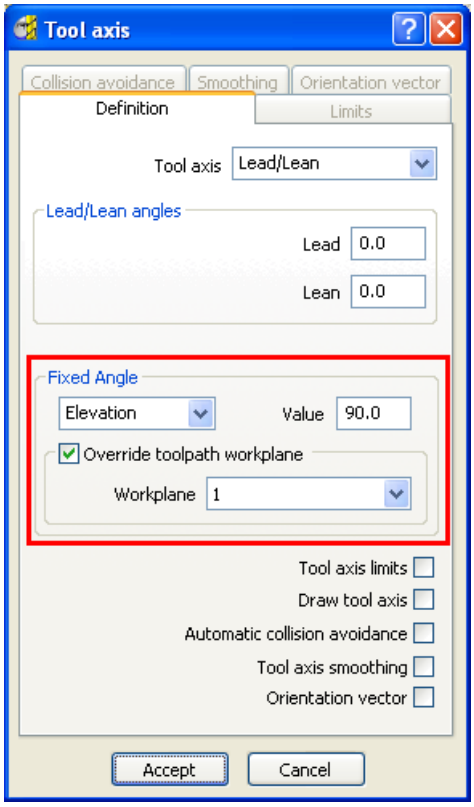
3D limiting of toolpaths

Limiting toolpaths to a 3D boundary uses a new algorithm and produces much better results.

- Toolpaths are now prevented from dropping below the boundary.
- Toolpaths no longer stop short, or extend beyond the boundary edge in sharp corners.
- 2D limiting is used when 3D limiting isn't applicable, even if this is for a limited portion of the toolpath.

Fixed tool axis angles

There is a new **Fixed Angle** frame on the **Tool Axis** dialog  .



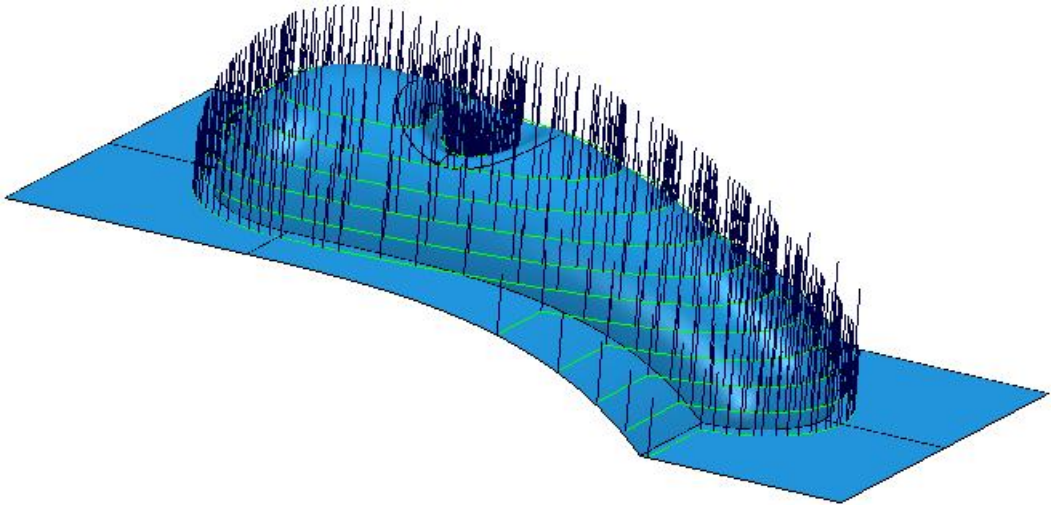
The **Fixed Angle** frame fixes the tool axis azimuth or elevation angle to a specified value after the orientation has been calculated using the primary definition. This fixes one rotational axis of a machine tool wherever possible, giving an improved surface finish and increases the overall feed rate by reducing acceleration and deceleration. The locked axis is only overridden to avoid a collision and to ensure the tool stays on the part.

__Fixed Angle__ is available for all tool axis definitions except for those with a __Tool axis__ of __Fixed Direction__ and __Automatic.__

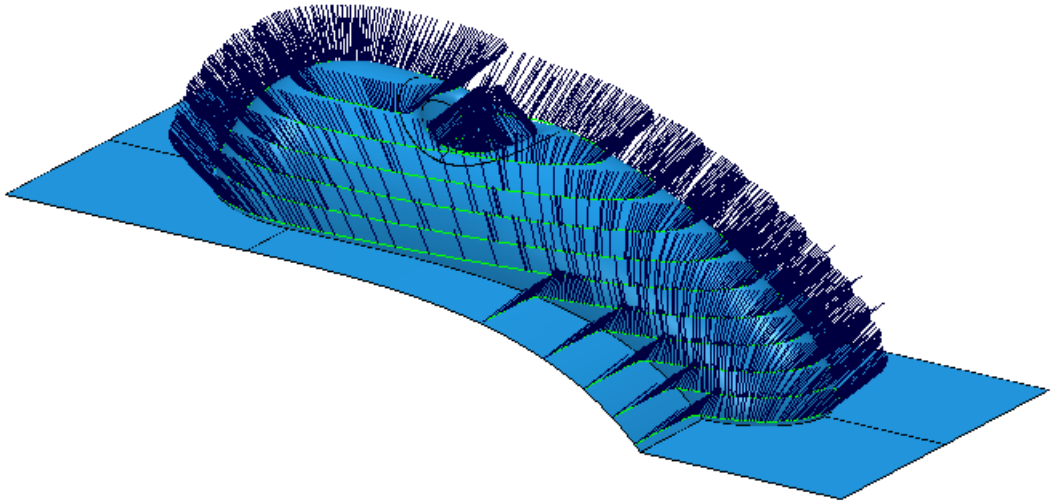
Fixed angle - determines whether you are fixing the **Azimuth** or **Elevation** angle.

The effect of this option is visible when you select **Draw Tool Axes** on the **Toolpath** toolbar.

A **Tool axis** of **Vertical** and a **Fixed Angle** of **None** gives:



A **Tool axis** of **Vertical** and a **Fixed Elevation Angle** of **45°** gives:



5.0 **Angle -** the angle of the fixed tool axis.

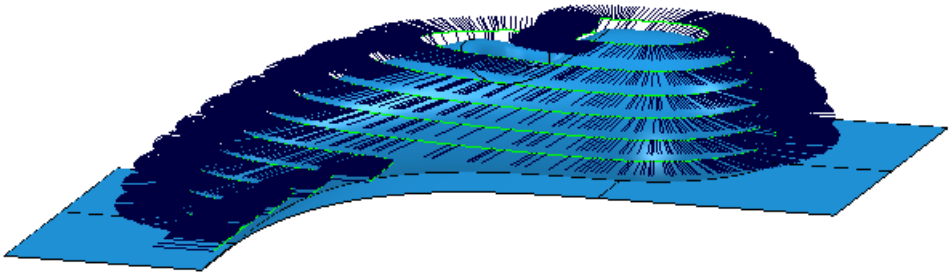
Automatic collision avoidance and tool axis limits can override the angle specified here.

Override toolpath workplane - a different workplane to the workplane used to generate the toolpath is used to define elevation and azimuth.

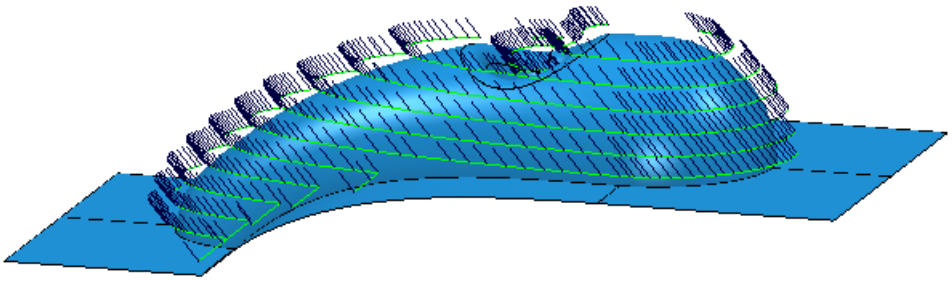
Workplane - the workplane used when fixing the tool axis angle. If no workplane is selected, the global coordinate system is used. This is the same workplane used for tool axis smoothing.

The effect of this option is visible when you select **Draw Tool Axes**  on the **Toolpath** toolbar.

- Select a **Tool axis** of **Vertical.**
- Select a **Fixed Elevation Angle** of **0**°.
- Deselected **Override toolpath workplane** gives:



- Select a **Tool axis** of **Vertical**.
- Select a **Fixed Elevation Angle** of **0**°.
- Select **Override toolpath workplane** selected.
- Select a **Workplane** created by rotating by 30 about the X axis gives:

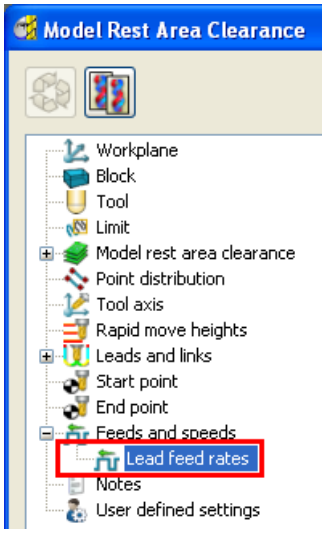


In this instance, part of the toolpath is removed as otherwise the tool would gouge the part.

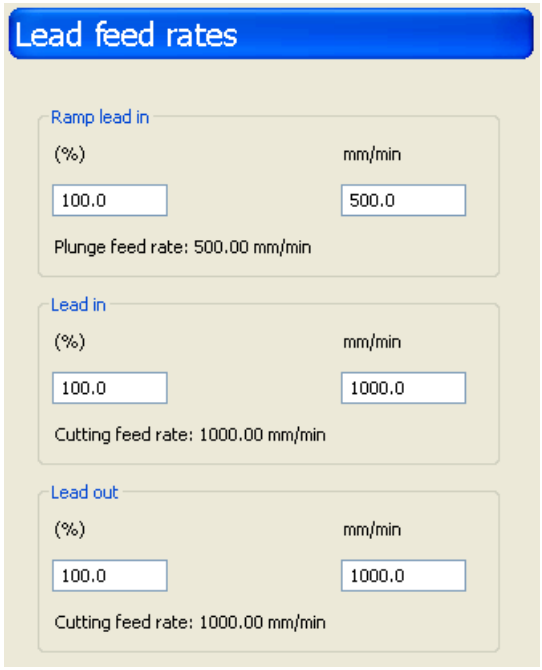
*When you use a **Tool Axis** of **Vertical** the azimuth is undefined. However, to fix the elevation an azimuth is needed. In this instance, the azimuth is defined as 90° from the direction of travel. Other **Tool Axis** types have a defined azimuth.*

Lead feed rates

There is a new page on the strategy dialogs of **Lead feed rates**.



Using the new **Lead feed rates** page, you can specify the **Ramp lead in**, **Lead in**, and **Lead out** feed rates for lead moves as a factor of the cutting feed rate. This enables you to use a slower entry and exit feed rate. This reduces the stress on the tool and so increases tool life. It also minimises damage to the part, especially when cutting brittle materials such as graphite.



For example, if you modify the **Lead in** feed rate factor to 50%, the lead in move will be performed at half the **Cutting feed rate**.

You can also specify factors above 100%.

The **Ramp lead in** references the **Plunge feed rate**; and the **Lead in** and **Lead out** references the **Cutting feed rate** specified in **Feeds and Speeds**.

Modifying the factor automatically updates the absolute feed rate value. Similarly, modifying the absolute feed rate value automatically updates the factor.

Ramp lead in

The **Ramp lead in** feed rate controls the speed of the tool when it ramps into the stock.

% - the factor by which the **Ramp lead in** feed rate is modified.

mm/min - the absolute feed rate of the **Ramp lead in** move.

Lead in

The **Lead in** feed rate controls the speed of the tool as it approaches the stock, before beginning a cutting move.

% - the factor by which the **Lead in** feed rate is modified.

mm/min - the absolute feed rate of the **Lead in** move.

Lead out

The **Lead out** feed rate controls the speed of the tool after it leaves the stock, at the end of a cutting move.

% - the factor by which the **Lead out** feed rate is modified.

mm/min - the absolute feed rate of the **Lead out** move.

*If you are using imperial units the **mm/min** is replaced by **in/min**.*

Transform toolpath enhancements

The toolpath transformation functionality is improved to make it easier to use.

The **Toolpath Transform** toolbar is displayed when you click on the **Toolpath** toolbar, or select **Edit > Transform** from the individual toolpath context menu.

Toolpath transformations allows you to move, rotate, or mirror a toolpath. You can easily create complex rectangular and circular toolpath arrays. PowerMILL displays a preview of the transformation which gives a quick visual check before transforming the toolpath.

On activating the **Transform Toolpath** toolbar most of PowerMILL's functionality is disabled until you exit from curve editing. This includes:

- the menu bar,
- most toolbars,
- explorer's context menus,
- graphics area's context menus,
- most normal commands are blocked.

Move - transforms the toolpath by the specified coordinates.

Keep Original - determines whether the entities are copied or replaced when transformed.

Replace Original - the original entities are replaced with the transformed ones.

Keep Original - keeps both the original and transformed entities.

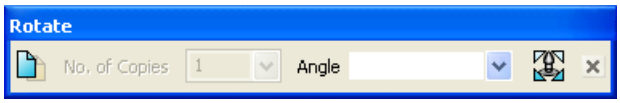
No. of Copies - the number of copies you want.

Move Origin - when selected, enables you to move the origin graphically, by dragging, or by entering coordinates using , , or and in the **Status** bar.

Finish - accepts the changes and closes the toolbar.

For more information, see the moving curves example or the moving toolpaths example (see page 74).

Rotate - rotates the toolpath around the specified axis by the selected angle.



Keep Original - determines whether the entities are copied or replaced when transformed.

Replace Original - the original entities are replaced with the transformed ones.

Keep Original - keeps both the original and transformed entities.

No. of Copies - the number of copies you want.

Angle - the required rotation angle in degrees.

Reposition Rotation Axis - when selected, enables you to move the origin of the rotation axis either graphically or by entering coordinates using or and in the **Status** bar.

Finish - accepts the changes and closes the toolbar.

For more information, see the rotating curves example or the rotating toolpaths example (see page 76).

Mirror - mirrors the toolpath along one of the principal planes of the active workplane or along an arbitrary mirror line. If no workplane is active, the mirroring is about the relevant plane of the global coordinate system.

Keep Original - determines whether the entities are copied or replaced when transformed.

Replace Original - the original entities are replaced with the transformed ones.

Keep Original - keeps both the original and transformed entities.

Reverse direction - reverses the direction of the mirrored toolpath.

Reverse order - reverses the toolpath order.

Mirror in XY - mirrors the entity in the XY plane.

Mirror in YZ - mirrors the entity in the YZ plane.

Mirror in XZ - mirrors the entity in the XZ plane.

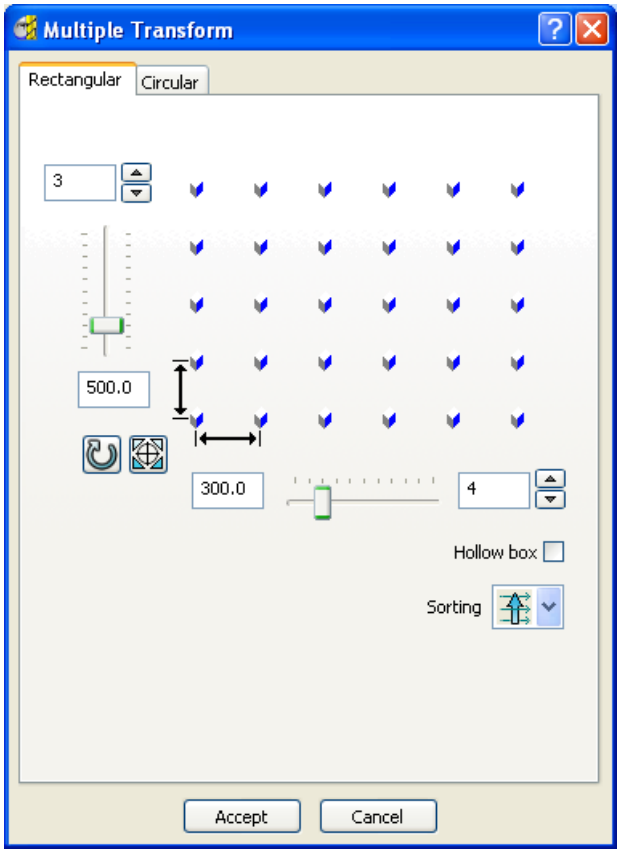
Mirror in Line (see page 77) - mirrors the entity in a plane defined by selecting either an existing line or two points.

Move Origin - when selected, enables you to move the origin graphically, by dragging, or by entering coordinates using , , or and in the **Status** bar.

Finish - accepts the changes and closes the toolbar.

For more information see Mirroring a toolpath in a line example (see page 77).

Multiple transform - an easier method of performing multiple **Moves** or **Rotations** .



The orientation of the transform is determined by the principal working plane , , or , set in the **Information** toolbar.

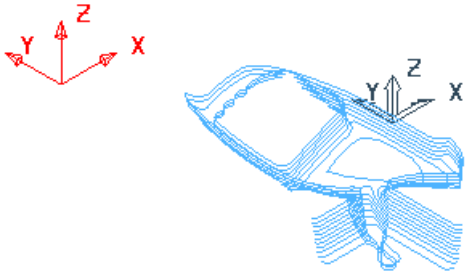
There are two tabs:

Rectangular (see page 63) - this is similar to using the **Move** option but gives a visual preview of the result, and much improved flexibility and control.

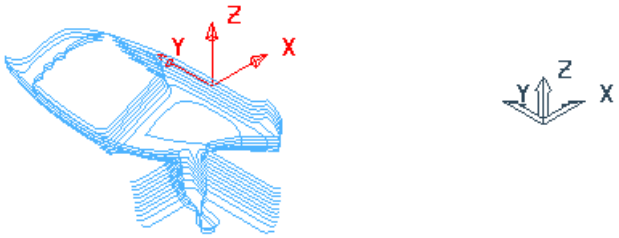
Circular (see page 68) - this is similar to using the **Rotate** option but gives a visual preview of the result, and much improved flexibility and control.

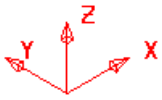
Transform to workplane - moves the toolpath so it is in the same place relative to the active workplane as it was to the global transform.

Converts this:



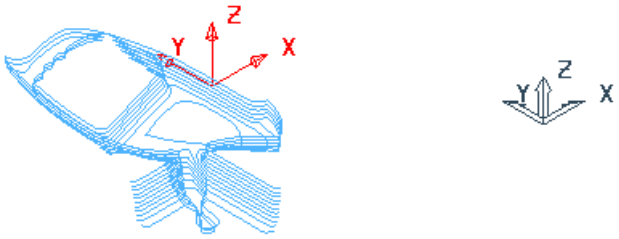
to this:



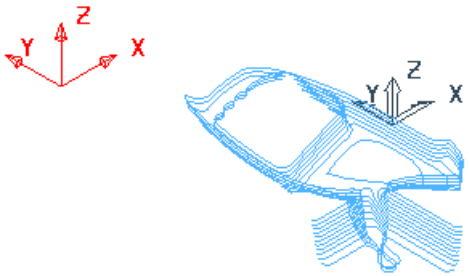
Where  is the global transform and  is the workplane axis.

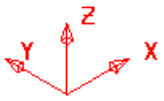
Transform to world - moves the toolpath so it is in the same place relative to the global transform as it was to the active workplane.

Converts this:



to this:



Where  is the global transform and  is the workplane axis.

Toolpath ordering - allows you to specify the order of the transformed toolpaths in the explorer. There are two options:

 **Toolpath group -** keeps the initial toolpath ordering. This is the default option.

 **Keep tool change -** orders the toolpaths according to their tools. This minimises tool changes.

 *If you select*  *and*  *then the toolpaths are ordered by tool usage within a toolpath group.*

 **Undo -** reverts to what it was before the last change. You can undo all the transformations made since the **Transform Toolpath** toolbar was raised.

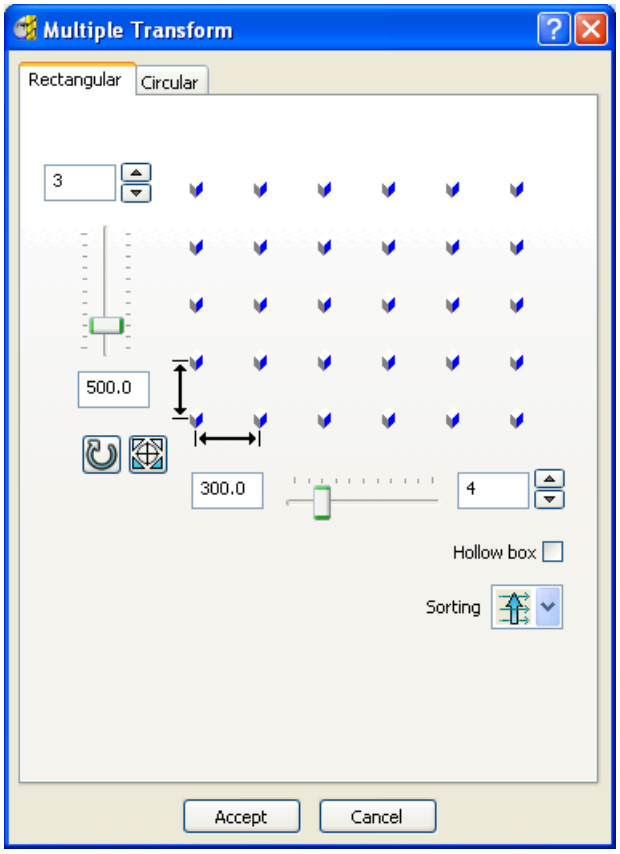
 **Redo -** reinstates the edit you have just undone. You can redo all the transformations made since the **Transform Toolpath** toolbar was raised.

 **Accept Changes -** accepts and keeps all the toolpath transformations.

 **Cancel Changes -** deletes all the toolpath transformations.

Multiple transform (toolpath)

Multiple transform is an easier method of performing multiple **Moves** or **Rotations** of toolpaths. It is available from the **Toolpath** toolbar or **Edit > Transform** on the individual toolpath context menu.



This works in the same way as **Multiple transform** on the **Curve Editor** toolbar (see page 23) except it works on toolpaths rather than curves.

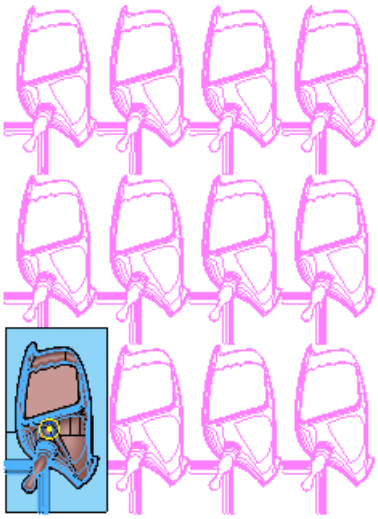
The orientation of the transform is determined by the principal working plane , , or , set in the **Information** toolbar.

For information on the **Circular** tab, see **Multiple Transform - Circular** (see page 68).

The examples use the **chainsaw.ige** model in the examples file with a model rest profile toolpath.

3 **Number of rows -** either enter a value or use .

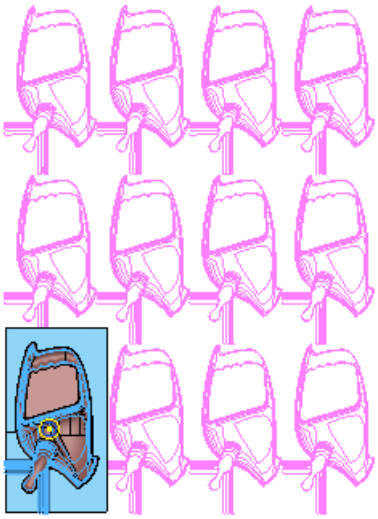
This toolpath transform has 3 rows and 4 columns:



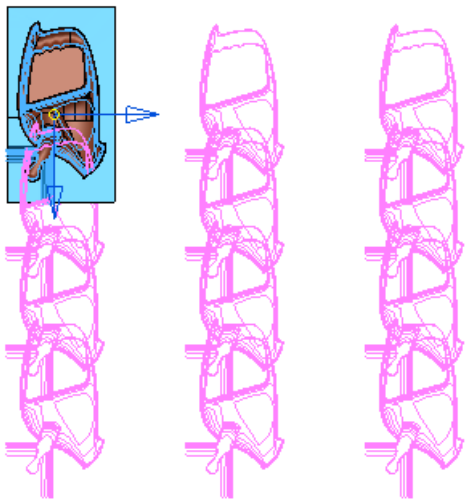
Distance between rows - by default these are the extents of the geometry you are transforming.

 **Rotate axis** - rotates the transform by 90° in a clockwise direction in the principal working plane.

Converts this:



to this:

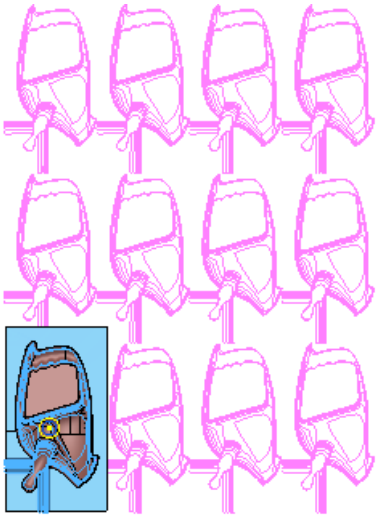


Move Origin - when selected, enables you to move the origin graphically, by dragging, or by entering coordinates using , , or and in the **Status** bar.

204.36 **Distance between columns -** by default these are the extents of the geometry you are transforming.

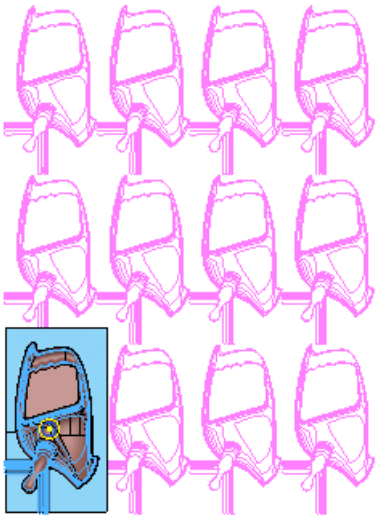
4 **Number of columns -** either enter a value or use .

This toolpath transform has 3 rows and 4 columns:

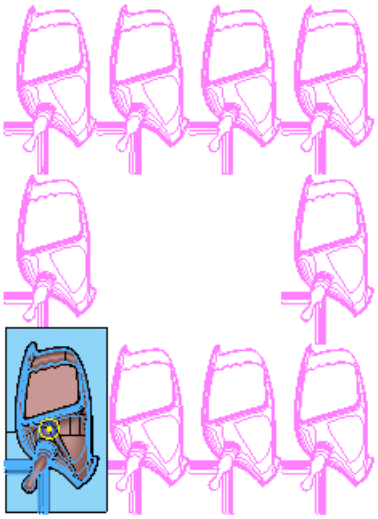


Hollow box - places the duplicated toolpaths around the perimeter of the pattern and removes the central ones.

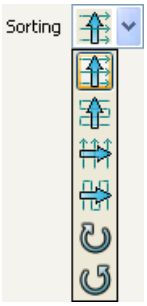
Converts this:



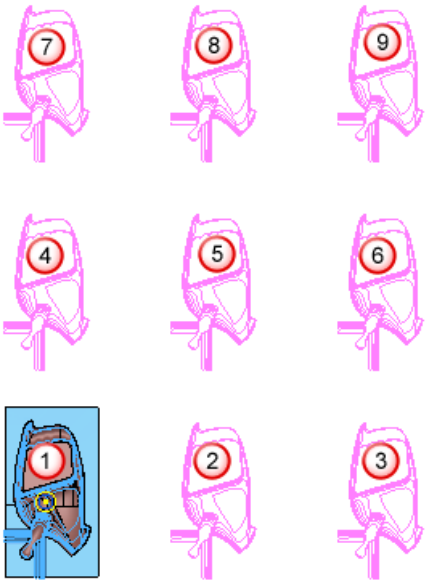
to this:



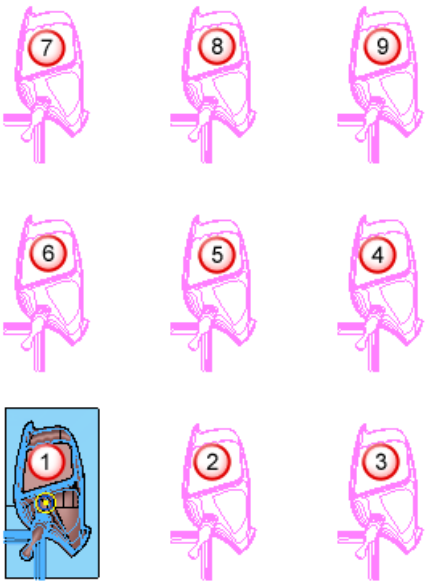
Sorting - defines the order you will machine the duplicated toolpaths. The start point is always the centre point of the original toolpath.



 **Along Y, one way in X -** creates a toolpath where the duplicated entities are machined in order along the Y direction, one way in X.



 **Along Y, two way in X -** creates a toolpath where the duplicated entities are machined in order along the Y direction, using two-way machining in X.

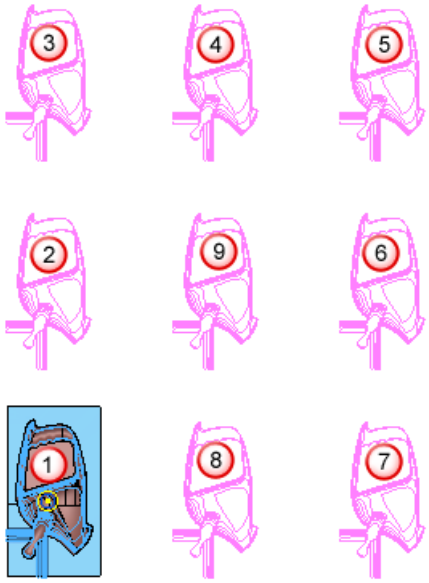


 **Along X, one way in Y -** creates a toolpath where the duplicated entities are machined in order along the X direction, one way in Y.

 **Along X, two way in Y -** creates a toolpath where the duplicated entities are machined in order along the X direction, using two-way machining in Y.

 **Clockwise -** creates a toolpath where the duplicated entities are machined in a clockwise direction.

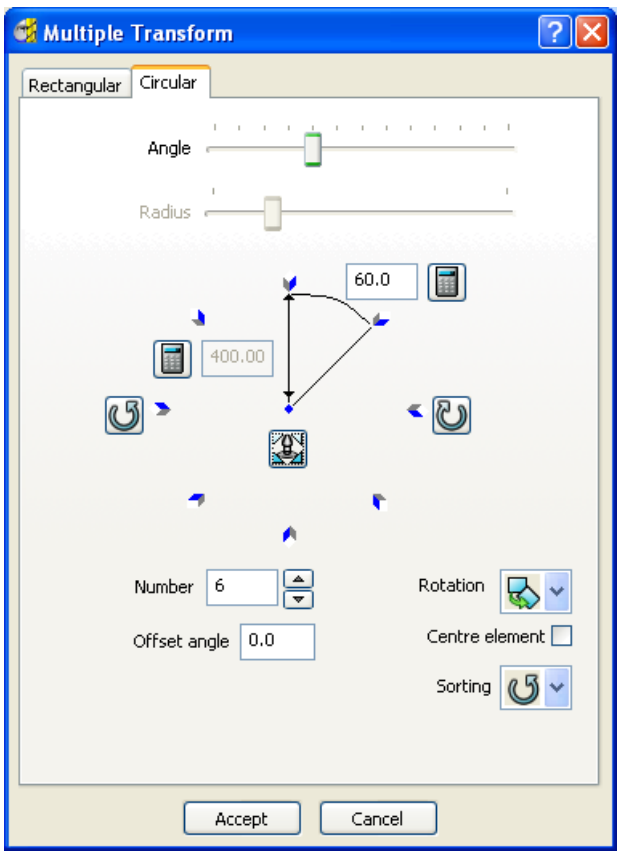
Anticlockwise - creates a toolpath where the duplicated entities are machined in an anticlockwise direction.



For more information, see Rectangular transform example (see page 78).

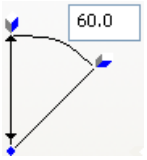
Multiple Transform - Circular (toolpath)

The **Circular** tab on the **Multiple Transform** dialog creates multiple **Rotations** of toolpaths.



This works in the same way as the **Circular** tab (see page 27) on the **Multiple transform** dialog (see page 23) on the **Curve Editor** toolbar except it works on toolpaths rather than curves.

The orientation of the transform is determined by the principal working plane , , or , set in the **Information** toolbar.



Angle - the angle between elements in the transform. You can also use the slider, or specify the **Number** of elements to determine the angle.

Angle lock - determines whether the rotation angle is calculated automatically or not.

Calculated - the values are calculated automatically by PowerMILL. This assumes that you want a full circular pattern (**Angle** = 360/**Number**).

Edited - the value is entered by you (or another user). The **Angle** and **Number** values operate independently. This enables you to create a partial circle rather than a full circular pattern.

and work as a toggle.

Radius - the radius of the pattern.

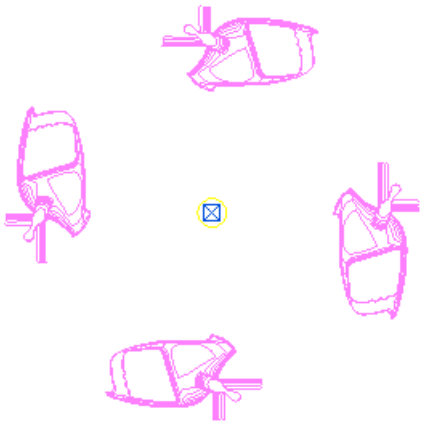
Radius lock - determines whether the rotation radius is defined automatically or not.

Calculated - the values are calculated automatically by PowerMILL. The radius is the distance from the centre of the rotation (defined by) to the centre of the toolpath.

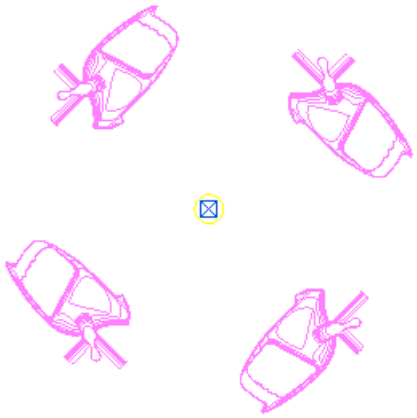
Edited - the value is entered by you (or another user).

Clockwise - rotates the transform clockwise by half of the **Angle**. Clicking this updates the **Offset angle**.

Original transform:

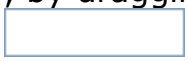


Clicking  changes it to:



and updates **Offset angle** to **-45°**.

 **Anticlockwise -** rotates the transform anticlockwise by half of the **Angle**. Clicking this updates the **Offset angle**.

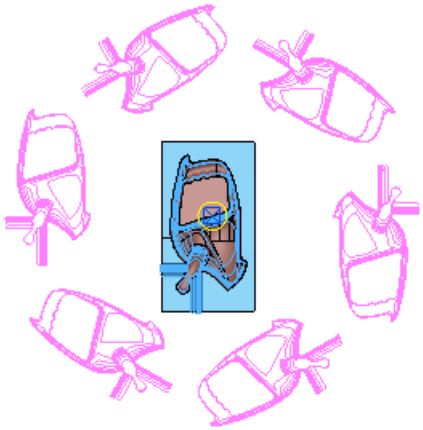
 **Move Origin -** when selected, enables you to move the origin graphically, by dragging, or by entering coordinates using  ,  , or  and  in the **Status** bar.

 **Number -** the number of entities in the circular pattern. If the angle lock is  , then editing this field edits the angle. If the angle lock is  then **Angle** and **Number** work independently.

It is best to see how these fields interact by example. If you have:

- An **Angle** of **60°**
-  selected.

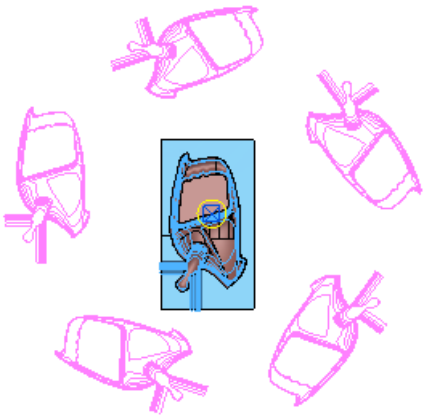
PowerMILL calculates the **Number** automatically (it is 6).



If you have:

- A **Number** of 5
-  selected.

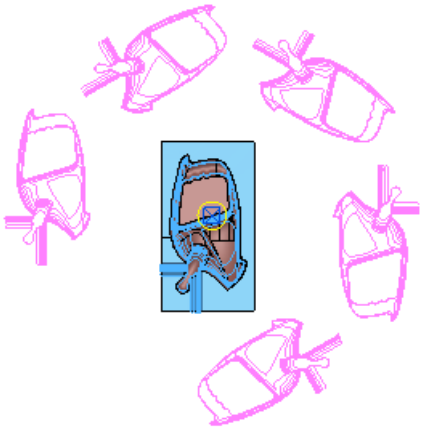
PowerMILL calculates the **Angle** automatically (it is 72°).



If you have:

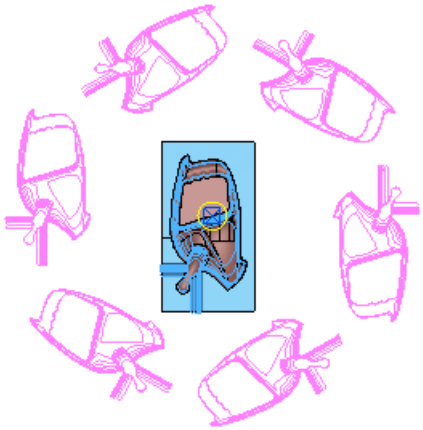
- An **Angle** of 60°
-  selected
- A **Number** of 5.

PowerMILL calculates a partial circular pattern.



Offset angle - determines the start angle of the transform.

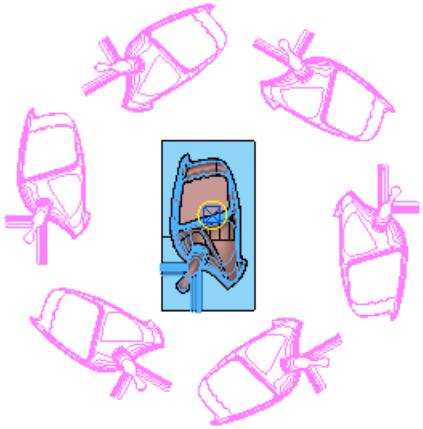
Offset angle of 0°:



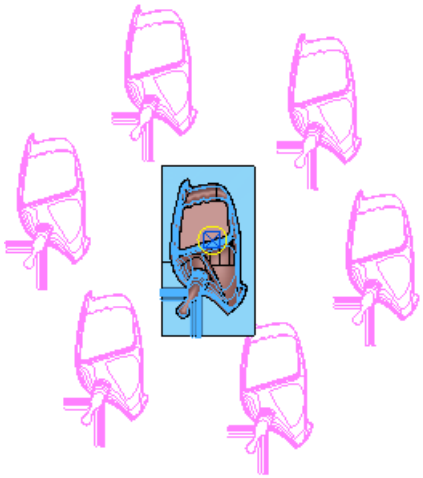
Offset Angle of 20°:

Rotation - determines whether you rotate or move the toolpath around the transform.

 Rotate and copy:

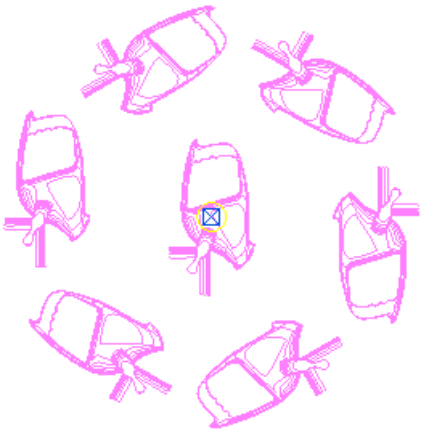


 Rotate and move:

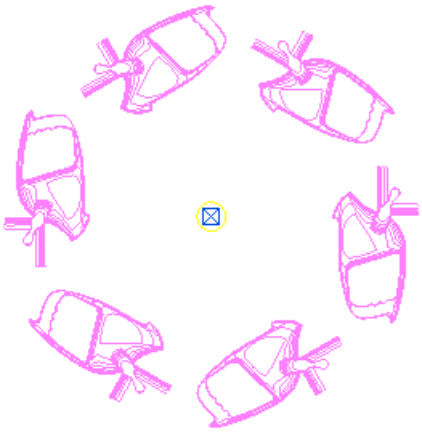


Centre element - creates an additional copy of toolpath at the centre of the circle.

Centre element selected:



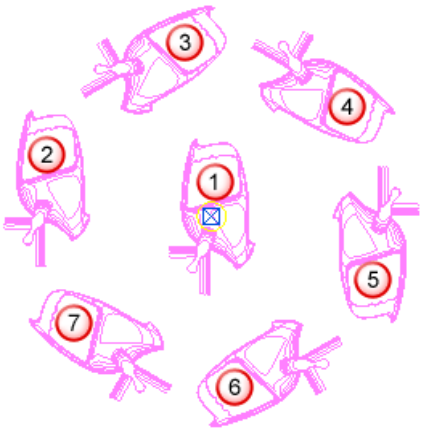
Centre element deselected:



Sorting - defines the order in which you will machine the duplicated toolpaths.

Clockwise - creates a toolpath where the duplicated entities are machined in a clockwise direction.

Anticlockwise - creates a toolpath where the duplicated entities are machined in an anticlockwise direction.

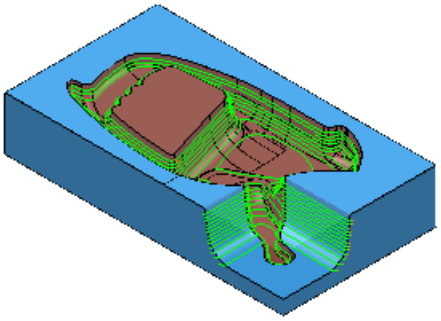


For more information see Circular transform example (see page 80).

Moving toolpaths example

This example shows you how to move a toolpath. It uses the **Keep Original** option so that you can easily see the effect of the transformation.

It uses the **Chainsaw.ige** model in the **Examples** folder with a rest profile toolpath as the active toolpath.

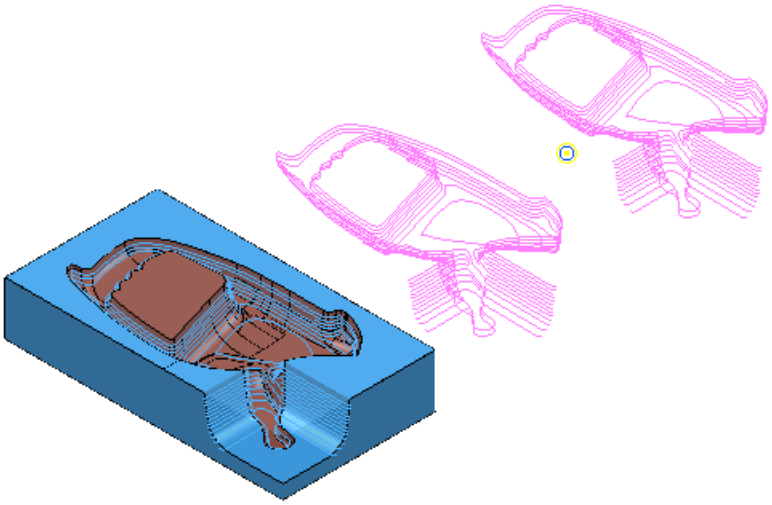


1 Click the **Move** button from the **Toolpath Transformation** toolbar. This displays the **Move** toolbar.

2 Ensure that is selected.

3 Enter a **No. of Copies** of 2.

4 Enter the coordinates of 300 0 0 in on the **Status** bar and press the enter key. This moves and copies the active toolpath.



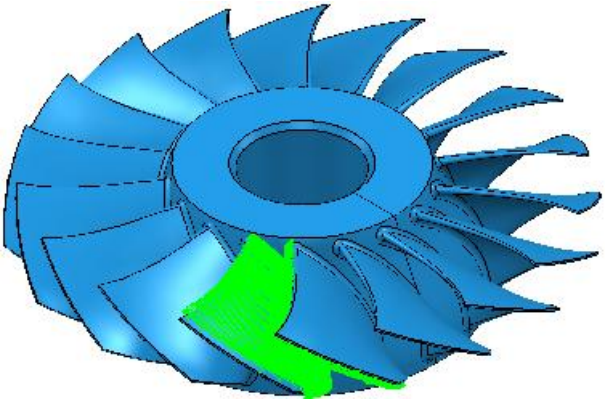
5 Click on the **Toolpath Transform** toolbar to accept these changes. PowerMILL creates the duplicate toolpaths.

For more complex examples, see Rectangular transform example (see page 78) and Circular transform example (see page 80).

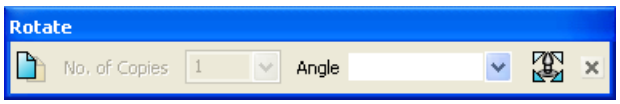
Rotating toolpaths example

This example shows you how to rotate a toolpath. It uses the **Keep Original** option so that you can easily see the effect of the transformation.

It uses the **Blisk_Simple.dgk** model in the **Examples** folder with a blade finishing toolpath as the active toolpath. It has the XY face as the principal working plane.



1 Click the **Rotate** button from the **Toolpath Transformation** toolbar. This displays the **Rotate** toolbar.

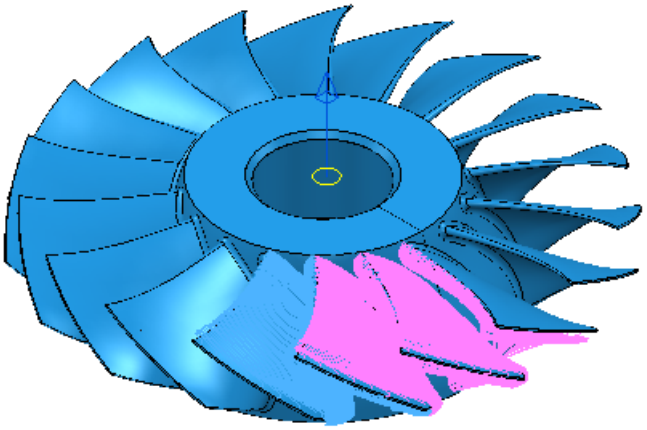


2 Ensure that is selected.

3 Enter a **No. of Copies** of **2**.

4 Click and enter the coordinates of **0 0 0** in on the **Status** bar and press the enter key.

5 Enter an Angle of **20°**. This rotates and copies the active toolpath.



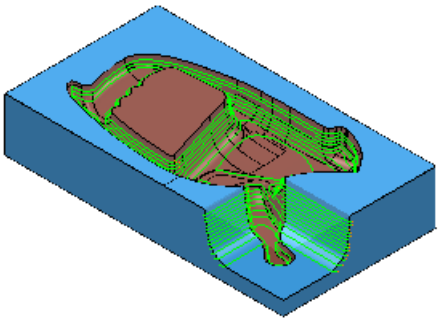
6 Click on the **Toolpath Transform** toolbar to accept these changes. PowerMILL creates the duplicate toolpaths.

For more complex examples, see Rectangular transform example (see page 78) and Circular transform example (see page 80).

Mirroring a toolpath in a line example

This example shows you how to mirror a toolpath in a user defined line. It uses the **Keep Original** option so that you can easily see the effect of the transformation.

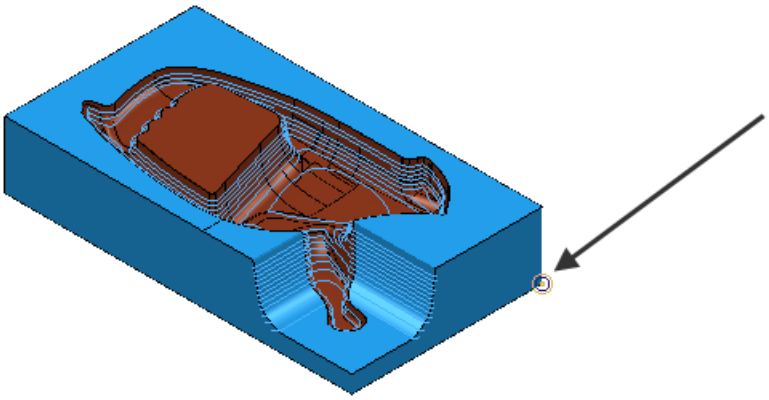
It uses the **Chainsaw.ige** model in the **Examples** folder with a rest profile toolpath as the active toolpath.



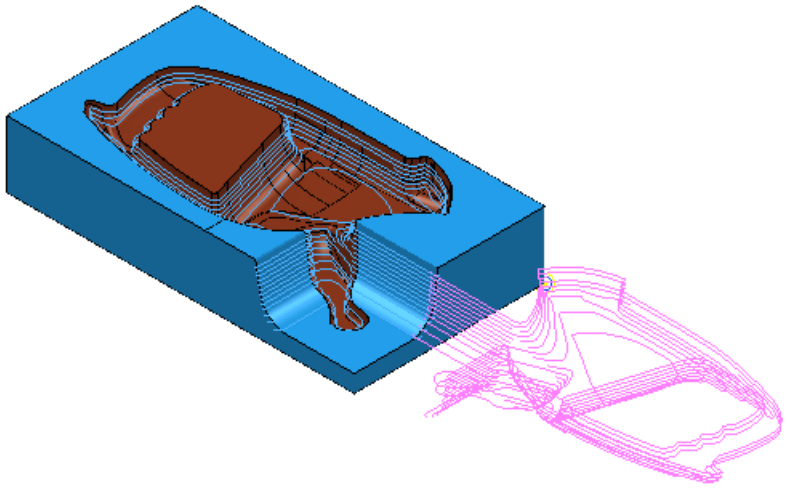
1 Click the **Mirror** button from the **Toolpath Transformation** toolbar. This displays the **Mirror** toolbar.

2 Ensure that is selected.

3 Click and click the bottom right-hand corner of the block.



4 Click . This mirrors and copies the active toolpath.

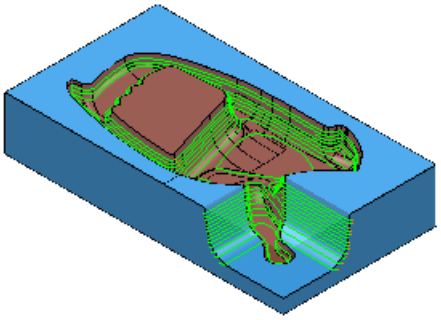


5 Click on the **Toolpath Transform** toolbar to accept these changes. PowerMILL creates the duplicate toolpaths.

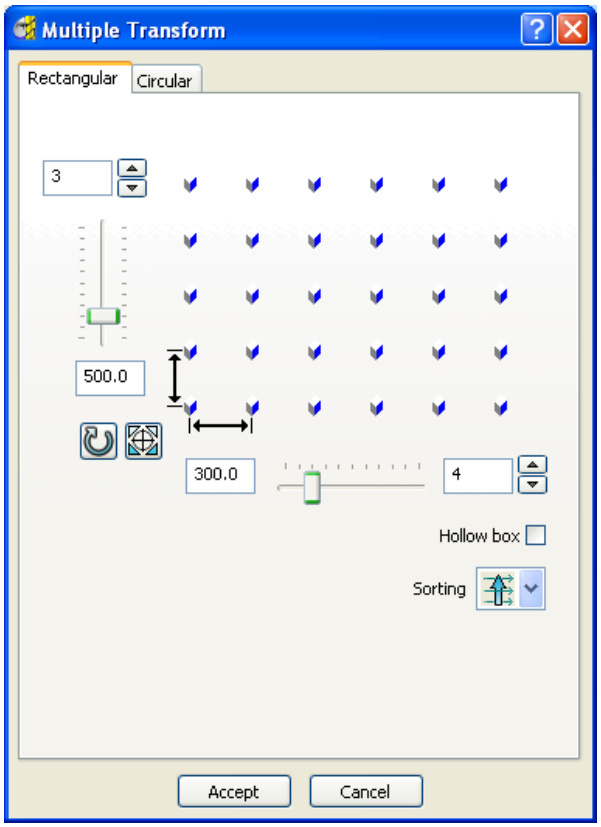
Rectangular transform example

This example shows you how to create multiple moves on a toolpath using a rectangular pattern. It uses the **Keep Original** option so that you can easily see the effect of the transformation.

It uses the **Chainsaw.ige** model in the **Examples** folder with a rest profile toolpath as the active toolpath.

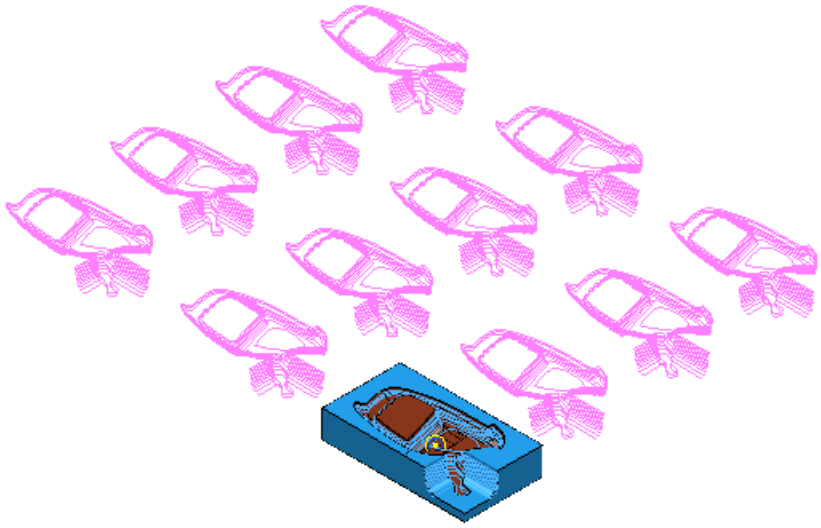


1 Click the **Multiple Transform** button from the **Toolpath Transformation** toolbar. This displays the **Multiple transform** dialog.



2 In the **Rectangular** tab enter:

- **a** a **Number of rows** of **3**.
- **b** a **Distance** between rows of **500**.
- **c** a **Distance between columns** of **300**.
- **d** a **Number of columns** of **4**.
- **e** **Hollow box** deselected.
- **f** Click **Accept**.

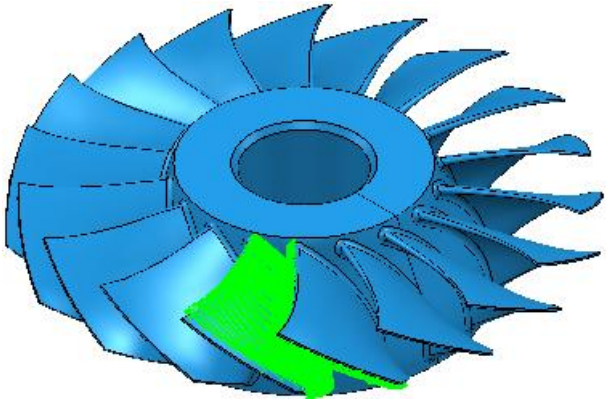


3 Click on the **Toolpath Transform** toolbar to accept these changes. PowerMILL creates the duplicate toolpaths.

Circular transform example

This example shows you how to create multiple rotations on a toolpath using a circular pattern.

It uses the **Blisk_Simple.dgk** model in the **Examples** folder with a blade finishing toolpath as the active toolpath. It has the XY face as the principal working plane.



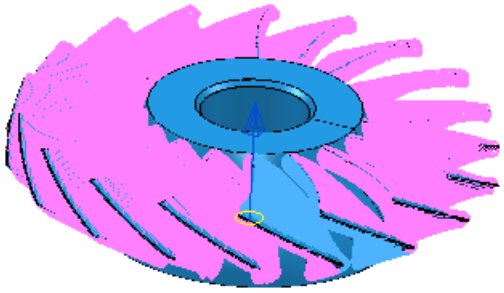
1 Click the **Multiple Transform** button from the **Toolpath Transformation** toolbar. This displays the **Multiple transform** dialog.

2 Select the **Circular** tab and enter a **Number** of **18**.

The toolpaths should be rotated around the centre of the hub, if so, go to step 4. If the toolpath isn't rotated about its centre go to step 3.

3 Click and enter the coordinates of **0 0 0** in on the **Status** bar and press the enter key.

4 Click **Accept**.



5 Change the principal working plane to the YZ face  .

6 In the **Circular** tab enter:

   a a **Number** of **4**.

   b a **Radius** of **600**.

   c Click  and enter the coordinates of **0 0 -400** in  on the **Status** bar and press the enter key.

   d Click **Accept**.

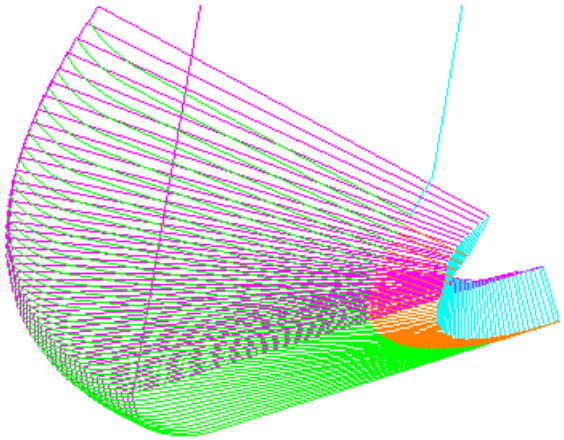
7 Click  on the **Toolpath Transform** toolbar to accept these changes. PowerMILL creates the duplicate toolpaths.

Drawing toolpath cutting moves

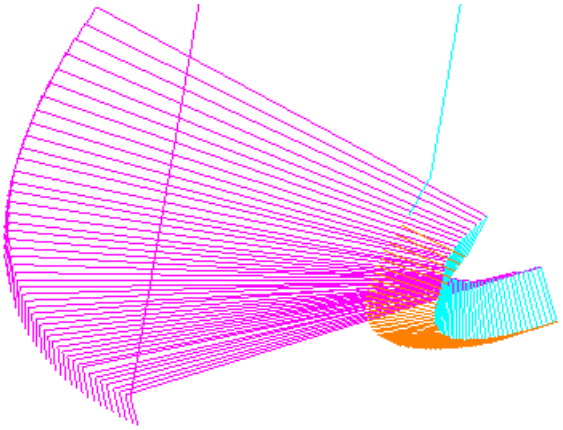
There is an additional option of **Draw Cutting Moves** on the drawing and viewing options  on the **Toolpath** toolbar.

Draw Cutting Moves - toggles the drawing of the cutting moves for the active toolpath. Not drawing the cutting moves is useful when trying to view toolpath leads or links.

Toolpath with cutting moves, leads and links drawn:



Toolpath cutting moves not drawn:

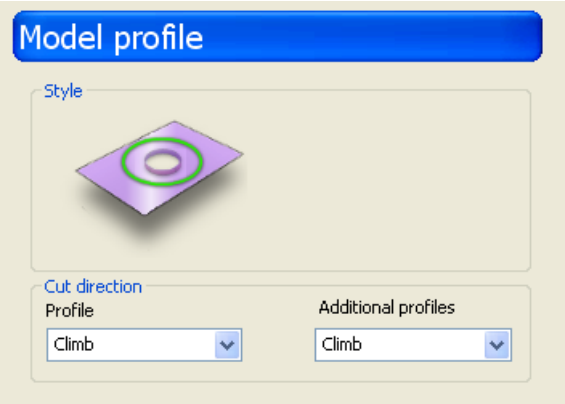


The toolpath leads and links are drawn.

Profile cut direction

Profile area clearance strategies have an additional option of **Additional profiles** on the **Cut direction** frame.

This enables you to have a different cut direction for the final profile pass than for all other passes. Previously, all profile passes had the same cut direction.



Profile - the cut direction of the final profiling pass.

Additional profiles - the cut direction of all passes except the final profiling pass.

The affected strategies are:

- Model Profile,
- Model Rest Profile,
- Slice Profile,
- Feature Set Profile,
- Feature Set Rest Profile.

Blisk machining enhancements

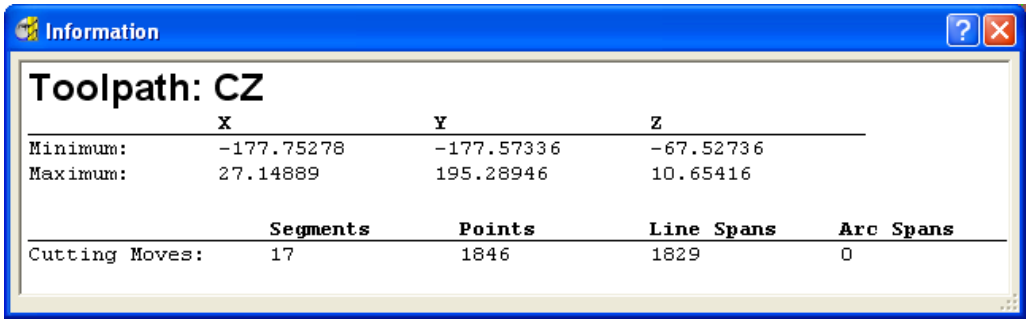
Blisk machining can now machine hubs which bend upwards at their ends. It is essential that the hub surfaces are correctly oriented as it is the outside of the surface that is machined.

In previous versions blisk machining couldn't create toolpaths on hubs (or shrouds) that bent upwards towards the rim.

General toolpath enhancements

There are several generic improvements to toolpaths:

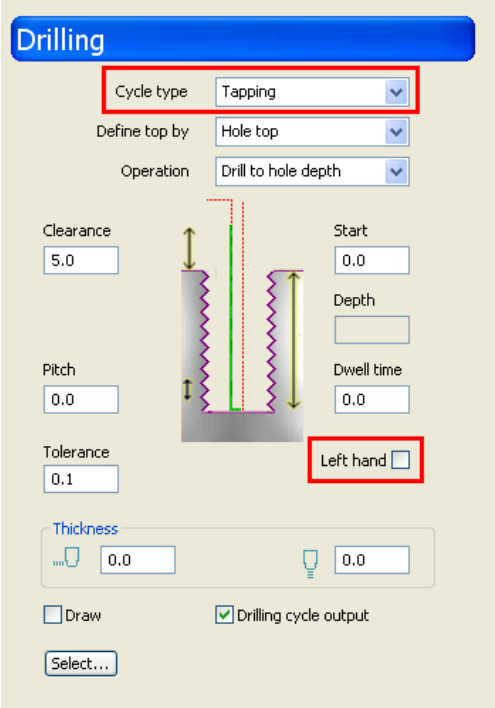
- All machining strategies now use the new-style machining strategy dialogs. This is a tabbed dialog where pages are selected from the tree in the left hand panel. This is simpler to use and provides an easier way to create toolpaths.
- 3D offset, optimised constant Z, parametric offset, and steep and shallow finishing strategies can now use automatic collision avoidance.
- The **Properties** option on the individual toolpath context menu displays some information on the cutting move as well as the toolpath name and it's extents.



- Pattern finishing now avoids duplicate points eliminating jerky movements of the machine tool.
- Steep and shallow finishing always machine all shallow regions, even when the toolpath workplane is different to the block workplane.
- You can now use skim links on embedded pattern toolpaths with a negative offset.
- There are several improvements to corner toolpaths:
  - Corner clearance toolpath segments are no longer generated above the block.
  - Improvements to corner finishing and corner clearance toolpaths, especially when using end mills and tip radius reference tools.
  - Corner finishing removes more small corners and works better in deep slots.
  - Corner multi-pencil finishing toolpath produce better results and use less memory.
  - You can now limit a corner multi-pencil toolpath to a 3D boundary.
- Constant Z toolpaths have improvements to contact normals.

- Undercut constant Z machining has several enhancements:
  - Improved calculation times.
  - Improved handling of complex tool holders.
  - Reduced fragmentation.
- You can now use a large negative thickness on rest area clearance toolpaths.
- When copying a toolpath which uses a reference pattern, the pattern is also copied.
- Stock model rest area clearance creates better toolpaths. They are far less fragmented.
- Improvements to the tool axis smoothing of embedded pattern and surface finishing toolpaths.
- Swarf machining doesn't move away from the surface you are machining.
- When tapping, you can now create left handed threads.

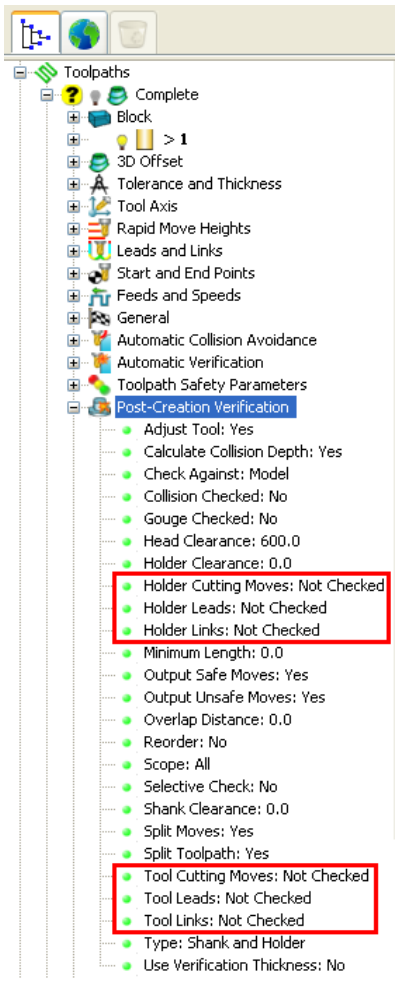
The **Tapping Cycle type** adds an additional item of **Left hand** for left handed threads.



- The list of possible toolpaths to choose as a reference toolpath no longer includes the current toolpath, so it isn't possible to accidentally make a toolpath reference itself.
- If you create a workplane from a strategy dialog, it automatically becomes the active workplane.

Toolpath verification

Some new parameters are displayed in the **Post-Creation Verification** part of the toolpath tree:



They are:

- Holder Cutting Moves
- Holder Leads
- Holder Links
- Tool Cutting Moves
- Tool Leads
- Tool Links

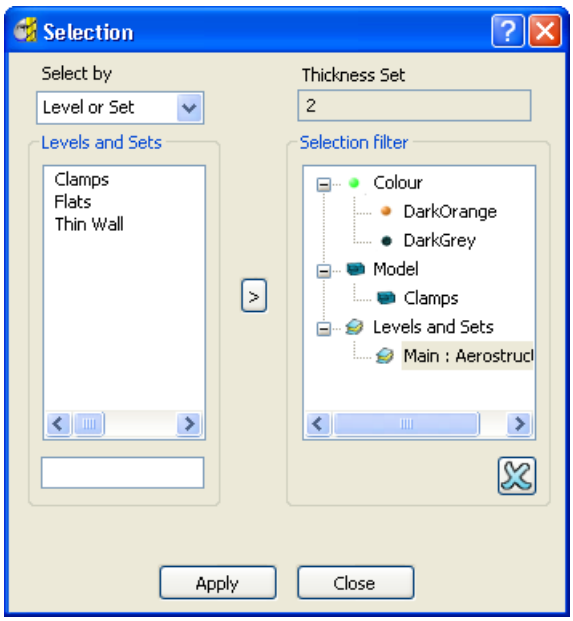
User interface

There are several user interface improvements:

- When drawing the cursor as a tool, the tool shank and holder are displayed as well as the tool tip (see page 88).
- To avoid duplication, options now available on the **Curve editor** toolbar are no longer available on the explorer context menus (see page 88).
- To make it easier to visualise the principal editing plane, the normal is displayed in a different colour on the active axes (see page 89).

Smart Selection

A new **Selection** dialog has been added to PowerMILL 2011 that enables you to select surfaces to be used within a component thickness set by filtering on a project's **Model**, **Colour**, and **Levels and Sets**.



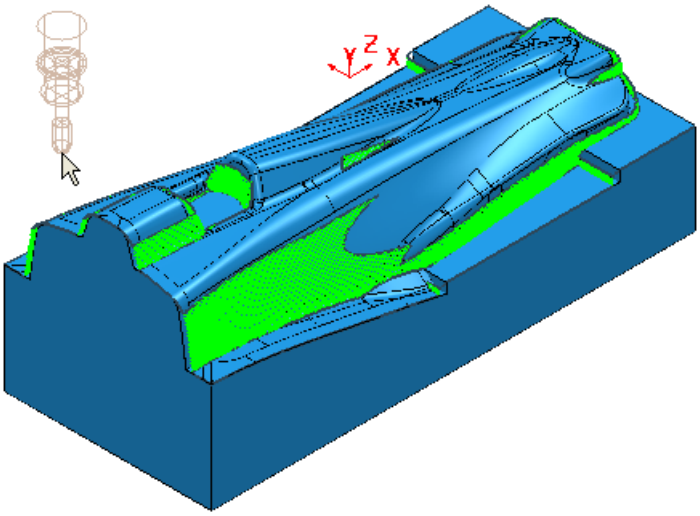
When a new component is imported into PowerMILL, the thickness preferences are automatically applied to the component. In addition, because these selection settings are stored in the toolpath template, you can transfer the settings by exporting and importing the template into other projects. This enables you to reduce set-up and programming times when machining similar components.

For example, using the **Selection** dialog, you can select red components and assign the colour to a thickness set to be ignored while machining. When you export the thickness set and colour preferences to a template file and import the template into another project, PowerMILL automatically assigns the selection settings to any red components in the target project.

- To select components for a thickness set, click  on the **Component Thickness** dialog. In the **Selection** dialog, select individual model components.
- To make general selections in a project, from the **Models** context menu, select **Select Model Components...** to display the **Selection** dialog.

Displaying the cursor as the tool

The **Draw > Cursor > Tool** option now displays the tool shank and holder as well as the tool tip. This improves the ability to do a visual check of the tool against the part.



Context menu options

To avoid duplication, options now available on the **Curve editor** toolbar are no longer available on the explorer context menus.

The **Offset**  button (see page 16) on the **Transformation** toolbar on the **Curve editor** toolbar replaces the individual boundary context menu options of:

- **Edit > Offset (3D Smooth)**
- **Edit > Offset 3D (Round Corners)**
- **Edit > Offset 2D (Round Corners)**
- **Edit > Offset 3D (Sharp Corners)**

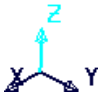
and the individual pattern context menu options of:

- **Edit > Offset 2D (Round Corners)**
- **Edit > Offset 2 (Sharp Corners)**.

Principal working plane enhancements

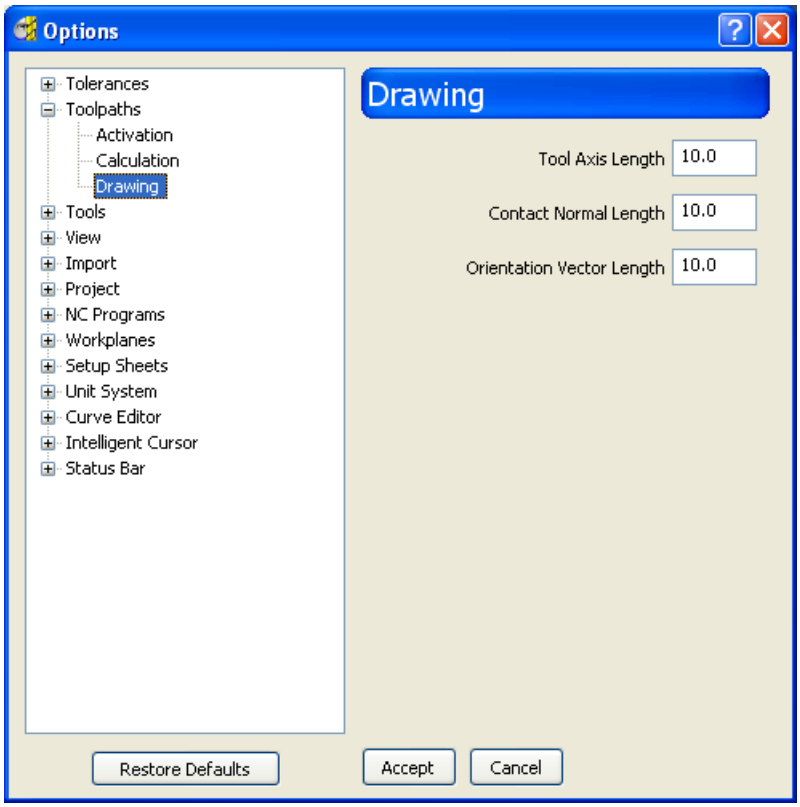
To make it easier to visualise the principal editing plane, the normal is displayed in a different colour on the active axes. By default, the normal to the principal editing plane is cyan.

The active axes is the graphic at the bottom left corner of the graphics window.



General enhancements

You can now change the **Orientation Vector Length**. This option is available on the **Options** dialog (available from the **Tools > Options > Toolpaths > Drawing** menu. The **Orientation Vector Length** is displayed when you **Draw Orientation Vectors**  .



You are no longer limited to the style of connection moves in an NC program when using orientation vectors.

Cutter compensation settings are kept when a toolpath is transformed.

The default thicknesses are considered when a pattern is dropped.

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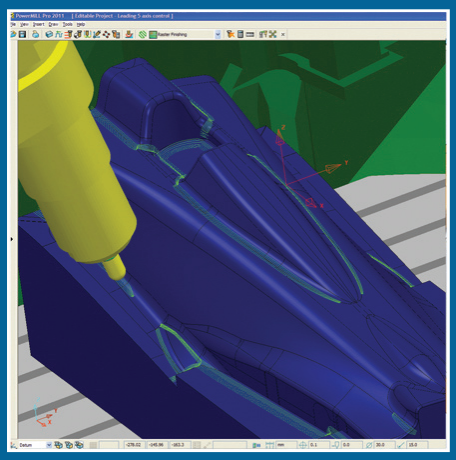

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