

TreeSoft Threads

Threads was written by Paul Rowntree, based on information and sample source codes provided by Vectric and other 'gadgeteers'. Any flaws in this package were introduced by me. I believe it works well, but no guarantees are given for its use in any application. **Threads** works with Aspire 4.0 (or greater) and VCP 7.0 (or greater). **It will not work with previous versions of either program.** Although Rowntree retains copyright, you are free to use the components in any way you wish, including personal and commercial applications. You are not permitted to redistribute the files, nor remove the copyright information that they contain, without written permission.

Threads is distributed as shareware. If you find it useful for your business or your hobby projects, please consider making a contribution at PaulRowntree.weebly.com to support its continued development.

Values in the provided database must be verified by the user before use.

Change Log

Sept 15, 2013	<ul style="list-style-type: none">- Tolerance can now be positive to loosen fit or negative to tighten fit- Added "Preview Thread Description" button, code- Dialog box visual fixes- Added Tooth Height parameter (measured from bottom of tool to the height of side V-cutter tooth) to allow top chamfers- Clarified manual to distinguish ToothHeight from ToothDepth- Third release
June 29, 2013	<ul style="list-style-type: none">- Fixed bug in metric checks, verified all combinations of job, tool, profile- Improved and documented sanity-check values- Added image of thread section, links to thread data tables- Improved angular resolution for small diameter cutters- Allowed code to make partial-depth threads- Second release
June 28, 2013	<ul style="list-style-type: none">- Added EndGroove option- First release
June 26, 2013	<ul style="list-style-type: none">- Converted input data- Added circular vector creation option
June 10, 2013	<ul style="list-style-type: none">- First draft written and working

Disclaimer

By downloading, installing and using this program you are accepting full responsibility for any and all consequences. CNC machinery is potentially dangerous, and the user is 100% responsible for ensuring that the output of **Threads** is safe to use, and that it will have the desired effects.

As always with CNC equipment, think many times before running code, and doing air cuts is often a good idea with new files. Verify the Z limits of the loaded files before cutting to ensure that you are not going to destroy your table top, spindle, or both.

Work and Play safely.

What is Threads ?

Threads is a 'gadget' for Vectric's Aspire 4.0 (and higher) and V-Carve Pro 7.0 (and higher) CAD/CAM tools. It builds threading toolpaths with programmable parameters for a side-V profile cutter to cut the threads.; these parameters are

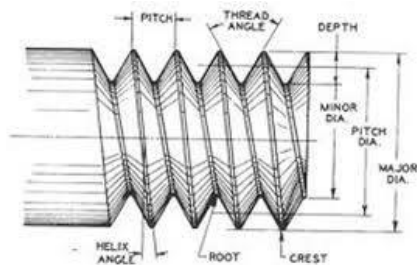
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stored in a simple editable database file (Threads.txt) and they can be adjusted at run time. The positions on the design that will receive the threaded toolpaths are set by the current list of selected vectors, or they can be read in from a CSV file. **Threads** will put an identical threading toolpath at the centre of each one. Male and Female threads, Left- and Right-handed threads are all supported. **Threads** can optionally create a circular vector that can be used to pocket out the centre void of a female thread or prepare the exterior rounded surfaces of a male thread.

Threads can be used to mount posts onto surfaces, make screw-tops for boxes, or thread metalwork for metal fasteners.

The gadget works with Aspire and VCP in exactly the same way.

A Word about Threads Definitions



This image was taken from Specbolt.com. The parameters we need to use are the Pitch Diameter, the Thread Pitch, and the Thread Angle. Rather than retype them here (and make many errors), I recommend you search online for the thread parameters. For example

For Metric thread parameters : <http://www.newmantools.ca/tech/threadm.htm>

For Imperial thread parameters : <http://www.portlandbolt.com/technicalinformation/thread-pitch.html>

Unpacking Threads

If using a Vectric installer, the files are already in their correct locations and are ready to run. Alternatively, the archive can be opened with Windows, WinZip, Z-zip, or any other standard unzipping program. Extract the files to any directory, then move the individual components in the directories shown below. Aspire or VCP will find the gadgets and show them in the Gadgets menu lists.

Windows Path	Contents
Aspire and VCP User Gadget directories, created during Aspire or VCP installation C:\Users\Public\Public Documents\Vetric Files\Gadgets\Aspire Vx.y\ or C:\Users\Public\Public Documents\Vetric Files\Gadgets\VCPro x.y\	Threads.lua Threads.txt Threads.html If you want, you can create a subdirectory and place these files inside it. This unclutters the Gadgets menu of Aspire and VCP.
Anywhere you want	Threads.pdf (this file) Example.crv

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Setting up the Tool Database

Threads requires a V-Bit in the Tool Database of Aspire or VCarve Pro. This example describes the Magnate #751 cutter (www.magnate.net) without implying that this company's products are superior or even adequate for any particular task. This tool has 90° cutting angle (θ), a 7/8" cutter diameter, and a 0.5" shank diameter. The shank is relatively long (5") to facilitate cutting long threads; I removed the bottom bearing from the cutter, and trimmed away a lower stub. I also removed 1.75" of the shank.

The three key parameters are (1) the V-Angle (in degrees), (2) the cutting diameter (in mm or inches), and (3) the tooth depth (in mm or inches). (1) and (2) are pretty obvious, and are entered as the V-bit angle and the tool diameter in the Tool Database. (3) is entered as Pass Depth in the Database. **Threads** treats (3) as the safe depth of threads that can be created with a tool; ensure this is set correctly to take advantage of this safety check. A **maximum** tooth depth means that the crest-to-crest thread pitch also has a **maximum** value for a given cutter, and this leads to a **minimum** value of threads-per-inch that you can create.

Tooth Depth for the #751 (In Theory)

Each cutting tip projects $(0.875'' - 0.5'')/2 = 0.188''$ (3/16") from the shank, and this is the maximum depth of groove that can be cut into a male or female thread. This in turn sets a **maximum** crest-to-crest thread pitch that can be cut. The formula to calculate this maximum pitch for a given ToothDepth and cutter angle is:

$$\text{Maximum Pitch} = 2 \times \text{ToothDepth} \times \tan(\theta / 2)$$

For a 90° cutter, the Maximum Pitch is 2 x ToothDepth; the Maximum Pitch of the #751 tool is 0.375" (3/8", or 2.7 threads per inch). Most threads will be finer than this, with 0.125" (8 threads per inch) being common.

60° cutters are also common; for these, the Maximum Pitch = 1.155 x ToothDepth.

Tooth Depth for the #751 (In Practice)

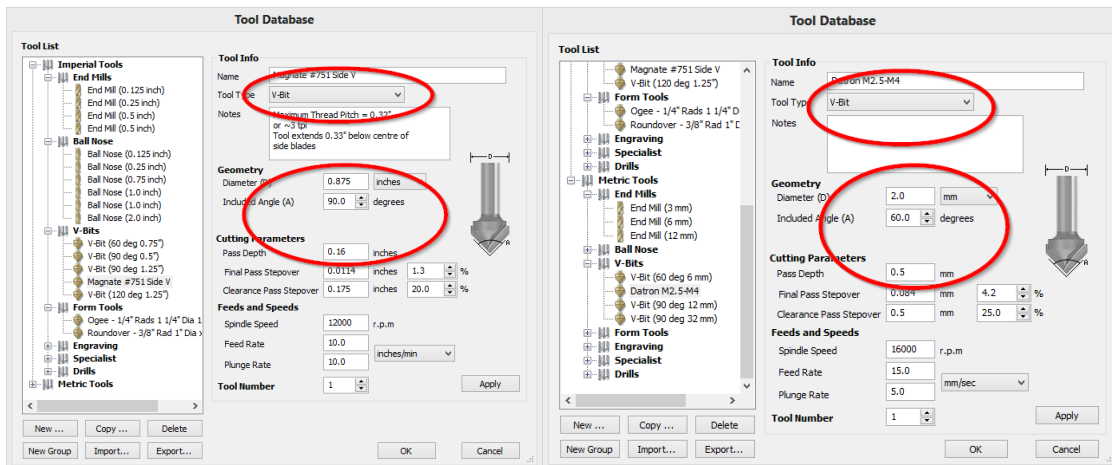
The cutting surfaces are not always simple to describe, and so it is better to measure the true tooth depth. The angle and cutting diameter are probably as advertised by the tool maker, but if you can check it, do so. For my #751 the tooth depth is 0.165", measured from the tip of the tool to the bottom of the cutting edges, perpendicular to the shank axis; this is a full 0.023" less than suggested above. The Maximum Pitch is calculated to be 0.300" (3.33 threads per inch).

The 'Maximum Pitch' referred to above means that both sides of the thread (M+F) are fully engaged, and each thread set being fully developed with the crests coming to perfect points. If the thread pitch is greater than this 'Maximum Pitch', you can still make threads with this tool, but

- 1) The threads won't be as deep, and they will be weaker.
- 2) The crests of the threads will be removed to expose flat tops.
- 3) You can make a Male or a Female thread this way, but possibly not working pairs : They may not engage with each other if you have removed too much of the thread crests. The parts you make with Threads should work with conventionally cut pieces (like commercial nuts and bolts).
- 4) **Threads** will give you a warning message if you are in this situation, but it will make the toolpath regardless.

These are screen-shots of the Magnate #751 (wood tool) and Datron 0068420L (micro-tool) entries in the Tool Database, showing the fields that should be set and the appropriate values. Give your cutter a bit of a break, and slightly undersize the Pass Depth (keeps the shank from touching the material). The Speeds and Feeds are not set yet, and will depend on your machine and materials.

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There is another parameter, called the Tooth Height, that is the vertical distance from the bottom of the tool (which is always used to set Z=0) to the tip of the cutting tooth of the side-V cutter. The Tooth Height is only used if you want to make a chamfer at the surface of the material. This value is entered on the **Threads** dialog box, not the tool database. It is also stored separately from the tool information.

Using Threads

The following values describe a threading tool trajectory within Aspire/VCP:

Data Field	Meaning	Values
Safe Z	The height of the tool above the material surface as the tool moves between threading sites	>0
Pitch Diameter	Mid diameter of thread, the diameter measured half-way along the tooth.	>1 mm, <1000mm >0.040", <40"
Tolerance	A measure of deliberate play/friction introduced into a thread. 0.0 is the default	>0 makes fit looser <0 makes fit tighter
Thread Length	Length of the threading pattern, measured along the thread axis. If POSITIVE : measured from the top of the material If NEGATIVE : measured from the bottom of the material	Any value
Thread Pitch	Distance between crests of adjacent grooves. Must be <Tooth Height, which is in the Pass Depth entry of the Tool Database	>0.30mm (M1.6 or larger) >0.010" (100 tpi or less)
Thread Sense	Male threads will be cut on the outside of a round shape (like a bolt), female threads are cut on the inside (like a nut)	Male, Female
Thread Direction	Normal threads are Right-hand threads (righty-tighty), but Left-hand threads work well too	RHT, LHT

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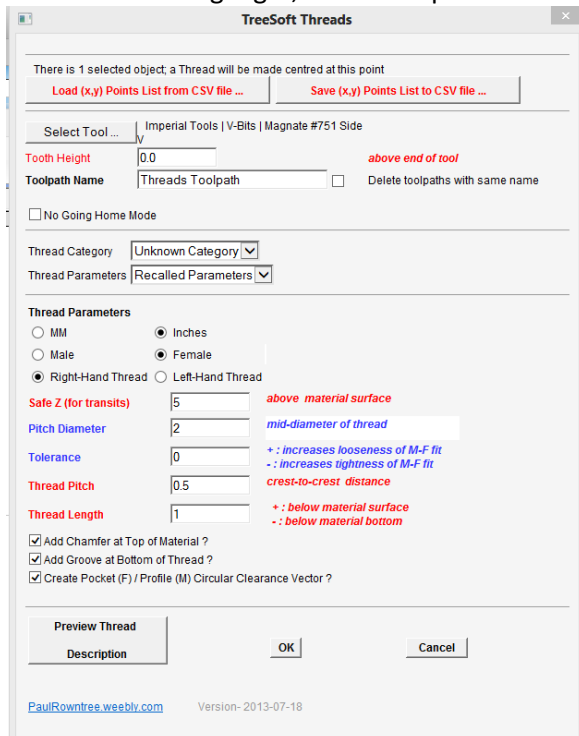
How Does Threads Work ?

On inside (female) threads, the calculations will put the tip of the cutter on a circle with a diameter given by (Pitch Diameter+Tolerance+GrooveDepth). For an outside (male) thread, the calculations put the tip of the cutter on a circle with a diameter given by (Pitch Diameter-Tolerance-GrooveDepth). It arranges the vertical descent (distance per degree of rotation around the thread) according to the specified pitch.

If you wish, it can add a circular groove at the lowest extent of the threading pattern, and/or a chamfer at the material surface.

Creating the Toolpath

1. After installing the files, restart Aspire or VCP, and verify that it has found the Threads.lua file by checking the Menu>Gadgets listing.
2. Before running the gadget, create a project and create one or more circular vectors on the 2D presentation. This example will make the female threads. The diameter of these vectors is not relevant, but the centres mark the thread sites. Select all of the circles, **but do not group them**. My material was set to 1.5" thick.
3. Run the **Threads** gadget, which will present a dialog box similar to the one shown below.

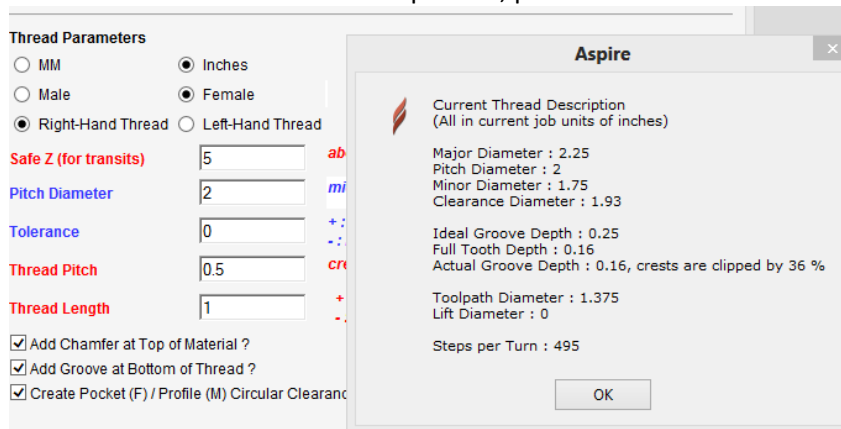


4. The text bar just below the explanatory text should identify the number of vectors that you selected. **Ignore the two buttons (Load ... , Save ...) below this message for now.**
5. Choose a side-cutting V-bit tool from the standard Vectric Tool database. The three parameters that are important are the cutter angle, the Diameter of the cutting surface, and the Pass Depth. Set the Tooth Height to 0.0 for now.
6. Enter an appropriate name for the toolpath. If the associated checkbox is checked, all existing toolpaths with exactly the same name (case-sensitive) will be deleted before creating the replacement. This makes iterative designing of the toolpaths very rapid.
7. Checking "No Going Home Mode" will set the Home Position to be the first threading site. When not checked, the home position is the lower-left corner of the material. Vectric recommends that the lower-left position be

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used for the home position (i.e. unchecked) but this may cause excessive and time-wasting motion of the tool. **Use this option with caution, as it may have unexpected side effects in this or future versions of Vectric software.** You can also disable the move to home at the start of the toolpaths in the post-processor definition file.

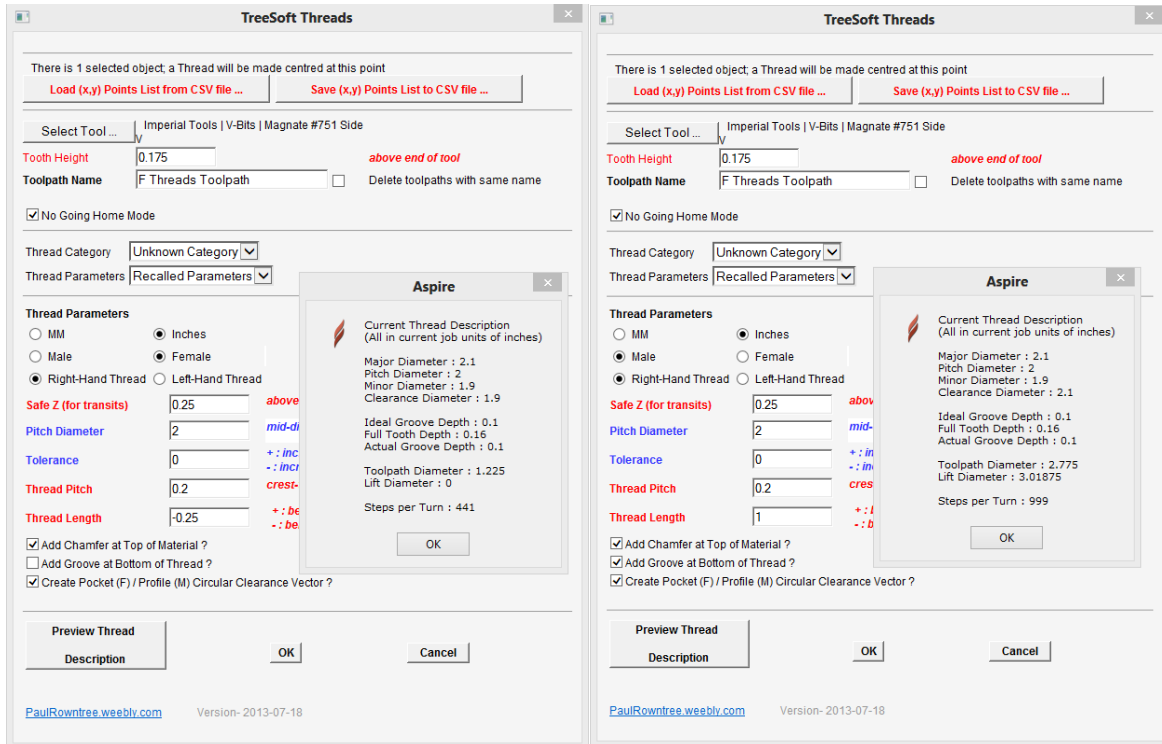
- Ignore the two DropDown selectors for the moment. Enter appropriate values in the numerical entry fields to describe the threading path you want, and select the appropriate units (millimeters or inches). Enter the Pitch Diameter. **Remember that negative values of the Thread Length (e.g. -0.1) correspond to the tool tip descending all way through the material, and this much further into the spoilboard (in the case below, 0.1 below the material bottom, in whatever units you are using). Threads does not limit the depth to the material thickness, ever. You are in control. Remember that the tips of the cutting teeth are not at the lowest point of the cutting tool.**
- As a case in point, we are going to thread a hole and dowel with a pitch diameter of 2.0" and a pitch distance of 0.2" (5 threads per inch). On my machine, a Tolerance of 0.0" works well; your equipment and job requirements may require different values. Some experiments are probably required. The Male and Female thread settings are provided in the "Manual Example" category of the Thread Database.
- If you want to see the calculated values for the thread pattern, press the "Preview Thread Description" button.



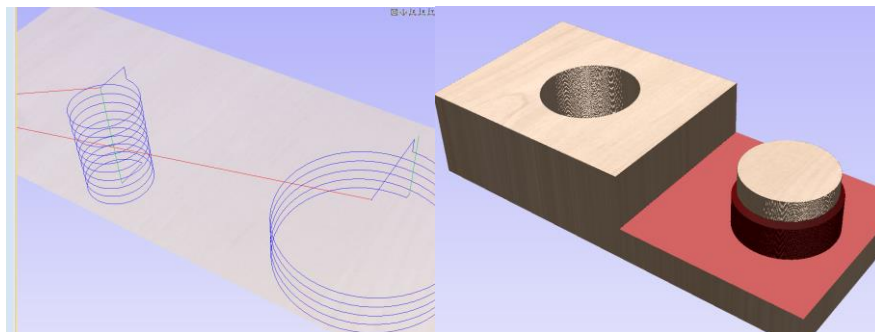
- The "Create Pocket (F) / Profile (M) Circular Vector" option gives a way to create a vector that you can use to pocket out the central void of a female thread, or to profile around a male thread. Normally this should be checked. These preparation cuts are run before the threading toolpath. They work as-is, and do not need extra allowance. If you want to remove the sharp crests from the threads (they might have burrs or be fragile), make the female ID slightly larger in diameter, and the male OD slightly smaller. Do not adjust the Pitch Diameter to remove the crests. The Male circles will always have a larger diameter than the Female circles. If this is unchecked, **Threads** will present the required Clearance radii in a message box.
- The "Add Groove at Bottom of Thread" option gives a way to add a complete revolution of the cutting tool at a fixed Z at the end of the thread. Normally, this should be checked, and it prevents the end of the thread groove from being damaged if you over-tighten the pieces (the end-groove lets the jamming take place against the inclined edges of the groove, instead of the end of the groove).
- The "Add Chamfer at Top of Material?" option gives a way to create a smooth bevel at the top of the material. For this to work, you have to have entered the "Tooth Height" into the numerical entry field under the tool selector button. The units are the same as used in the tool database for the selected tool.
- Verify the settings. Repeat step (14) as many times as necessary.
- Press "Ok" to accept or "Cancel" to reject the settings. If you accept them (and the parameters are reasonable), the program will generate the toolpaths and add them to the toolpath list so you can preview the results.
- If you pressed "Ok", the last set of parameters will be saved for the next use of **Threads**.

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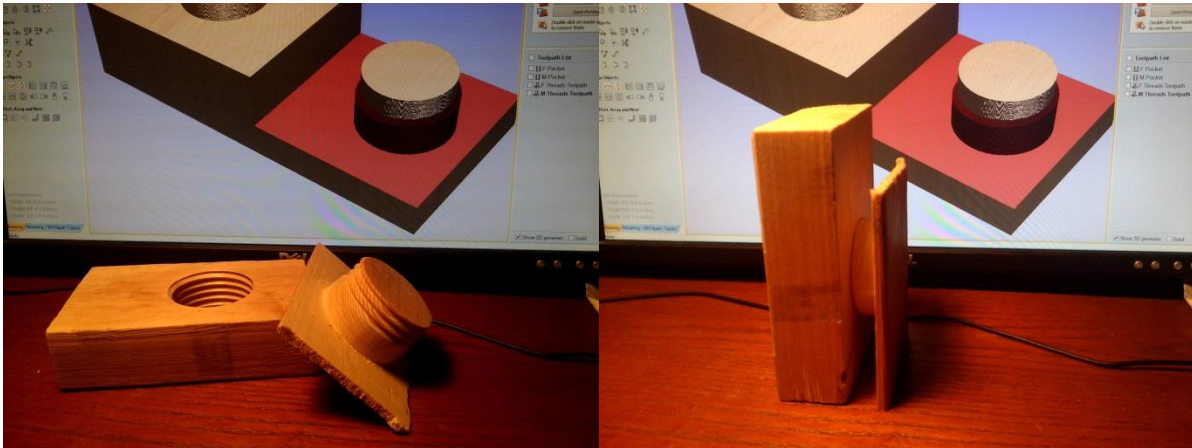
Here are the parameters used to create the example file's threads (female on left, male on right).



This is a preview of the tool trajectory cutting a female thread (on the left) and a male thread to fit it (on the right), along with the 3D version and photos of the final cuts. The VCP file is included in the **Threads** package.



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This is a preview of the **Threads** dialog interface.

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There is 1 selected object; a Thread will be made centred at this point

[Load \(x,y\) Points List from CSV file ...](#) [Save \(x,y\) Points List to CSV file ...](#)

Select Tool ... Imperial Tools | V-Bits | Magnate #751 Side

Tooth Height *above end of tool*

Toolpath Name Delete toolpaths with same name

No Going Home Mode

Thread Category

Thread Parameters

Thread Parameters

MM Inches

Male Female

Right-Hand Thread Left-Hand Thread

Safe Z (for transits) *above material surface*

Pitch Diameter *mid-diameter of thread*

Tolerance *+: increases looseness of M-F fit
-: increases tightness of M-F fit*

Thread Pitch *crest-to-crest distance*

Thread Length *+: below material surface
-: below material bottom*

Add Chamfer at Top of Material ?

Add Groove at Bottom of Thread ?

Create Pocket (F) / Profile (M) Circular Clearance Vector ?

Preview Thread

Description

PaulRowntree.weebly.com Version- 2013-07-18

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Threads and Vectric previews

Vectric's previews of toolpaths cannot show thread profiles because they are undercuts. As a result, you have to check your parameters well, and probably do some practice cuts on scrap material for a while. They show the correct width and diameters on the surface. The database simplifies making threading patterns that you use often and reduces the chance of numerical errors.

Using CSV Files to Position Threading Sites

Possible scenarios:

- You want to coordinate the positions of threaded holes between projects. You could export the circular vectors via dxf or eps files; unfortunately, in some cases Aspire/VCarve Pro will shift them on the project workspace during importation, losing the alignment between projects.
- A list of positions for threaded holes is available as a list of (x,y) pairs, and you don't really want to create all of these vectors by hand.

The two push-buttons below the text bar that identifies how many vectors were selected (the buttons you ignored at step 5) allow you to load up (x,y) coordinates from a CSV file, or to save the selected coordinates to a CSV file for later use. The file "MultiThread.csv" that is included in the **Threads** package gives the coordinates of 3 locations. If you load this file from the **Threads** gadget, the loaded coordinates will be used, and the selected vectors will be ignored. These coordinates are absolute and do not change when loaded; the holes will stay where you put them, even if the different projects have different origins or material sizes (but they must have the same unit base). Threaded patterns will be created in the order that the (x,y) pairs are found in the CSV file.

Here are the lines from MultiThread.csv

```
; Selected object centres written to CSV file
;
-3, 0
0, 0
3, 0
```

No 2D vectors are made when you load these points, and so if you re-run the gadget to modify to Threads parameters, you will have to reload the CSV file as well.

Using the Database

The text file Threads.txt in the gadget directory holds the preset parameters for the threads. **The information in the provided database file must be verified/adapted prior to use.** You can edit this file with Notepad, keeping a backup copy in case the file becomes unusable. The structure of the file is described in the text header. It is also a good practice to record the dates that you have edited the file (line 3), and perhaps identify the changes made.

```
;
; database file for Threads
;
; col 1 : Name of Threads profile
; col 2 : millimeters = 1, inches=0
; col 3 : Male=1, Female=0
; col 4 : RHT=1, LHT=0
;
; col 5 : PitchDiameter
; col 6 : Tolerance
;
; col 7 : ThreadLength
; col 8 : ThreadPitch
; col 9 : EndGroove = 1, no EndGroove = 0 )
;
```

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```
Threads Manual
F Manual Example,0,0, 1, 2.0, 0.0, -0.5, 0.20, 1
M Manual Example,0,1, 1, 2.0, 0.0, 0.75, 0.20, 1
Favourites
Two Inch 8tpi, 0, 0, 1, 2.0, 0.0, -0.5, 0.125,1
Three Inch 8tpi, 0, 0, 1, 3.0, 0.0, -0.5, 0.125,1
```

The lines with only one piece of information start “Categories’ in the database (e.g., “Favourites”), and can be used to collect similar types or similar functions for your projects. You can use any Category names you wish, and you can have as many Categories as you need. Names and Categories are case-sensitive.

Each of the other lines describes a **Threads** profile, with a more-or-less useful name. You can have as many profiles in the file as you wish. You can repeat the same name if you want, but this would be confusing.

There are two selector controls on the **Threads** front panel that you ignored at step 9 above. The top one lists all **Threads** Categories that were found in the database. The lower control lists all **Threads** parameter sets in the database. Selecting a Category moves the first entry of that group to become visible in the listing field. Selecting a new profile name in the lower box makes that entry active

The parameters used to create the toolpath are *always* those shown in the edit fields, regardless of the names and categories that may be visible in the DropDown lists.

Tips for Using Threads

- 1) The units associated with the shapes, tools and jobs can be freely mixed; use millimeter or inch unit systems as you see fit.
- 2) **Threads** toolpaths cannot be edited after construction; fortunately they can be easily recreated with new parameters.
- 3) Setting a small negative value as the Thread Length (-0.1”, -2.5mm) will extended the threaded region beyond the thickness of the material. This can be used to compensate for parts of the cutting tool that extend below the actual cutting surfaces.
- 4) The cutting vertex of side cutters is not at the tip of the tool, and you will have to consider this when pocketing out the holes for female threads and setting the thread depths.
- 5) If you want to put a chamfer at the surface of the material, enter the Tooth Height into the numerical entry field just below the Tool Selection button; use the same units as the entries in the tool database. Check the box below the main data entry fields, then press ‘Ok’.
- 6) Good threads require a well-trammed spindle with respect to the table.

If you use **Threads** to produce something interesting, please consider posting photos on the Vectric forums. If you have any questions, I am frequently on the Vectric and CNCZone forums as PaulRowntree, or you can reach me via the PaulRowntree.weebly.com website.

If you found Threads to be a useful piece of software, please consider making a contribution commensurate with its value to your toolchain, and appropriate to the benefit that it has brought to your projects. This will support its continued development.

Specialized toolpath models can be prepared upon request.

Cheers!

PR