



Installing and Using the Bantam Tools FR-4 Milling System

This tutorial will show you how to properly install and use the Bantam Tools FR-4 Milling System. The Bantam Tools FR-4 Milling System captures airborne dust while milling FR-4 and other materials, and can greatly reduce the chemical risks involved with milling these materials. This is a great way to use the Bantam Tools Desktop PCB Milling Machine to mill sturdier prototype PCBs with safer and more consistent methods. To purchase our FR-4 Milling System, visit our store [here](#).

Tools, Materials, and Files

Tools:

- (1) Bantam Tools Desktop PCB Milling Machine
- (1) Bantam Tools FR-4 Milling System
- Heavy Viscosity Mineral Oil (Available by the pint or gallon from McMaster-Carr)

Materials Included in FR-4 Milling System:

- (1) Mineral Oil Tub
- (2) Handle Nuts
- (2) Long Bol



Step 1: Setting Up Your Mineral Oil Tub

To start, place your Mineral Oil Tub face up on a clean surface. Slide the two bolts through the bolt slots in the FR-4 Milling System. Thread a Handle Nut on the end of each bolt and turn it until the tip of the bolt is just barely through the Handle Nut.

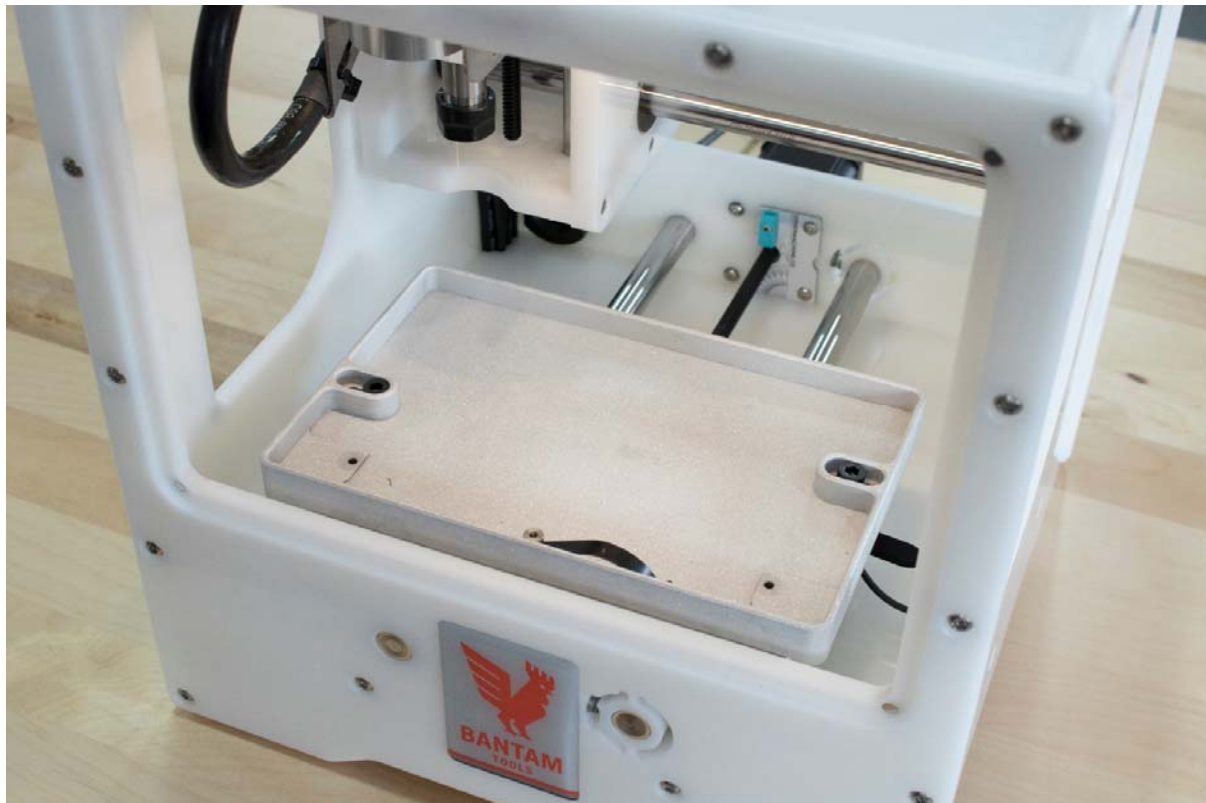
NOTE: You should only need to do this process during initial setup. For general use you will not need to remove the Handle Nuts from the Mineral Oil Tub.

Step 2: Placing Your FR-4 Milling System

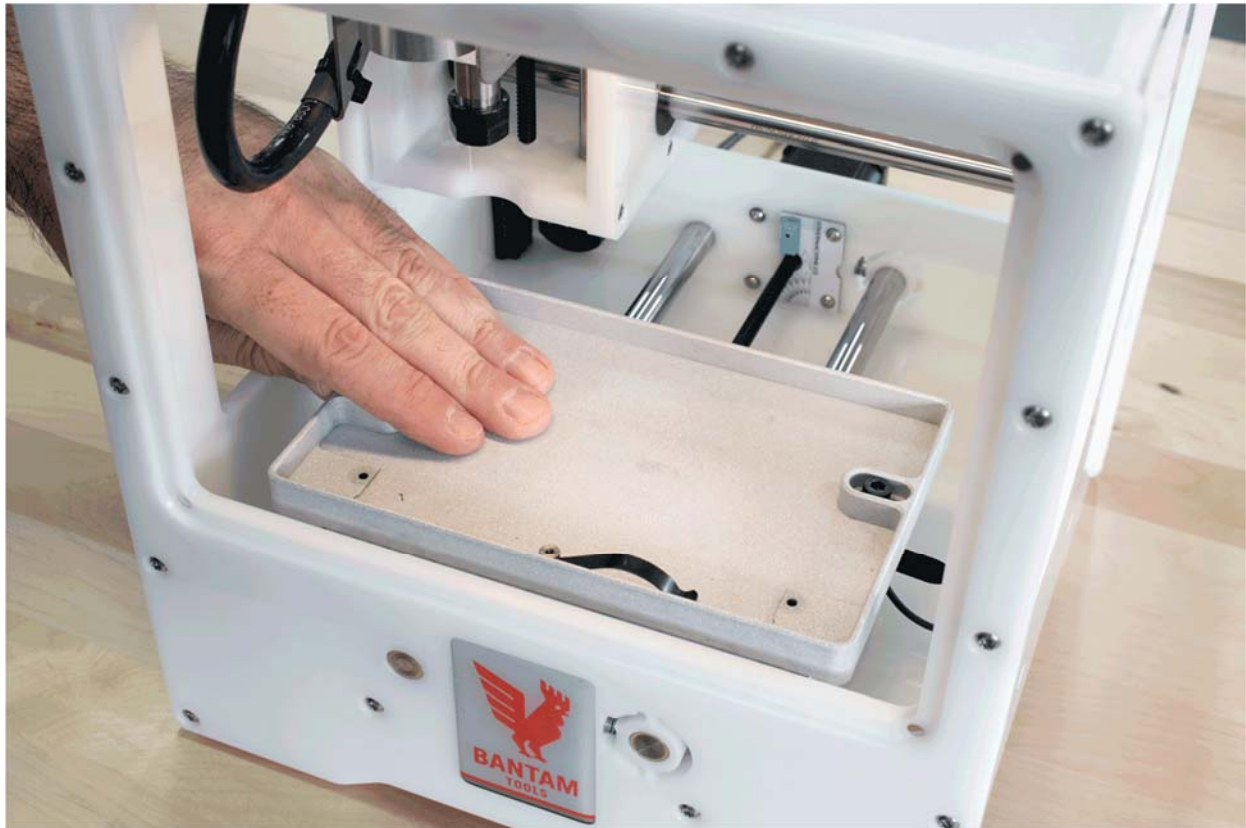
First, clear your spoil board by removing any materials and fixturing such as the alignment bracket. If you use the material thickness probing clip, remove it from the spoil board and install it in any of the holes in the Mineral Oil Tub.

With each bolt slid to the farthest edges of the Mineral Oil Tub, place the assembly on your milling machine's Spoilboard.

Using the alignment features (the bottom left bolt hole and left edge of the Spoilboard) place the FR-4 Milling System. The front of the FR-4 Milling System will be flush with the front of the Y-Carriage, and it will have an even amount of hangover on each side of the Spoilboard.



To hold the FR-4 Milling system in a stable location, apply diagonal pressure right and downwards. This will locate the Mineral Oil Tub into a stable position against the alignment features. While holding the FR-4 Milling System firmly, yet carefully, against the alignment features, slide each bolt inwards so the handle nut slides into the T-Slot. Tighten the allen bolts after both are as far inwards as allows. The bolts should be snug, but not overtight. For easier installation and removal, a quarter or half turn of each bolt should be enough.



IMPORTANT: Your first time doing this may take some adjustment, so we advise installing and removing the FR-4 Milling System at least once *without* mineral oil to set up the Handle Nut heights up properly.

Step 3: Setting Up Your Milling Operation

To set up your milling operation, run the bracket alignment setup in your Bantam Tools™ Desktop Milling Machine Software. The internal bracket in the Mineral Oil Tub will act like your normal alignment bracket, and can be treated as such. Attach your FR-4 or other material to the alignment bracket within the FR-4 Milling System using double-sided tape. Make sure the surface is totally clean and oil free before taping it down.

Now it's time to fill the FR-4 Milling System with mineral oil. Fill the Mineral Oil Tub about $\frac{1}{3}$ to $\frac{1}{2}$ of the way, which will be 1.5 - 2 fl. oz. of mineral oil. For bigger bits, taller material, or longer programs, fill with more mineral oil, as it will increase in opacity as you mill your FR-4 board.

WARNING: if you fill within about 1 mm of the top surface, there is a risk of overflow from the FR-4 Milling System when the Y-carriage is in motion. Monitor your FR-4 Milling System closely at the beginning of every new job to prevent overflow

Step 4: Clean Up After Milling

To properly clean your FR-4 milling system you'll need to remove it from your machine. First, loosen the bolts a quarter turn and slide to the fully exterior position. Once the Handle Nuts are out of the way you can carefully lift and remove it from your milling machine. There are recesses in the FR-4 Milling System which the Handle Nuts rest in, which allows you to set the entire tub flat on the surface of a table without spilling.

Dispose of the majority of the contaminated mineral oil in a trash can before removing your finished part. It is easiest to remove your part from the FR-4 Milling System in the typical fashion using a scraper, but do so slowly to avoid splashing mineral oil. Wash your parts and FR-4 Milling System thoroughly with water and dish soap. Dry thoroughly, and you should be ready to mill another part using your FR-4 Milling System!

WARNING: if you do not correctly remove all the oil from your FR-4 Milling System, your next part may not successfully stick and can slide during milling. It is important to get a clean surface after every milling job

Notes on Functionality:

- The alignment bracket is replicated in the oil tub. This means that when the FR-4 Milling System is properly installed (using the alignment features) you can locate the bracket using the same location procedure as the standard PCB alignment bracket.
- The alignment features and installation method described above allow the position of the Oil Tub to be fairly repeatable, so much so that you may not need to use the locate fixturing feature in software every time it is removed. For extremely precise work, however, we recommend you locate the bracket every time before you start milling.

- You can operate your Probing Clip inside your FR-4 Milling System, and submerge it in mineral oil, if you wish to do on-material tool touch off while using the FR-4 Milling System.
- Avoid spilling mineral oil within your milling machine, particularly on any of the ways or the spindle pulleys and drive belts. If you do spill, clean oil with a lint free rag to the best of your ability.
- If you do spill some mineral oil, tilt your machine slightly forward so it pools near the front of the machine, then remove as much of it as you can.
- Clean and dry your FR-4 Milling System immediately after every use.
- Avoid milling FR-1 with the Bantam Tools FR-4 Milling System.