GibbsCAM® 14

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Broaching Tutorials

3D SYSTEMS

Proprietary Notice

BROACHING TUTORIALS

These short tutorials provide an introduction to using Broaching functionality. As with most GibbsCAM tutorials, the parts are in metric units. The Broaching examples covered will be Keyway Broaching, Linear Corner Broaching, and Linear Hex Broaching, as well as a brief example of Rotary Broaching.

The tutorials assume you have existing knowledge of GibbsCAM machining. The parts are already created and are simplified to focus on learning how to use Broaching.

KEYWAY BROACHING

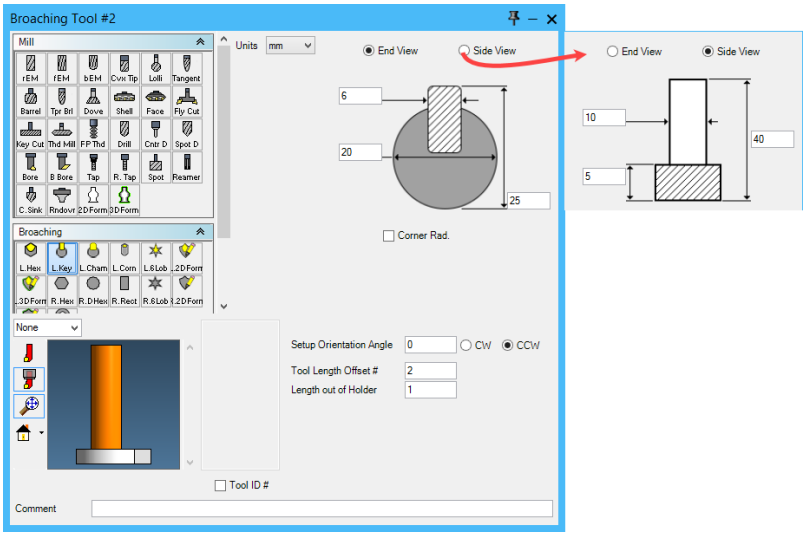
In this tutorial we will create a Keyway broach on a simple flattened cube shape.

1. Open the file `Broaching_Keyway.vnc`, located in the sample files folder.

   This file contains circle geometry, a pre-defined drilling tool and a drilling operation. The drilling operation cuts a hole in the body which is slightly larger than the broaching tool. The hole dimensions will normally be supplied by the broaching tool manufacturer.

2. Create a Linear Key broaching tool as shown:

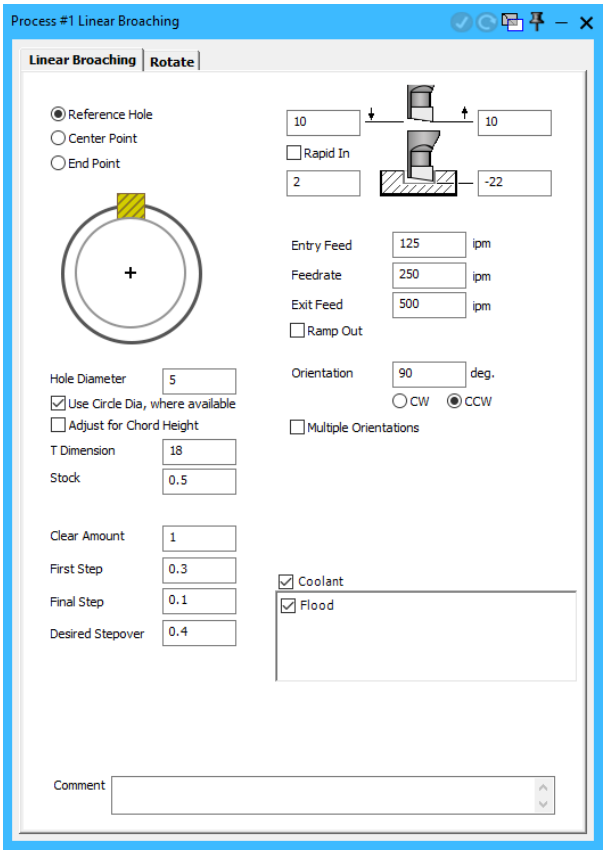
   The tool dialog shows the end view of the broaching tool. Selecting the side view option (as indicated) will display the side view and additional dimension input values used to fully describe the tool.



We will now use this tool to broach a single keyway in our part.

3. Drag the broaching tool onto process tile #1 and select the Linear Broaching process from the menu.

4. Enter details into the process dialog as shown:
   You will notice that as you click on the input boxes for hole diameter, T dimension, Clear amounts etc., the graphics on the dialog change to illustrate the dimension to be entered.



We want to use the pre-drilled hole geometry, and so the hole strategy we will choose is Reference Hole. The Clearance position is defined relative to the circle – how far **inside** the hole the tool is clear. This position is where the tool moves to above and below the part between stepovers.

The tool will move into position and then plunge straight down to cut the First Step outside the circle. This step is typically a slightly smaller dimension than the subsequent steps. This is because you may not know exactly how much stock there is, and you wouldn't want to risk taking too much material off and maybe damaging the tool.

The tool will then move back and up to the clearance position. The subsequent steps outside the circle will then be at or near the Desired Stepover, which we have set at 0.4mm. The software divides the number of cuts evenly to leave the exact Final Step cut, which is normally smaller in order to get a nice clean finish.

The orientation is measured from the positive X axis at 0 degrees. We wish to cut at 90 degrees counterclockwise. Multiple Orientations is unchecked, as we are only cutting one keyway.

Note that we have not checked the Adjust for chord height option. This means that the 0.3mm First step will be measured from the circle radius at the center of the cutting edge of the broaching tool. If we check this option, then the 0.3mm step is measured from the corner of the cutting edge of the broaching tool.

Adjust to chord height unchecked

Adjust to chord height checked

5. Now pick the circle geometry and click Do it.

A right-side view reveals the toolpath: note the smaller final cut. We have added a green dotted line to illustrate how the tool starts at the clearance, moves to the cut, plunges down through the material, and then returns to the clearance area.

6. Render the operation.

LINEAR CORNER BROACHING

In this tutorial we will broach the corners of a rectangular cutout in order to create sharp corners.

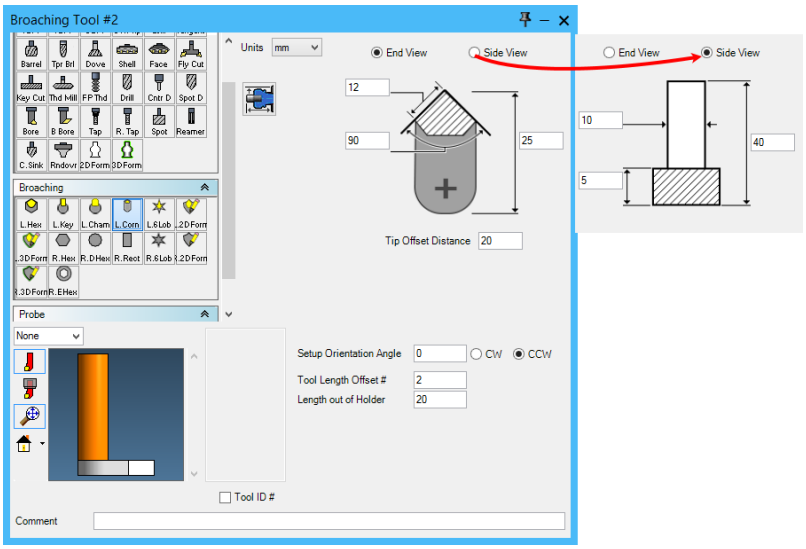
1. Open the file Broaching_LinearCorner.vnc, located in the sample files folder.

   This file consists of a simple flattened cube with rectangular geometry, a pre-defined Rough Endmill, and a pocketing operation. The pocketing operation cuts a rectangular hole in the body but, because of the shape of the tool, it leaves the corners uncut. This is where corner broaching is most useful.

2. Render the operation.

   Note the rounded corners.

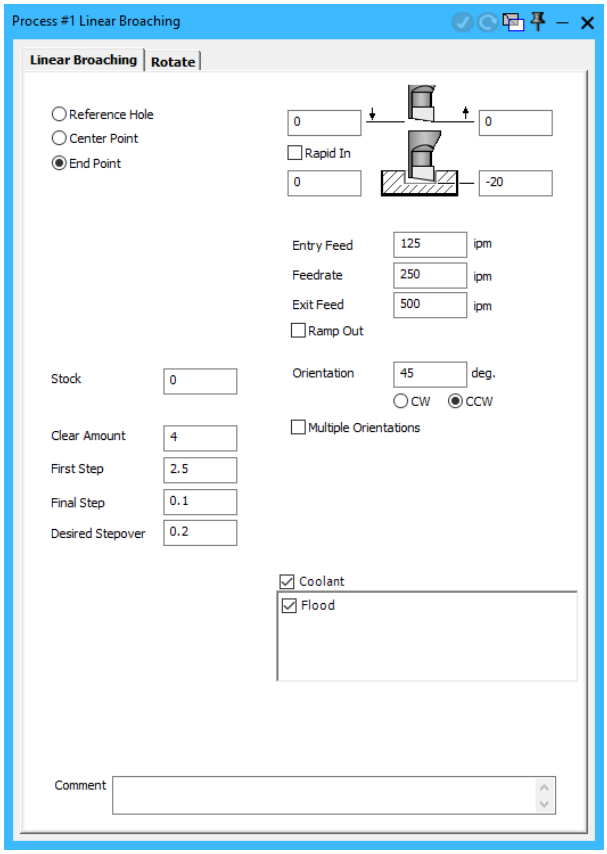
3. Create a Linear Corner broaching tool as shown:



We will now use this tool to broach all four corners of our rectangle.

4. Drag the broaching tool onto process tile #1 and select the Linear Broaching process from the menu.

5. Enter details into the process dialog as shown:



The hole strategy we will use for this process is End Point. This is used to specify dimensions relative to a point. We will start by broaching the top right corner. Note that the options on the dialog have changed from those in the Reference hole strategy dialog.

The stock field defines how much stock to leave behind after the final pass. You may need to leave some stock behind for hand finishing.

Click on the Clear Amount field. You will see that the diagram changes to indicate that the dimension required is from the tool to the corner point.

The tool will move into position and then plunge straight down to cut the First Step into the corner. In this case, the first step can be larger as we are cutting into a corner.

The tool will then move back and up to the clearance position. The subsequent steps into the corner will then be at or near the Desired Stepover which we have set at 0.2mm. The software divides the number of cuts evenly to leave the exact Final Step cut, which is normally smaller in order to get a nice clean finish.

The default orientation for the end point strategy is to move the tip of the broaching tool along the X-axis in a positive direction towards the selected point (this is defined as 0 degrees). We wish to cut at an angle of 45 degrees counterclockwise so that the tool cuts the top right corner.

Multiple Orientations is designed for use where there are multiple corners that are all the same distance from a given point and the angle from one point to the next is the same. We could use

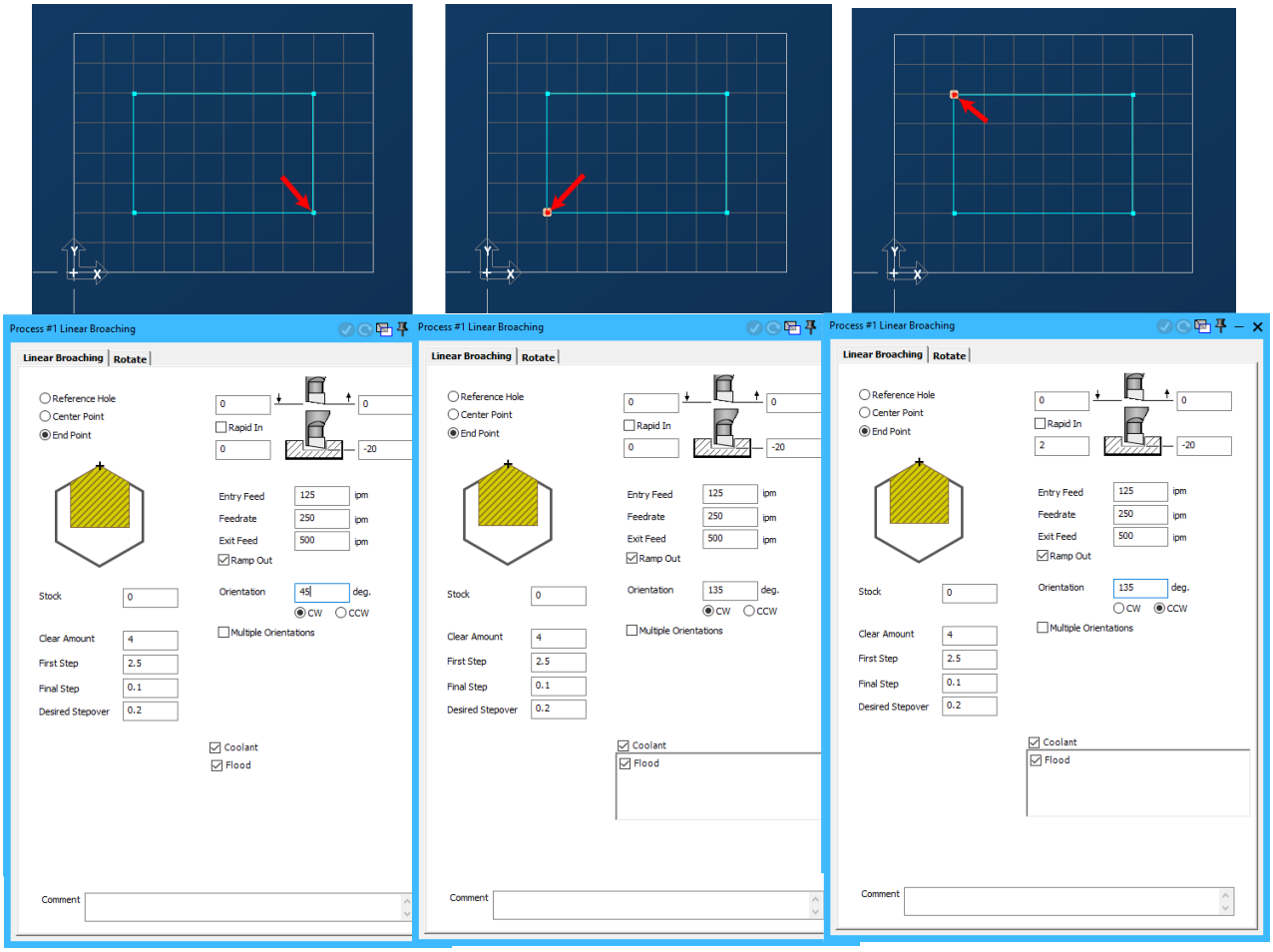
this option if we were broaching a square; however, for a rectangle, the angles between each point are not identical. Therefore we must broach each corner with a separate operation.

6. Pick the top right corner point and click Do it. 

Note the 45 degree angle of the toolpath and the narrow final cut.

7. Render the operation.

8. To cut the remaining corners, create three more operations using the same values, but changing the Orientation angle and direction and picking corner points as shown below.



9. Render the operations.

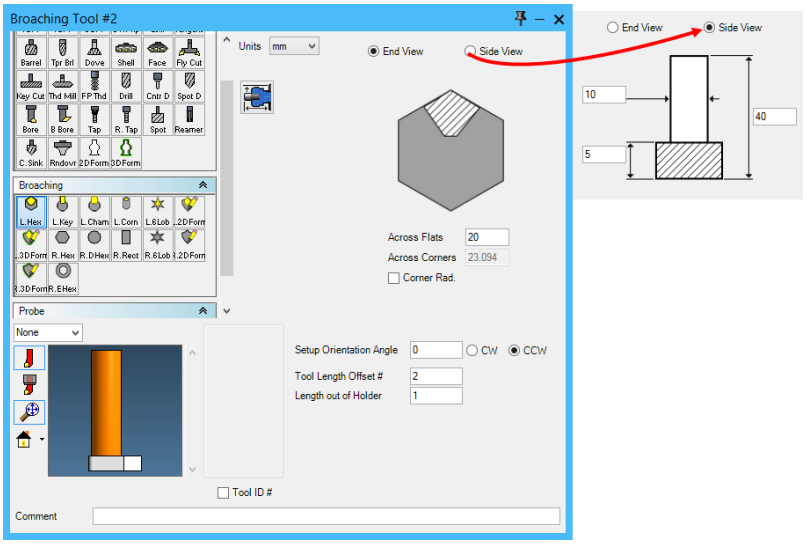
LINEAR HEX BROACHING

In this tutorial we will create a Hexagonal broach on a simple flattened cube shape.

1. Open the file Broaching_LinearHex.vnc, located in the sample files folder.

   This file consists of a simple flattened cube with point geometry, a pre-defined drilling tool, and a drilling operation. The drilling operation cuts a hole in the body which is large enough to fit the broaching tool. The hole dimensions are normally supplied by the broaching tool manufacturer.

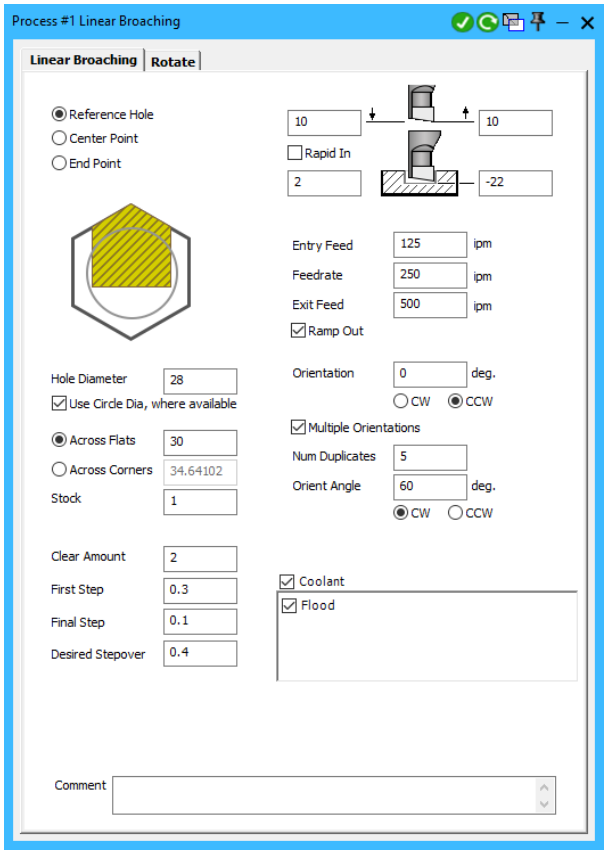
2. Create a Linear Hex broaching tool as shown:



We will now use this tool to broach a hexagonal shape in our part.

3. Drag the broaching tool onto process tile #1 and select the Linear Broaching process from the menu.

4. Enter details into the process dialog as shown:



The hole diameter is 28, the size of the tool used in the drilling operation. We can define the size of the hexagon using either the distance across flats or distance between opposite sharp corners. Note how the diagram changes when you switch between the Across Flats and Across Corners options. In order to cut all six sides of the hexagon, we have checked the Multiple Orientations checkbox. We will be repeating the original cut another 5 times, at 60 degrees in a clockwise direction.

5. Now pick the point geometry and click Do it.

An isometric view reveals the toolpath. Note that first cut is on the X positive axis, because our Orientation was defined as 0 degrees.

6. Render the operation.

ROTARY BROACHING

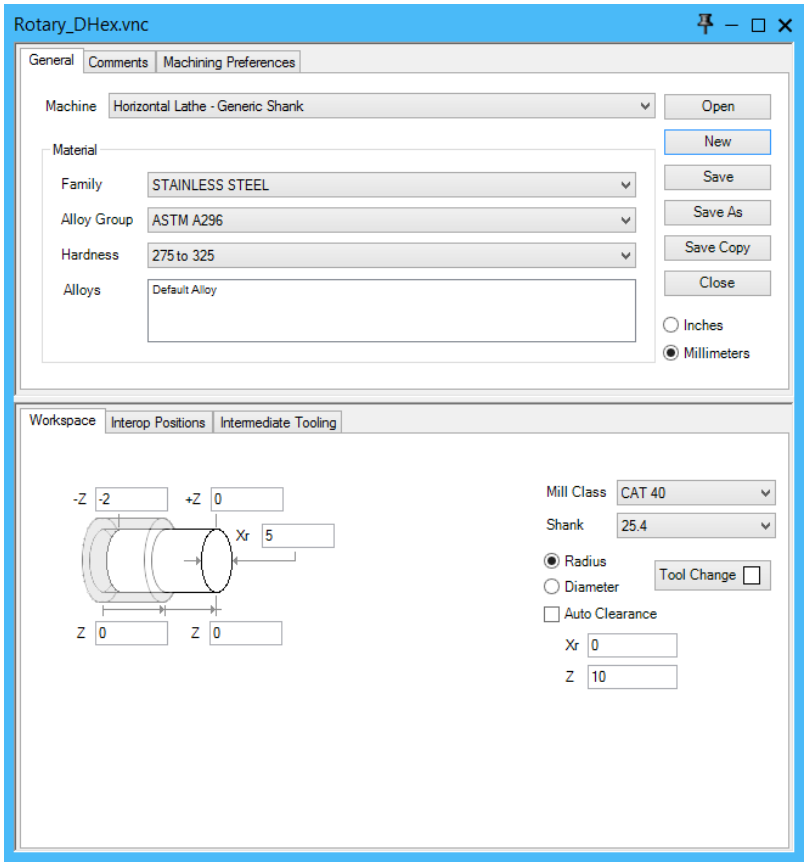
Rotary broaching can be used on Mills and Lathes, in this tutorial we will rotary broach on a horizontal lathe.

Unlike linear broaching, a rotary broaching tool is held in a special holder such that the tool is very slightly off axis and free to spin in the holder. By rotating either the part or the tool holder, once the broaching tool engages with the part it starts to “wobble” in the holder. This wobble effect enables the entire shape of the broaching tool to cut into the material as it is moved into the part.

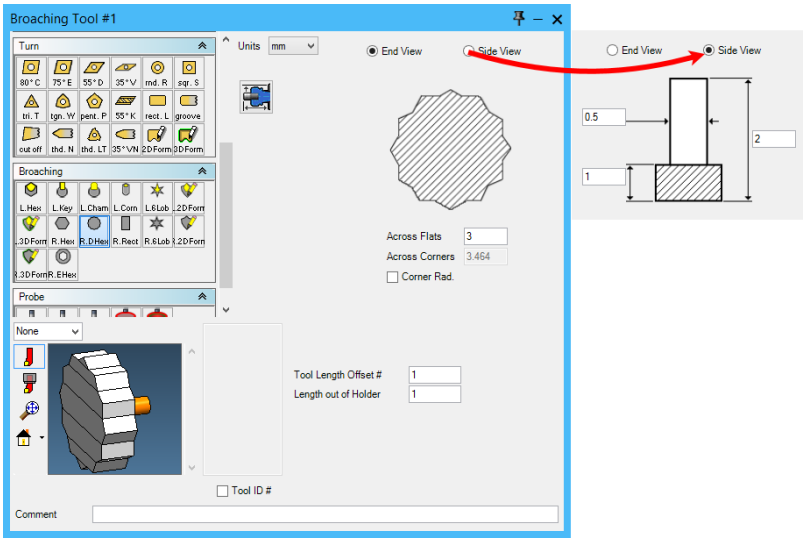
Since the tool is able to move freely in the holder, there is no control over the orientation of the tool in relation to the part when it engages with material. Therefore rotary broaching is not suitable for parts where the orientation of the broached shape is important.

Because the engagement orientation is unpredictable, a rotary broaching process is completed in one pass.

1. Create a new file called Rotary_DHex.vnc, entering the following into the DCD:

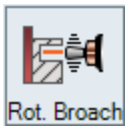


2. Create a rotary broaching tool as shown:



We will now use this tool to broach a single hexagon in our part.

3. Drag the broaching tool onto process tile #1 and select the Rotary Broaching process from the menu.



4. Accept the defaults in the process dialog as shown: The -Z depth is automatically set to -2, the full depth of the part.

Rotary broaching uses a single selected point to define the start position. However, we are broaching on the face of a turned part and this would be the XY CS. A 2-axis lathe only has a ZX CS, and so in this special case (2-axis lathe), we automatically assume a reference point of 0,0 and ignore any selected geometry.

5. Now Do it to create the operation. 

6. Render the operation.

Conventions

GibbsCAM documentation uses two special fonts to represent screen text and `keystrokes or mouse actions`. Other conventions in text and graphics are used to allow quick skimming, to suppress irrelevancy, or to indicate links.

Text

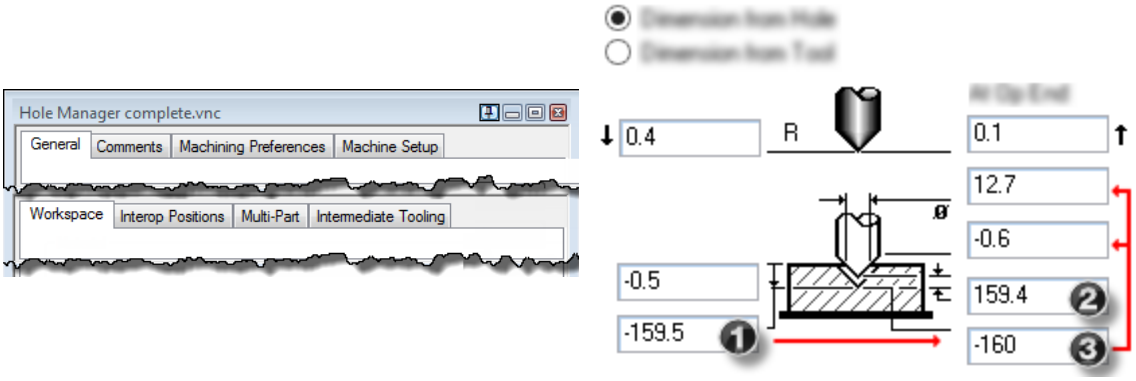
Screen text. Text with this appearance indicates text that appears in GibbsCAM or on your monitor. Typically this is a button or text for a dialog.

`Keystroke/Mouse`. Text with `this appearance` indicates a keystroke or mouse action, such as `Ctrl+C` or `right-click`.

`Code`. Text with `this appearance` indicates computer code, such as lines in a macro or a block of G-code.

Graphics

Some graphics are altered so as to de-emphasize irrelevant information. A “torn” edge signifies an intentional omission. Portions of a graphic might be blurred or dimmed to highlight the item being discussed. For example:



Annotations on a graphic are usually numbered callouts (as seen above), and sometimes include green circles, arrows, or tie-lines to focus attention on a particular portion of the graphic.

Faint green borders that outline areas within a graphic usually signify an image map. In online help or a PDF viewer, you can click a green-bordered area to follow the link.

Links to Online Resources

Link	URL	Action / Description
Go	http://www.GibbsCAM.com	Opens the main website for GibbsCAM.
Go	https://online.gibbscam.com	Opens a restricted website containing materials available for download. Requires a GibbsCAM Online Services account; to set up an account, contact GibbsCAM Support.
Go	https://store.GibbsCAM.com	Opens the website for the GibbsCAM Student Store.
Go	https://GibbsCAMMacroWiki.3DSystems.com	Opens a wiki containing documentation and examples of GibbsCAM macros. Requires a GibbsCAM account.
Go	http://kb01.GibbsCAM.com	Opens a Knowledge Base article, **Contour Operations Using Thread Mill Tools**, that explains in detail the correct way to program Contour processes using Thread Mill tools.
Go	mailto:GibbsCAM.Support@3DSystems.com	Runs your email client to create a new message addressed to the 3D Systems Technical Support department for GibbsCAM.
Go	mailto:GibbsCAM.Registration@3DSystems.com	Runs your email client to create a new message addressed to the 3D Systems Registration department for GibbsCAM.
Go	mailto:GibbsCAM.Sales@3DSystems.com	Runs your email client to create a new message addressed to the 3D Systems Sales department for GibbsCAM.
Go	http://www.autodesk.com/inventor	Opens an external website that provides more information on Autodesk Inventor products.
Go	http://www.celeritive.com	Opens an external website that provides more information on VoluMill Ultra High-Performance Toolpath (UHPT) from Celeritive Technologies.
Go	http://www.predator-software.com	Opens an external website that provides more information on a CNC editor and a virtual CNC viewer from Predator Software, Inc.