

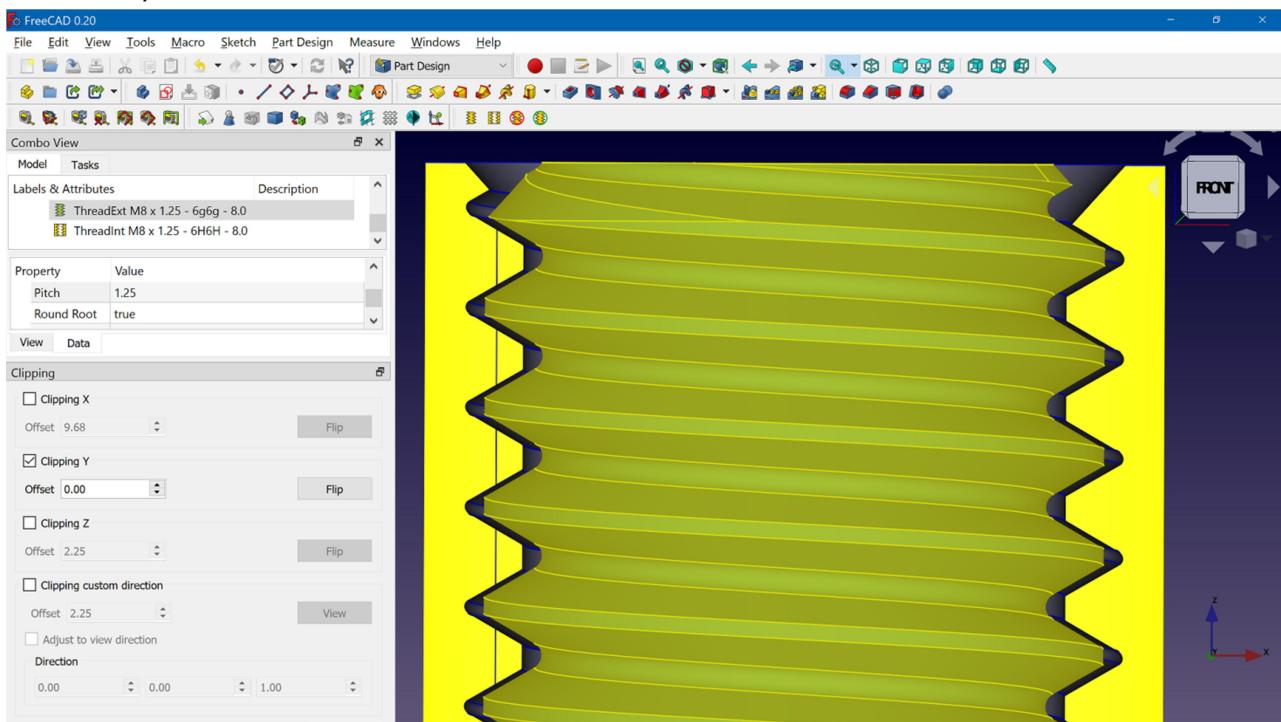
ThreadMaker – FreeCAD Macro to Create Standardized and Custom Thread Shafts and Inserts

ThreadMaker was designed originally with 3D Printing in mind, specifically for the ability to model functional and parametric threaded objects which are not necessarily standardized fasteners. Also NPT and free-hand tapering of threads is supported.

ThreadMaker Macro convenience features include:

- Global thread enable/disable acts on all ThreadMaker bodies in the active document, so that you can design and model without the delays caused by CPU-intensive helical thread generation. Then, when you are ready to render your project in final form, just hit the thread enable button and go make a nice sandwich while all your threads recompute. **Note:** These also act on threads created with Fasteners Workbench!
- Context-sensitive input dialog and properties panels allow you to constrain a thread body to ISO 261 standards, or switch to custom mode for free-hand entry of diameter, pitch, and taper.
- Also provided by the input dialog and Thread Parameters panel is fully automated implementation of ISO 261 Thread Standard and the ISO 965 Tolerance Class Standard it references.
- Thread Parameters input dialog remembers your MRU (Most Recently Used) thread dimensions, even if you alternate between thread shafts and thread inserts. This makes it easy to produce mating parts in just a few mouse clicks.

The following figure shows a mating pair of ISO 261 M8 threads, using the most common tolerance settings: 6g or Ext and 6H for Int. Both thread bodies are shown with the rounded root option. Since the last thread I created before these two was also an M8 with the same settings, it only took 2 mouse-clicks to create each thread body here.



Description

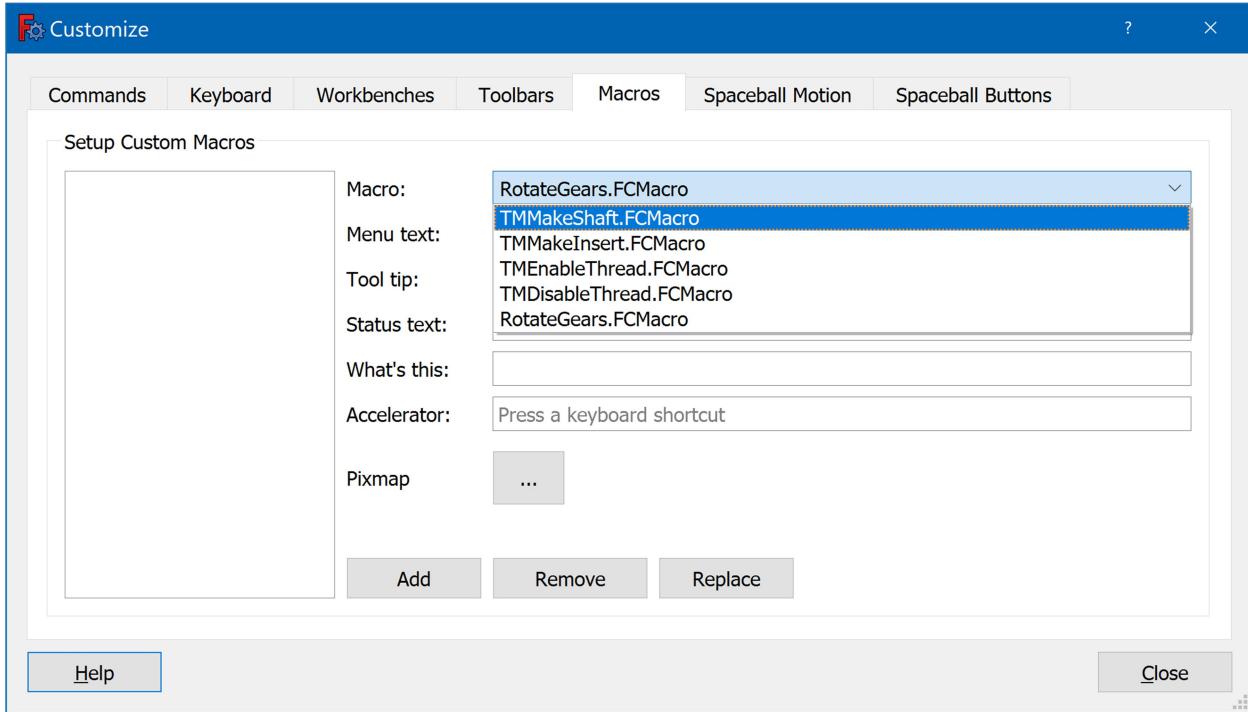
ThreadMaker is actually a collection of 4 macros:

-  **TMMakeShaft.FCMacro** – Creates fully parametric, ISO 261 or customized threaded shafts in the active document, on the origin.
-  **TMMakeInsert.FCMacro** – Creates fully parametric, ISO 261 or customized threaded inserts in the active document, on the origin.
-  **TMDisableThread.FCMacro** – Disables thread generation on all ThreadMaker shafts and inserts in the active document. Thread computation can severely impact the document refresh time. This utility macro lets you avoid thread generation while working the document. All disabled ThreadMaker objects in the document change to transparent blue, threadless shafts or cylinders (except when inside a Part Design Body, as described in [Limitations](#)).
-  **TMEnableThread.FCMacro** – Enables thread generation on all ThreadMaker shafts and inserts in the active document. This may take a long time to run (minutes) if you have many thread bodies. All enabled ThreadMaker objects are restored to their original color in addition to being threaded.

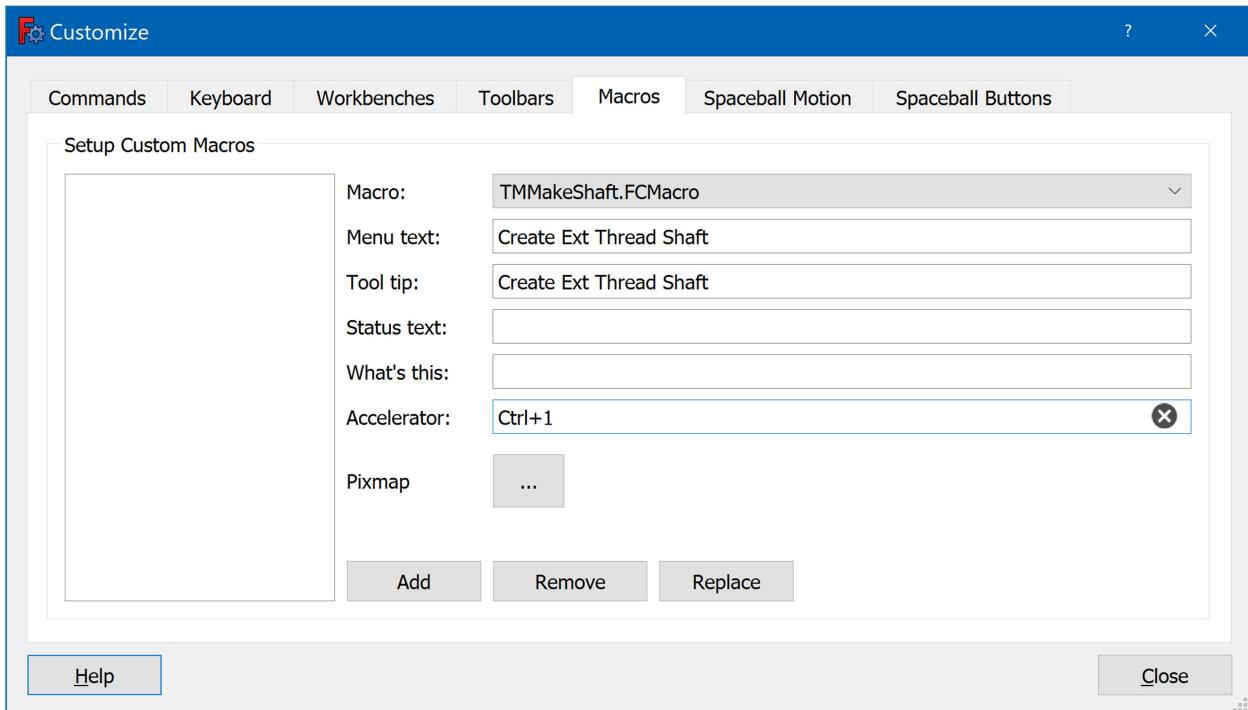
Toolbar Installation

The ThreadMaker Macro files should be installed in your FreeCAD Macro directory, as described in the TMREADME.txt file. Once the files are in place, you can execute these macros from the Macros dialog (FC Menu Bar -> Macro -> Macros), without performing this procedure for Toolbar Installation. If you have decided to keep these macros, then you can follow the steps in this section to install ThreadMaker buttons on your toolbar for convenience.

1. Open the Customize dialog (FC Menu Bar -> Tools -> Customize), then select the Macros Tab. Select TMMakeShaft.FCMacro from the dropdown list as shown.

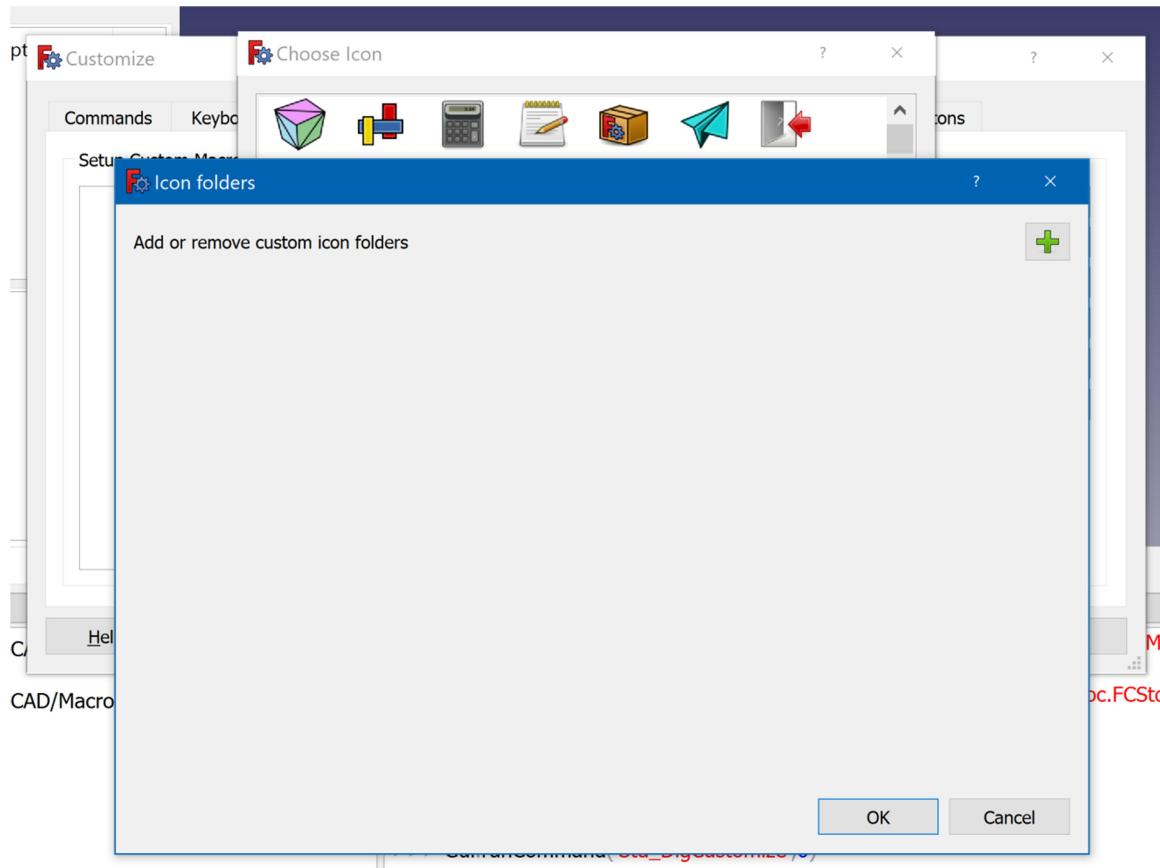


2. Fill in the rest of the dialog as shown. Optionally, you can assign a keyboard shortcut (Accelerator) such as **ctrl+1** to launch this macro. The Menu text and Tool tip should be a short description of the macro function.

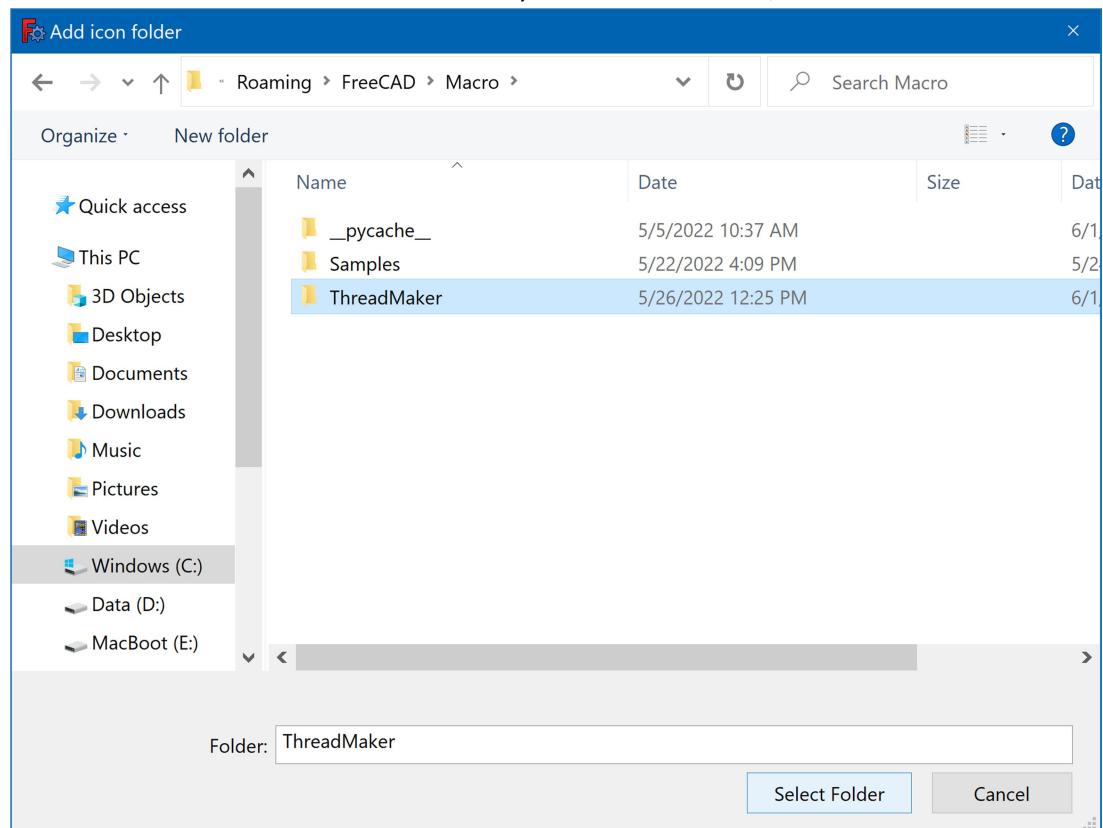


3. Click the [...] button next to the Pixmap label. The Choose Icon dialog comes up showing every imaginable icon in FC, except for our ThreadMaker icons (Note: if this is your second time through these steps, then your ThreadMaker icons are already showing, and you can skip on to step 6). On Choose Icon dialog, click

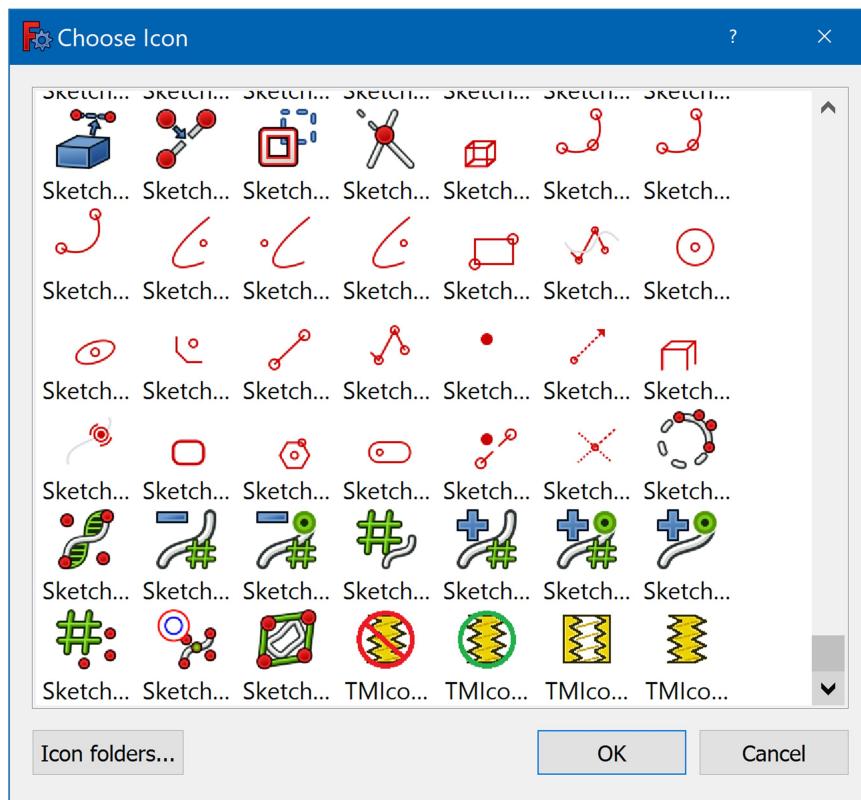
the [Icon Folders] button. Now you see the Icon Folders dialog:



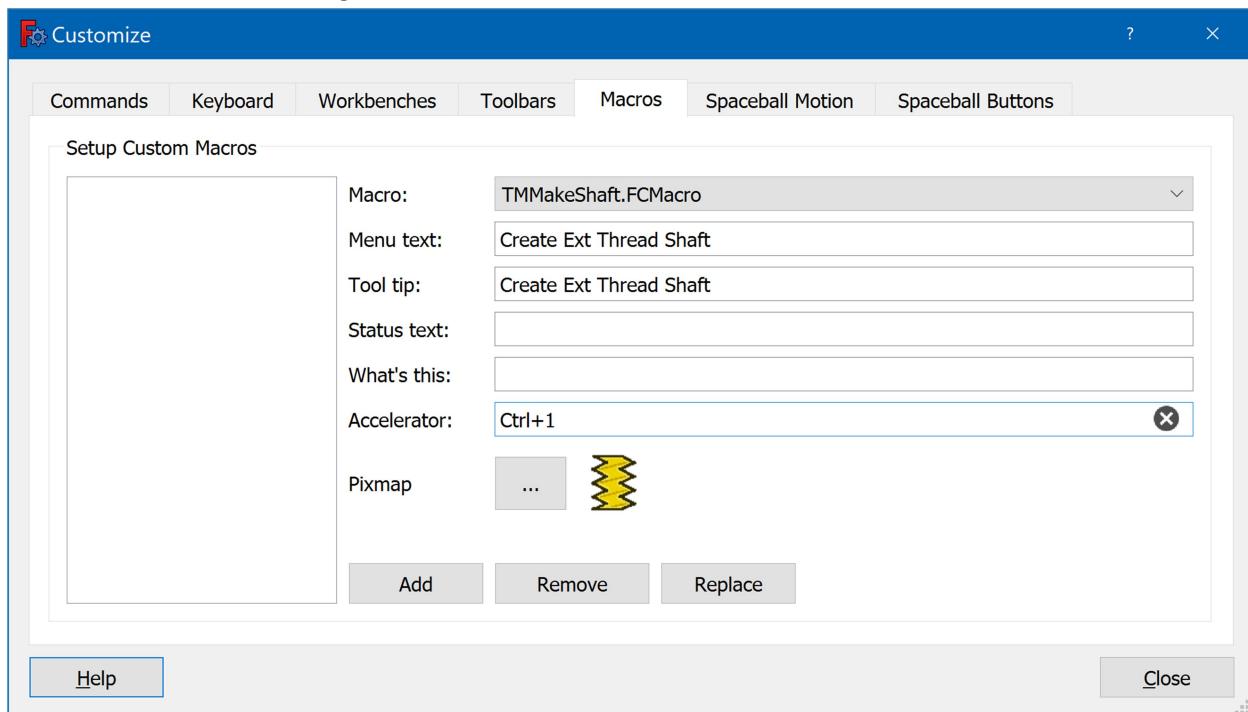
4. Click on the green [+] button at the top right of the Icon Folders dialog. This presents the “file finder” dialog. Find and select the ThreadMaker folder in your FC Macro folder, as shown:



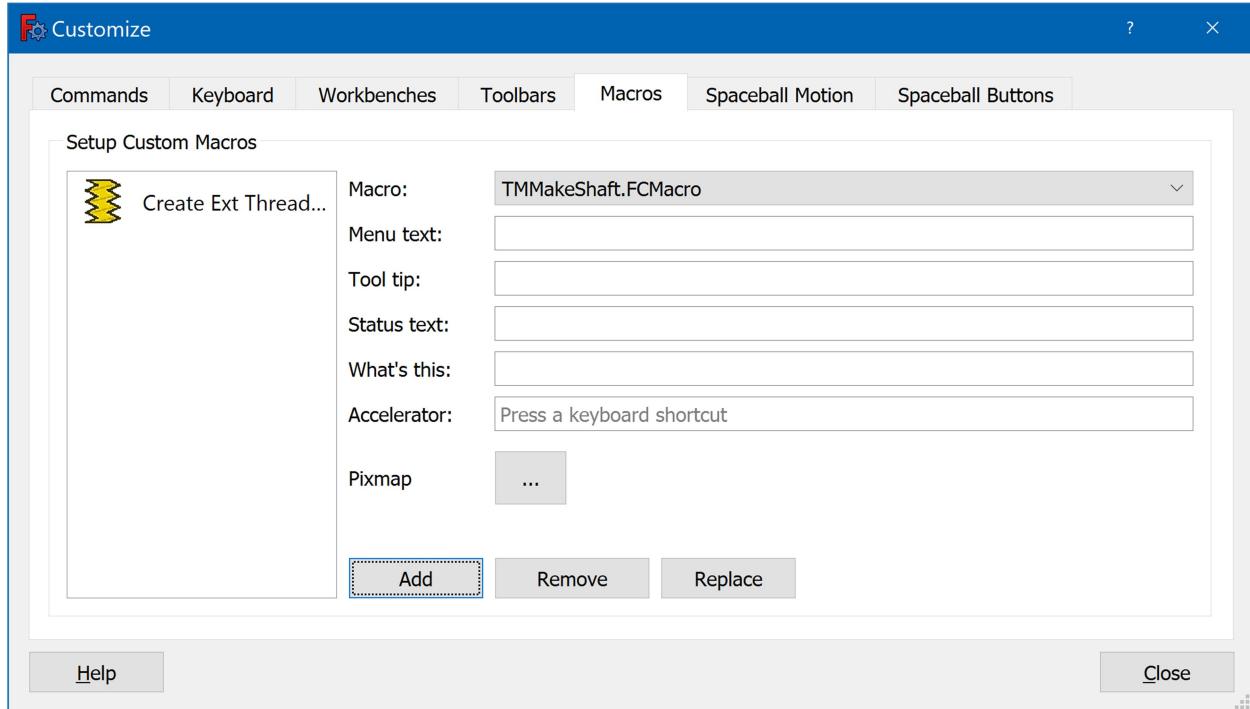
5. Click the [Select Folder] button when you have ThreadMaker folder selected. Then click [OK] button on the Icon Folders dialog. Now you should see the ThreadMaker icons in the Choose Icon list (you may need to scroll to the bottom). ThreadMaker icons are shown here (last 4 in bottom row):



6. Select the last icon above (plain yellow thread shaft), named TMIconShaft. Then click the [OK] button to get back to the Customize dialog. Your TMMakeShaft macro now has an icon:



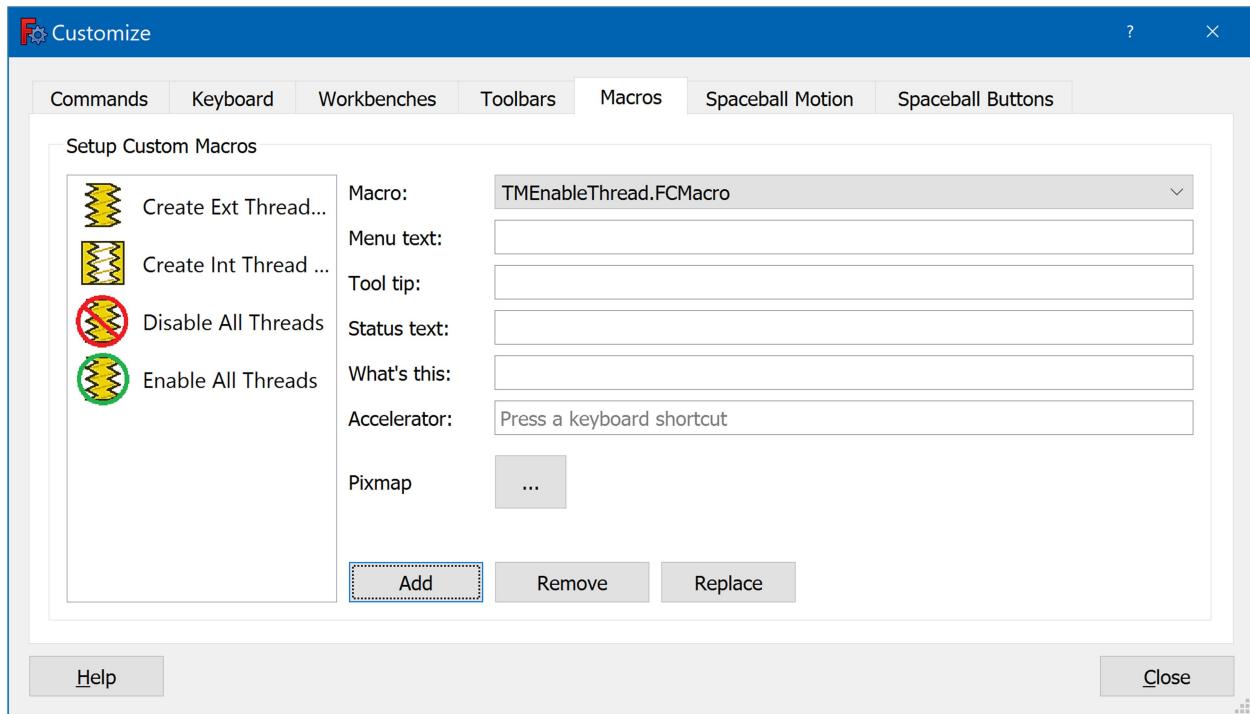
7. Click the [Add] button, and a new entry for your TMThreadShaft macro appears in the Setup Custom Macros list:



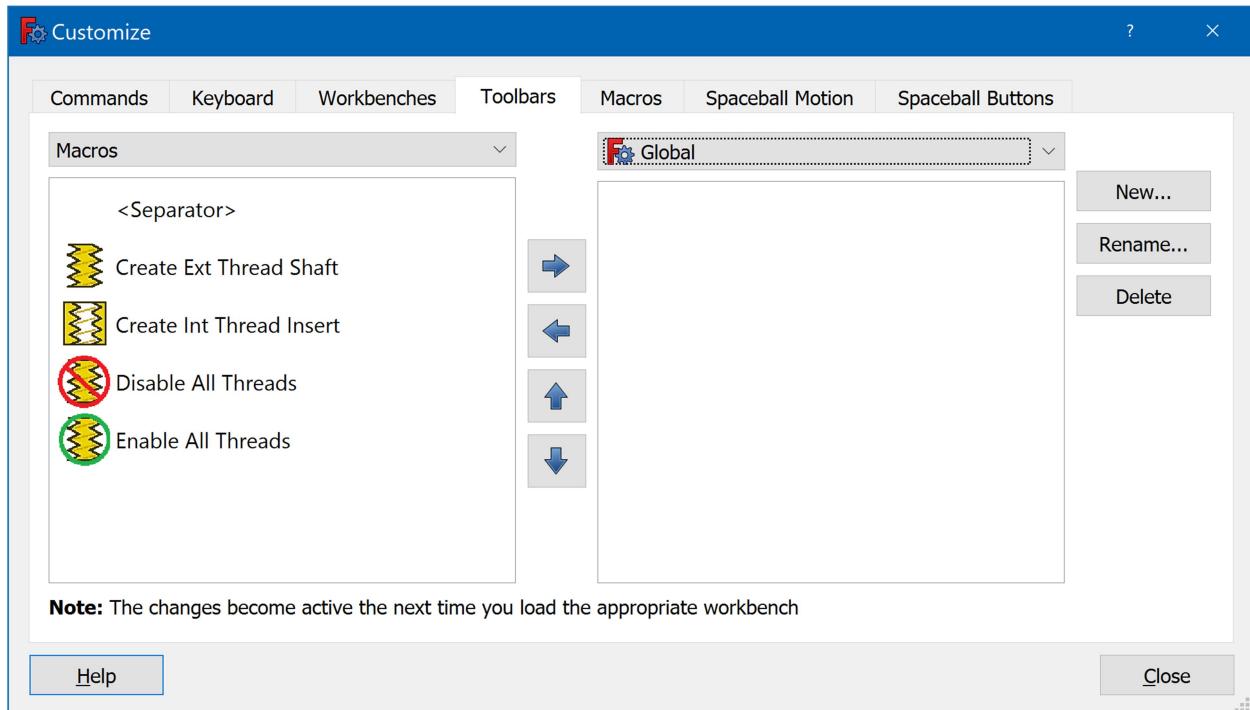
8. BEFORE YOU CLICK [Close] button, click on the Macro dropdown list and select the next TM macro: TMMakeInsert.FCMacro. Now repeat the prior sequence for the next 3 macros as follows:

- Repeat the above steps (2-7) for TMMakeInsert.FCMacro. The icon for TMMakeInsert is the white thread shaft with a yellow insert around it.
- Repeat the above steps (2-7) for TMEnableThread. The icon for TMEnableThread is the yellow thread shaft with the green circle around it.
- Repeat the above steps a third time for the TMDisableThread macro, choosing the icon with the red slash circle around it.

This is what the Customize dialog should look like after reaching this step all 4 times:

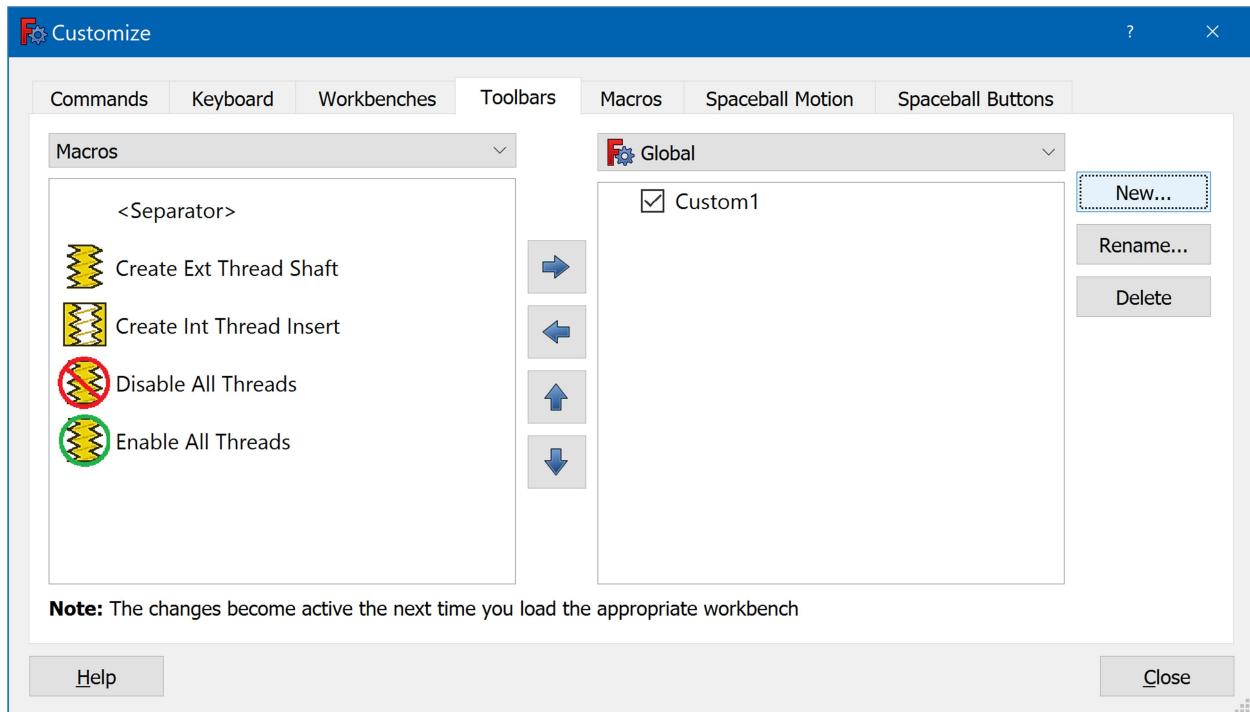


- With the above dialog still open, click on the Toolbars tab. In the drop list on the left, find and select Macros. In the drop list in the right, find and select Global (optionally, select Fasteners WB if you have it loaded, and want TM icons to only show when Fasteners is active WB):

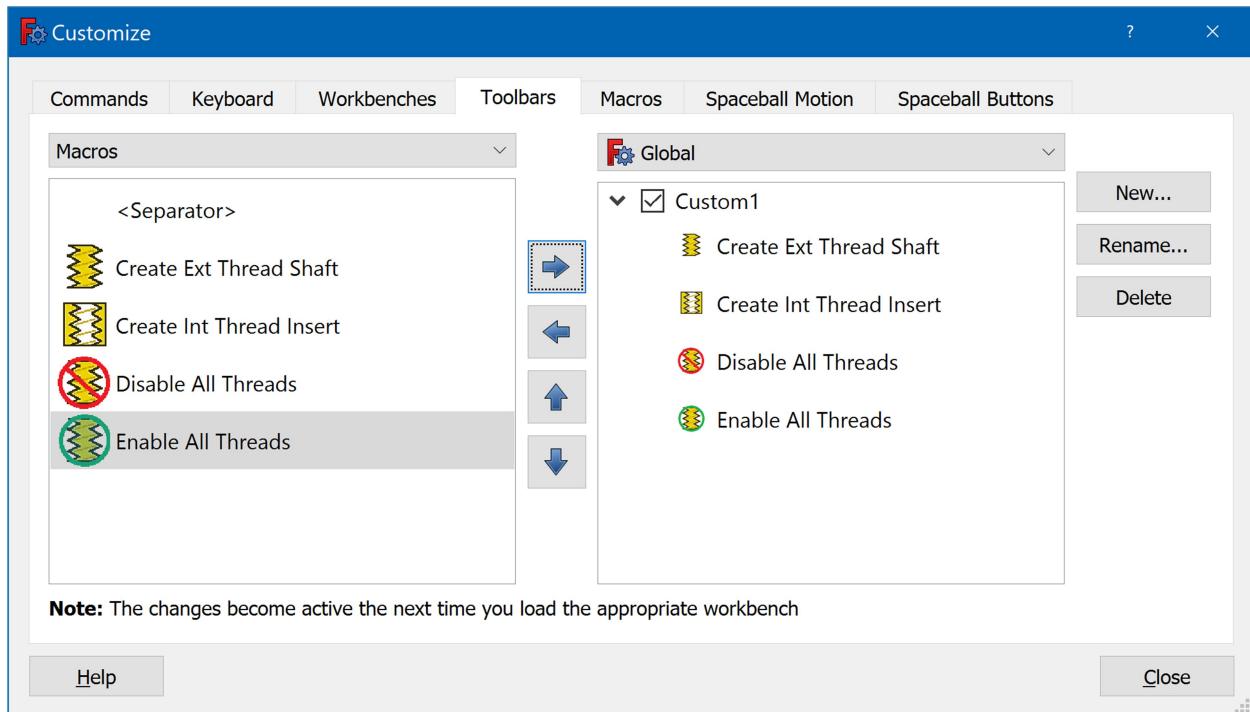


- The FC Global Toolbar is available in all workbenches. Before you can move macros from the left side (Macros) to the right (Global toolbar), you first have to create a new "folder" under the Global (or Fasteners)

toolbar. Click the [New...] button on the right, and either accept or replace the “folder” name:



11. Now you can select each macro in turn (left column), and click the blue [->] button to move it into the Global toolbar (right column):



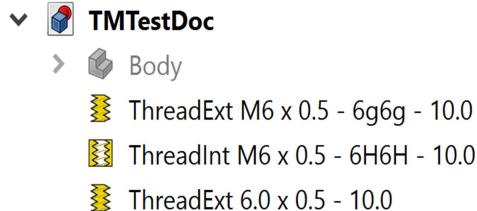
12. Click the [Close] button, and you now have the 4 ThreadMaker icons in your FreeCAD toolbar.

Usage

TMMakeShaft

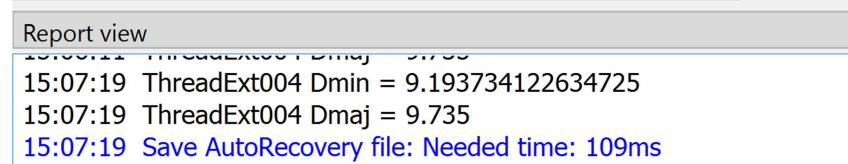
1. If you performed the Toolbar Installation steps above, just click the  TMMakeShaft icon. Otherwise, launch the TMMakeShaft macro from the FreeCAD Macros command.
2. Fill in the Thread Parameters dialog with your desired thread dimensions and options (see Options section below). This dialog remembers your last **accepted** settings.
3. Click OK or hit Enter to accept your dimensions and generate a “ThreadExt” object in the active document. Click Cancel or hit Escape to cancel the operation.

- The ThreadExt object label will include the primary dimensions in standardized format, or a



simile of that for Custom threads.

- The true values for Major and Minor Diameter, after Standardized Tolerances and Clearance are applied, are shown in the Report View. This will happen any time a thread property is changed which re-dimensions the thread.



- Double-click on the ThreadExt object will launch the Transform Tool.

TMMakeInsert

1. If you performed the Toolbar Installation steps above, just click the  TMMakeInsert icon. Otherwise, launch the TMMakeInsert macro from the FreeCAD Macros command.
 2. Fill in the Thread Parameters dialog with your desired thread dimensions and options (see Options section below). This dialog remembers your last **accepted** settings.
 3. Click OK or hit Enter to accept your dimensions and generate a “ThreadInt” object in the active document. Click Cancel or hit Escape to cancel the operation.
- The ThreadInt object label will include the primary dimensions in standardized format, or a simile of that for Custom threads, just as for ThreadExt shown above.
 - The true values for Major and Minor Diameter, after Standardized Tolerances and Clearance are applied, are shown in the Report View. This will happen any time a thread property is changed

- which re-dimensions the thread. **Note that the outer diameter of the insert body will always be 1.0 mm larger than the thread Major Diameter (Dmaj in the report view).**
- Double-click on the ThreadInt object will launch the Transform Tool.

TMDisableThread

1. If you performed the Toolbar Installation steps above, just click the  TMDisableThread icon. Otherwise, launch the TMDisableThread macro from the FreeCAD Macros command.
2. All ThreadMaker objects are de-threaded and rendered in transparent blue.

TMEnableThread

1. If you performed the Toolbar Installation steps above, just click the  TMEnableThread icon. Otherwise, launch the TMEnableThread macro from the FreeCAD Macros command.
2. All ThreadMaker objects are threaded and rendered in their original colors. This may take some time (minutes) if the number and length of thread bodies is high, and the thread pitch is low. For reference, it took 57 seconds to recompute a 9.735 x 0.5 – 50.0 custom thread shaft in FC 0.20 for Windows on a 5GHz Intel i5 Core PC. That's 1.14 seconds/mm length at 0.5 pitch.

Options

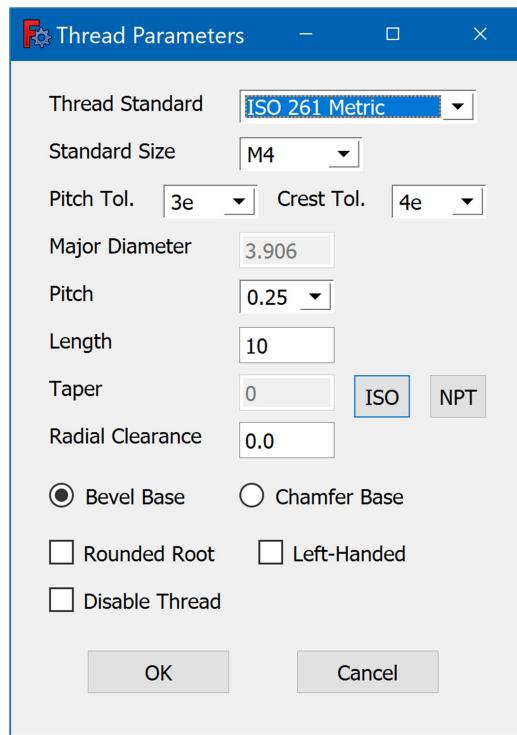
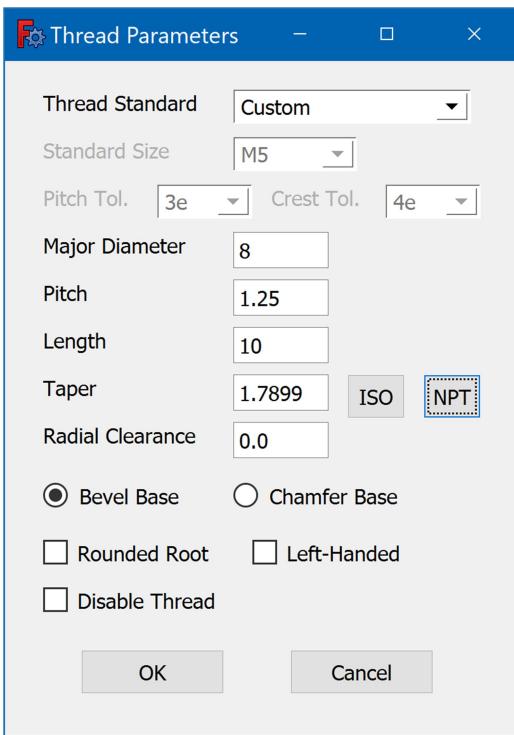
The Thread Parameters dialog appears whenever you create a new thread object with TMMakeShaft or TMMakeInsert. This dialog always remembers the last settings you **accepted**. The dialog reconfigures itself when a ISO 261 Standard is chosen from the list box at the top.

When Thread Standard = “Custom”, the list boxes for Standard Size and Tolerances are greyed out, while the rest of the boxes are open for input. Pitch is entered free-hand into a text box.

When Thread Standard is non-Custom, the Standard Size and Tolerance list boxes are activated, while Major Diameter and Taper are greyed out. Pitch is now a selection list, allowing only standardized pitch selection.

When switching from Standard to Custom, the Major Diameter (post-tolerance) is preserved in its input box.

When switching from Custom to Standard, ThreadMaker attempts to grab the last used standard size, and will default to M10 if it can't find it in the standard size list.



Thread Standard – Presently only 2 values are available: “Custom” and “ISO 261 Metric”. The choice for Thread Standard reconfigures the rest of the dialog box as described above.

Standard Size- Available for non-Custom threads only, lists all thread sizes defined by the thread standard.

Pitch Tol. / Crest Tol.- Available for non-Custom threads only, lists all tolerance grades for pitch and crest allowed by the thread standard. See ISO 965 for details on how tolerance works. See the notes at the bottom of the TMMakeShaft.FCMacro file for a summary.

Major Diameter- This is the outer-most (from thread axis) diameter of the thread. When Thread Standard is non-Custom, this box is greyed out and shows the actual O.D. of the selected thread size, after applying Tolerances.

Pitch- The thread pitch. When Thread Standard is Custom, any value ≥ 0.1 and $\leq (\text{Diameter}/2.3)$ is valid. When a non-Custom standard is chose, this is a list-box with only standard pitch values listed.

Length- Length of threaded shaft. This length should at least be larger than $\text{Pitch} * 1.5$, in order to avoid possible geometry errors during thread body generation.

Taper- Taper angle for threaded shaft. For Custom threads, enter any taper angle (thread generator passes testing for taper angles up to 5 deg., which is more for art work). There are 2 convenience buttons next to the Taper box: [ISO] and [NPT]. These buttons will pre-populate the Taper box with a standardized value. Taper box and the 2 buttons are disabled unless Thread Standard = “Custom”.

NOTE: It is possible to enter a Taper value which causes the top of the shaft to taper to a point at or below the thread’s length. This will fail to generate. You can fix Taper in the ThreadExt/ThreadInt object properties if this happens.

Radial Clearance- Any positive quantity entered here will increase the “gap” between mating internal and external thread bodies. A positive value will decrease both major and minor diameters of an external thread

(ThreadExt); and will increase both diameters in an internal thread (ThreadInt). A negative value is valid, and does the reverse.

This feature was added with 3D printing and electroplating in mind. It is NOT specifically allowed under the ISO 261 standard, but IS available in ThreadExt/ThreadInt properties for a standardized thread. If you add clearance to a standardized thread, that clearance is applied to the thread diameters in addition to the selected Tolerances are applied.

NOTE: Clearance is included in the Major Diameter shown on the Thread Parameters dialog, just as the Tolerances (non-Custom) are.

Bevel/Chamfer Base- These radio buttons define the type of physical base made at the “bottom” end of the thread shaft or insert. The “top” end will always be beveled. The illustration below shows 2 ThreadExt objects created with bevel base (left) and 2 ThreadExt objects created with Chamfer base (right).

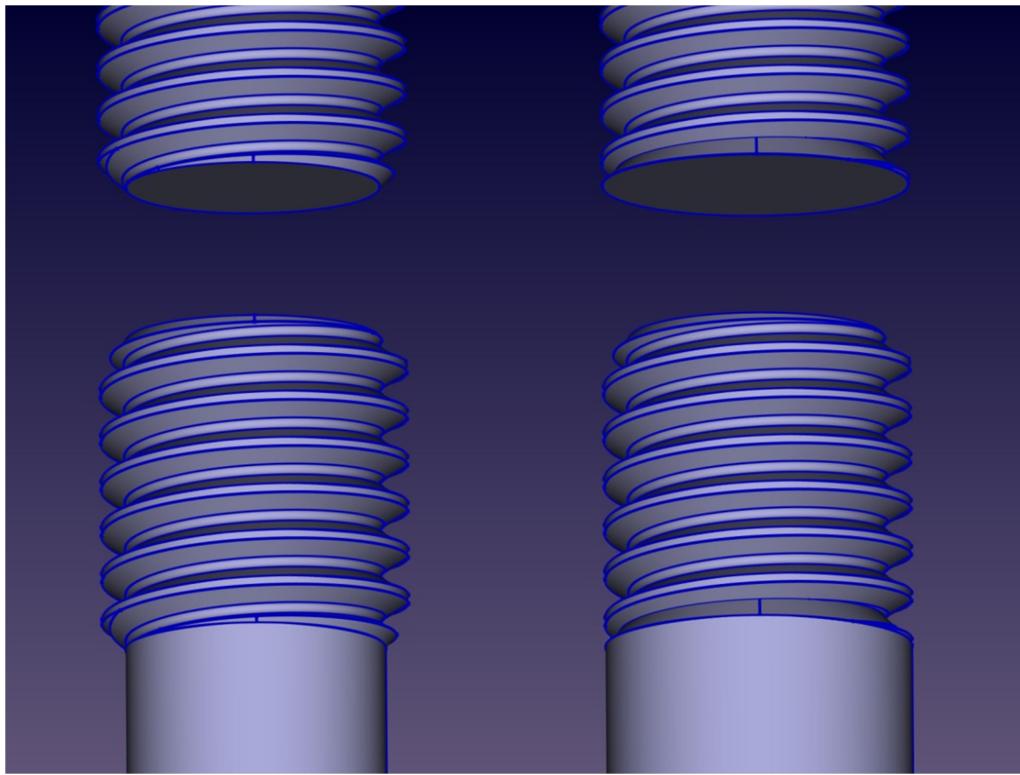


Figure: Bevel base ThreadExt objects on the left, Chamfer base threads on the right.

Bevel base is used when you want both ends of the thread shaft to accept internal thread fittings; or you want both ends of a thread insert to accept external threads (ie- a nut). On an external thread, bevel base is also for attaching the thread shaft to a solid shaft which fits the thread I.D. This is shown on the left in the figure above.

Chamfer base is used when you want to attach the thread shaft or insert to a surface which is larger than (or equal to) the thread O.D., as shown on the right above.

Rounded Root- This setting allows for an optional rounded root profile, per ISO 68-1M. The “valley floor” between threads is either flat or rounded according to this checkbox. The Minor Diameter is rounded on an external thread, the Major Diameter is rounded on an internal thread.

Left Handed- Checking this will generate a left-handed thread instead of the usual right-handed thread.

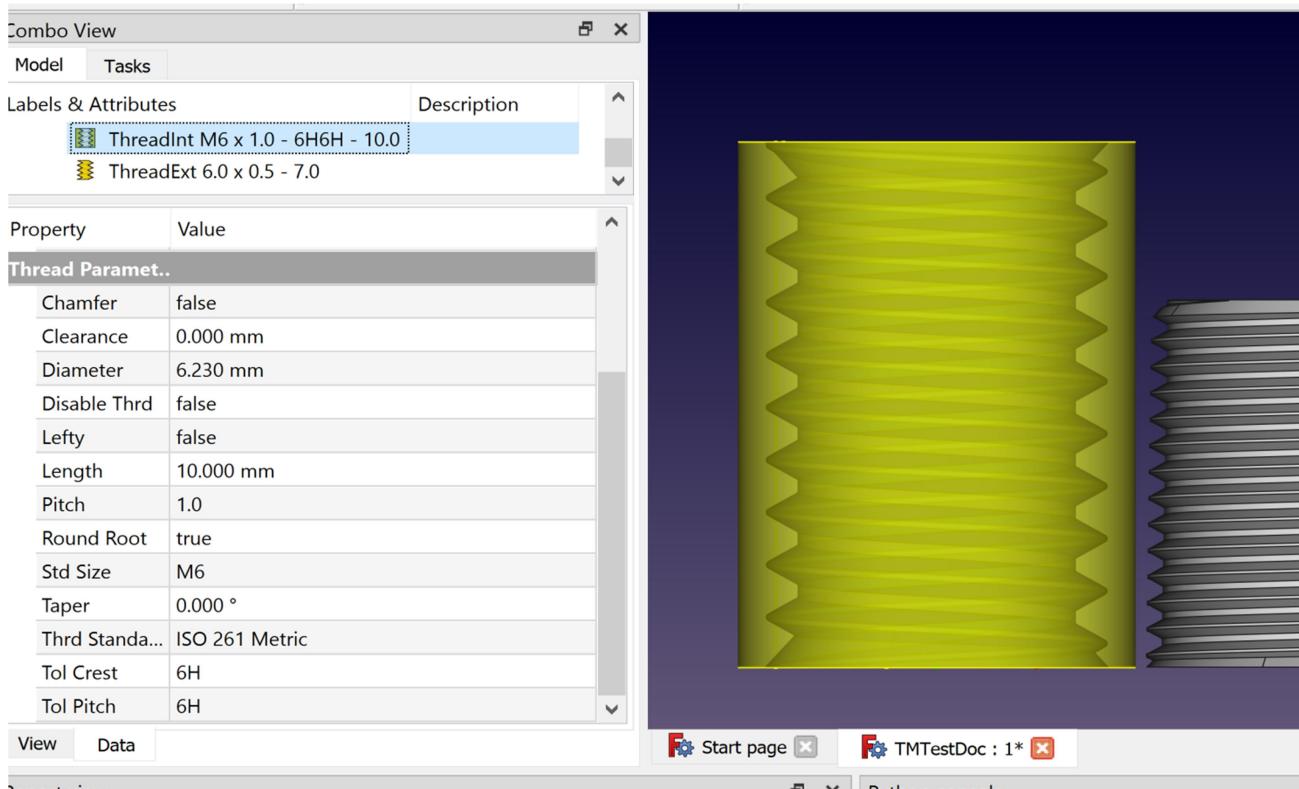
Disable Thread- Checking this causes the thread body to be generated rapidly, and without threads. If you specified a long thread length and/or low thread pitch (<1.0), it may take half a minute or more to build the fully threaded shaft. To avoid this wait time, and get instant response, click this checkbox before you click OK.

Thread objects are changed to transparent blue when Disable Thread is true (except when merged into Part Design Body, which overrides sub-shape color).

OK/Cancel buttons- On this dialog, hitting Enter is the same as clicking OK; hitting Escape is the same as clicking Cancel. If you cancel, the values in the dialog are not saved for the next time.

Properties

In your FreeCAD document, all the ThreadExt and ThreadInt objects contain the exact same properties as shown above in **Options** (Thread Parameters dialog). Also, the properties re-configure themselves when switching between ISO 261 and Custom standards, in exactly the same way as the Options Dialog shown in **Options**. In the Data tab (in FreeCAD Combo Panel), you will see a section titled “Thread Parameters” as shown below:



An “ISO 261 Metric” thread is shown here, so the Taper and Diameter boxes are read-only until Custom is chosen for Thrd Standard.

Please note that FreeCAD will attempt to regenerate the thread with every little change made in Thread Shaft Properties. **Therefore, it is good practice to set Disable Thrd = True before re-dimensioning ThreadExt objects.** Then all the changes will be recomputed in one refresh when you enable threads again.

Limitations

- Long processing time for threads with small pitch and/or long length; and for numerous Thread objects in a single document. The Thread Disable and Thread Enable macros were created to avoid long delays during document refreshes. You can also disable threads for individual Thread objects, and when defining new threaded objects.
- Threaded objects are mostly interoperable with Part Design tools. A Thread object in PD works as a basefeature, and works with PD boolean fuse. By using PD Fuse instead of dragging a thread into a PD Body (basefeature), you can keep the parametric thread object (and its control settings) bundled with the body. When using PD basefeature mode, the parametric thread object remains outside the body. A Thread object cannot be used in PD pattern tools, but it works great with Draft array tools. Also, PD Body overrides shape color for disabled Thread objects.
- Presently, only one thread standard is implemented: ISO 261 Metric Standard. I plan to add a tapered thread standard and an English thread standard, soon as I can work out which is most wanted in the global FreeCAD user community. In the meanwhile, you can use the “Custom” mode to enter thread dimensions from the data tables of any other thread standard which uses (or can use) the ISO 68-1M 60 deg. Triangle thread profile.