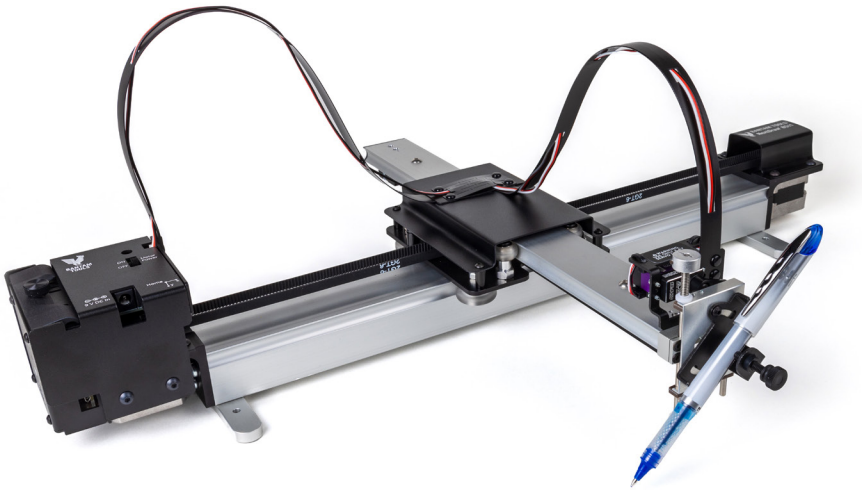
BANTAM TOOLS®

Bantam Tools NextDraw™

Drawing Machines



User Guide

Bantam Tools NextDraw™ 8511	(SKU AS100013, AS100026)
Bantam Tools NextDraw™ 1117	(SKU AS100015, AS100027)
Bantam Tools NextDraw™ 2234	(SKU AS100016, AS100028)

Version 1.4.0
Last updated: March 29, 2025

Preliminaries

0.1 Quick Start?

If you're new to the Bantam Tools NextDraw, and want to get up and running *as quickly as possible*, here are the most important parts to know about:

1. Follow section "1.2 Unboxing NextDraw", starting on page 10.
This section covers a couple of initial hardware setup steps that you don't want to miss.

2. Install software.
Visit bantam.tools/ndsoft for the latest downloads and instructions

3. Section "3. Quick start: Making your first plot", starting on page 28.
Follow along with this section, which walks you through the steps of making your first plot with the NextDraw.

4. Contacts & resources: Here, and again on the ***last page*** of the guide.

If you get stuck or need advice at any point, please don't hesitate to reach out for help!

Contact resources: bantam.tools/ndcontact

Our live support chat: bantam.tools/chat

Online documentation and resources: bantam.tools/nddocs

0.2 Welcome to NextDraw!

This is the user guide for the NextDraw family of drawing machines. This guide is here to help you get started. It covers how you set up and use the machine, tips for operation, details about the software, and pointers to additional resources.

This guide covers operation of the following standard NextDraw models:

- **Bantam Tools NextDraw 8511**
- **Bantam Tools NextDraw 1117**
- **Bantam Tools NextDraw 2234**

Additionally, the sections of this guide covering everything except the physical setup of the machine and automatic homing, are applicable to AxiDraw brand machines produced by Evil Mad Scientist, if they have been updated to current firmware, when using Bantam Tools NextDraw™ software.

0.3 This guide is updated from time to time.

Both this guide, and the NextDraw software are updated from time to time. We encourage you to check back occasionally for the latest version of this manual, and to check that you have the latest version of the software. You can also use the **Configuration** tab of the Bantam Tools NextDraw software to check online for available updates.

You can download the latest version of this guide at bantam.tools/ndguide

Look at the front cover of the guide to find the date and version number of the guide that you are looking at.

0.4 Copyright notice

Software and manual: © 2025 Windell H. Oskay, Bantam Tools

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1. Introduction, unboxing, and setup

1.1 Introducing the Bantam Tools NextDraw™

The Bantam Tools NextDraw™ is the proven and reliable computer-controlled plotter that provides versatile solutions to artists, innovators, educators and handwriting enthusiasts.

The drawing head extends beyond the body of the machine, making it possible to also draw on flat objects bigger than the machine itself. For example, you can set it right on top of a box to write an address or add decorations. You can even set it on top of a poster board, chalkboard, or whiteboard to draw graphics in place.

The pen holder fits a wide variety of pens, including Sharpie fine and ultra-fine point markers, most rollerball and fountain pens, whiteboard markers, and so forth. It can even hold a fountain pen at a proper angle of 45° to the paper. You can also use implements that aren't pens, such as pencils, chalk, charcoal, brushes, and many others.

As an added bonus, the brushless pen-lift mechanism empowers users to use writing implements that need pressure on the paper, including traditional ball-point pens.

The Bantam Tools NextDraw™ is a hardware and software ecosystem designed for a range of innovative applications not limited to drawing and handwriting. The ecosystem features a variety of accessories available to expand your capabilities and help you explore your creative frontier.

1.2 Unboxing NextDraw

The Bantam Tools NextDraw ships in a box with foam padding that cradles it during shipping. The box also includes an accessory bag with power supply, USB cable, the pen clip, spring kit, and some basic tools for maintenance.



The **NextDraw 8511** and **NextDraw 1117** ship fully assembled and ready to use. Lift these models out of their cradling foam, taking care to ***lift by the base only***, and ***not by the flexible cable guides***.

The **NextDraw 2234** ships slightly disassembled to fit in a (yes very large but) reasonably sized box, and requires some re-assembly. If you have just received a new NextDraw 2234, please see its re-assembly guide to get started.



1.3 Included parts and accessories

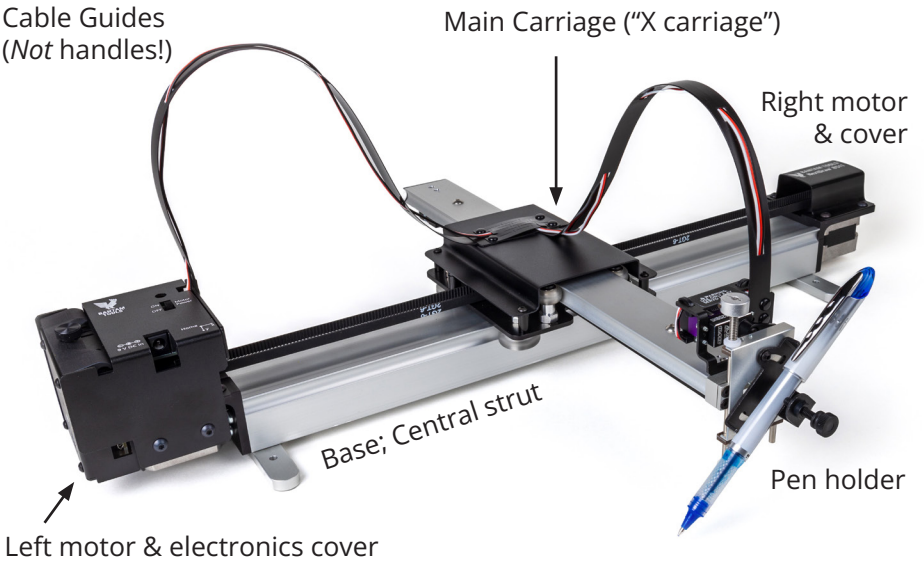
Here are the parts that come with NextDraw:

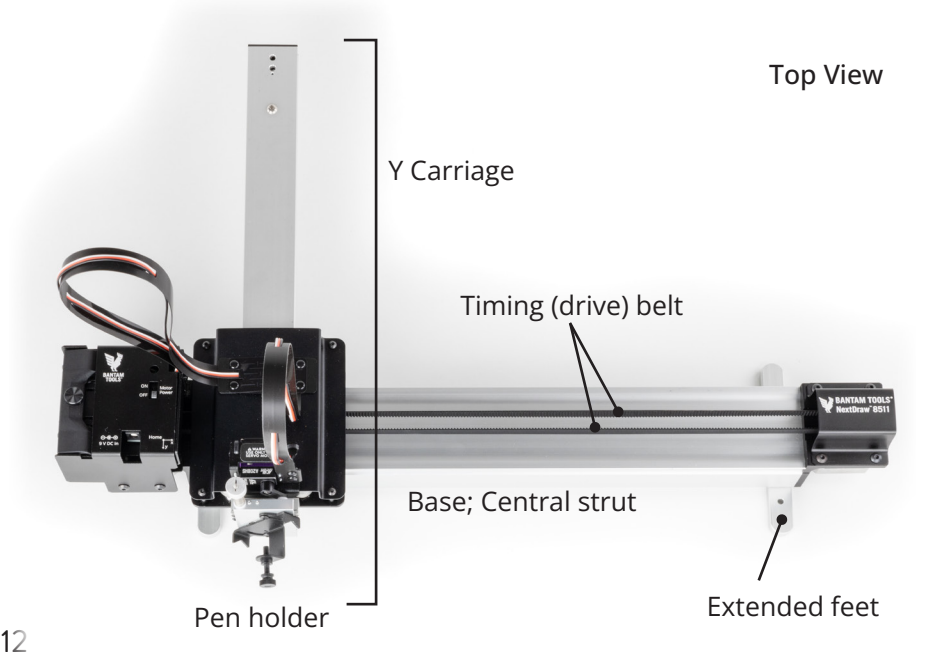
1. The Bantam Tools NextDraw itself
2. Universal-input plug-in power supply, 9 V DC 2.5 A (US or multi-plug)
3. USB cable, A to Micro-B
4. Hex drivers and wrenches
   Sizes include 2 mm, 2.5 mm, and 3 mm hex drivers, and low-profile 8 mm and 10 mm wrenches. Of these, only the smallest (2 mm) hex driver is used in everyday operation.
5. Pen clip
6. Spring kit

To learn more about available NextDraw accessories, please visit:
bantam.tools/ndacc

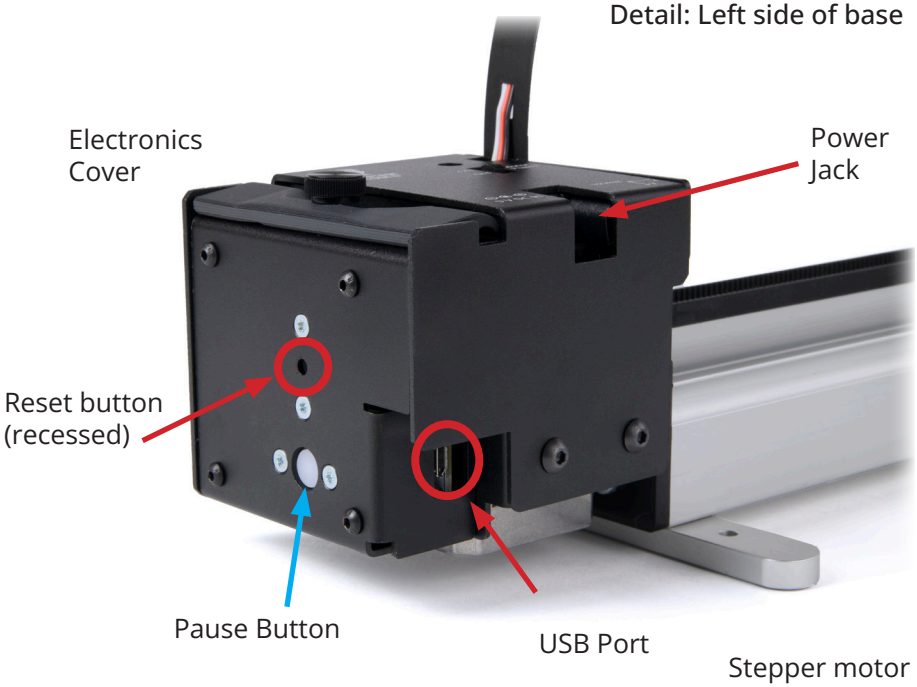
1.4 Bantam Tools NextDraw anatomy

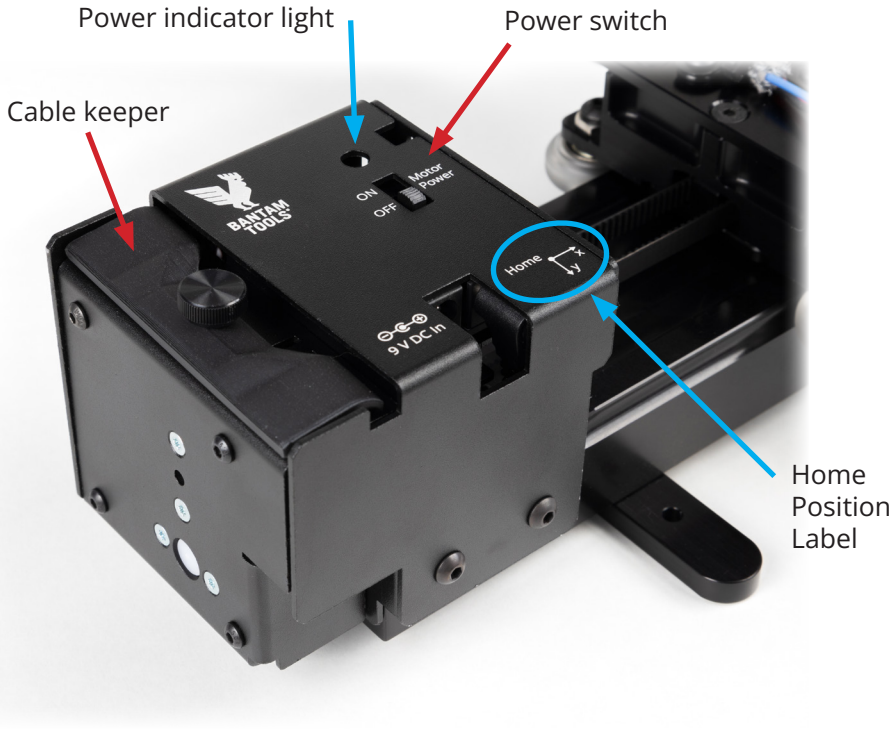
Let us look at the parts and features of the NextDraw. We will refer to these parts by name throughout this guide. The details and appearances of some of these parts vary between models, for example the base of the NextDraw 8511 is a silver-colored aluminum extrusion, while the NextDraw 1117 and 2234 have bases made from black-colored billet aluminum.



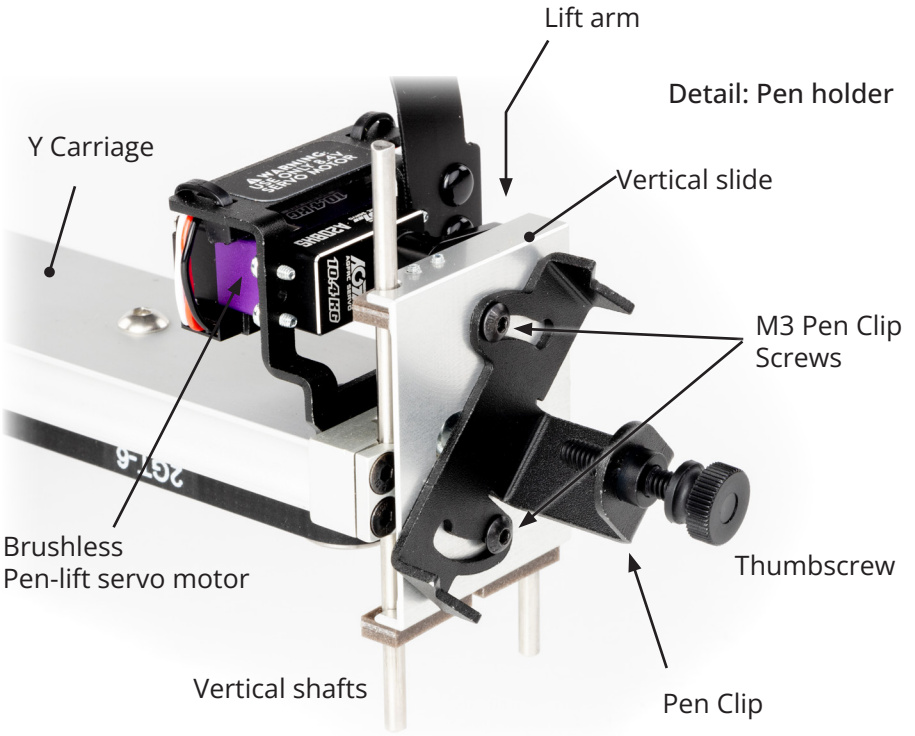


Detail: Left side of base





§1.4 Bantam Tools NextDraw anatomy, continued.



1.5 Safe handling of the NextDraw

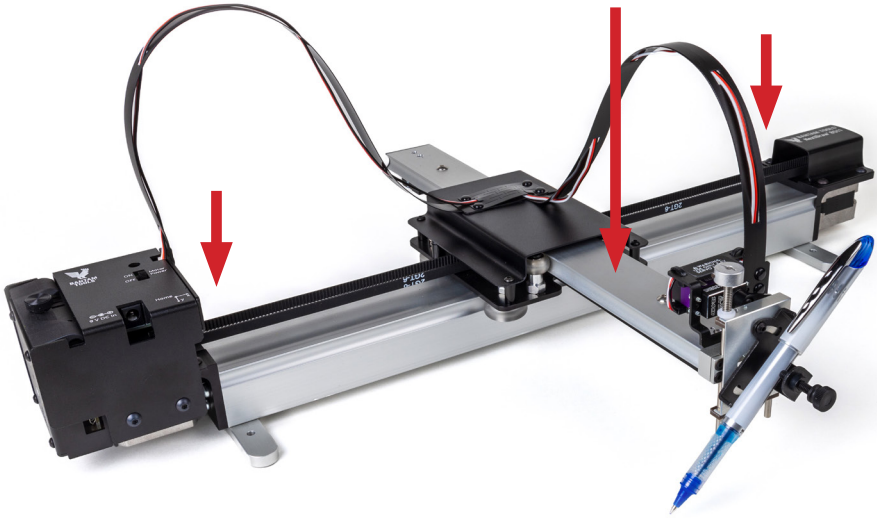
1). **Lifting:** Lift NextDraw by the central strut of the base only. Do not lift by the cables, cable guides, carriages, or pen holder.

The NextDraw 1117 has a handle milled into the back of the central strut, to provide an easy well-defined lifting point in the middle of the machine.

The NextDraw 2234 should be lifted with two hands to support it. There are handles milled into the back of the central strut, close to the two ends.

2). **Heat:** The motors at the two ends of the base may get warm. This is normal, but it is helpful to be aware of it. They should not get too hot to touch.

3). **Moving parts:** NextDraw has exposed moving parts. Keep fingers, hair, and other things that could get caught, crushed, or tangled safely away from the belt and the pinch points between the moving carriage, the pen holder, and the motor covers.

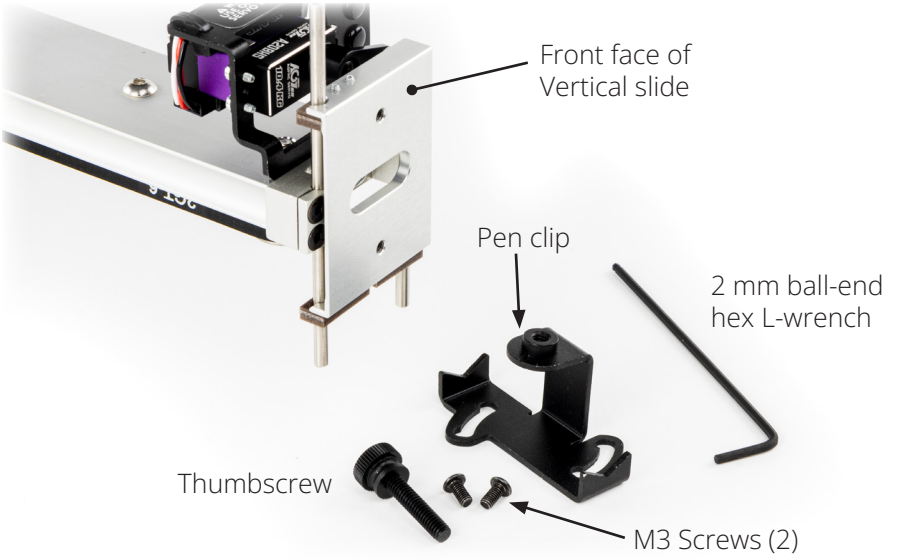




Warning: Keep fingers away from pinch points while NextDraw is operating.

1.6 Attach the pen clip

The first setup step is to attach the pen clip, which is removed for shipping.





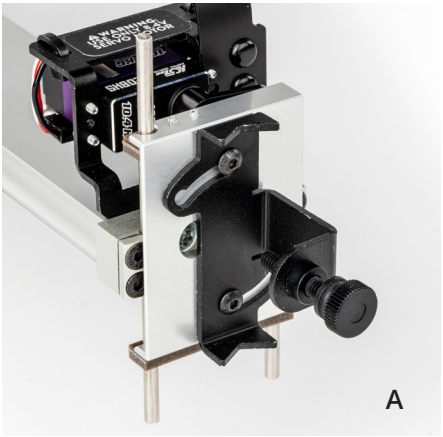
Thread the thumbscrew into the pen clip. Use the two M3 screws to attach the pen clip to the front face of the vertical slide, using the long 2 mm hex L-wrench (the smallest of the included L-wrenches).

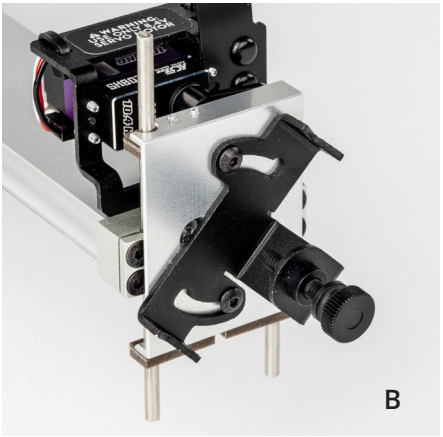
For ease of adjustment, we recommend that you orient the pen clip as shown here, with its “open” side to the left.

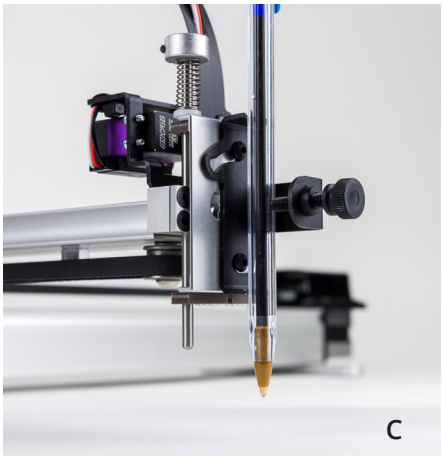
1.7 Pen clip orientation

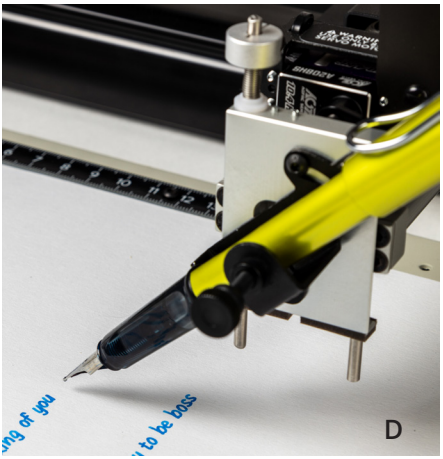
The pen clip can be attached in two different orientations: Vertical, which points the pen straight down, or diagonal, which holds the pen at a 45° angle to the paper. Which to use mostly depends on what type of pen you are using.

To switch between the orientations, loosen (but do not remove) the two small screws. Lift the pen clip slightly, then rotate it to the other position. Lower it back down and tighten the two screws back into place.









The vertical pen position (**A**) is generally the best choice for technical pens, pens that require pressure, such as ball-point pens (**C**), or multi-color plots.

The diagonal position (**B**) is generally the best choice with fountain pens (**D**) or other pens that write better at an angle.

1.8 USB, Power, and Cable management

The NextDraw needs power to operate and connects to your computer by USB. Here, we connect the two cables and secure them with the cable keeper.

1.8.1 About the power supply

The plug-in power adapter included with the NextDraw (9 V dc, regulated, center positive) works with worldwide mains power (100-240 V ac). Do not plug the power supply into any kind of voltage-converting power adapter.

The power supply comes in two versions, one with a North American style power plug, and an International multi-plug version available at https://bantam.tools/9vint .



WARNING: Use only the original, supplied plug-in power supply. If you are unable to identify which power supply is the original, please contact technical support. If your power supply needs to be replaced, use only the original type.

1.8.2 About the USB cable

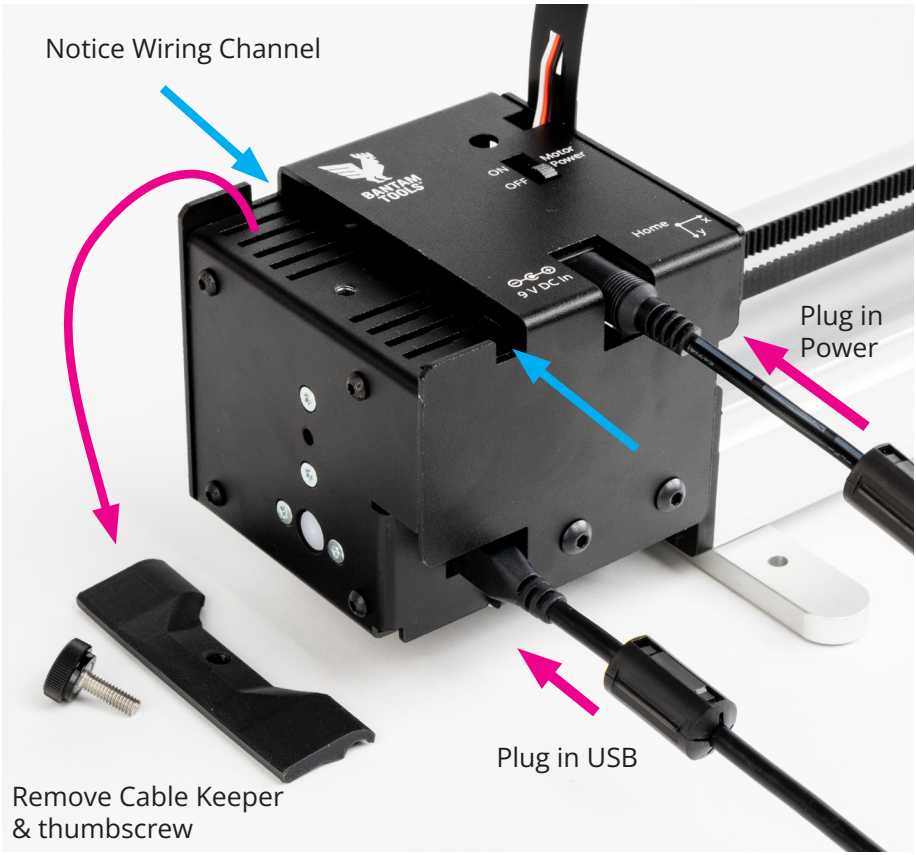
All Bantam Tools NextDraw models currently ship with a USB A to Micro-B cable. You can switch this out for other types of high-quality USB micro cables (e.g., USB C to Micro-B) as needed.

If your computer uses USB C, we recommend using a direct USB C to Micro-B cable (https://bantam.tools/ucmb) rather than an adapter.

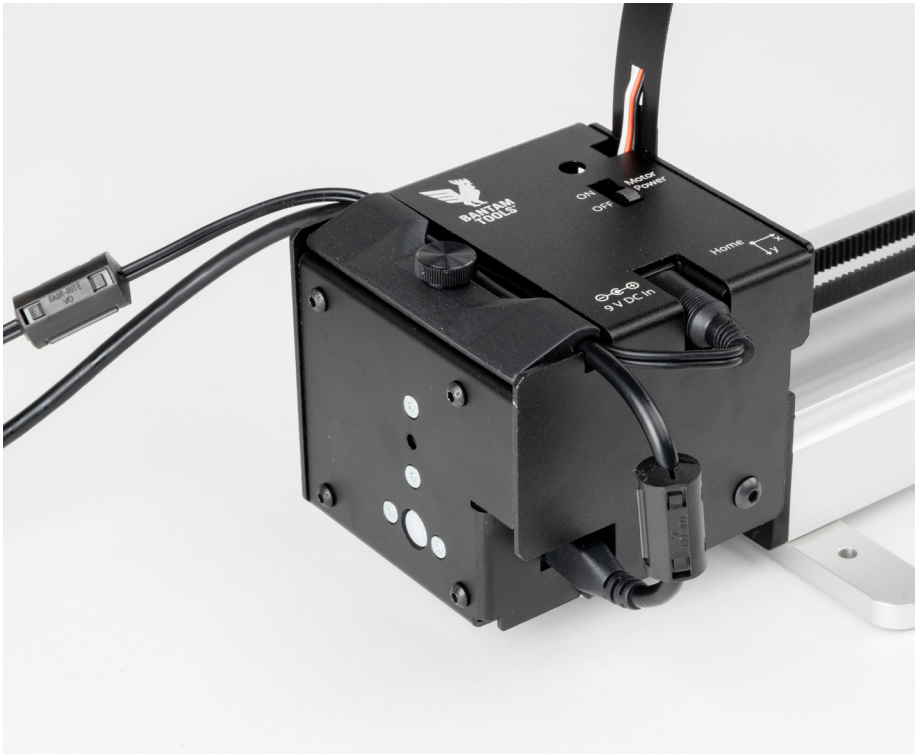
1.8.3 Connect Cables and the Cable Keeper

Plug in the power and USB cables.

Then, remove the **Cable Keeper**, a black plastic clip held in place by a thumb-screw. Removing the Cable Keeper exposes the **Wiring Channel**, on the top of the left motor & electronics cover.



Guide the two cables back and into the Wiring Channel, and then place the Cable Keeper over the cables. Use the thumbscrew to secure the Cable Keeper in place.



Using the Cable Keeper like this keeps your desk neat by pointing the cables backwards, and provides important strain relief that prolongs the life of your cables and electronics.

2. Initial Software Setup

2.1 Install the software

You will need to install software on your computer to operate the NextDraw.

Please start at: bantam.tools/ndsoft .

Starting there, please follow the directions specific for your operating system:

- For Mac and Windows, there are easy installers that you can download.
- For Linux, one or more manual steps are required.

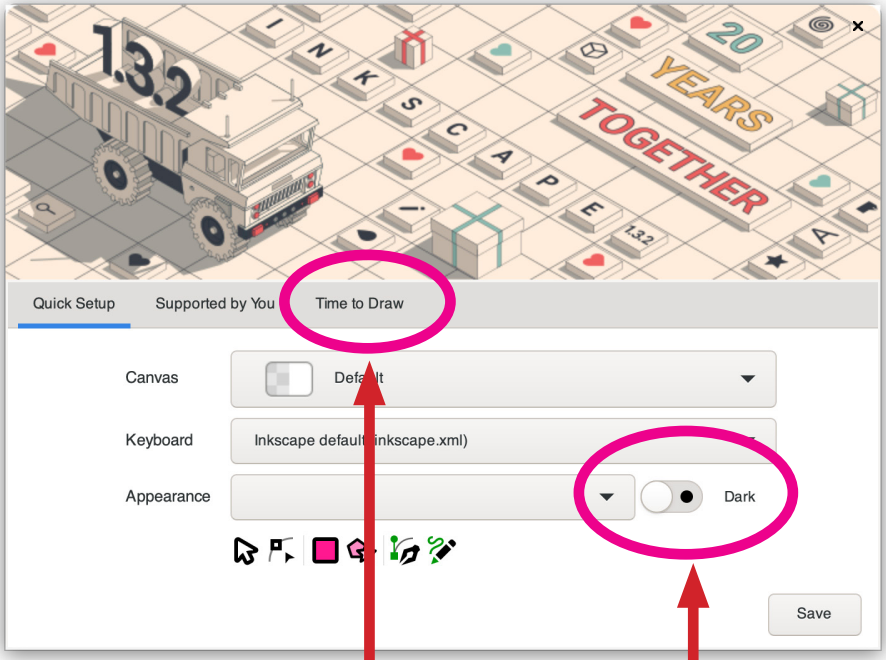
The software that you will install consists of two main parts: **Inkscape**, the superb (and free) drawing program, and a set of plugins, or **extensions** that directly operate the NextDraw from within Inkscape.

If you run into any difficulty while following along with the installation steps, please contact us for support —*we are here to help*. You can find our contact information on the last page of this user guide.

2.2 Opening Inkscape for the first time

Once you have installed the software, open Inkscape.

If this is the first time that you open Inkscape, you may be greeted by several "first-time setup" screens. The exact appearance of these screens will vary between Inkscape versions.

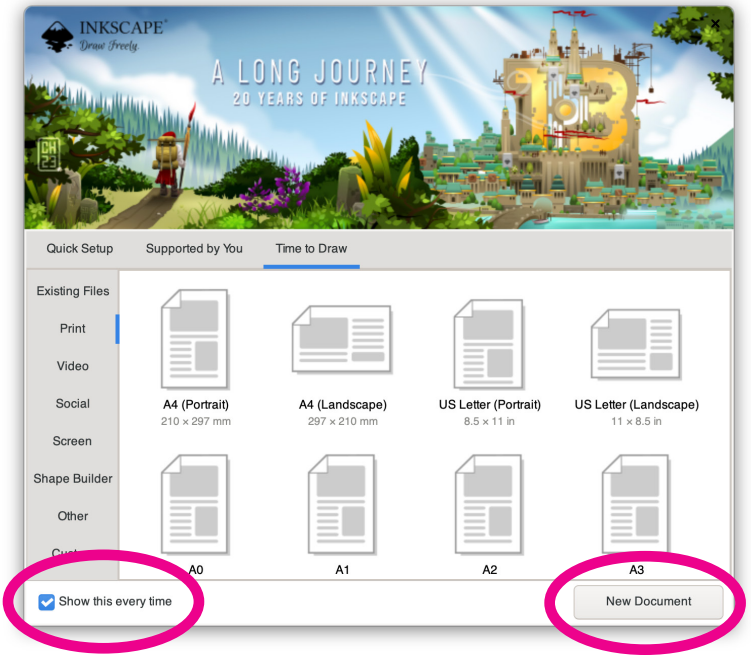


Optionally, select light or dark theme for Inkscape.

Click here to go to last setup screen.

You can use the last of the setup screens to create a new document from several different page-size templates.

However, we generally recommend to uncheck the “Show this every time” box, so that you don’t see these screens again past the first time opening Inkscape.



Optional but recommended: Uncheck this box so that these “first-time setup” screens aren’t shown every time that you open Inkscape.

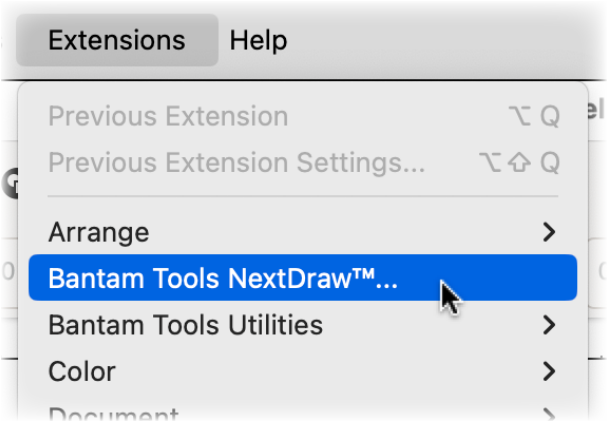
Click here to close this screen and continue.

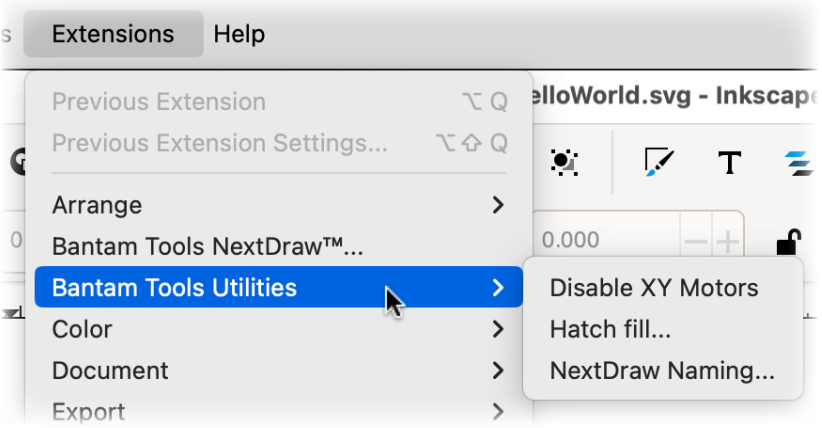
2.3 The Bantam Tools extensions

Once you have Inkscape open and are past any "first-time setup" screens, the NextDraw software, if properly installed, can be found within the **Extensions** menu of Inkscape.

There are two relevant items in the Extensions menu: **Bantam Tools NextDraw™**, the primary software interface to NextDraw, and the **Bantam Tools Utilities** submenu, which contains several supplemental tools.

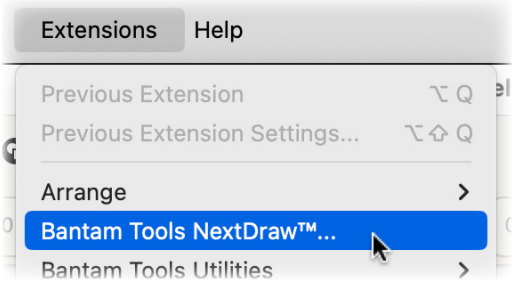
Later in this user guide, we will go into depth about the different features of the software and how to use it.



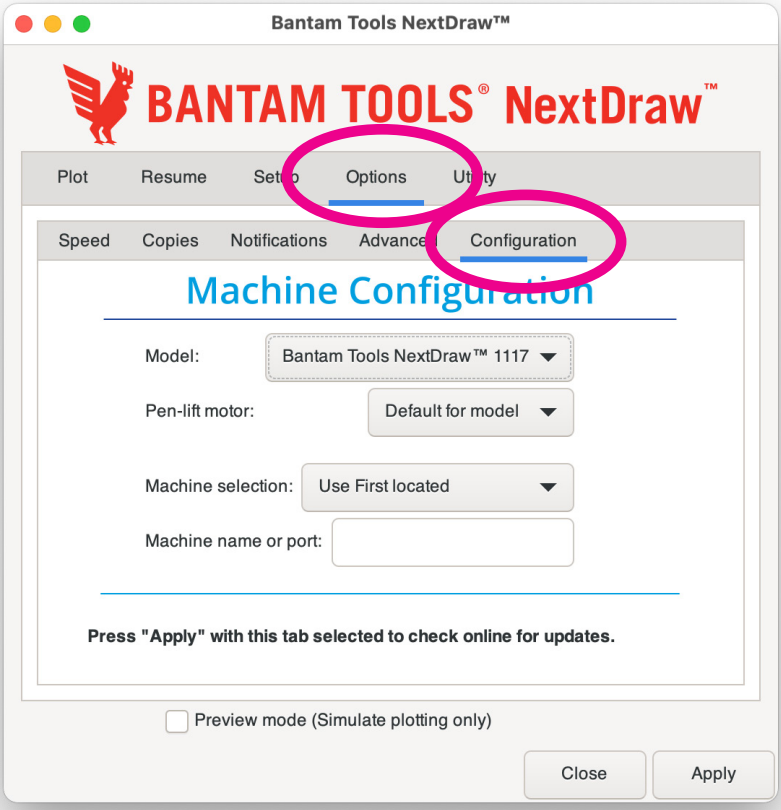


2.4 Select your model

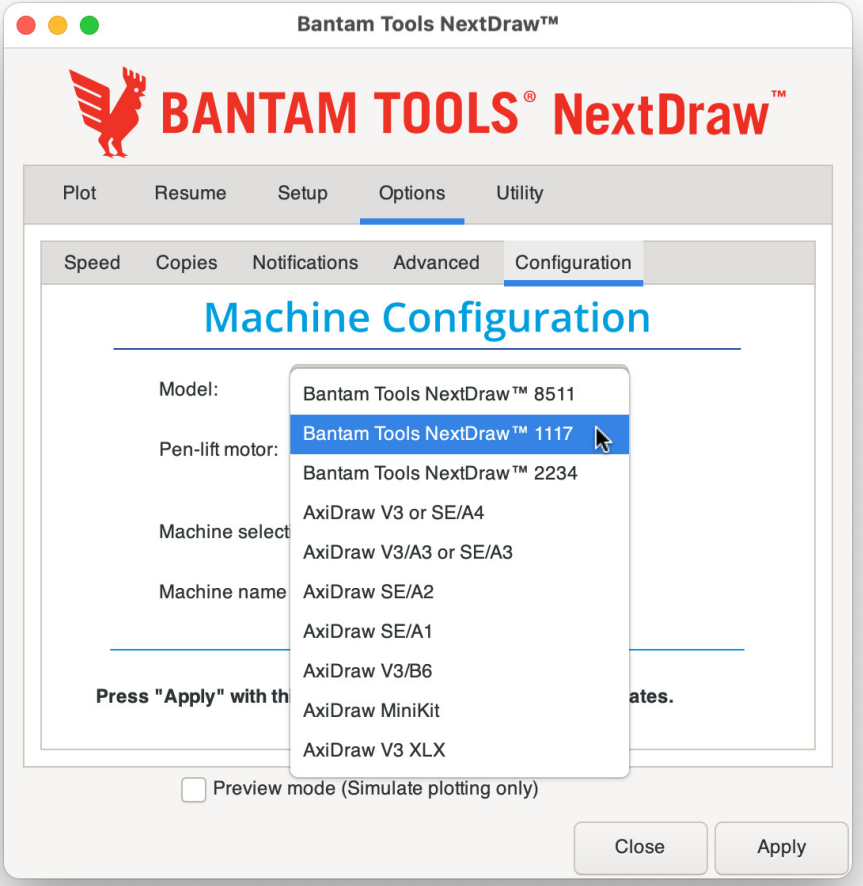
The most important software configuration step is to select which model of plotter you are using. Open **Bantam Tools NextDraw** from the **Extensions** menu of Inkscape.



With the panel open, click to select the **Options > Configuration** tab:



Then, select which model of plotter you are using from the **Model** drop-down menu:



The list of models supported by the software includes the different sizes of Bantam Tools NextDraw, as well as AxiDraw machines manufactured by Evil Mad Scientist.

If you are using an AxiDraw machine that has been upgraded with a brushless pen-lift motor, also select “Brushless upgrade” from the **Pen-lift motor** drop-down menu.

2.5 Aside: Alternative software, CLI, and APIs

The Bantam Tools NextDraw software is available in two alternate versions that may be helpful for developers or for anyone who would to control the machine programatically rather than through Inkscape. Additionally, there is a low-level serial control protocol available that can be used to control the machine outside of the NextDraw software.

2.5.1 Bantam Tools NextDraw CLI API

The Bantam Tools NextDraw command-line interface (CLI) is proven, reliable, and feature-rich control software that can be used on its own or integrated with almost any other system. It offers essentially the full set of features otherwise available through Inkscape. However, as a command-line utility, it can be used on its own or from within almost any scripting or programming environment.

You can learn more about it at: https://bantam.tools/nd_cli

2.5.2 Bantam Tools NextDraw Python API

The Bantam Tools NextDraw Python API is proven, reliable, and feature-rich control software that can be used within your own Python scripts. It offers essentially the full set of features available through Inkscape, and allows you to call and operate those features from within your own Python scripts.

In addition to the core functionality of plotting SVG files, the Python API also provides an "interactive" context for sending individual motion commands including "Goto XY" type movements.

You can learn more about it at: https://bantam.tools/nd_py

2.5.3 Low-level "EBB" command protocol

If you would like to directly interface to the NextDraw's EBB motor control board, it has a serial command protocol that you can control from any programming interface that can address your USB port.

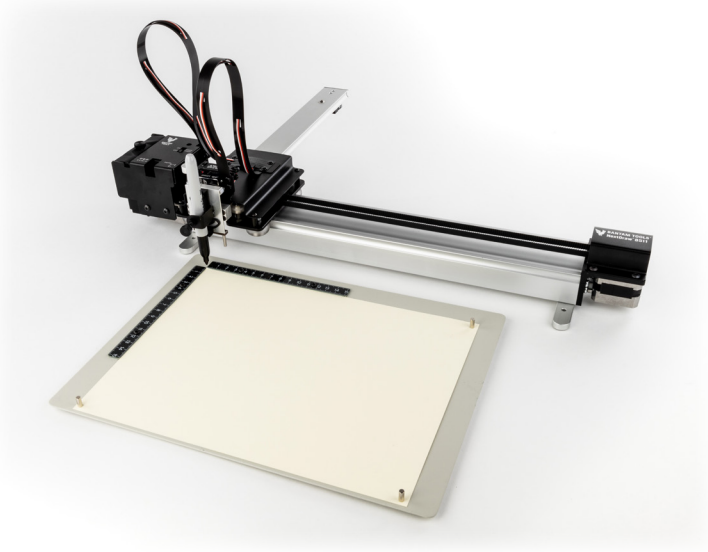
For more information, please see the documentation links on our wiki site: http://bantam.tools/nddocs

3. Quick start: Making your first plot

In this section, we will briefly walk through the steps to make your first plot. After this section, we will discuss each part of this process in additional depth.

3.1 Pen and paper

For your first plot, you'll need a pen (or something else to write with) and paper (or something else to write on).



The easiest way to fix paper in place is to use one of the magnetic easel accessories, (Letter/A4: bantam.tools/mea4 , Tabloid/A3: bantam.tools/mea3) a painted and textured sheet of heavy steel with magnets to hold down paper.

However, just about any way to hold paper can work. You can use a clipboard, a magnetic table with magnets, or tape to hold down paper.

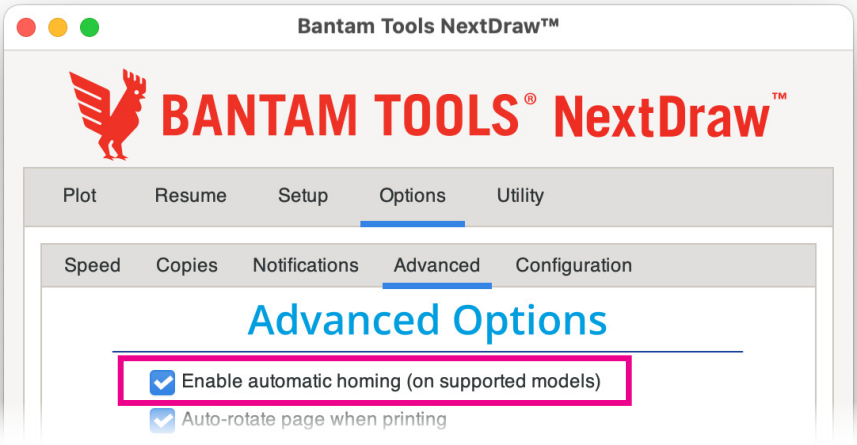
3.2 Automatic and Manual Homing

In most cases it is necessary to move the carriage to the **Home Corner** prior to beginning a plot. This is where the carriage is as far left and as far back as it can go: where the pen holder is closest to the engraved label "Home".

When a plot finishes, the NextDraw will return to the Home Corner automatically, leaving it ready for your next plot.

3.2.1 Automatic Homing

Bantam Tools NextDraw drawing machines have an automatic homing feature which is enabled by default. The option to control it can be found on the **Options > Advanced** tab of the Bantam Tools NextDraw software.



If the **Enable automatic homing** option is checked, the NextDraw will perform an automatic home-finding sequence before starting a plot, automatically moving to the Home corner, if it is not already homed. The sequence and directions of movements to locate this position may be counterintuitive in some cases.

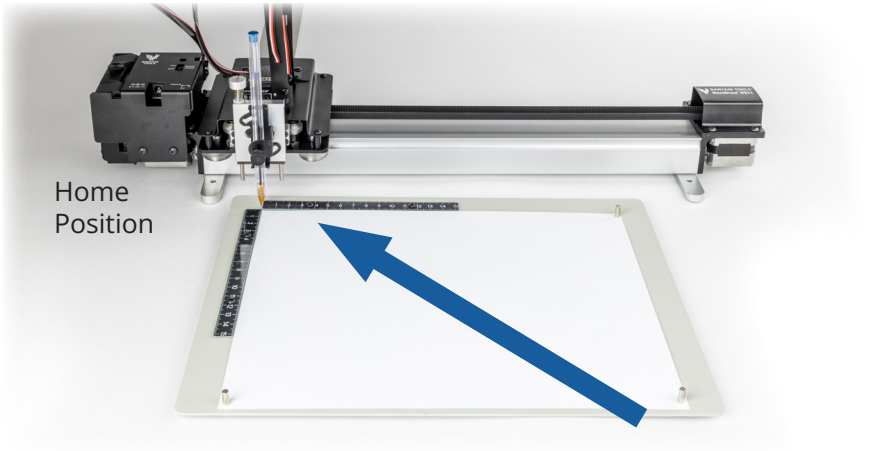
The Homing sequence is also started automatically if you use the Walk Carriage utility commands (§6.13.1 Walk Carriage commands, on page 88) before the carriage is not homed.

Homing will be performed again when power is lost or when switching between plotting modes that require switching motor configurations.

When automatic homing is disabled — or on legacy AxiDraw machines that do not support automatic homing — it is necessary to follow the guidance from the next section on manual homing.

3.2.2 Manual Homing

When automatic homing is disabled — or on machines that do not support automatic homing — it is necessary to move the carriage to the Home Corner by hand before starting a plot.



The carriage should only be moved when the power to the motors is off. If it does not move easily, turn off the motors so that you are not trying to force them.

To turn off the motors, select from the Extensions menu in Inkscape:
Extensions > Bantam Tools Utilities > Disable XY Motors



Alternately, you can use the **Raise pen, turn off motors** command in the **Setup** tab of the Bantam Tools NextDraw software.

You can also switch off the power, using the main power switch, in order to release the motors and move the carriage. (The power switch is present on Bantam Tools NextDraw machines and AxiDraw machines with the brushless upgrade.)

Once motor power is off, slide the carriage to the Home Corner by hand. Move it by holding onto the solid block of metal behind the vertical slide of the pen holder.



Do not push the vertical slide of the pen holder or pen directly.

3.2.3 Aside: Home position with manual homing

When automatic homing is not active, the position where the motors are first energized is said to be the **plot origin**. That position will be recorded and maintained as the "effective home" position for the plot, even if it is not at the machine's Home corner. (This provides an effective means to start plots at positions other than at the true Home position.)

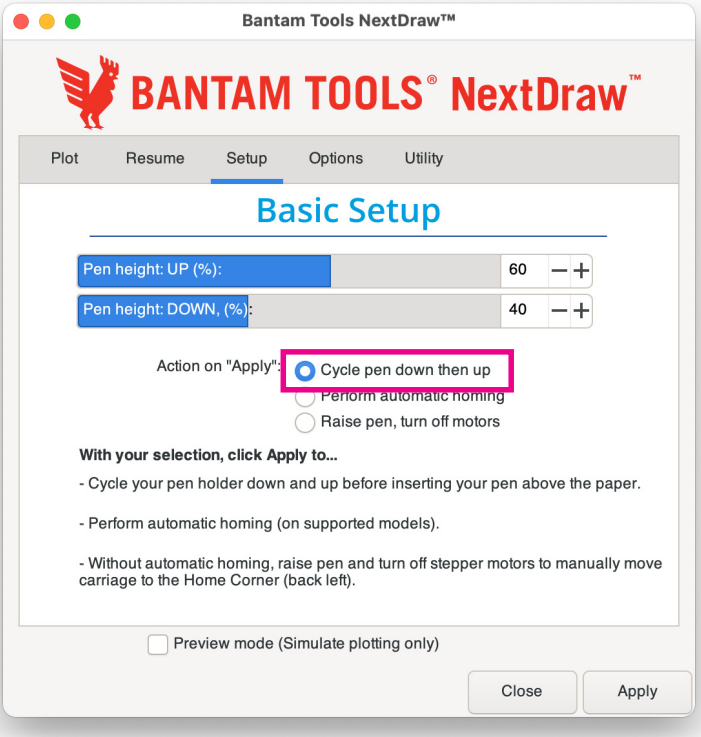
If a plot in progress is stopped such that the motors are still energized but the carriage was not returned to its plot origin, the machine will remember its position offset from the plot origin. So long as the motors have stayed energized, any new plot started will be positioned with respect to the same plot origin position.

The **Walk Carriage** utility commands (page 88) can be used to offset the position from where the motors are first energized. The carriage position ***when you begin a plot*** will be recorded and maintained as the plot origin.

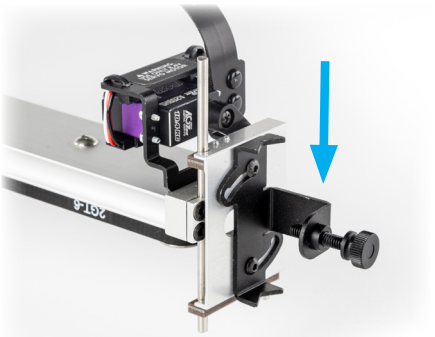
3.3 Check pen-up and pen-down positions

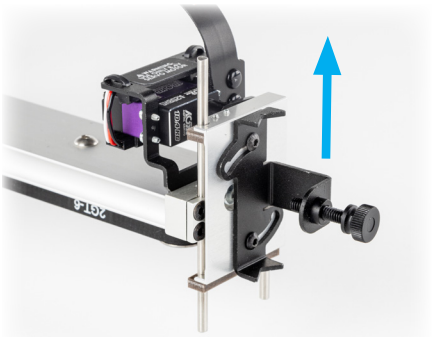
Within Inkscape, open the Bantam Tools NextDraw software:
Extensions > Bantam Tools NextDraw

In the **Setup** tab, select the **Cycle pen down then up** action:



Then, click **Apply**. If the power is on and everything is set up correctly, the pen lift motor should lower to its pen-down position, wait just a moment, and then lift to the pen-up position. It will do so again each time that you press **Apply**.



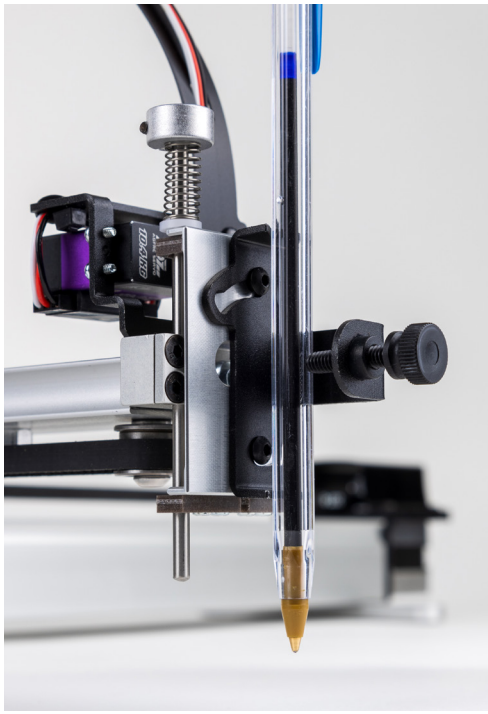


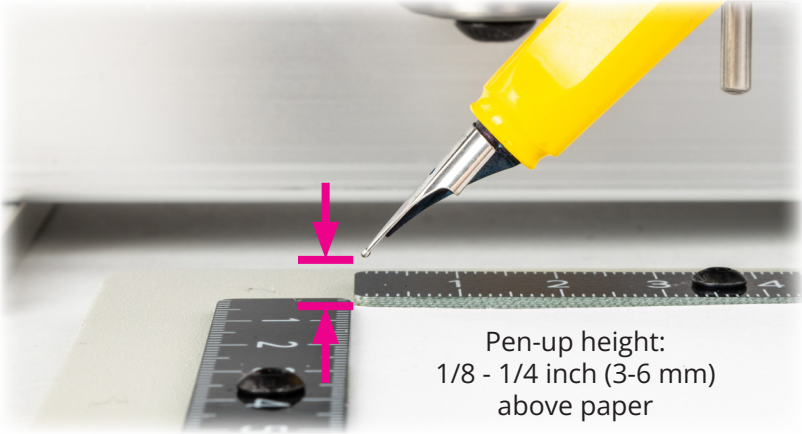
3.4 Insert your pen

Starting with the NextDraw **at the pen-up position**, insert your pen into the pen clip, just above the paper, and tighten it in place with the thumbscrew.

Whether your pen is oriented vertically or diagonally, the height of your pen tip should end up approximately 1/8 to 1/4 inch (3 - 6 mm) above the surface of the paper.

Take care to only apply *gentle force* with the thumbscrew; do not tighten it more than necessary.



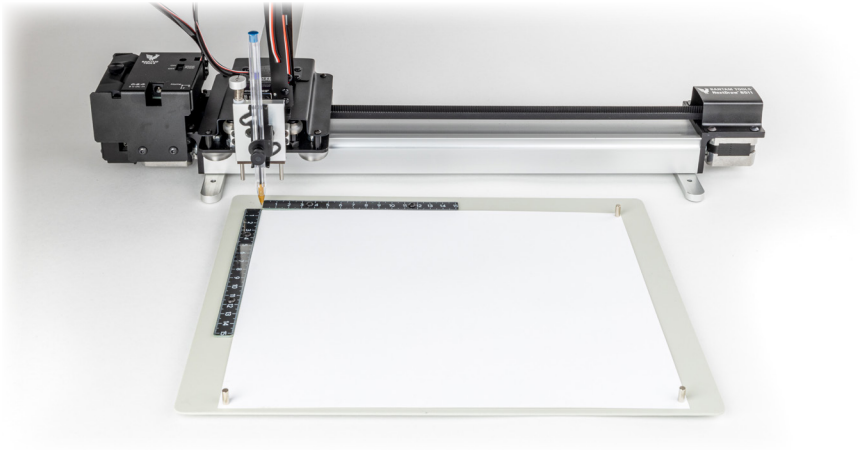


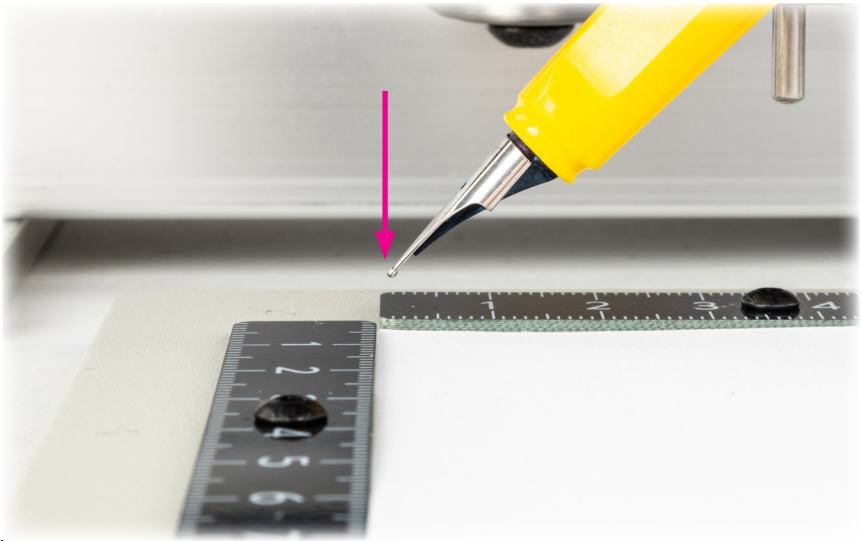
3.5 Position your paper

With the carriage at the home corner, position the upper-left corner of your paper ***directly beneath*** the tip of your pen, such that if your pen were to be lowered, it would touch the corner of the paper closest to the Home corner. (Keep in mind that, depending on your setup, it may be preferable to move the NextDraw itself, rather than the paper.)

Square the paper up so that its top edge is parallel to the base of the Next-Draw.

The photos below shows the paper positioned correctly, with its corner directly under the tip of a pen – in these cases a ball-point pen, as well as a fountain pen mounted at 45° to the paper.



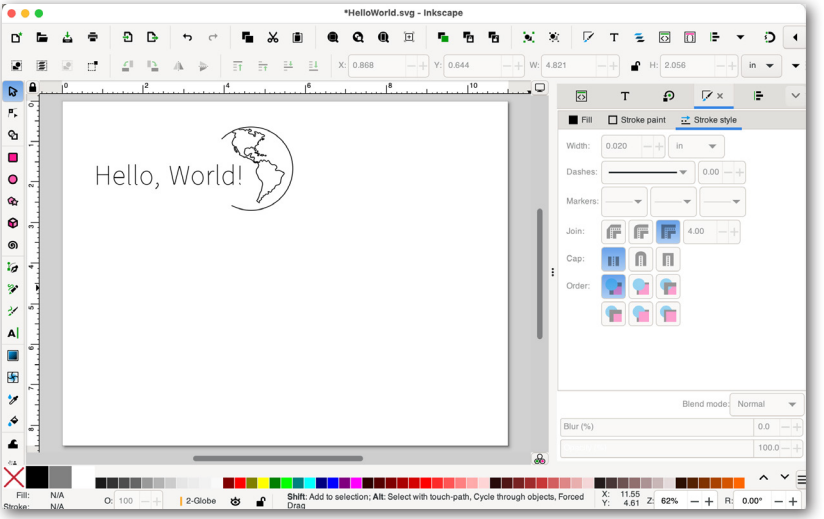


3.6 Open a document and print it

Download the set of NextDraw example files from: bantam.tools/ndex

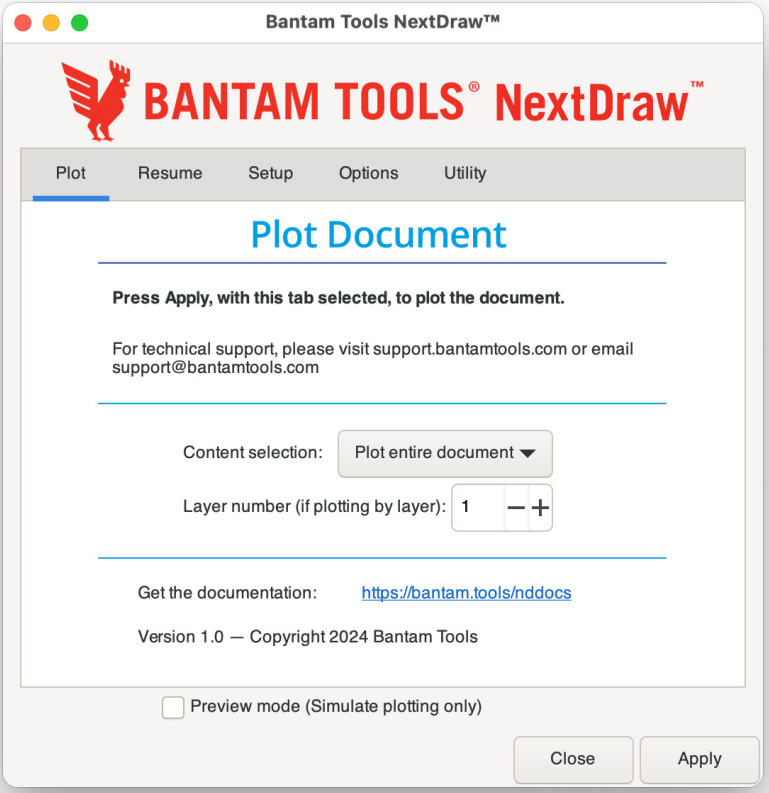
The download is a small zip archive of example files. Open (unzip) the archive. Then, within Inkscape, open up the file called **HelloWorld.svg**.

Once open, the document should look approximately like this in Inkscape:



If you cannot see the full page outline when you first open the file, select from the menu **View > Zoom > Page**, or type the number '5' on your keyboard.

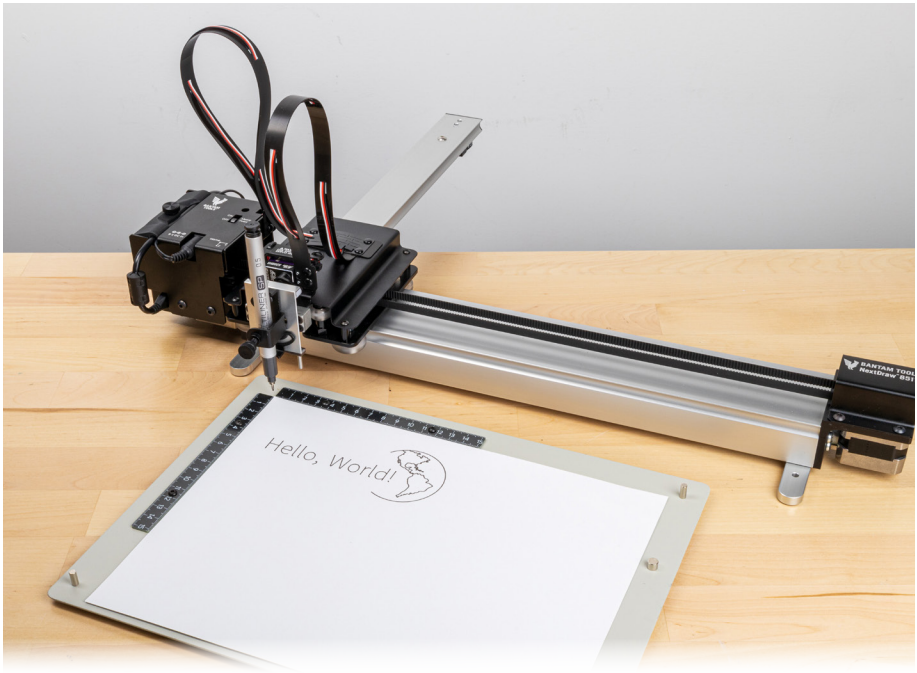
Finally, open **Extensions > Bantam Tools NextDraw**, switch to the **Plot** (first) tab, and click **Apply** to begin the plot.



The NextDraw should now begin printing your document, and will return back to the Home Corner, with pen up, when it finishes.

If you need to stop the plot for any reason, press the **Pause button** on the left side of the machine. (See "1.4 Bantam Tools NextDraw anatomy" on page 12.)

With a black pen, it will look something like the following:



3.7 Recap: Setting up a print

Let us summarize the steps that we've been over:

1) If automatic homing is not enabled, move carriage to the Home Corner.
2) Use the **Setup** tab to **Cycle the pen down then up**.
3) Clip in your pen, with height just above the paper.
4) Position your paper with its upper-left corner below the pen tip.
5) Use the **Plot** tab in NextDraw Control to plot the document.

The next few sections of this guide cover these same topics in greater detail.

4. Workholding

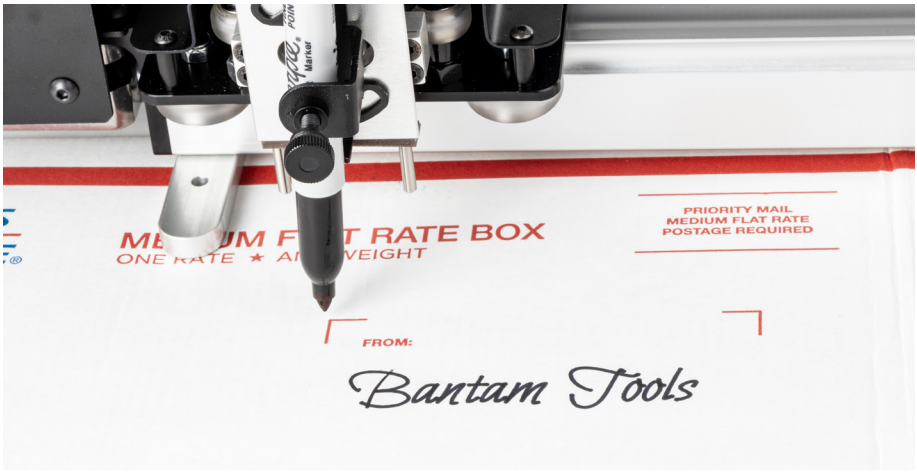
Whatever workpiece you wish to write or draw upon – whether that is paper, boxes, wood, cloth, or cookies – needs to be held such that it does not shift while plotting.

4.1 Printing on large workpieces



For large items such as the poster board and box shown here, the Bantam Tools NextDraw may be placed directly on top of the workpiece. Other examples of large workpieces that NextDraw can sit upon might include things like shipping boxes, fabric, wooden surfaces, chalkboards or whiteboards.

Position the NextDraw such that the pen tip is at the upper left corner of the ***area that you intend to plot upon***. The software will treat the corner of the page in your Inkscape document as Home Corner for the purpose of plotting.



4.2 Printing on small workpieces

Common solutions to hold smaller workpieces include clipboards, sometimes with rubber feet, tape, and magnets, in combination with a magnetic work surface.

Bantam Tools also sells “magnetic easels” – textured steel boards with rulers and magnets – are available as optional accessories for NextDraw in two different sizes: Letter/A4: bantam.tools/mea4 , Tabloid/A3: bantam.tools/mea3 .

Most of our usage examples are made with the magnetic easels, in part because they make the paper position easy to see in photographs.



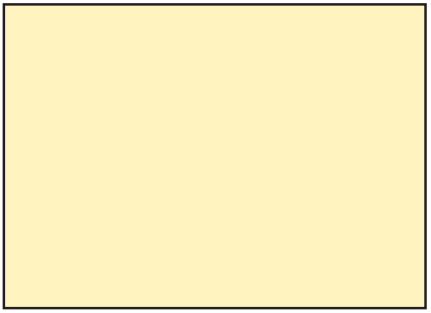


4.3 Document orientation

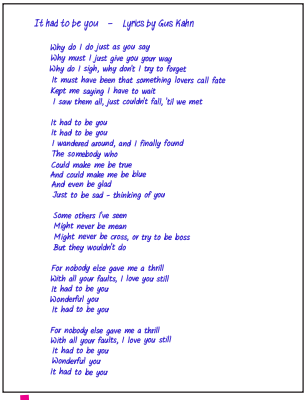
4.3.1 The shape of the travel area

The “travel” or “print area” of the NextDraw is wider than it is tall.

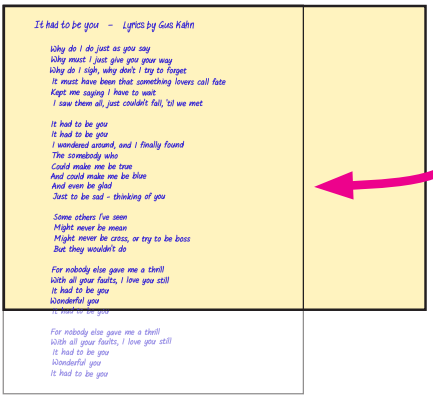
For example, on the Bantam Tools NextDraw 8511, the travel area is about 11.8 x 8.5 inches (30 x 21.6 cm). A full page (letter or A4) can fit in the printable area, but only if it is wider than it is tall.



Travel area: 11.8 (wide) x 8.5 inch



Document
8.5 wide x 11 inch



Document *does not*
fit vertically like this!



This document *does* fit
easily when rotated.

4.3.2 The Auto-rotate feature



If your document is wider than it is tall (or square), it is said to be in **landscape orientation**, it will print in its original orientation. The envelope above is a good example of a document that is wider than it is tall.



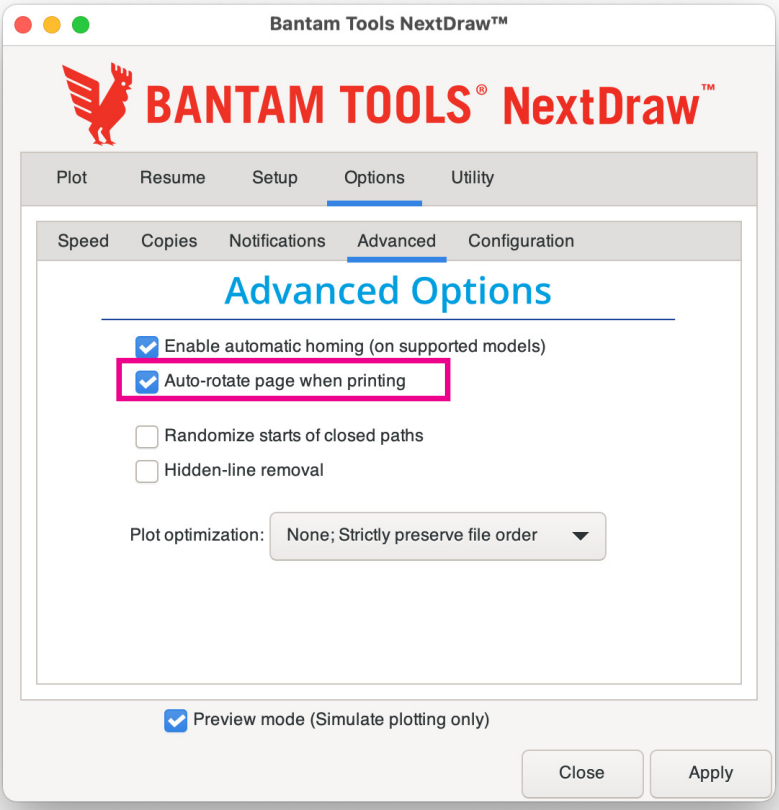
However, If your document is taller than it is wide, it has **portrait orientation**; and will normally print "sideways" as in the lower example above.

This **Auto-rotate** feature makes it so that you can work with tall documents, print things the full size of the travel area, and not have to rotate the document on your screen.

Whether vertical or horizontal, rotated or not, it is always the corner of the paper *closest to the Home Corner* that one aligns below the tip of the pen.

4.3.3 Enabing or disabling Auto-rotate

The Auto-rotate feature is controlled by a checkbox in the Bantam Tools NextDraw software, located on the **Options > Advanced** tab.



The option is enabled by default.

If you uncheck the box to disable automatic rotation, files will only print in the same orientation as they appear in your document.

5. Pens and the pen holder

5.1 About the pen holder

The pen clip included with the NextDraw fits pens up to ⅝ inch (16 mm) in diameter. Other types of pen holders and mounts are available as optional accessories.

The maximum recommended pen weight for standard applications is 1.6 oz (45 g). When using heavier implements, reduce acceleration and consider fastening the extended feet of the NextDraw to your table with clamps, weights, or screws to prevent excess motion and to prevent the machine from tipping forward.

The design is such that the pen rests on the surface by its own weight. That allows it to ride over surfaces that are textured or otherwise uneven, however it also means that the pen holder does not apply much if any downward pressure. In cases where downward pressure is helpful, you can use the **Spring Kit**, included with the NextDraw, to apply pressure.

5.2 Pen choices

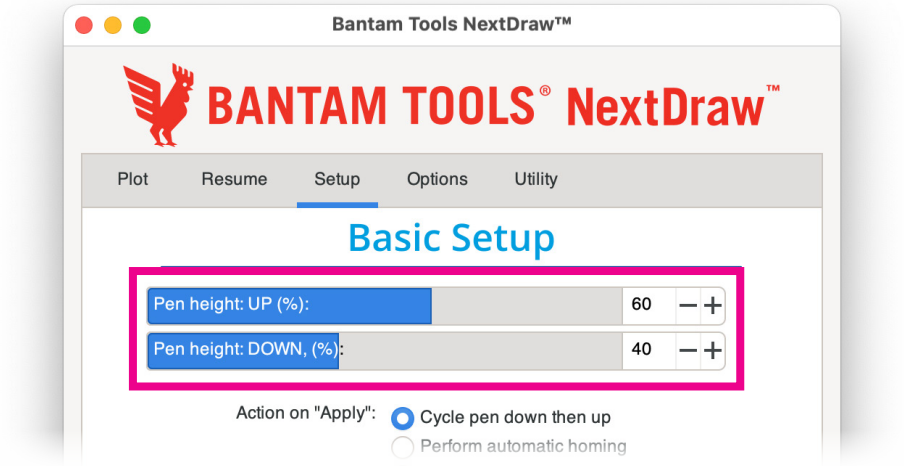
Good choices for pens include fountain pens, permanent markers, rollerball pens, technical pens, (small-bodied) whiteboard markers, liquid chalk markers, and other writing and drawing instruments that do not require significant pressure.

While we refer to writing and drawing instruments as "pens" to be concise, other instruments such as automatic pencils, chalk, charcoal, and brushes can also work well in many cases. Others, like traditional ball point pens, may work poorly unless you apply pressure with the Spring Kit.

> ***Aside: Fragile or delicate pens:*** If you choose to use fragile pens (such as high-end fountain pens with celluloid barrels), exercise great care when inserting the pen. You may wish to wrap the barrel in a thin, soft cloth to avoid scratching, and use little or no pressure from the thumbscrew. Moderately priced fountain pens, like the Lamy Safari or the Pilot Metro, tend to be quite tough, and require little special treatment.

5.3 Adjusting pen heights

The pen-up and pen-down heights are configured in the **Setup** tab of the Bantam Tools NextDraw software. Both values can each be adjusted between 0 and 100% to suit your needs. Higher percentage values lift the pen higher.



Once you have some experience with the process, the "pen" part of getting ready to plot is described by two quick steps:

1) Cycle the pen holder to the pen-up position.
2) Insert your pen, just above the paper.

You may find it helpful, when inserting the pen, to rest the its tip on a consistent spacer such as a thin bottle cap or a stack of a few coins.

The default pen heights of 60% (up) and 30% (down) are a good starting point. When changing either value, cycle the pen down and up to physically move the pen holder to the new positions.

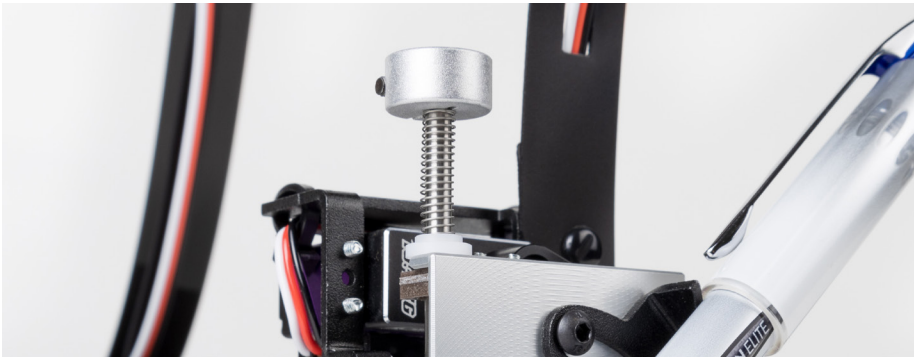
Tip 1: With a consistent pen height, if you find that the pen is not touching down everywhere that it needs to, use a lower pen-down position. If you find that the pen is not lifting everywhere it needs to, raise the pen-up position.

Tip 2: When cycling the pen to try new heights, you can protect the paper that you will be writing upon with another sheet of paper, to avoid writing on your actual workpiece.

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5.4 The Spring Kit

The Bantam Tools NextDraw includes a Spring Kit that can optionally be used to increase speed and to add downward pressure for writing.



5.4.1. Working without the Spring Kit

Normally and by default, the pen-lift stage of the Bantam Tools NextDraw rests a pen on the writing surface essentially ***by gravity alone***, lifting it off the page before and after each path drawn.

This works well in most circumstances, especially when working with fountain pens, markers, or liquid-ink rollerball pens, all of which write well without added pressure.

One possible issue that you may encounter is that the lift arm of the brushless pen-lift servo on the NextDraw can lower the pen faster than gravity alone. Without adding a spring to keep the vertical slide in contact with the lift arm, the pen can bounce off the paper, and bounce when raised as well. This can, at the fastest pen lifting and lowering speeds, lead to plot defects and excess noise.

5.4.2. About the Spring Kit

When installed, the Spring Kit presses the pen down towards the page while writing. That's helpful for working with certain types of writing implements, such as traditional ball-point pens, which require downward pressure.

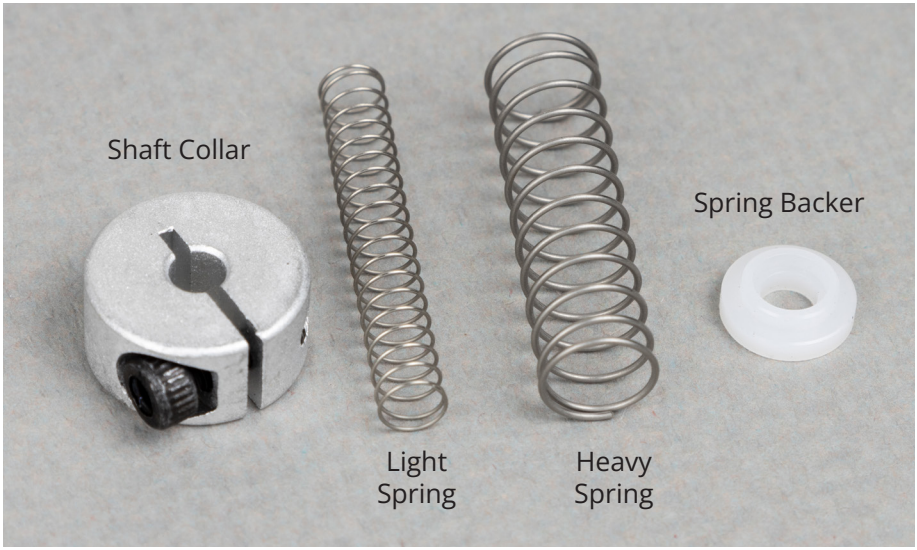
It also helps the pen to raise and lower faster by keeping the vertical slide in contact with the lift arm.

Downward pressure can increase the overall amount noise when using the machine — since a pen can potentially make a lot of noise when it hits paper hard.

Downward pressure can also damage or destroy, and is thus generally not recommended for, delicate pens such as fountain pens or technical pens, and it can cause rapid wear on fiber-tip pens.

Using the spring kit reduces the available vertical travel range, as the spring does take up some part of that range. The critical part of what follows will be setting the pen-up height correctly with a spring in place.

WARNING: Carefully read and follow these instructions when using the Spring Kit to avoid potential damage to your pen-lift motor and/or vertical pen-lift stage.

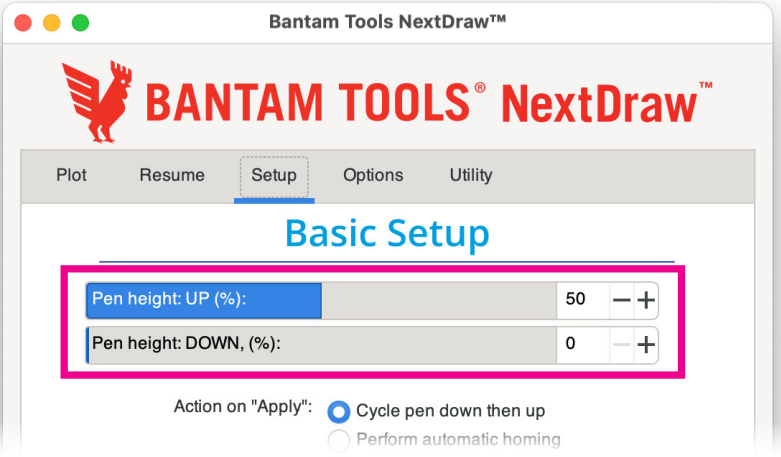


5.4.3. Parts in the Spring Kit

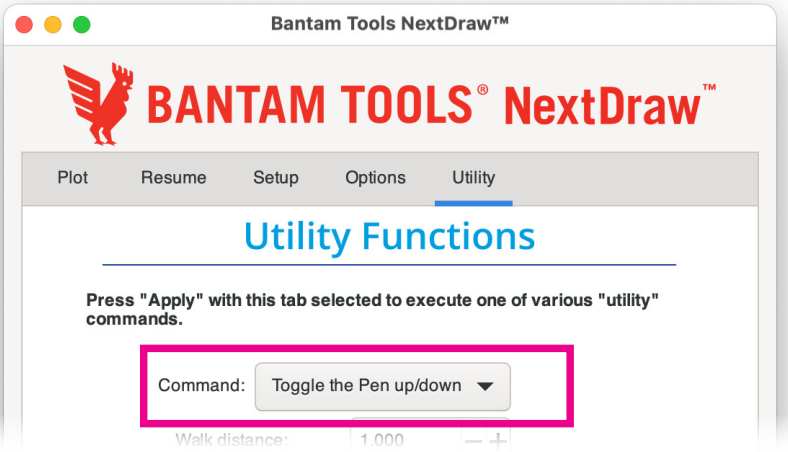
There are four parts to the Spring Kit: A **Shaft Collar**, a **Light Spring**, a **Heavy Spring**, and a machined plastic piece called the **Spring Backer**.

Springs wear out over time; replacements are available from Bantam Tools.

5.4.4. Initial setup for Spring Kit

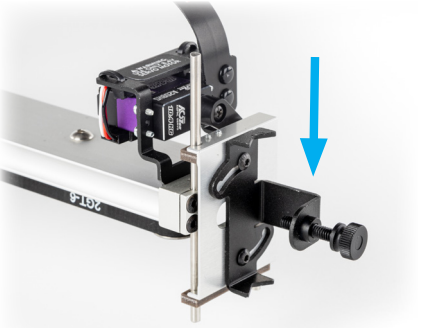


In the **Setup** tab, set the pen-up height to **50%**, and pen-down to **0%**.



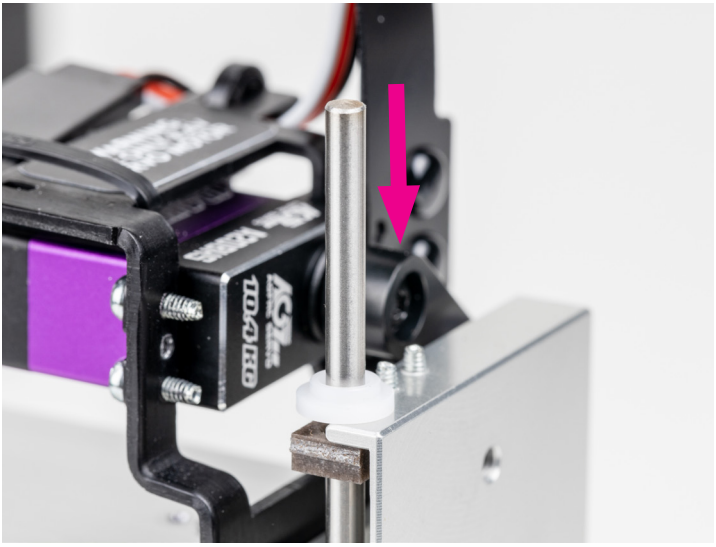
Then, in the **Utility** tab, select the **Toggle the Pen up/down** command.

Click **Apply** to toggle the vertical slide up and down until you are sure that it is in the “pen down” position.

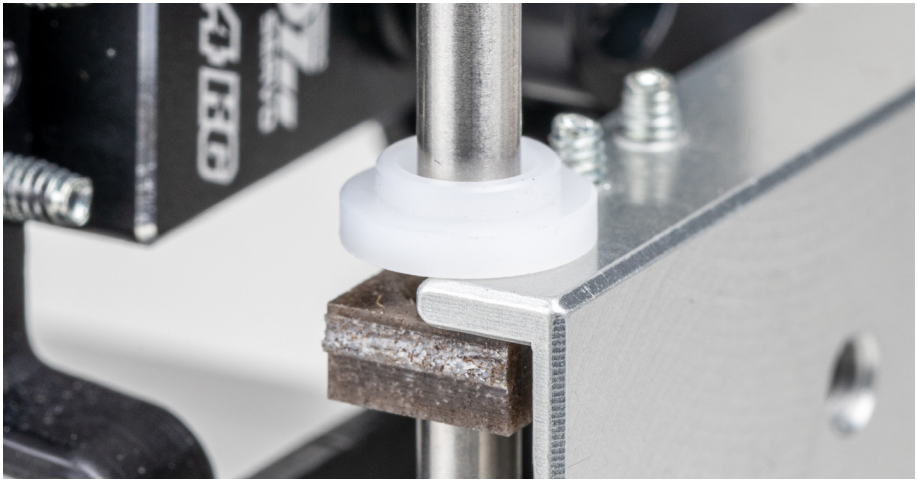


5.4.5. Add the Spring Backer

The spring backer has one smooth side and one side with a ridge on it.



With the vertical slide in the “pen down” state and the pen-up/pen-down positions still set to **50%** and **0%**, place the spring backer over the shaft that extends above the vertical slide.



Orient the backer smooth-side down, with the ridge on the top.

5.4.6. Add the Spring

Place a spring, either the light or heavy one, over the shaft and spring backer. The light spring sits inside the raised ridge on the spring backer and the heavy spring sits around it.

The heavy spring gives about twice the force of the light spring, and works well for pens that require substantial force, such as traditional ballpoint pens.

The light spring does not add as much pressure; just a little bit. But that can make a substantial difference when working with gel pens and other types that benefit from a small amount of pressure.

If you're just getting started, either spring is a reasonable choice. You can always switch later if you want less or more downforce.



Light spring

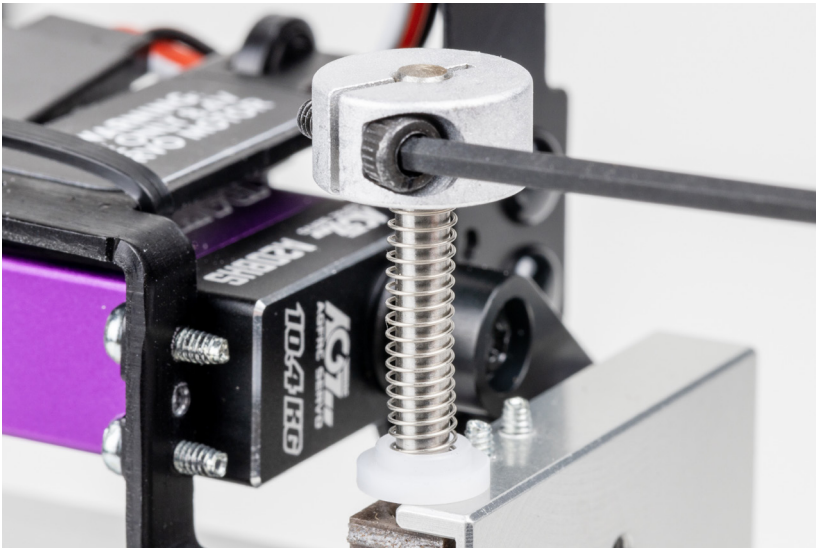


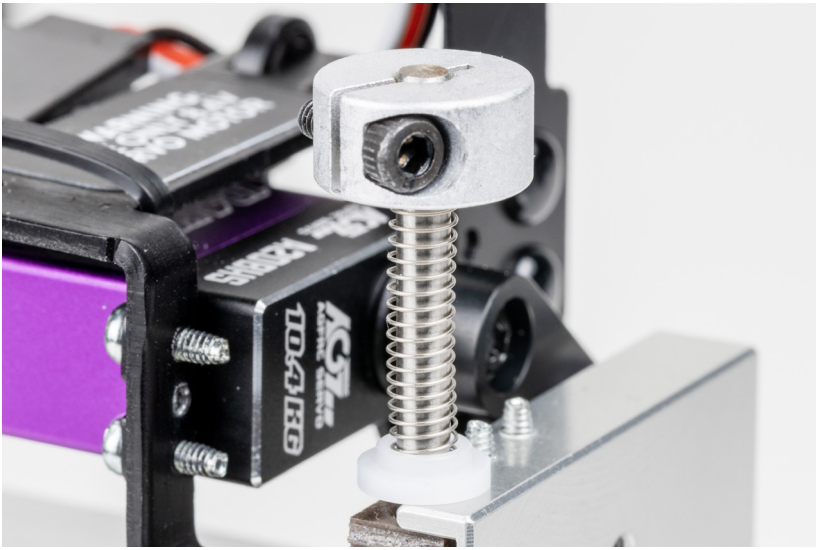
Heavy spring

5.4.7. Add the Shaft Collar

Slip the Shaft Collar over the end of the shaft until its top is flush with the top of the shaft. (If there is a gap between the bottom of the Shaft Collar and the top of the spring, it's OK to lower the Shaft Collar to the top of the spring.)

Tighten it firmly in place with your 2 mm hex L-wrench (the same one used to adjust the pen clip). Ideally, use the long end to start it, and the short end of the wrench to tighten it well.





5.4.8. Test the safe range of motion

The safe range of motion for the vertical slide is from the bottom of travel until the spring is ***almost*** compressed to a solid. The spring **must not** become fully compressed to a solid or it can potentially damage the servo and slide. See the pictures below for reference.

Go back to the **Setup** tab and toggle the pen up– and be ready to toggle it right back down again if necessary.

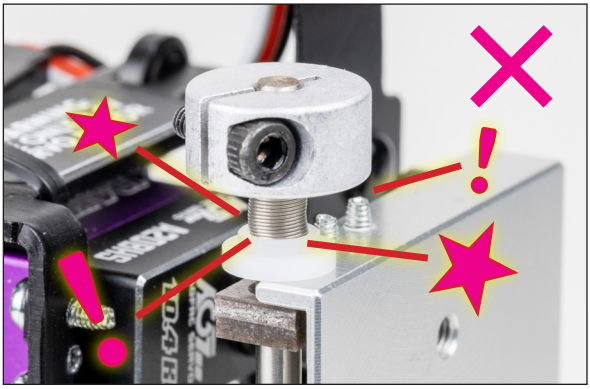
With the pen raised, make sure that the spring is not compressed all the way to a solid.

If the spring **is** compressed to a solid, toggle the pen back down immediately. Then, select a lower pen-up position and try again.

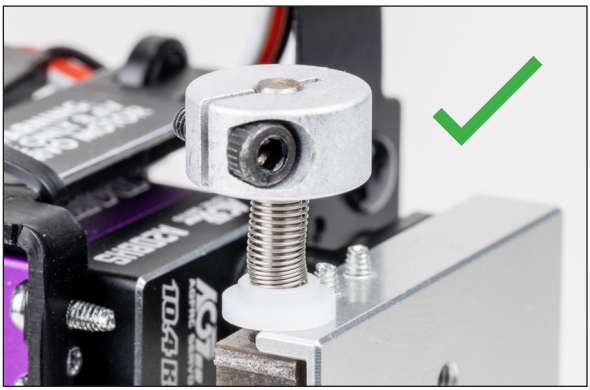
If the spring is not compressed to a solid, then you can adjust the pen-up position higher, so long as it does not become solid. Once your pen-up position is set, then choose your pen-down position to give an appropriate range of vertical motion for your application. A starting range of about 30 is typical.

Spring compressed to a solid in the pen-up position.

Avoid this situation; it can damage the motor and slide.



Acceptable pen-up position, with spring not compressed to a solid.



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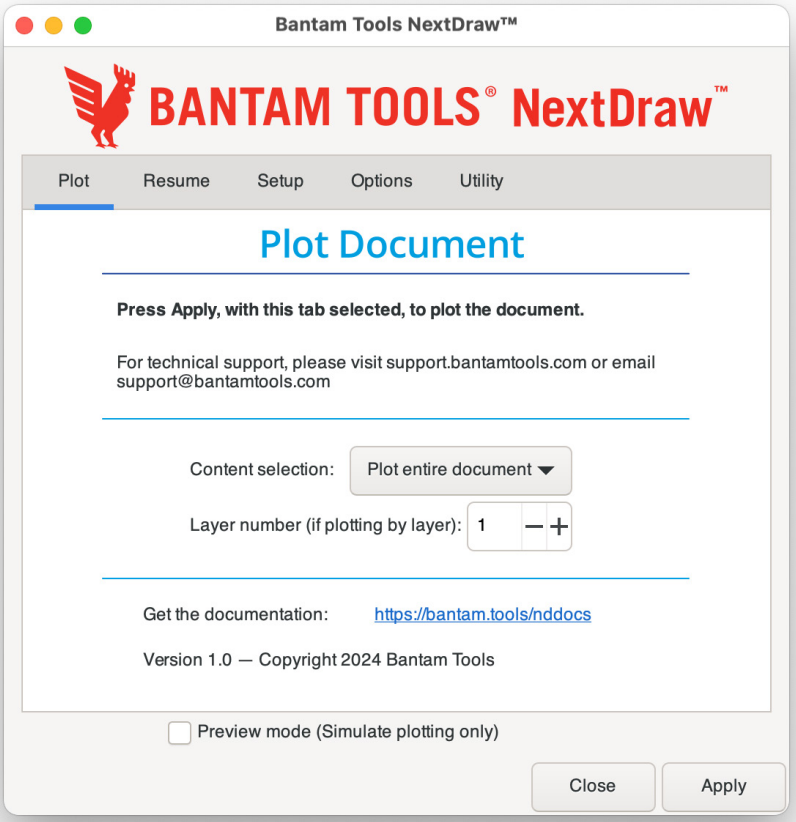
6. The Bantam Tools NextDraw extension

In this section we will introduce the features and options of the Bantam Tools NextDraw extension for Inkscape, the primary interface to the NextDraw. It can be found within your Inkscape menu at

Extensions > Bantam Tools NextDraw™...

The software has a tabbed interface, where the different tabs contain different settings or control different functions.

One option, **Preview mode**, is available in every tab. It can be enabled by checking the box. When checked, **Preview mode** simulates plotting only, letting you see how your document will plot. You can read more about preview mode in §6.8 Preview mode, on page 72



6.1 Plotting the document

The **Plot** tab is used to plot the document on the NextDraw.

There are two options on the **Plot** tab: **Content selection** and **Layer number**.

To plot the entire document, select **Plot entire document** from the **Content selection** drop-down menu, and then press **Apply**.

This will plot the entire document, including all visible layers. You can select which parts of a document will plot by hiding and showing different parts of the file, or by using Layer-based features as we will discuss in section §6.3 Working with multiple layers and colors, on page 58.

6.2 Pausing, resuming, and canceling plots

6.2.1 The pause button

To stop a plot in progress, press the pause button: the large white button on the left-hand side of the NextDraw. (See the pictures on page 13.) The NextDraw will raise the pen and stop moving once the queued set of motion commands has exhausted.

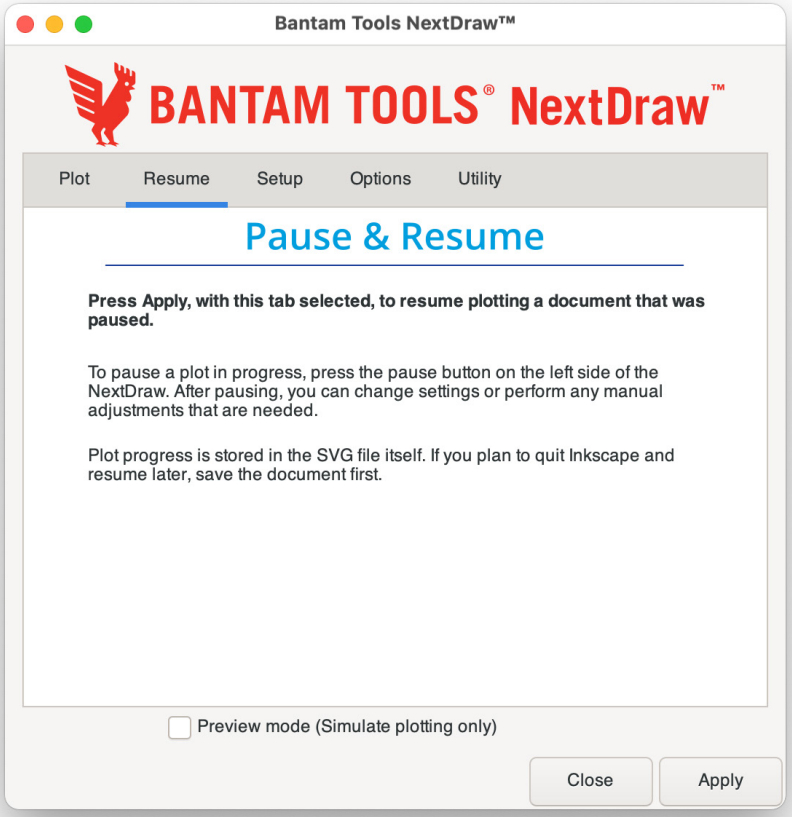
> ***Note:*** You must *physically press the pause button* to stop a plot in progress. (Inkscape has a "Cancel" button, but it does not stop running extensions.)

Once paused, you can make adjustments in the settings (for example, to the pen height or plotting speed), before resuming, if you choose to do so.

Certain settings that affect plot order, such as hidden line removal and plot optimization cannot be changed between pausing and resuming a plot.

6.2.2 To resume a plot after pausing

To resume a plot after pausing, select the **Resume** tab and click **Apply**.



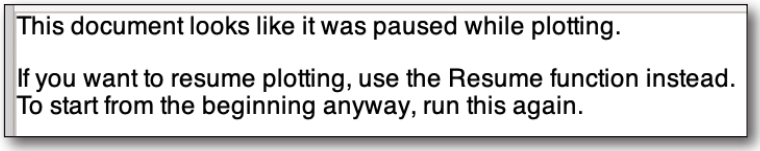
Plot progress is stored in the SVG file, so if you plan to quit Inkscape and resume later, save the document first.

6.2.3 Canceling a paused plot

No explicit action is needed to cancel a plot that was paused in progress.

If power to the machine has not been maintained and automatic homing is disabled, be sure to move the carriage to the Home position before starting another plot.

When an SVG document has plot progress data in the file, indicating that a plot was previously paused, and you try to start a new plot from the **Plot** tab, (rather than resuming with the **Resume** tab), you may instead get a warning message:



This message is intended to prevent the occasional accident where one starts a plot over from the beginning, rather than resuming it.

If you do intend to start a new plot, press **Apply** again to override the warning and start the plot.

6.3 Working with multiple layers and colors

By default, the Bantam Tools NextDraw software will print all visible paths in your document. A document can, at your option, be organized into multiple **Layers**.

When you use the **Plot** tab to print a full document that contains multiple layers, each visible layer will print, and the order of printing is from lowest layer first to highest layer last.

You can also use the **Plot** tab to plot a single layer, or some specific set of layers. These methods are particularly useful for organizing and plotting documents that require multiple pens or colors.

6.3.1 Inkscape's Layer menu

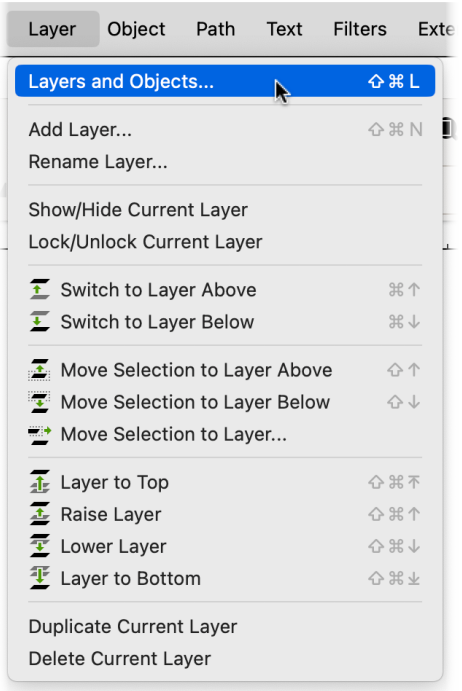
To create layers and move objects between them, use the commands in Inkscape's **Layer** menu.

The commands in this menu let you add, remove, and re-arrange layers as you see fit.

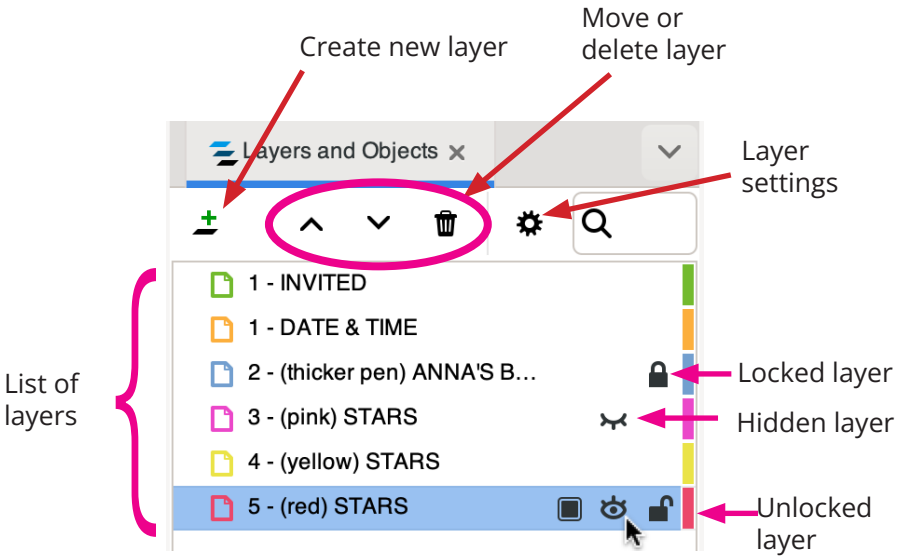
You can also use the "Move Selection" commands in this menu to move selected objects between layers.

To see a list of the layers in the document, as well as to see which layer the selected object is in, you can open the **Layers and Objects** panel by selecting it from this menu:

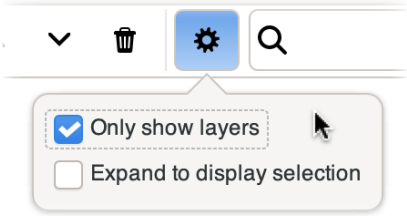
Layer > Layers and Objects...



6.3.2 The Layers and Objects panel



The **Layers and Objects** panel lists layers in the document and the objects within those layers. You may wish, as we have done here, to select the option to only show the layers, not objects within them.



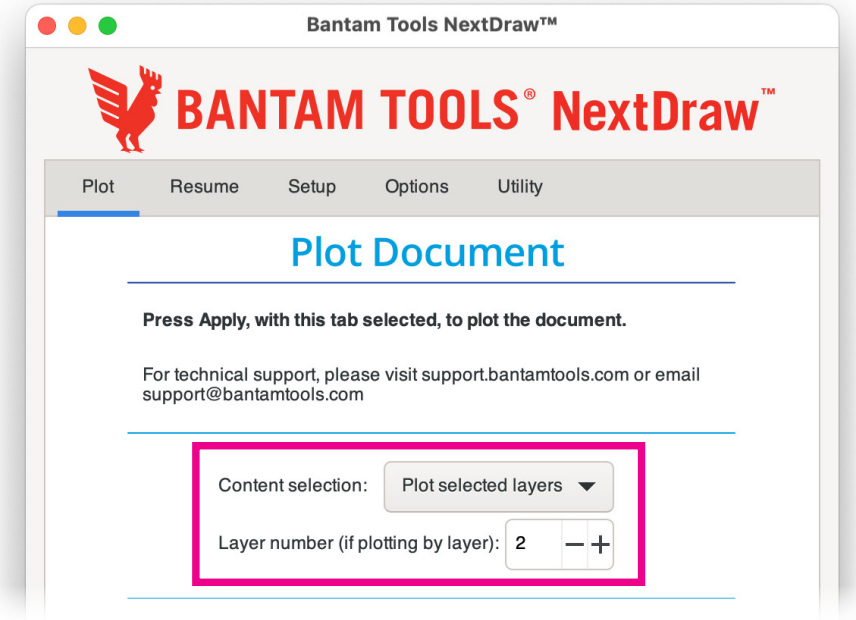
Within this panel, you can add, remove, re-order, rename, hide, show, and lock layers.

The document shown here, one of the NextDraw example files, has 6 layers with different names. (We have also hidden one layer and locked one layer to show what that looks like.)

The "eye" symbols to the right of the some layer names indicate if layers are visible. An "open eye" (or no eye) indicates that the layer is **visible**. A "closed eye" symbol indicates that a layer is **hidden**. Click the eye to show or hide an individual layer. Hidden layers and objects will not be printed; Hiding layers is an effective way to plot only certain parts of a document.

The "lock" symbols to the right of the eye symbols indicate if a layer is **locked**. A locked symbol (closed padlock) indicates that the layer is locked and cannot be changed. You can click the lock symbol to lock or unlock a layer.

6.3.3 Selecting layers to print by number



In addition to hiding and showing layers, you can select which visible layers to plot, directly within the **Plot** tab. To do so, select **Plot selected layers** from the **Content selection** drop-down menu, enter the **Layer number** to select and press **Apply**.

When you start a plot this way, the NextDraw will only plot layers with names that begin with the number entered in the **Layer number** field. Give layers that you wish to print this way names that begin with an integer in the range 0 through 1000.

After plotting one or more layers by **Layer number**, you can change any settings that you wish to, or switch to a different pen, and then plot other layers with a different **Layer number** selection. This makes it possible to plot portions of a document with different colors and (e.g.,) speeds.

Only "top-level" layers, not sublayers or other named groups, can be selected for plotting by **Layer number**.

Example 1: Suppose that a document has three layers with the names,

1 - Red circles
2 - Blue squares
2 - Blue waves

You could put a red pen in the NextDraw, and then plot the "1 - Red circles" layer alone by entering 1 as the **Layer number** and pressing **Apply**. You can then change to a blue pen, enter 2 as the **Layer number**, and press **Apply** to print both of the "Blue" layers.

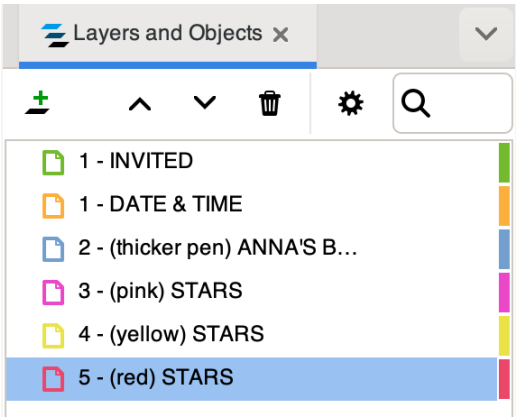
Example 2: Example file, multicolor_layers.svg

This is the same file that we looked at previously, in the context of the **Layers and Objects** panel.



This file has two layers that start with the number 1 (and thus would print together if selected by **Layer number**), and four additional layers that are set up to print separately, with different pens.

The rest of the layer name, after the number, can be used for any notes that you might have about the context or setup for those layers.



6.3.4 Additional Layer Control features

Beyond selecting layers in the **Plot** tab, there are additional **Layer Control** commands and parameters that can be specified through the layer name.

You can use properly formatted codes to specify the pen-down height and the speed for printing specific layers. There are also special codes that can introduce a timed delay while plotting or force a programmatic pause (as though you had pressed the pause button to halt a plot). These types of codes are seldom added in everyday plotting, but can be useful in developing templates or workflows for specialized applications.

One additional, and particularly useful, feature is that any layer with a name starting with a percentage sign (%) is designated as a **documentation layer**, and will never be plotted.

The Layer Control features are always active, and (where applicable) take precedence over settings within the Bantam Tools NextDraw extension for Inkscape. For example, they can be used to plot different layers at different speeds, even while the software setting only allows a single speed setting.

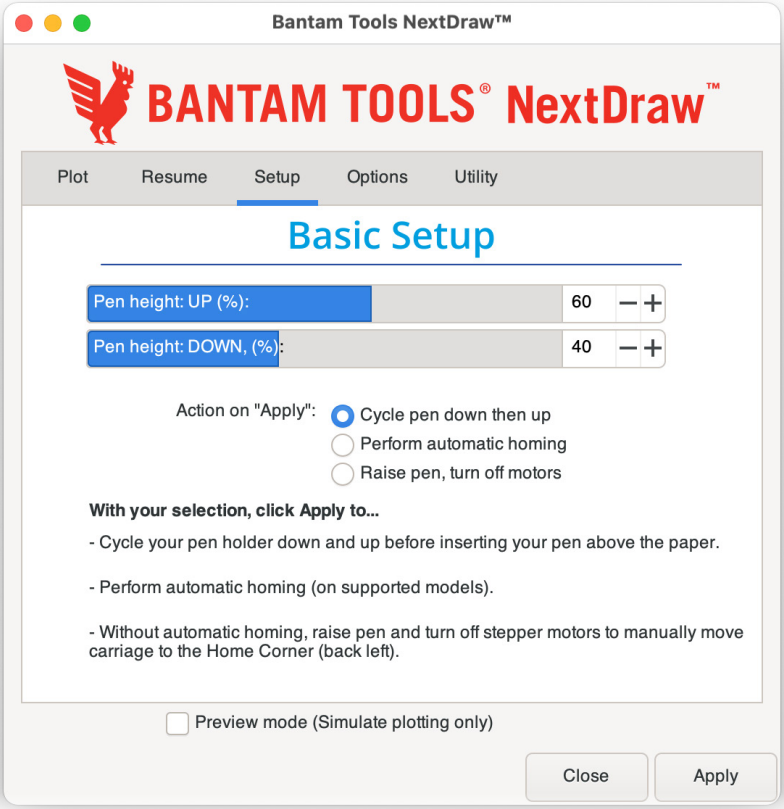
As with plotting by L**ayer number**, Layer Control features only work on the names of "top-level" layers, and not sublayers.

The complete syntax for NextDraw Layer Control can found at:
bantam.tools/ndlc

6.4 The Setup tab

We have already discussed, in §5.3 Adjusting pen heights, on page 44, using the **Setup** tab to set pen heights and cycle the pen.

The **Setup** tab has two further actions that it can perform, when selected: **Perform automatic homing** and **Raise pen, turn off motors**.



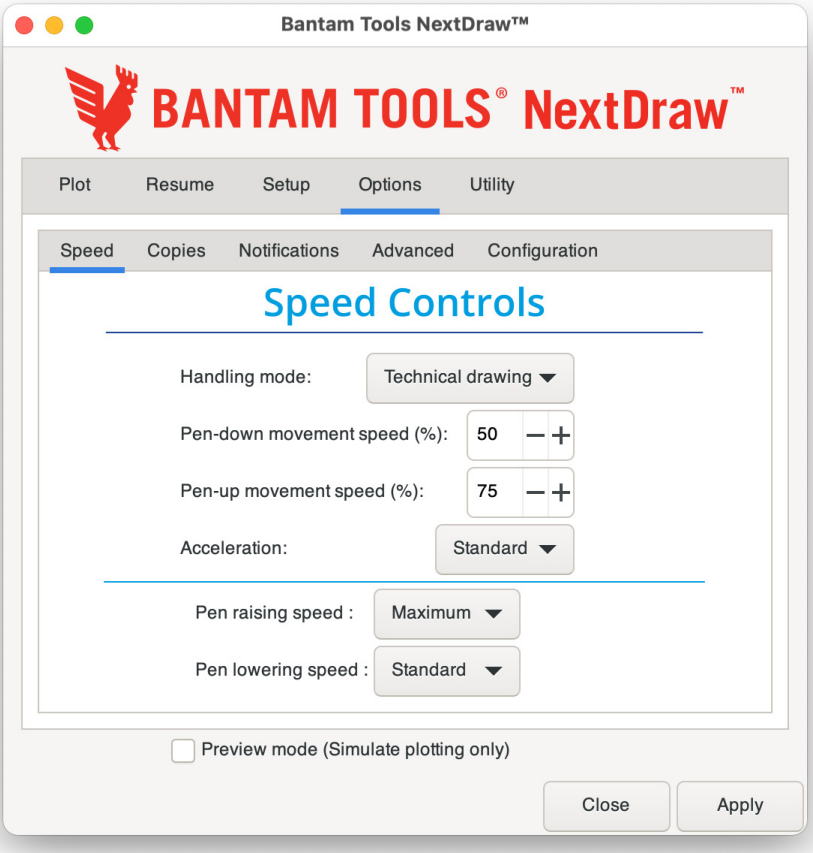
Select **Perform automatic homing** and click **Apply** to begin the automatic homing cycle to move the carriage Home. (It isn't usually necessary to perform Homing with this option, but it is here in case you have a reason to do so outside of the usual context of starting a plot.) Automatic homing is only available on supported plotter models, and only when **Enable automatic homing** is checked on the **Options > Advanced** tab. See §3.2.1 Automatic Homing, on page 29 for more information.

Select **Raise pen, turn off motors** and click **Apply** to raise the pen holder to its pen-up position and disable the XY stepper motors. This is a useful setup function for manual homing; see §3.2.2 Manual Homing, on page 30.

6.5 Speed controls

The Options tab contains several panels that allow you to configure the behavior of the machine and how plots are processed.

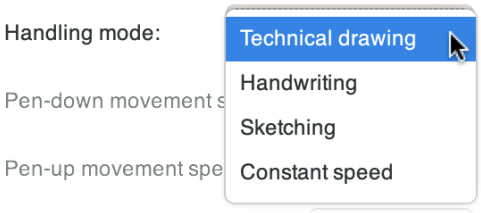
The first of these, the **Options > Speed** tab, presents options that control the speed of the NextDraw. These include the speed limits and acceleration rates used for the horizontal (XY) carriage motion, as well as pen lifting and lowering rates.



The upper part of this panel has controls for **Handling mode**, **Pen-down movement speed**, **Pen-up movement speed**, and **Acceleration**. These options, together, control the rates of horizontal (XY) carriage motion.

Clicking the **Apply** button with the **Speed** tab selected has no effect; settings are saved automatically, and clicking **Apply** does not initiate a plot or perform any other function.

6.5.1 Handling modes



The **Handling mode** drop down menu allows you to select one of four general **Handling modes**: **Technical drawing**, **Handwriting**, **Sketching**, or **Constant speed**. These names are descriptive, but you may find that one or a different handing mode works best for you and your actual usage.

The choice of Handling mode controls the *overall scales* of precision, speed and acceleration. For example, "100%" speed in **Sketching** is faster than "100% speed" in **Handwriting**, and Maximum acceleration in **Handwriting** is higher than Maximum acceleration in **Sketching**.

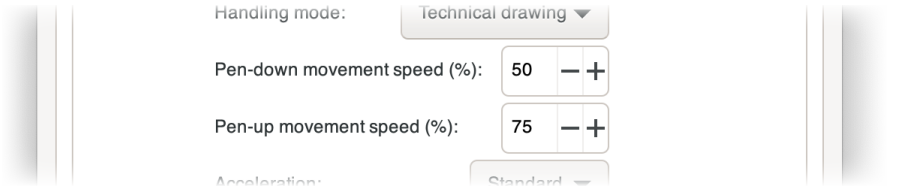
The default Handling mode, **Technical drawing**, uses a moderate top speed, medium-high Maximum acceleration, and high precision. It is a good starting point for many applications, including handwriting-like work in cases where precision is more important than speed.

The **Handwriting** Handling mode has moderate top speed, very high Maximum acceleration, fast pen-up speeds, and relatively low precision. For handwriting-like work where acceleration on tiny strokes and curves is much more important than the top speed that can be achieved, the **Handwriting** Handling mode can give a significant reduction in total plot time.

The **Sketching** handling mode has a high top speed, moderate Maximum acceleration, fast pen-up speeds, and moderate precision. For artwork consisting of long strokes, where the top speed is more important than acceleration on small strokes, the **Sketching** Handling mode can give a significant reduction in total plot time.

The **Constant speed** handling mode disables acceleration and moves the pen at a constant speed when it is down. It has a relatively low top speed, "instantaneous" acceleration, and high (theoretical) precision. In practice, motion artifacts from taking corners without slowing down make it less precise than the **Technical drawing** Handling mode except at low speeds. The **Constant speed** Handling mode is most useful for specialized applications where moving at a constant speed is a priority. The constant speed motion applied by this mode applies only when the pen is down; Acceleration is used during pen-up travel.

6.5.2 Pen-up and pen-down movement speeds



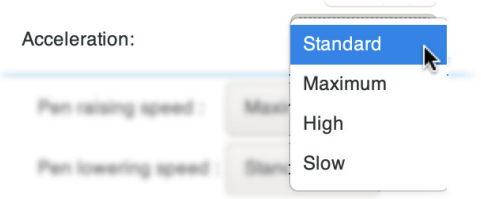
The **Pen-down movement speed** and **Pen-up movement speed** parameters allow you to select what maximum speed will be used with the pen down (for writing or drawing) or pen up (for moving between paths).

Both values are given as percentages (1-100%), and give percentages of the "top speed" available in the selected Handling mode.

In all cases *except* the **Constant speed** Handling mode, these two speed settings control *speed limits*: The maximum speeds that can be developed, given sufficient distance to accelerate. These speed limits may or may not be reached in a given distance, depending on the **Acceleration** setting.

When **Constant speed** Handling mode is selected, the speed of travel when the pen is down is controlled directly by **Pen-down movement speed**.

6.5.3 Acceleration

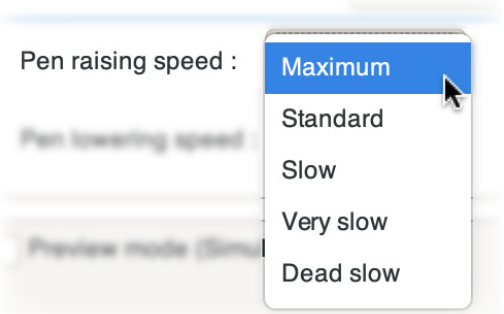


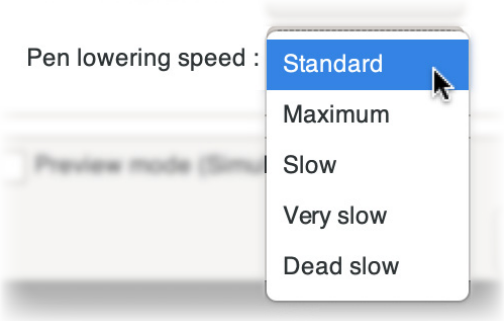
The **Acceleration** setting controls how quickly the pen will approach the speed limits set by the **Handling mode** in combination with the **Pen-down movement speed** and **Pen-up movement speed** values. **Acceleration** is at least as important as the speed limits in determining the total time that a plot will take. Slower acceleration values tend to give smoother movement and neater curves at the cost of longer plot times.

There are four values available to select from a drop-down menu, **Standard**, **Maximum**, **High**, and **Slow**. The default value, **Standard**, is a moderate value between **High** and **Slow**.

6.5.4 Pen raising and lowering speeds

The **Pen raising speed** and **Pen lowering speed** parameters control the vertical motion speed between the heights set in the **Setup** tab (page 44). The pen raising and lowering speeds can each be selected from a drop-down menu, with options **Maximum**, **Standard**, **Slow**, **Very slow**, and **Dead slow**.

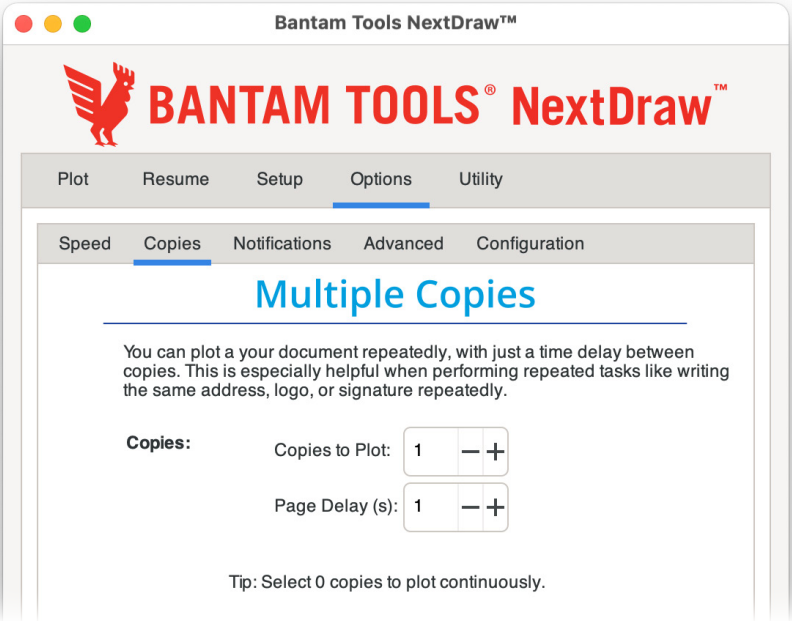




The NextDraw pauses horizontal motion while raising or lowering the pen, until that motion is complete. These pauses prevent it machine from making pen-up movements until the pen is actually clear of the paper, and also prevent pen-down movements from beginning until the pen is touching the paper.

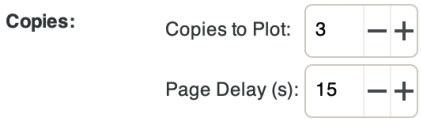
If you are trying to increase the speed of your plots, be aware that the total vertical travel distance is an important factor in how long pen lifting and lowering takes. Thus, try to decrease the vertical range first, and look at the speeds next. Slower lifting (and especially) lowering can potentially lead to neater writing and prolong the life of the pen-lift motor as well as your pen tip.

6.6 Printing multiple copies



The **Options > Copies** tab lets you print multiple copies of the same document with an optional time delay between copies. If **Copies to Plot** is any value other than 1, then after the first copy finishes, the next copy will automatically begin after a time delay in seconds given by **Page Delay**.

For example, to plot 3 copies with 15 seconds delay between each, enter 3 for **Copies to Plot** and 15 for the **Page Delay**.



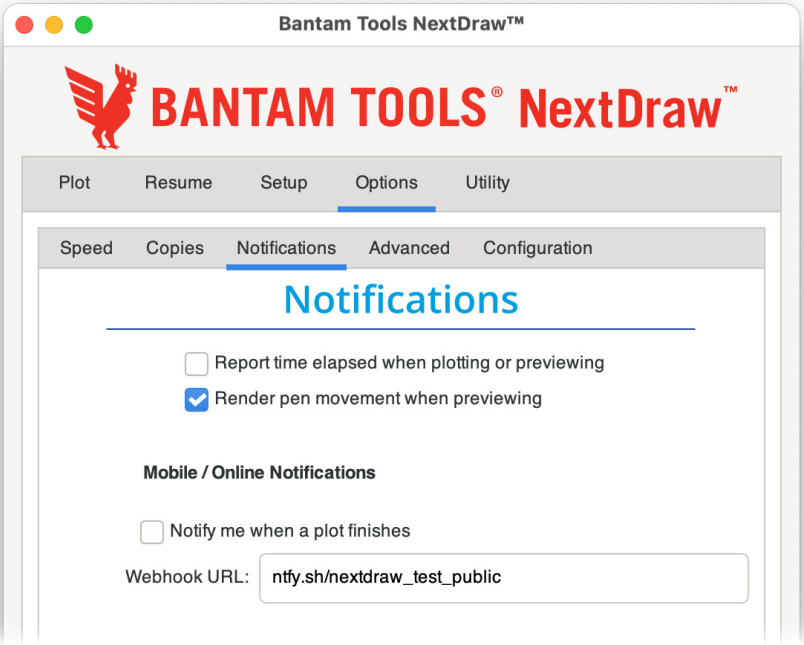
As a special feature, if **Copies to Plot** is set to 0, pages will plot continuously — separated by the given **Page Delay** — until the Pause button is pressed. This is a great feature for repeating tasks, such as using the NextDraw as a signature machine to sign a whole stack of pages.

The **Page Delay** can range from 0 (no added delay) to 3600 seconds (1 hour).

As with the **Speed** tab, this is an options tab for which **Apply** has no effect.

6.7 Notifications settings

The **Options > Notifications** tab lets you configure reporting and notification settings, including mobile notifications when a plot finishes. As with the **Speed** and **Copies** tabs, this is an options tab for which **Apply** has no effect.



The first two options on this tab are **Report time elapsed** when plotting or previewing, and **Render pen movement** when previewing. The second item, Render pen movement, is not discussed until section §6.8 Preview mode, on page 72.

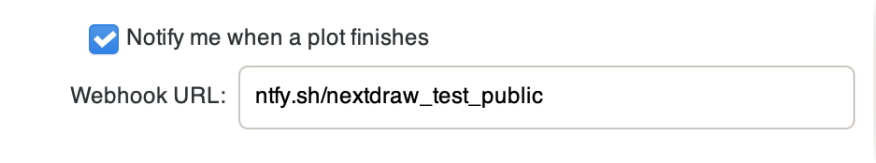
6.7.1 Report time elapsed

When the **Report time elapsed** option is checked, a dialog box will report the elapsed time and pen-travel distance after each plot or plot preview.

When used with **Preview mode**, this option can provide accurate estimates of how long a plot will take. (Preview mode is discussed in section §6.8 Preview mode, on page 72.)

When **Report time elapsed** is checked and you use the **Resume** tab to resume a stopped plot, note that the distance reported reflects pen-down distance from the beginning of the plot, ***not from where it resumed***.

6.7.2 Mobile/Online Notifications



The Bantam Tools NextDraw software has the ability to send notifications via when a plot finishes, using a specialized type of Internet request called a **Webhook**. This feature is disabled by default. Webhooks are a method of sending requests to various third-party services, frequently used for generating notifications such as mobile alerts.

Webhook notifications are sent when a plot ends (whether completed or interrupted), but only when ***all four*** of the following conditions are met:

1. A document is being plotted with the **Plot** or **Resume** tab,
2. The document is being physically plotted; **Preview mode** is disabled,
3. The **Notify me** check box is checked, which enables notifications, and
4. A **Webhook URL** is provided

Various online services exist to trigger actions upon receipt of a webhook post. Beyond notifications, Webhooks can be used for integration with other software or hardware, to trigger other actions that should follow a plot.

Online services that support Webhook functions for free or low cost include:

- NTFY (ntfy.sh)
- Make (make.com; formerly Integromat)
- IFTTT (ifttt.com)
- Zapier (zapier.com).

6.7.3 Setting up notifications with NTFY

Our recommended service for notifications is NTFY (ntfy.sh), a free service that can provide mobile or desktop notifications, and does not require that you create an account.

If you would like to set up mobile notifications on your phone or tablet with NTFY, the steps to do so are as follows:

1. Download the NTFY app for your device, following links at ntfy.sh .
2. In the NTFY app, click the "**+**" button to add a subscription.
3. For **Topic name** in NTFY, pick and enter `your_topic_name`
4. Press **Subscribe** to subscribe to that topic.
5. In the NextDraw software, check **Notify me**.
6. And, for **Webhook URL**, enter `ntfy.sh/your_topic_name`.

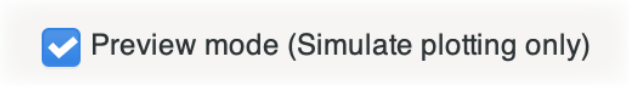
In these steps, you pick a **Topic name** for the notifications. Topic names cannot contain spaces or special characters.

Your Topic name should be something unique that no one will guess, so that you only send and see notifications that you intend to.

If, for example, you were to use `nextdraw_test_public` as your Topic name, then anyone who subscribed to that Topic name in NTFY would be able to see when your plots finish, and, if you subscribed to that topic, you would get a notification any time that someone else using that same Topic name finished a plot. In *most* cases, it is better to instead use a "secret" name that only you — and anyone else you want to give access to — can be notified.

You can also subscribe to NTFY topic notification on a regular computer: Visit ntfy.sh/app — As with the mobile apps, no account is needed.

6.8 Preview mode



Preview mode is enabled when the **Preview mode** checkbox at the bottom of the Bantam Tools NextDraw control panel is checked.

Checking the **Preview mode** checkbox does not, itself, perform any action. However, when you do press **Apply**, for example on the **Plot** tab, the software will operate in Preview mode.

When Preview mode is enabled, most everything in the software will work normally, with the significant exception that the software will not connect to the NextDraw. Preview mode can be useful to test workflows, estimate timing, or otherwise preview how the NextDraw will plot a document, even without the NextDraw present.

Certain modes and commands that are primarily designed to communicate with the NextDraw over USB — including most in the **Setup** and **Utility** tabs — are unavailable while in Preview mode.

6.8.1 How to run a Plot preview

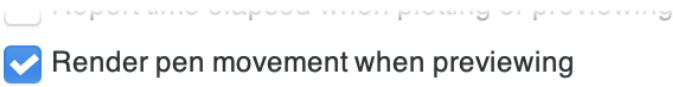
To run a **Plot preview**, check the **Preview mode** checkbox, select the **Plot** tab, and press **Apply**.

Running a Plot preview performs all of the processing normally done in plotting a document with the exception of sending the motion commands to the NextDraw. This can catch any errors in processing the document.

If the **Report time elapsed** option is checked in the **Options > Notifications** tab, a dialog box will report the estimated time and plot distance for plotting the document. This ability to estimate the time needed for a plot is one of the most useful features of Preview mode.

Preview mode can also be used with the **Resume** tab active, to simulate the process of resuming a plot.

6.8.2 Preview mode rendering



An option available on the **Options > Notifications** tab is **Render pen movement when previewing**. When checked — as is default — we say that **Preview mode rendering** is enabled.

Preview mode rendering simulates and "draws" the path of the NextDraw pen across the page when you run a Plot preview.

Here is how the example file **HelloWorld.svg** looks when you click **Apply** from the **Plot** tab with **Preview mode** enabled and **Preview mode rendering** enabled:

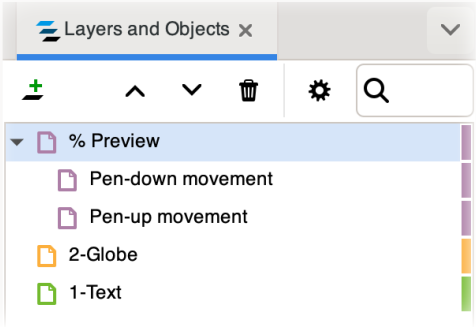


Pen-down movement — where the NextDraw draws on the page — is rendered in blue, and pen-up movement between paths is shown in light red.

These preview paths are drawn on your page in a non-printing **Documentation layer** when you run a Plot preview. (See section §6.3.4 Additional Layer Control features, on page 62 for more about Documentation layers.)

6.8.3 Working with rendered previews

You can select from the menu **Layer > Layers and Objects...** to open the **Layers and Objects** panel to hide, show, or remove the Preview layers. Each time that you render a new preview it will overwrite the old one.



The pen-down drawing and pen-up drawing portions are rendered as separate **sublayers** within the Preview layer, so that you can hide one, the other, or both. (If you don't see the sublayers in the list, use the triangle next to "% Preview" to expand its sublayers.)

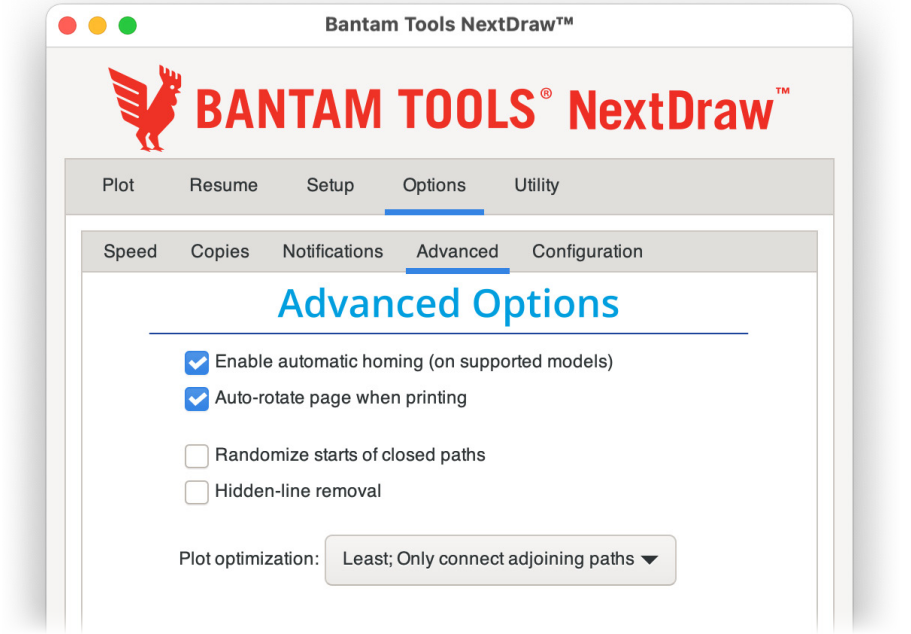
Since previews are rendered within a documentation layer, these layers will not plot on the NextDraw, nor will their contents be rendered as part of future preview renders. See section §6.3.4 Additional Layer Control features, on page 62 for more about Documentation layers.

Preview layers are ***erased and overwritten*** every time that you run a new preview. Do not add any graphics or information that you want to keep to existing preview layers, as they may easily be overwritten.

In addition to using the **Layers and Objects** panel to hide or remove rendered previews, you can also use the **Strip plotter data from file** option on the Utilities tab to remove rendered previews from your document.

6.9 Advanced options

The **Options > Advanced** tab has additional options that control the behavior of plots. As with similar tabs under **Options**, pressing the **Apply** button with the this tab selected has no effect: This tab on its own does not initiate a plot, perform homing, plot optimizations, or any other action.



The last two options, **Hidden line removal** and **Plot optimization** are discussed in the following sections, §6.10 Hidden-line removal, on page 77 and §6.11 Plot order and optimization, on page 78.

6.9.1 Enable automatic homing

The **Enable automatic homing** option, checked by default, enables automatic homing, on Bantam Tools NextDraw models. Uncheck this option in order to change the behavior, using manual homing only.

See section §3.2 Automatic and Manual Homing, on page 29 for more information about these two ways of using the machine.

6.9.2 Auto-rotate page when printing

Documents taller than wide (those in portrait orientation) are normally rotated sideways when plotted. To force documents to always print in the same orientation as on your screen, uncheck the **Auto-rotate page when printing** option.

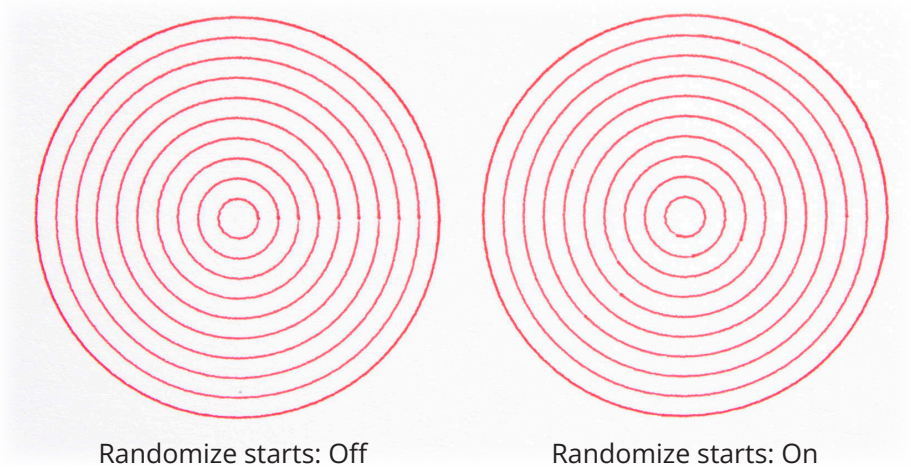
See §4.3 Document orientation, on page 40 for more about how document orientation is determined.

6.9.3 Randomize starts of closed paths

A pen may form a visible mark at the location where it is lowered or raised. In artwork where the same closed shape is repeated many times, that can cause a seam-like visual artifact if many of those marks line up at matching points on the repeated shapes.

When **Randomize starts of closed paths** is enabled, the start position of closed paths — e.g., circles, rectangles, and squiggles that form a full loop with no obvious start or end point — will be randomized, which can help to hide that specific type of visual artifact.

As a demonstration, see the two figures below, each consisting of ten concentric circles and plotted with a red pen:

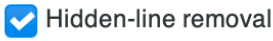


Randomize starts: Off Randomize starts: On

The circles on the left were plotted with the option disabled, as is default. Starting at the center of the circles and looking to the right, you may be able to see a small visual artifact where the pen set down and lifted at each circle.

The circles on the right were plotted with **Randomize starts of closed paths** enabled. The visual artifacts are still present, but they are less noticeable because they do not line up.

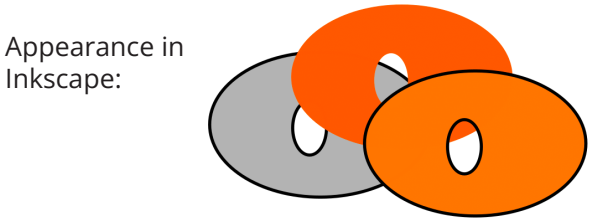
6.10 Hidden-line removal

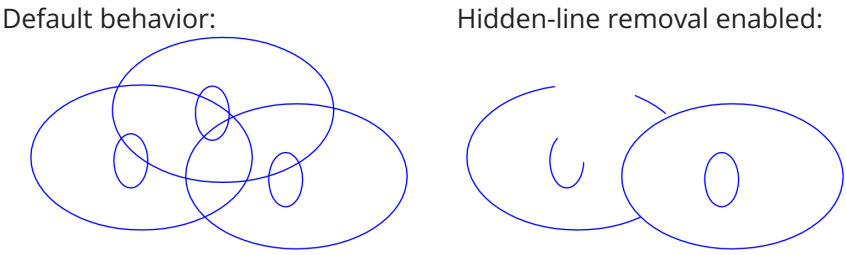


The **Hidden-line removal** option in **Options > Advanced** changes document processing, such that objects hidden behind other objects will not print.

By default, with this option disabled, the NextDraw draws all paths in the SVG document. The fill and stroke (outline) properties of individual objects are ignored. In other words, all paths are normally plotted as though each has a stroke and no fill.

When **Hidden-line removal** is enabled, the NextDraw software will instead plot paths only if (1) they do have a stroke applied to them, and (2) they are not occluded behind filled objects. An object that does not have a stroke property (e.g., no outline in Inkscape) will not plot, nor will one hidden behind a solid fill. The example below illustrates these differences.





There are two important factors to bear in mind. First, **Hidden-line removal** requires additional processing time before plotting, especially in instances with large numbers of objects to process. (When you don't need this feature, leave it turned off.)

Second, the **Hidden-line removal** processing routine does not preserve the orientation of individual SVG strokes. When you use it, we generally recommend also using the **Plot optimization option**, set to **Full; Also allow path reversal**, for efficient plotting.

6.11 Plot order and optimization

The **Plot optimization** option in the **Options > Advanced** tab can re-order elements in your document to reduce pen-up travel, and thereby reduce total plotting time.

6.11.1 How plot order is determined

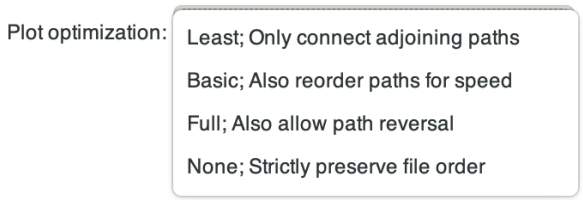
Elements within a document are normally plotted in the same order in which they appear in the file. This order is generally the order in which the objects were created; it might also be figuratively referred to as "bottom to top," as draws puts new objects "on top" of existing ones.

For example, draw a circle and then a rectangle. Then, the NextDraw will plot the two objects in the order that you created them: The circle will plot before the rectangle. The rectangle can also be described as being "above" the circle— a description that makes sense if you imagine painting one object and then painting the other on top of it.

You can use the tools in the **Object** menu to rearrange the order of objects, for example with the **Object > Raise** and **Object > Lower** menu commands. If you raise our example circle above the rectangle, the rectangle will plot first.

If a document has multiple layers, lower layers plot before higher layers; you may wish to open the Layers panel to see their order for reference.

6.11.2 Plot optimization options



The **Plot optimization** drop-down menu in **Options > Advanced** has four items:

- **Least; Only connect adjoining paths** (default)
- **Basic; Also reorder paths for speed**
- **Full; Also allow path reversal**
- **None; Strictly preserve file order**

By default, most types of Plot optimization are disabled, and objects in the document will be plotted in the order given by the file. However if either "Basic" or "Full" is selected, then elements within the file will be reordered to reduce pen-up travel when you plot or run a plot preview from the **Plot** or **Resume** tab. Detailed descriptions of these options follow in the next sections.

The optimization routine is layer-aware: It will only re-order objects within layers. That makes it safe to use on multicolor plots where colors are separated by layers. (See §6.3 Working with multiple layers and colors, on page 58.)

Changes to the order of elements during Plot optimization are *ephemeral*. A temporary copy of the file is created and re-ordered when you plot; no changes to the order of elements in your file are retained.

> ***Aside:*** There is an advanced method to save a file ***after*** optimization, for times when that's helpful. See §7.5 Bantam Tools NextDraw Plob Export, on page 98.

6.11.3 Default: Least; Only connect adjoining paths

If the default option, **Least; Only connect adjoining paths** is selected, then paths in the document will plot in the same order and (if **Hidden-line removal** is disabled) direction as given in the document.

One exception to note is that if one path ends right where another begins (on the same layer), those paths will be joined together, reducing the number of pen lifts needed. To disable path joining, select **None; Strictly preserve file order**.

6.11.4 Basic; Also reorder paths for speed

If **Basic; Also reorder paths for speed** is selected, the plotting order of objects within your document will also be altered to reduce pen-up travel.

Every graphical element within each layer will be broken into its constituent pen-down strokes, or "subpaths", and those subpaths will be re-ordered. This optimization option preserves the *direction* of each subpath, if **Hidden-line removal** is disabled: Each subpath will be plotted from its start to its end, in the same direction that it appears in the file. For paths that are drawn by hand, this direction is normally the same direction in which it was initially drawn.

6.11.5 Full; Also allow path reversal

If **Full; Also allow path reversal** is selected, the same re-ordering processes are used. However, during the re-ordering process, the direction in which individual sub-paths are drawn may be reversed to reduce pen-up travel time. This option generally leads to the fastest overall plotting time. See §6.11.8 Example: Path reversal, on page 83 for a visual example of path reversal.

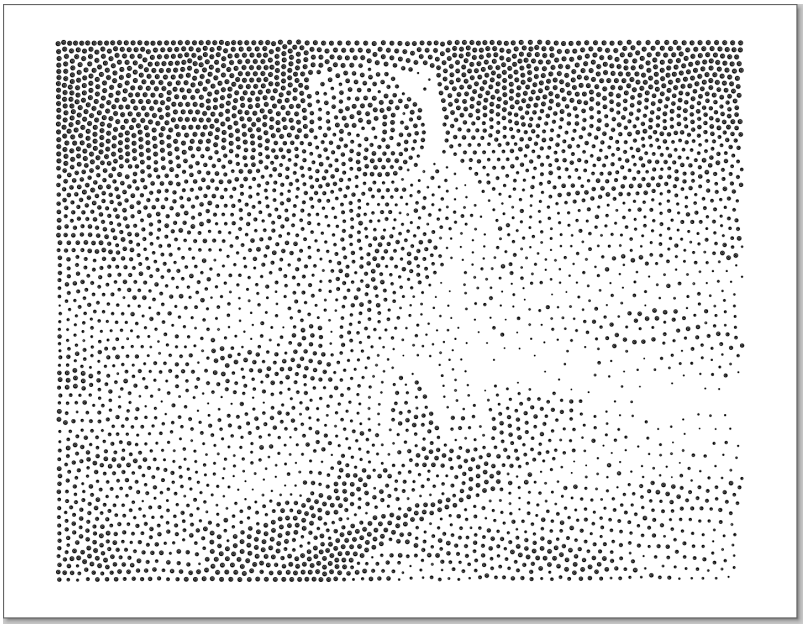
6.11.6 None; Strictly preserve file order

The **None; Strictly preserve file order** option disables all re-ordering and path joining methods. Paths will plot in the order and (if **Hidden-line removal** is disabled) direction as given by the document. This option is chiefly useful in scientific or engineering applications, or specialty use cases such as re-inking a brush, where the order of operations is programatically determined.

6.11.7 Example: Previews and optimization

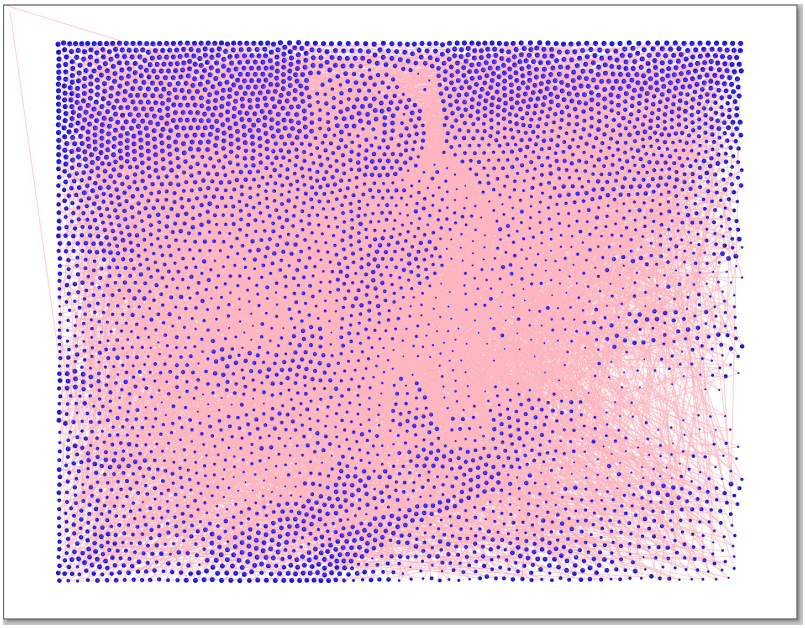
When managing complex plots, it may be helpful to use **Preview mode** with **Preview mode rendering** (page 73) and **Report time elapsed** (page 69) enabled, in order to preview what the plot order looks like and estimate the plotting time with different options.

As an example, here is a stipple drawing, created with StippleGen, consisting of about 4700 little round spirals, laid out on a letter-size sheet of paper.



For this example, the stacking order of the stipples within the file has been *randomized*, such that there is only a random order to which the filled circles appear in the file and how they will normally print.

If we enable **Preview mode**, **Preview mode rendering**, and **Report time elapsed**, and then run a Plot preview using the **Plot** tab, we get the following mess, where the blue lines represent drawing, and light-red lines represent pen-up travel:



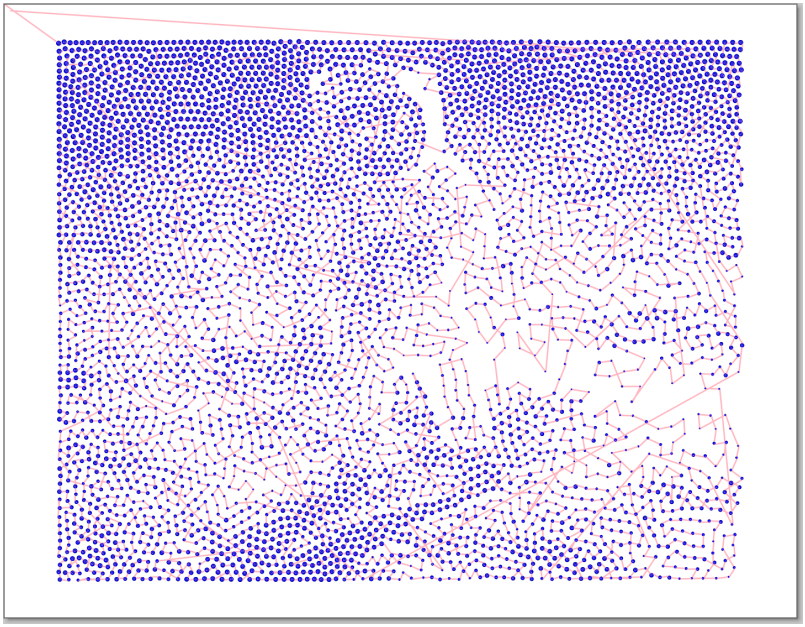
The time report from this plot reads as follows:

Estimated print time: 57:47 (Minutes, seconds)
Length of path to draw: 31.079 m
Pen-up travel distance: 547.127 m
Total movement distance: 578.206 m
This estimate took 20 Seconds

As you can see by the numbers and the amount of pen-up travel shown in red, this plot is ***dominated*** by pen-up travel. *Only about 5% of the travel is with the pen down.*

(continues)

If we now enable plot optimization, selecting "Full" reordering and go back to the **Plot** tab to run the plot, we get the following, more pleasing result:



With optimization enabled, the statistics are as follows:

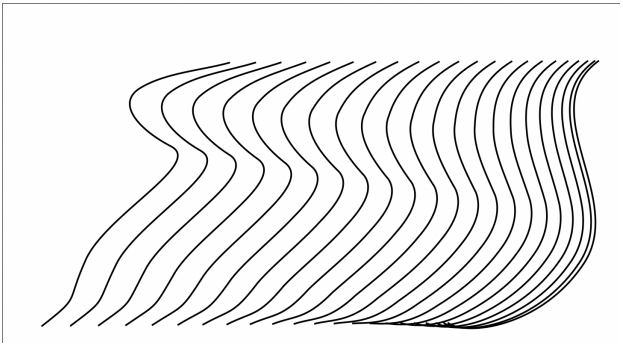
Estimated print time: 27:33 (Minutes, seconds)
Length of path to draw: 31.080 m
Pen-up travel distance: 15.748 m
Total movement distance: 46.827 m
This estimate took 21 Seconds

Thus, with **Full** optimization enabled, this particular plot now takes less than half the time: 28 minutes instead of 58. And, about ⅔ of the travel distance is spent with the pen down, a vast improvement over 5%.

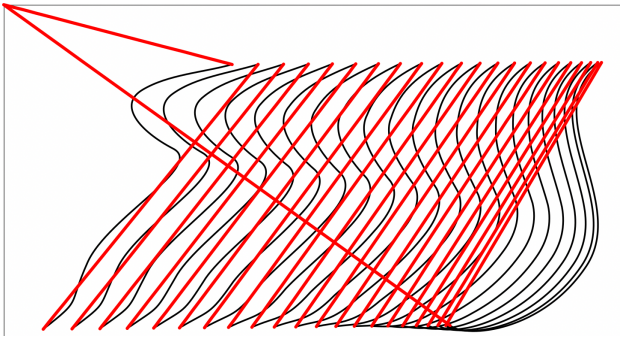
Aside: While this is a stark example, many real-world documents do exhibit this level of initial disorder, for example when you start with scanned and traced artwork, or documents generated programatically.

6.11.8 Example: Path reversal

The path reversal option in **Plot optimization** can significantly improve performance in some circumstances. This example drawing has 22 slightly varying curves, each drawn in the same direction, from top to bottom:

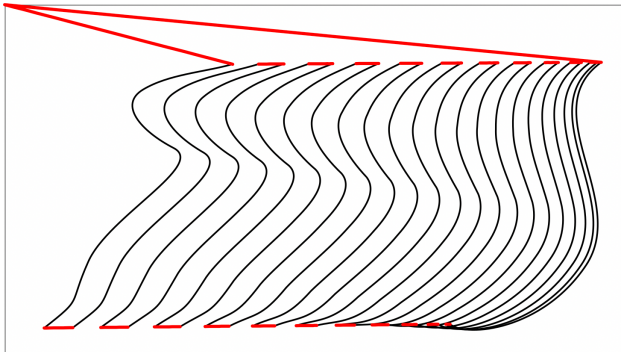


If we plot this with **Preview mode** and plot optimization set to **Basic; Also reorder paths for speed**, it neatly organizes the curves, and plots each of them in the original direction, top to bottom:

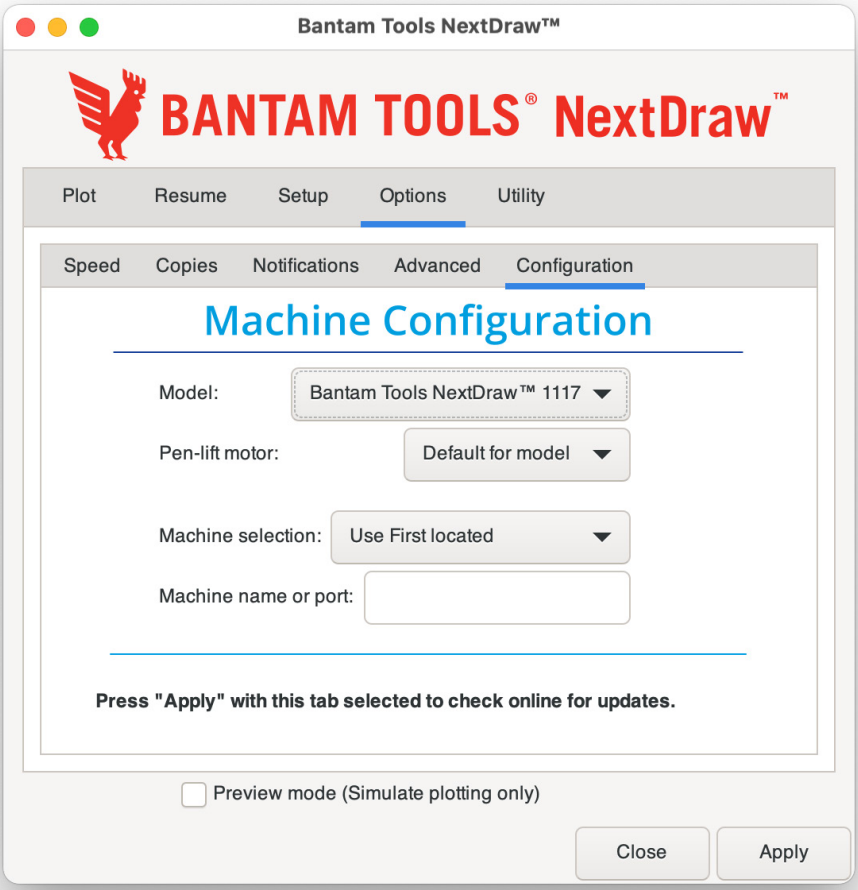


As you can see from the amount of (red) pen-up travel, a significant amount of the total motion is still with the pen up.

We can get a much more efficient result by using the **Full; Also allow path reversal** option for **Plot optimization**:



6.12 The Configuration tab



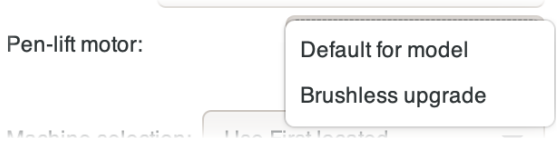
The **Options > Configuration** tab allows you to specify which model of NextDraw hardware you are using, specify which particular NextDraw to plot to (if you are managing multiple machines), and check for software updates.

Press **Apply** with the **Options > Configuration** tab selected to check online for software updates.

6.12.1 Selecting your model

The **Model** selection drop-down menu lets you select which model of plotter you are using. See §2.4 Select your model, on page 25 for more about this option.

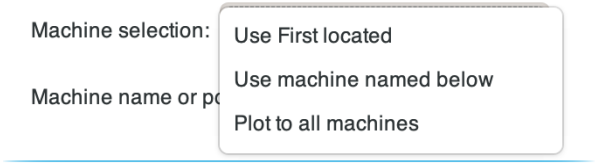
6.12.2 Pen-lift motor option



As an addendum for the model selection, if you are using an *AxiDraw with a brushless upgrade*, then select **Brushless upgrade** for the **Pen-lift motor** option. For all other cases (a Bantam Tools NextDraw, an AxiDraw with standard or coreless pen-lift motor), leave this as **Default for model**.

> ***Advertisement:*** If you have an AxiDraw that doesn't have a brushless pen-lift motor, it's a huge upgrade in speed, capability, and reliability. Consider getting one: bantam.tools/adbu

6.12.3 Machine selection



There are two additional controls in the **Configuration** tab that are relevant when working with multiple machines: the **Machine selection** drop-down menu and the **Machine name or port** text input box.

The **Machine selection** drop-down menu has three options:

- **Use First located** (default)
- **Use machine named below**
- **Plot to all machines**

If **Use First located** (the default option) is selected, the Bantam Tools NextDraw software will communicate the first NextDraw located via USB. Keep this option selected if you are working with a single machine.

If **Use machine named below** is selected, the NextDraw software will only look for and drive a specific machine, as entered in the **Machine name or port** text entry box. Use this method when you have multiple machines to drive and want to plot to a specific machine.

The **Machine name or port** may be specified with a USB Nickname – like "California" – or with a traditional enumerated serial port name like "COM6" on Windows or "/dev/cu.usbmodem1441" on a Mac. Since serial port names can change, it is best practice to use a USB Nickname when working with multiple NextDraw machines. (For more about USB Nicknames, see §7.3 NextDraw Naming, on page 94)

If **Plot to all machines** is selected, a document that is plotted will be simultaneously sent to all detected plotters. Use this option when you have several NextDraw machines and wish to plot the same document, simultaneously, on multiple machines. (A typical desktop-class computer can support up to 2-3 NextDraw machines working simultaneously.)

When plotting the same document to multiple machines, any individual unit can be stopped by pressing its physical pause button, but plots that are stopped generally cannot be resumed.

6.12.4 Checking for updates

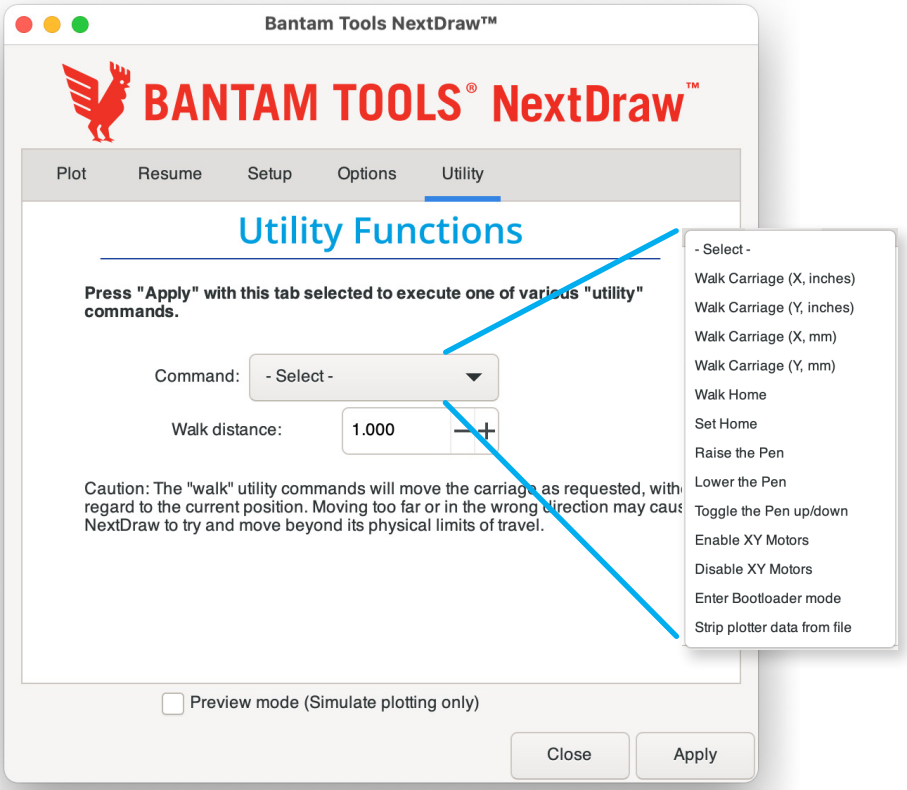
If you click **Apply** with the **Options > Configuration** tab selected, it will query and report both the versions of the Bantam Tools NextDraw software and the version of the NextDraw's "EBB" firmware. Additionally, this function will check online to see if newer software versions are available. We do highly encourage you to update to the latest available version.

As of the most recent edition of this user guide, the Bantam Tools NextDraw is shipping with firmware version 3.0.2. If you do need to update your firmware, please visit bantam.tools/ndfw .

6.13 Utility Functions

The **Utility** tab allows you to manually execute several basic and advanced commands that aren't typically used in the course of everyday operation.

Select the operation to perform from **Command** drop-down menu, and then press the **Apply** button. For certain commands, like the "walk" commands, you can also enter a distance.



The individual **Command** options are detailed in the following sections.

6.13.1 Walk Carriage commands

The first four manual commands in the Utility tab menu are **Walk Carriage** commands that move, or "walk" the carriage in the X or Y direction by the numeric distance given in the **Walk distance** field:

Walk Carriage (X, inches), **Walk Carriage (Y, inches)**
Walk Carriage (X, mm), **Walk Carriage (Y, mm)**

There are two different units (inches or mm) for each direction (X or Y). The distance to walk — in the selected units — is given by **Walk distance**, which may be positive or negative:

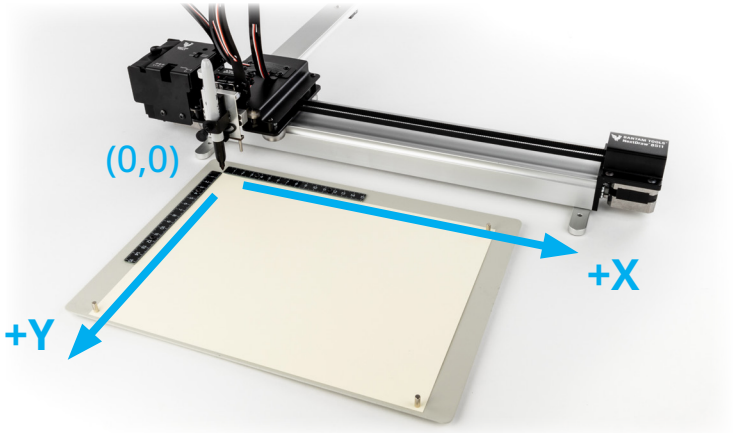


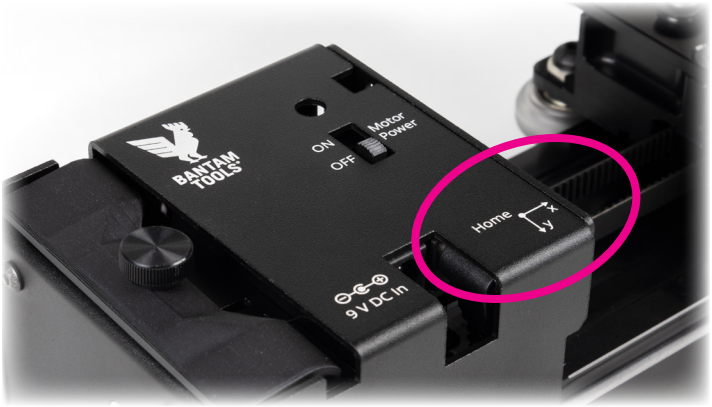
The Walk Carriage commands can be used to reposition the carriage or make small calibration adjustments to the carriage position before starting a plot, or (for example) while paused. This feature can be used to make tiny offsets to the initial position of a plot for fine-tuning alignment with different pens.

The position where a plot starts, if offset with Walk Carriage commands, is a temporary plot origin for that plot, and the carriage will return to that starting position when the plot ends.

Important note: *no limit checking* is performed on Walk Carriage commands; Take care not to run the NextDraw into its physical limits. If you are unsure, disable the motors and move the carriage **Home** by hand. Offsets made to the plot origin can also offset the plot position beyond the travel bounds of the machine.

For reference, the Home corner is (by default) the X=0, Y=0 position. Positive moves in both X and Y are both in the directions away from Home. These directions are also shown by the Home label on the Left motor & electronics cover.





6.13.2 Walk Home

The **Walk Home** command is a special "walk Carriage" type command that moves the carriage to the current **Global Origin** position. This is subtle, because that position may or may not be the same as the Home corner position.

When Automatic homing is active, the **Global Origin** position is normally the Home corner position, and so the **Walk Home** command will normally return the carriage to the Home corner.

With manual homing, the plot origin is the position where the motors were first energized. In normal operation, where the NextDraw is located in the **Home** position before enabling the motors, starting a plot, or using other Walk Carriage commands, **Walk Home** will return the NextDraw to the **Home** position. But, if the motors were enabled in some different position, this command will instead return the NextDraw to that position.

With either Automatic or manual homing, the **Set Home** command can be used to change the **Global Origin**, setting it to a new position after (for example) using **Walk Carriage** commands.

The **Walk Home** command can be used to reset the NextDraw carriage position after one or more **Walk Carriage** commands or after pausing a plot that will not be resumed.

6.13.3 Set Home

The **Set Home** command sets the current carriage position to be the "Global Origin" — the position to which **Walk Home** returns the carriage.

6.13.4 Raise the Pen, Lower the Pen

These two commands move the pen holder to the pen-up or pen-down position.

6.13.5 Toggle the pen up/down

This command moves the pen holder to the up position if it was down, and to the down position if it was up, when you press **Apply**.

6.13.6 Enable XY Motors, Disable XY Motors

These two commands either energize the two stepper motors or turn power off to them. The carriage can be moved by hand only when motor power is off.

6.13.7 Enter Bootloader Mode

This command puts the Bantam tools NextDraw's "EBB" control board into "bootloader" mode. This utility mode is sometimes used in reprogramming the firmware. If you should accidentally enter this mode, press the reset button to reboot the NextDraw.

6.13.8 Strip plotter data from file

The NextDraw software stores certain configuration data within your document. This data includes the setup data necessary for resuming a file that was paused or otherwise stopped while printing.

While this data does not typically cause any issues, this command can strip that data from the file, should that need arise.

This command will also remove:

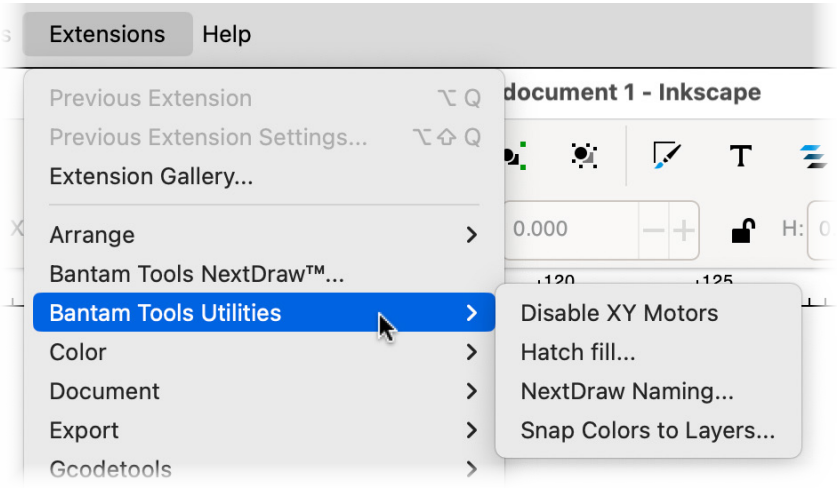
- Any ability to resume a plot that was paused
- Any "resume" warning about a plot containing a paused plot
- Rendered preview layers

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7. NextDraw Utilities

In addition to the main Bantam Tools NextDraw software, there are several additional programs included. Three can be found in the menu under:

Extensions > Bantam tools Utilities



One additional program, **Bantam Tools NextDraw Plob Export**, is only accessible when saving a file through **File > Save a copy...**

7.1 Disable XY Motors

Disable XY Motors can be found in the menu at:

Extensions > Bantam Tools Utilities > Disable XY Motors

This is a single-purpose "shortcut" command that turns off power to the motors that control the XY position of the NextDraw carriage. Motor power is off by default at power up. This command is often useful to turn off power to the XY motors so that the carriage can be manually moved from one position to another, and in particular to the home corner, prior to plotting, when using manual homing.

This command is equivalent to using the **Utility** tab in the Bantam Tools NextDraw software, with **Disable XY Motors** selected. (See §6.13.6 Enable XY Motors, Disable XY Motors, on page 90.)

This shortcut command is intended for use with a single machine; it performs the action on the first one located via USB.

7.2 Hatch Fill

The Hatch Fill utility can be found in the menu at:

Extensions > Bantam Tools Utilities > Hatch Fill...

Its usage is described in §8.11 Filling shapes and text, on page 113.

7.3 NextDraw Naming

The NextDraw Naming utility allows you to assign a **USB Nickname** to a specific machine. It can be found in the menu at:

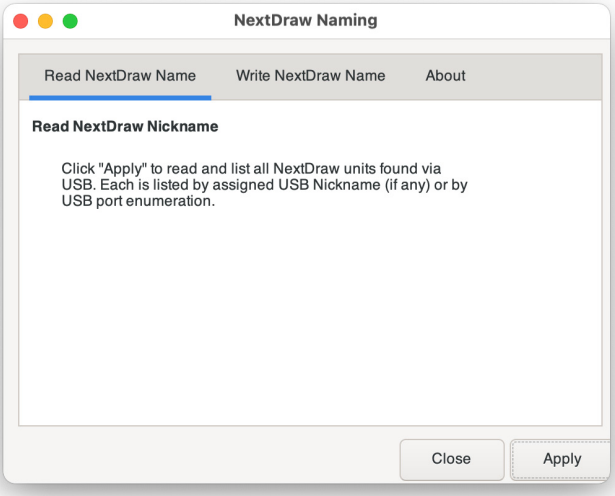
Extensions > Bantam Tools Utilities > NextDraw Naming...

A USB Nickname is a semipermanent label, stored in the flash memory of a Bantam Tools NextDraw or an AxiDraw. This label may be used to identify and address that machine by name. USB Nicknames are not required, but can be helpful if you have more than one machine connected: You can use them to specify which machine to plot to from the Bantam Tools NextDraw software. See §6.12.3 Machine selection, on page 85.

Important note: USB Nicknames are ***semipermanent***. Updating your NextDraw firmware will reset its configuration, removing any USB Nickname.

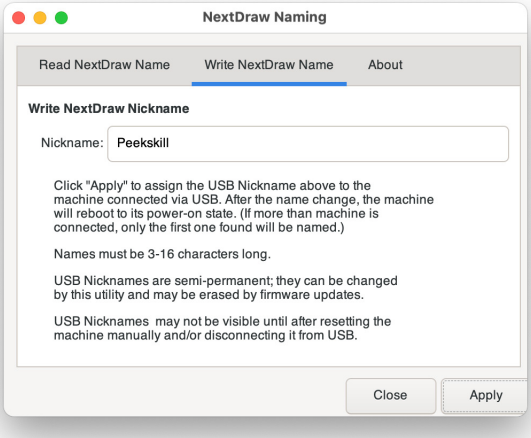
7.3.1 Read NextDraw Name

If you click **Apply** with the **Read NextDraw Name** tab selected, it will search for all attached machines and list them. They may be listed by their USB Nickname or by their USB port enumeration, if no USB Nickname has been assigned. This tool can be useful for listing available machines, even if you are not using USB Nicknames.



7.3.2 Write NextDraw name

The second tab, Write NextDraw Name, is for writing a USB Nickname to a specific machine.



To assign the USB nickname, enter a name between in the text box (here “Peekskill”) and click **Apply**. Before writing the name, it is recommended that you disconnect any other connected machines, so that you can be sure of which one you are writing the USB Nickname to.

Writing an empty name will clear the nickname.

You can use the **Read NextDraw Name** tab to verify that the name has been written correctly. ***However***, note that updates to USB Nicknames may not be visible until after resetting the machine manually and/or disconnecting it from USB.

7.4 Snap Colors to Layers

The Snap Colors to Layers utility can be found in the menu at:
Extensions > Bantam Tools Utilities > Snap Colors to Layers...

This utility helps you organize multi-color drawings by automatically sorting objects based on their stroke colors and optionally moving them into separate layers. This is particularly useful when preparing documents for multi-color plotting where you want to plot different colors with different pens, one layer at a time.

When you open the utility, you'll see a panel with eight color slots. Each color has three associated controls:

- A color swatch that you can click to select a different color
- A **Layer Name** text field where you can specify the layer name
- An **Enable This Color** checkbox to include or exclude that color

The default layer names follow the format "1-black", "2-red", and so forth, with a leading digit that makes them easy to select by layer number when plotting (see §6.3.3 Selecting layers to print by number, on page 60).

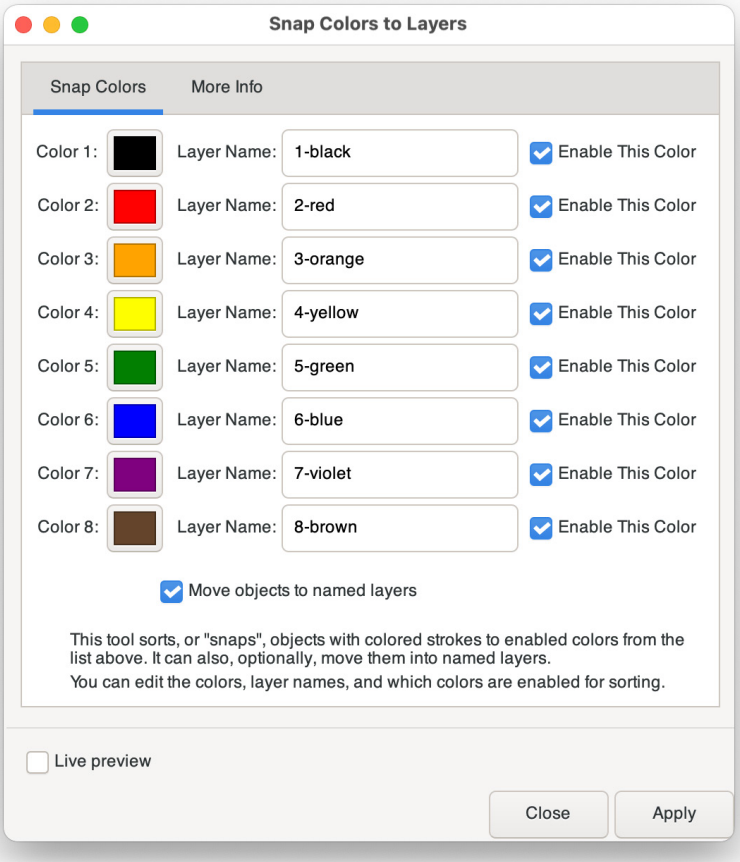
At the bottom of the panel, you'll find the **Move objects to named layers** checkbox. When checked, the utility will not only adjust stroke colors but also move objects into the corresponding named layers.

7.4.1 Using Snap Colors to Layers

The Snap Colors to Layers utility simplifies the process of preparing complex multi-color documents for plotting with the NextDraw, reducing the need for manual color adjustment and layer organization.

Before running Snap Colors to layers, we recommend that you save your document, as this feature makes permanent changes to your file. Then, open the utility and:

- Click any color swatch to open a color picker and select colors
- Check or uncheck the **Enable This Color** boxes to control which colors are used
- Edit the **Layer Name** fields to match your preferred naming scheme
- If you want objects to be organized into layers as well as having their colors adjusted, check the **Move objects to named layers** option.
- Optionally, check the **Live Preview** option to see the effect of your settings before applying them.
- Click **Apply** to process the document.



When the utility runs, all objects with stroke colors in your document will have their stroke colors adjusted to the nearest enabled color from your list. If the **Move objects to named layers** option is checked, the objects will also be organized into layers named according to your specifications.

This utility is ideal for preparing multi-color plots where you want to:

- Standardize colors for visual consistency
- Reduce numerous similar colors to a manageable number of distinct colors
- Automatically organize objects into numbered layers for sequential plotting

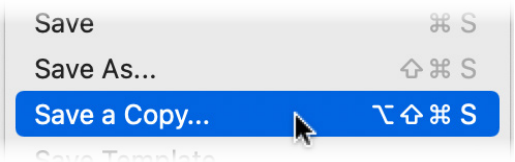
7.5 Bantam Tools NextDraw Plob Export

The Bantam Tools NextDraw software includes an advanced feature to export a "Plot Digest" or **Plob** file. A Plob is a pared-down SVG format that the software "digests" the file into, after processing, including hidden line removal, cropping at travel bounds for a specific plotter model, and any randomization and optimization steps. A Plob file is this intermediate state of the document, saved just before plotting. The name Plob originally comes from a contraction of "Plot Object."

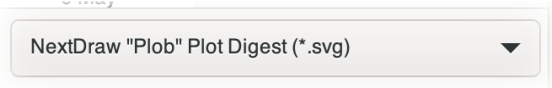
Opening and plotting from a Plob lets the NextDraw software start (or resume) plotting ***almost immediately*** because it does not have to process the file again from scratch.

That speed gain can be helpful with very large SVG files that take a while to process before plotting, especially if you expect to pause and resume plotting several times. You can also run a Plot preview from a Plob, with the same time savings.

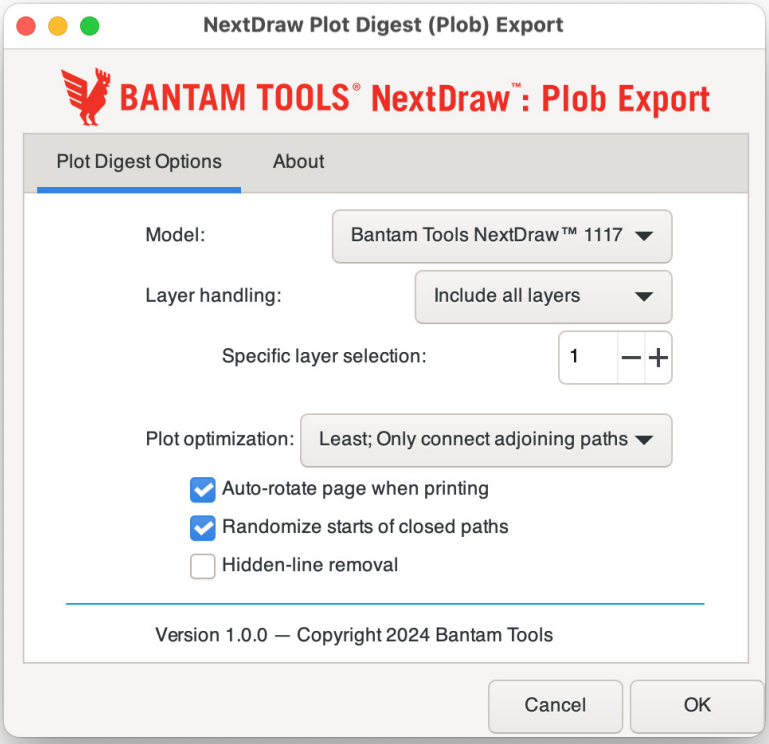
One common use case for Plob files is preparing and plotting files from different computers, especially when the computer that will do the plotting is a budget computer like a Raspberry Pi.



To export a Plob, select **File > Save a Copy...** in Inkscape and then select file format **NextDraw "Plob" Plot Digest (*.svg)**.



Choose a name and location to save your Plob, and click **Save** to open the **Bantam Tools NextDraw Plob Export** dialog.



In the dialog, select the options for your plot including the plotter model that you are preparing prepare the Plob for. Exporting a Plob takes as much time that it would for the NextDraw to begin plotting the file. However, you may be able to save that time when printing, since the NextDraw software can skip the initial processing and optimizations.

Important note 1: Generating a Plob is destructive. ***Always*** save as a copy with a new name and keep your original document.

Important note 2: You cannot make changes to a Plob after generating it. If you do, it will no longer be recognized as a valid Plob (and not skip processing). Instead, modify and export a new Plob from your original document.

8. Designing for NextDraw

8.1 General considerations

The Bantam Tools NextDraw is a **pen plotter**, which is fundamentally a single function device. Its sole function is to guide a pen (or other implement in the pen holder) along the set of vector lines, curves, and paths that you provide. All things that the machine is ultimately capable of – such as drawing graphics, writing text, or signing documents – are expressions of this basic function. It is capable of drawing anything that can be composed from a set of lines.

Certain object types are automatically treated as paths, for example circles and rectangles. Other types of objects that are made of curves – like text – may need to be converted from (editable) text into simple paths before plotting. Many object types cab be converted to paths in Inkscape with the menu command **Path > Object to Path**.

8.1.1 Objects that are not paths

The NextDraw does not directly plot objects that are not made of paths.

This includes pictures (raster or bitmap images, such as JPG, GIF, and PNG files), nor effects such as fills, gradients, and background colors. These kinds of things require conversion to paths before plotting. That is straightforward in some cases, and not in others.

Two notable helper tools are the Hatch Fill extension (see §8.11 Filling shapes and text, on page 113) and the various third-party tools for converting images into sketches (see §8.12 Vectorizing images, on page 115).

8.1.2 Importing graphics

The native file format of the NextDraw software is **SVG** ("scalable vector graphics" – a standard interchange format). You can create artwork directly in Inkscape or use other programs that can export SVG directly, such as Adobe Illustrator or CorelDRAW. Inkscape can also usually import artwork in formats including EPS, DXF, AI, CDR, and PDF, though going through SVG is more reliable.

If you encounter difficulties opening SVG documents in Inkscape, one approach that can help is to start with an empty document in Inkscape, and then use the **File > Import** command to place your document. See the next section, §8.2 Templates and document size, on page 102, for more about empty documents.

It is worth noting that the file type itself is not a reliable indicator of whether or not a file suitable for use on the NextDraw. For example, a PDF document with vector paths from Adobe Illustrator will generally work very well, but it is also possible to create a PDF that contains nothing but a picture in JPG format. In the latter case, the image still isn't vector graphics, even though it's tucked into a PDF file.

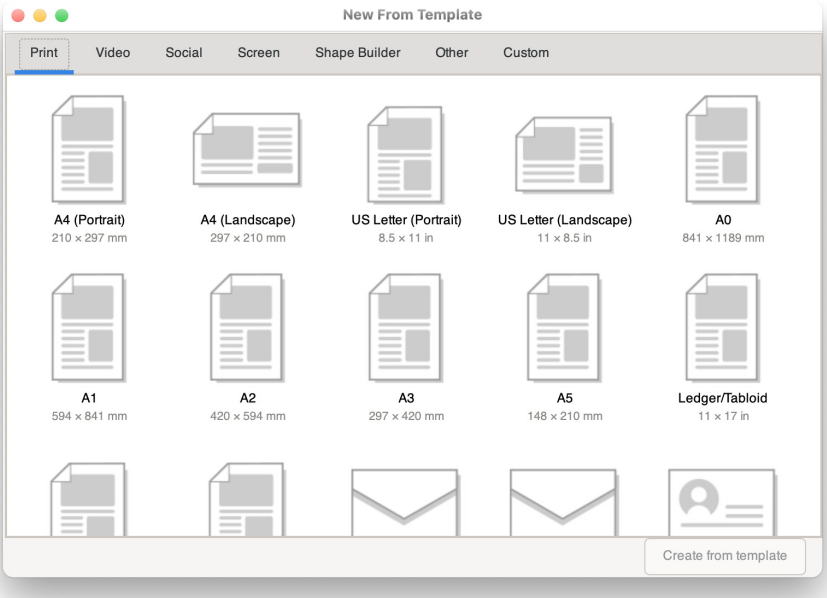
8.2 Templates and document size

When designing in Inkscape, it is recommended to create new documents by using a template, for example an A4 or US Letter sized document.

In some cases, you may need to manually enter your document size.

The Bantam Tools NextDraw software will automatically clip and remove any paths in your document that exceed the document bounds when printing, so it is often helpful to match your document size in Inkscape to your actual paper size.

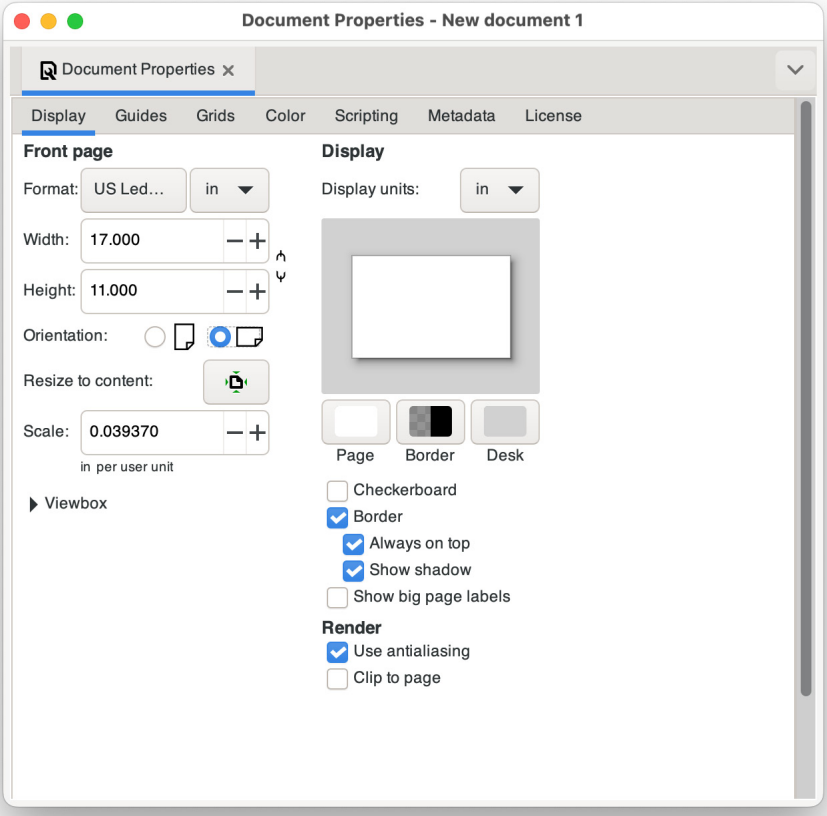
8.2.1 New from Template



You can create a basic document from a template by selecting **File > New from Template**, selecting a document size — such as US Letter (Landscape) — and pressing **Create from template**.

8.2.2 The Document Properties window

For other page sizes (not available within this panel), go to **File > Document Properties...** after creating a document. There, you can find a long list of standard paper sizes that you can choose from.



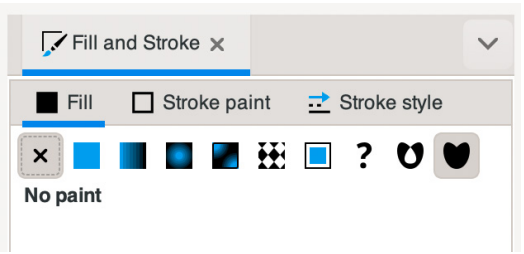
The Document Properties window also lets you custom enter the exact size of your document, select between portrait and landscape orientation, and pick the display units that are used in measurements and on-screen rulers.

If you frequently use page sizes that are not available in the Templates list, you may wish to save blank documents to use as your own templates.

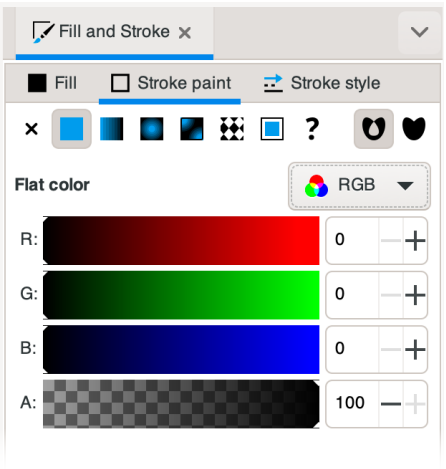
8.3 Visualizing paths in your document

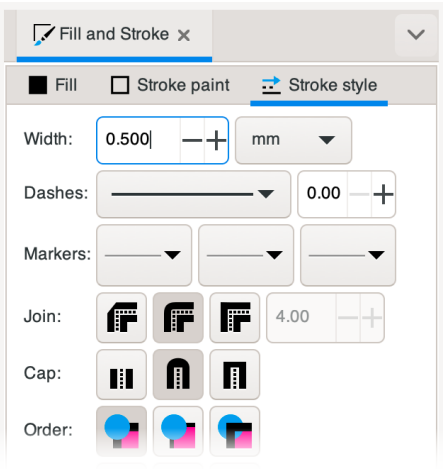
When working with documents containing mixed object types or styles, it can be helpful to visualize all of the paths without their fills. This is especially helpful when **Hidden-line removal** is disabled.

To see all of the paths in your document, select all in your drawing (From the menu: **Edit > Select all in all layers**). Then, open the **Fill and Stroke** panel (**Object > Fill and stroke**). In the **Fill** tab, select **No paint**, the "×" icon:



Then, in the **Stroke paint** tab, select "Flat Color". And, in the **Stroke style** tab, select a consistent width, say 0.020 inches or 0.5 mm.





This procedure often provides a good visualization of how the NextDraw will view your page. However, it is not a precise representation of how plotting will work. For example, it shows the outlines around objects even if they are not yet converted to paths.

For a more exact preview of how your document will plot, use **Preview mode** with rendering enabled (see §6.8 Preview mode, on page 72).

8.4 Fonts, characters, and languages

The Bantam Tools NextDraw is designed to trace the vector paths that you provide to it. The document that you prepare can include any number and variety of different text and graphical elements, so long as they are converted to paths before you plot them.

As its sole function is to follow paths, the NextDraw hardware itself does not use fonts (built-in or otherwise) nor does it have knowledge about any written languages. Thus, it has no preference for one language over another, and is equally happy to write in English, Japanese, or Arabic, *so long as you can provide suitable input*. Similarly, you can use fonts in any typeface style or character set – including international languages and including fonts that resemble handwriting.

Most fonts types like TrueType (TTF) and OpenType (OTF) that are installed on your computer are usable directly within Inkscape. You can create and edit text objects in Inkscape by selecting the text tool, which you can select by clicking the icon shown here, or by using **F8** on your keyboard. You can select between available fonts using the Text and Font panel, accessible in the menu at **Text > Text and Font...**.

To convert editable text into paths that can be plotted, select the text elements that you wish to convert. Then, choose from the menu **Path > Object to Path**. You may wish to save a separate copy of your document before converting to paths, in case you wish to edit the text again later.



The text above was written in regular outline fonts, and converted using Object to Path for printing.

8.5 Outline fonts

All standard computer fonts — those found in formats including TrueType, PostScript, and OpenType — are **Outline fonts**. In outline fonts, each character in the font file describes a vector outline shape, which will be filled in by tiny pixels when displayed on your screen or rendered by an inkjet or laser printer.

Things are different when you wish to use a pen plotter. As described in the previous section, you can easily convert outline font text into a set of paths for plotting, and then plot it with the NextDraw. When you do so, the machine will follow the actual vector paths in that font, which are those outlines.

Below is a sample of text written in a common handwriting-like font:



The upper line of the sample shows the text filled in, as it will typically appear on your screen, or when printed on a laser printer. The lower line shows the outline: *These are the actual vector shapes contained within the font file*, and illustrates how the output will look when printed with a pen plotter.

Now, if you had picked that handwriting-like font with the intent of creating handwriting-like output on the NextDraw, this is *probably not what you had intended*.

The cause of this "unexpected" behavior is that one might easily (though mistakenly) assume that a handwriting-like font contains handwriting-like strokes. The letters "t" and "x" both look like they *could* be made up of two strokes that overlap, and the "O" looks like it could be a single loop. However, in order for outline fonts to render correctly on your screen, the "t" and "x" are instead each composed of a single (but complex) closed loop, while the "O" consists of two closed loops, one inside the other.

To be quite explicit: there is absolutely no data contained within an outline font that represents or corresponds to the visually apparent centerline of the characters. This fact is consistent for all standard computer fonts, and will present no unexpected behavior, *so long as you are aware of it*.

8.5.1 Handwriting-like output with outline fonts

When trying to achieve output close to that of natural handwriting, an "outlined" effect is not desirable. To mitigate it, pick handwriting-like fonts that have *a thin and consistent stroke width*. If a font is available in multiple weights, pick the lightest (thinnest) one available. This, combined with the use of a medium or broad nib pen can often make it so that the two sides of the outline blend together.

Using a broad-point pen, particularly a broad-nibbed fountain pen, is the one of the most effective ways to make a document look closer to hand written. It is also helpful to pick a larger font size, closer to that of natural handwriting (perhaps 18 pt) as a starting point. When writing by hand, people tend to write much larger than typical typed lettering.

8.5.2 Block and display output

In some cases you may wish to work with text that has large block letters, display text, or other instances with characters that have a wide cross section. Text like this will have a very visible outline, which you may or may not want to fill in with ink.

The best way to fill in text is the **Hatch Fill** utility, as described in §8.11 Filling shapes and text, on page 113. When you apply a hatch fill, it will create a back-and-forth pattern for the pen to follow, to fill in the shape. While it may be counterintuitive to fill in text this way, it is actually closer to how outline fonts are intended to be used: The outline is filled in with ink.

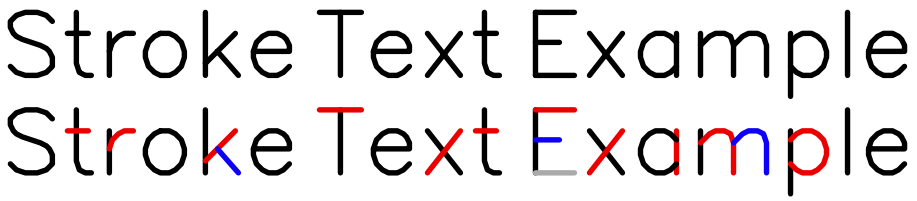


8.6 Stroke fonts

In addition to regular computer fonts (outline fonts), pen plotters like the Bantam Tools NextDraw can in some cases make use of a second class of specialized fonts, called **Stroke fonts**. In a stroke font, each visible character is *defined by strokes of non-zero width*, as opposed to the area within an outline.

While they do have some restrictions, stroke fonts are ideal for use with pen plotters, since they plot efficiently (for example, the "o" is one loop, not two). They are particularly suited for handwriting-like applications, because they can closely mimic how humans write: Along the visual center lines of the text.

The following sample of text is rendered with a stroke font, using **Hershey Tex**., a basic stroke font tool that is now included with Inkscape. The second line is identical to the first, except that we have colored the individual paths (strokes) within each character so that you can tell them apart:

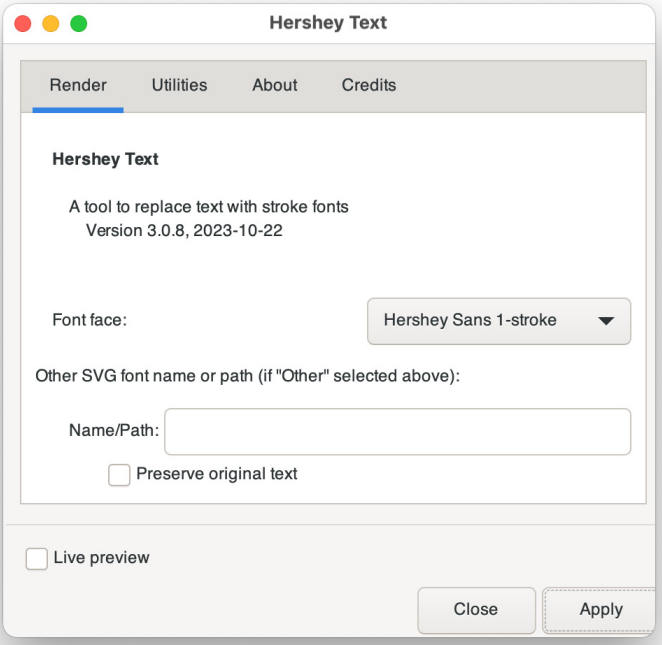


As you can see, characters like the "t" and "x" here are composed of two intersecting strokes. Similarly, a letter "o" in this font consists of a single loop. This particular stroke font is a **single-stroke** font, since each visible line is made up of only a single path. There are also some stroke fonts that use multiple strokes to construct wider characters, e.g., bold fonts.

There two important drawbacks to stroke fonts. First, they are not regular computer fonts, so they generally cannot be used in the same ways as other fonts. You cannot, for example, install them as regular fonts on your computer nor use them in word processors or graphics applications. Second (and mostly *because* of that first reason) there are at present few available stroke fonts. Despite these obstacles, stroke fonts are still worth mentioning: In cases where you *can* use them, they are the best solution for using fonts with a plotter.

8.7 Hershey Text

Inkscape includes an application that we developed called **Hershey Text**, which is capable of typesetting text in a small number of included stroke-based fonts. You can find it at **Extensions > Text > Hershey Text**.



Hershey Text takes editable text that you type and replaces it with rendered stroke-font text: Vector paths that the pen can follow. Once you have rendered text into paths, it can no longer be edited as though it were text.

To use Hershey Text, start with a document that contains text objects. Select the **Render** tab, and select a **Font face** from the drop-down menu. When you press **Apply**, it will render all text elements on your page into the selected stroke-based typeface. If you would like to convert only certain text elements, press **Apply** with just those elements selected.

If the **Preserve original text** box is checked, then the original text elements on the page will be present after you **Apply**. If it is unchecked, then the original font elements will be removed once rendered.

A full user guide for Hershey Text is available at: bantam.tools/hershey

8.8 NextDraw Merge & Stroke Font Utility

For users focusing on handwriting-like applications, the **Bantam Tools NextDraw Merge** software package is available for purchase separately.

This package contains two main software components: **Bantam Tools Stroke Font Utility** and **Bantam Tools NextDraw Merge**, as well as API versions of the Stroke Font Utility.

Learn more at: bantam.tools/ndm

8.8.1 The Bantam Tools Stroke Font Utility

Bantam Tools Stroke Font Utility is a professional grade software package that lets you manage the process of working with stroke fonts to create fine-tuned documents that look like genuine handwriting.

Like Hershey Text, the Bantam Tools Stroke Font Utility is a Inkscape Plugin to render plotter-ready stroke-based text. The Bantam Tools Stroke Font Utility includes gorgeous new stroke fonts. It also offers the ability to introduce subtle "handwriting-like" defects, to help break the appearance of computer-generated writing. And it provides full support for standard and custom third-party stroke fonts from Quantum Enterprises, including their "Scriptalizer" feature that can substitute multiple glyphs (character forms) into written text.

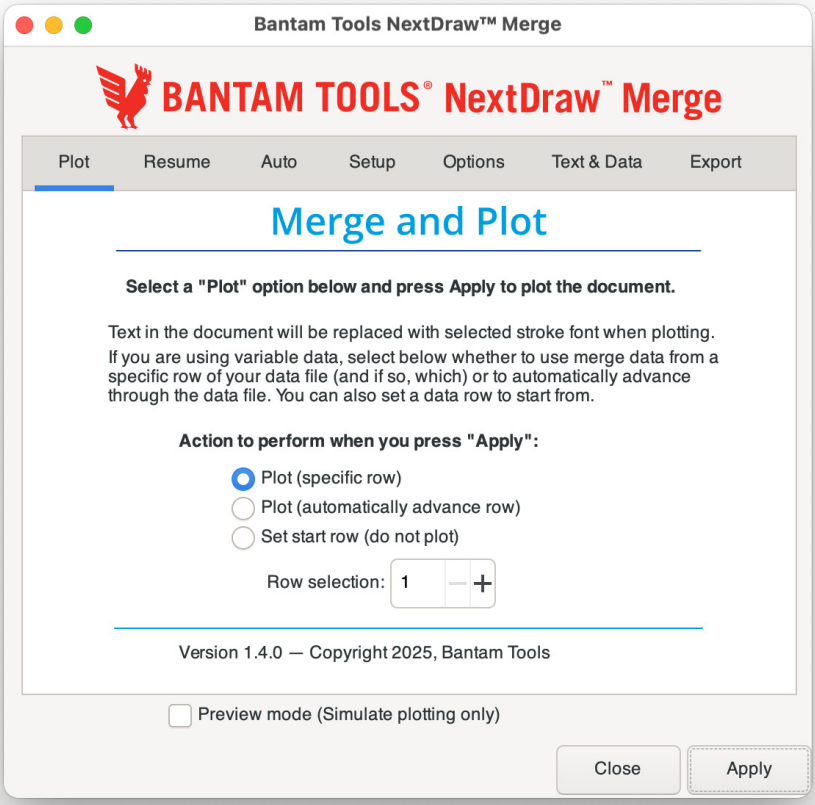
8.8.2 Bantam Tools NextDraw Merge

Bantam Tools NextDraw Merge Software automates the process of writing handwritten-like notes, labels, letters, and envelopes.

It is a merge and machine control software for handwriting applications, which harnesses the full capabilities of both the Bantam Tools Stroke Font Utility and the Bantam Tools NextDraw software for Inkscape.

NextDraw Merge can, in a single step, perform stroke-font rendering on your document, complete with handwriting-like defects — internally using the Bantam Tools Stroke Font Utility — and plot it on the NextDraw. It can plot the next document after a time delay or button press.

You can also, optionally, use NextDraw Merge to automatically populate your template with data sourced from a CSV (spreadsheet) file before rendering the text, and repeat with data from subsequent rows of your CSV file. This is an enormously powerful workflow for creating beautiful, customized notes and letters. In addition to plotting, NextDraw Merge can also export stacks of rendered SVG documents, for use with other workflows.



8.8.3 The Bantam Tools Stroke Font Utility APIs

The **Bantam Tools Stroke Font Utility** also includes feature-complete command-line and Python APIs for rendering text. For scripting and automation, and other cases where using Inkscape is not appropriate, these APIs provide a means of directly rendering text within SVG documents.

8.9 Capturing signatures and handwriting

The highest fidelity method to transform some handwritten text – whether a single signature or a full page of text — into something that the Bantam Tools NextDraw can plot is to use direct handwriting capture, or what you might refer to as "real-time" capture.

In direct capture, you use your computer to record each stroke as it is written, and then save the resulting set of paths as a vector artwork file. This method can also be used when replicating handwriting. For example when replicating historical signatures, it is necessary to trace along the strokes of existing writing and to capture those strokes as you trace them.

For much more about ways to capture and trace handwriting — including a link to **jSignature**, a program that can easily capture your signature in real time — please see our detailed documentation about handwriting capture, found on our main NextDraw documentation site:

bantam.tools/nddocs

It is worth noting that direct handwriting capture is the best possible way to digitize a signature, or other things that don't need to change when they are written. For documents that need to be printed with different text each time, handwriting-like single-stroke fonts are a more appropriate solution.

8.10 Aside: Tracing of scanned handwriting

While we are frequently asked about this, it should be noted that there is not any straightforward way of automatically converting scanned handwriting into a set of high-quality vector paths that a plotter such as the NextDraw can follow. Simple approaches such as centerline tracing rarely approximate the quality and character of real human handwriting.

This is a longstanding problem in artificial intelligence called "handwriting trajectory reconstruction." Solving it is outside of what the NextDraw software aims to support. (Again, the function of the NextDraw is to plot the vectors that you supply to it.)

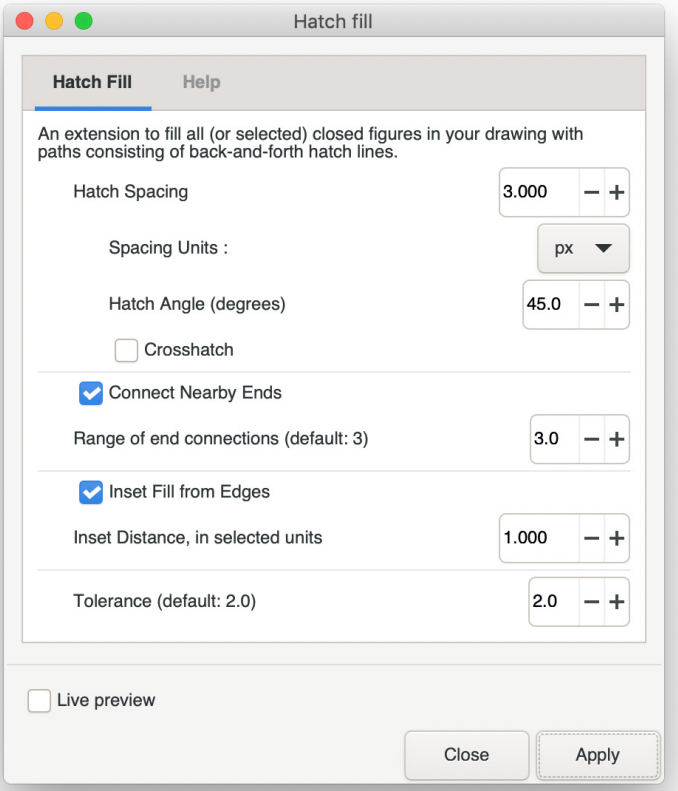
When software that performs handwriting trajectory reconstruction becomes available, the NextDraw will be here, ready to plot its output.

8.11 Filling shapes and text

The Bantam Tools NextDraw follows the actual vector paths in your documents, and thus normally ignores any "fill" inside shapes, since fills do not consist of vector paths.

A special utility, **Hatch Fill**, is included with the NextDraw software that can fill shapes with vector paths – hatch marks – such that the shapes can be filled in with pen strokes on your page. You can find it in the menu at:

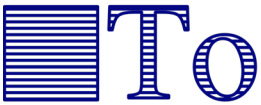
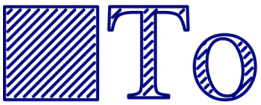
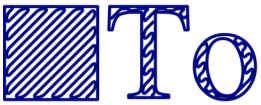
Extensions > Bantam Tools Utilities > Hatch fill.



Hatch Fill will fill any selected objects with a series of back and forth lines, with adjustable spacing and angle. The hatch spacing is can be set in different units: Screen pixels, inches, or mm. The default value of 3 px is often a good starting value. A lower spacing will produce a more uniform fill, and a higher spacing will produce a more traditional hatch fill for shading. You can use the **Live preview** option to see the effects of different choices without actually applying them to your shapes and text.

The **Connect nearby ends** option, enabled by default, connects the ends of the hatch lines to make long wiggling paths that plot very efficiently. An additional option is provided for insetting the fill from the edges. This helps to avoid "coloring outside the lines" when using the hatch fill.

Here are some examples of how different settings can be used in Hatch Fill. Each of the following are examples are shown actual size, with a 0.016 inch (0.4 mm) stroke width, similar to that of a fine rollerball pen. The Tolerance parameter was set to 1.0.

Objects, including any applied hatches	The hatch fill alone	
		(1) No fill
		(2): Spacing 3 px, Angle 0°. Connect nearby ends: off Inset: off
		(3) Spacing 3 px, Angle 45°. Connect nearby ends: off Inset: on, distance 1.0
		(4) Spacing 3 px, Angle 45°. Connect ends: On, Range 3. Inset: on, distance 1.0
		(5) Same as (4), but with crosshatch: on
		(6) Same as (4) but with Spacing 1.0 px (crosshatch is off)

Examples (4) and (6) above — with a single hatch at 45 degrees, inset from the edges, and with the ends connected — usually give good results for most situations. The key parameter that you'll need to adjust (based on the pen that you use and so forth) is the Hatch Spacing.

8.12 Vectorizing images

The process of turning images (JPG, PNG, photoshop files, etc) into vector artwork is generally outside the scope of the Bantam Tools NextDraw software. That said, how to do so ***is*** a frequently asked question so we are including some notes on the subject.

The process of converting a photograph into a piece of pen-ready vector line art can most accurately be described by the word "sketching." That is to say, it is not so much a matter of file conversion as one of artistic interpretation. There are a limitless number of ways to represent a photo with a set of strokes. Artists that work with plotters often write their own programs to perform this kind of conversion, and we will point out a few of these programs.

Inkscape includes a vectorizing tool, found in the menu at **Path > Trace bitmap**. It works by tracing the outlines of darker regions. It does work, and is sometimes useful for very simple shapes, but it generally *does not* produce high quality output that works well on plotters. You may end up with (for example) ghostly effects, or tens of thousands of tiny little loops that represent stray pixels on the input photo.



A second approach to vectorizing images is to use a "squiggle" drawing program. Tutorials for using three different Squiggle programs to create vector artwork are available at: bantamtools.com/squiggle



Drawing Bot V3 is a third-party program that can render photographs into sketch paths, available in free and premium versions from:

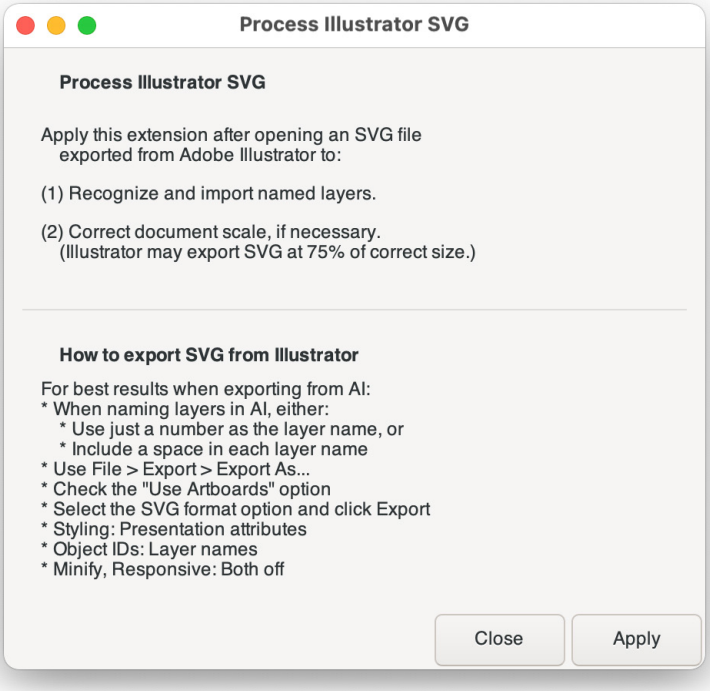
https://drawingbotv3.com

8.13 Importing from Adobe Illustrator

Adobe Illustrator users may notice two issues when working with SVG files imported from Illustrator into Inkscape. First, Inkscape does not automatically recognize layers in Illustrator SVG files, and instead usually treats them as regular groups. Second, the document and objects in it may be scaled down, at only 75% of the correct size.

Inkscape includes a tool that we developed for correcting these two issues in files imported from Adobe Illustrator. It can be found in the menu at:

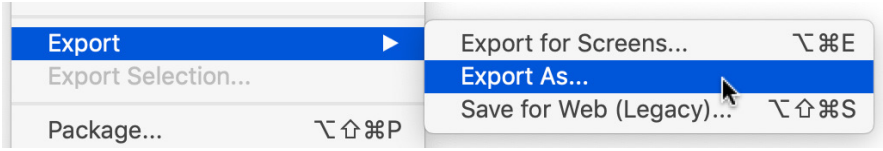
Extensions > Document > Process Illustrator SVG



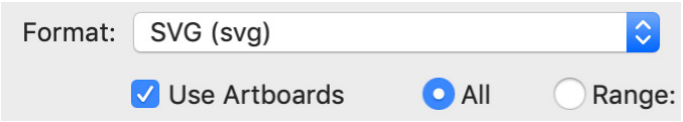
When you run this extension, it automatically detects any named Illustrator layers and sublayers in the file and converts them into named Inkscape layers an sublayers. It also detects if the file is displayed at the 75% scale, and if so, scales it back to 100%.

The user interface of the Process Illustrator SVG extension provides a list of the recommended steps to export SVG from Illustrator before opening it in Inkscape and running this extension. Amongst these steps, it is recommended to pick layer names in AI that contain at least one space, for example “1 Lemon” or “Lemon yellow”, rather than “Lemon” or “1Lemon”.

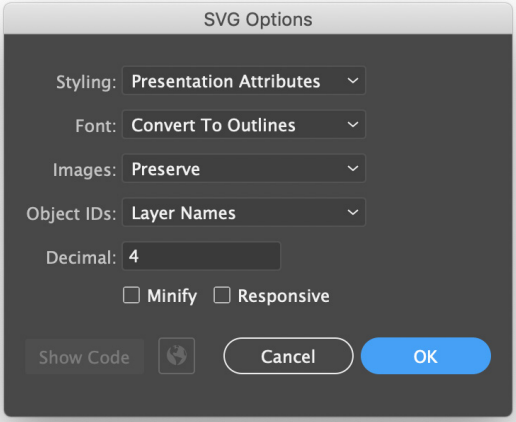
In Illustrator, export your file with:
File > Export > Export As...



Then, select SVG format, and check the "Use Artboards" option when saving:



The SVG Options window is displayed as part of the saving process. In it, select **Presentation Attributes** for styling, and **Layer Names** for Object IDs. Make sure that the Minify and Responsive options are not selected.



Using this recipe for exporting SVG can solve any number of minor issues that we have seen in exporting from AI to Inkscape.

9. Maintenance and troubleshooting

Bantam Tools NextDraw™ drawing machines does not require any regular maintenance under normal conditions.

9.1 Troubleshooting plot area

If you should find that the NextDraw does not appear to have access to the full plotting area of the machine, double check that you have selected the correct model of NextDraw in §2.4 Select your model, on page 25.

9.2 No lubrication required

The X carriage contains wheels that allow the X shafts and Y parts to slide. The wheels contain shielded and/or sealed ball bearing mechanisms that are permanently filled with grease. The pen-lift (Z) stage uses grease-free Teflon-filled plain bearings. ***NEVER apply oil or grease to any of the sliding mechanisms.***

9.3 Cleaning

Clean the Bantam Tools NextDraw only with a soft, clean cloth. The non-electronic metal parts may be cleaned with a cloth moistened with soap and water if needed. Avoid other cleaners and solvents. Do not wet the motors, cables, or controller board.

9.4 Storage

Store the Bantam Tools NextDraw with the carriage either in the Home position or (especially if it needs to be put away in a box) in the far opposite corner, fully extended such that the cable guides have the lowest profile. Unplugging the plug-in power supply when not in use for long periods of time will save power and prolong the life of the machine.

9.5 Belt tension

The Bantam Tools NextDraw uses a single timing belt, looped in an "X" shape around the two motors and the Y carriage. This belt may gradually stretch a small amount, and can be re-tensioned where it is anchored, if necessary. The necessary hex wrench (2.5 mm) is included with the NextDraw. Do not retension the belt unless it is actually necessary to do so.

9.6 The wrenches

Three hex wrenches and two thin-profile crescent wrenches are included with the Bantam Tools NextDraw. The 2 mm ball-end wrench is used for switching the pen between the vertical and angled orientations. The others are provided in case more significant adjustments are required; they are not needed in most circumstances. However, if something should come loose, it is nice to have the right tools on hand. Contact technical support for guidance if needed.

9.7 Loss of position

The most significant thing that can go wrong under normal operation is a loss of position control while the carriage is moving. This is typically manifested as a loud grinding or screeching noise, along with pen marks not going where they are supposed to go. It can happen when moving at too high of a speed for the drawing conditions, or when the carriage hits an unexpected obstacle– for example if it was bumped while moving (or if it was not moved to the Home Corner before plotting with manual homing).

If this should happen, press the pause button as soon as possible to cancel the plot.

If you are using **automatic homing** on a Bantam Tools NextDraw, cycle the power off and on, which will cause it to perform a full homing cycle when you resume or begin a new plot.

If you are using **manual homing**, use **Disable XY Motors** to de-energize the motors, and then manually return the carriage to the Home Corner before trying to plot again.

9.8 Wheel adjustments

The X and Y carriages roll on wheels that are tensioned against them. It is possible for these wheels to come slightly loose and need adjustment. If the NextDraw extended arm (Y carriage) seems loose or floppy, please contact technical support and we can walk you through the process.

9.9 Service, repair, and parts support

The NextDraw is designed to be serviceable, and we are here to help. Nothing should require regular replacement. However, most parts of the machine can be unscrewed and replaced if necessary. Please contact technical support directly if you need assistance with troubleshooting or repairing a mechanical issue.

10. Bantam Tools NextDraw Tips and Tricks

1. It is often possible to get better print quality on top of a small stack of paper (say, 3-5 sheets) which gives a little cushion to your writing.
2. High quality paper – especially paper designed for use with pens – tends to give dramatically better results with pens than does cheap copy/laser paper. Bristol paper with a smooth finish is a great example of a paper designed to work well with pens.
3. The flatter that your paper is held, the better your print quality will be. Paper that is warped or "bubbled" will flex as the pen writes, leading to distortion. When the bubbles or warping are tall enough, it can also lead to stray marks on your page during pen-up movements.
4. Reducing the amount of vertical pen travel that is needed will make your plots faster, and also improve print quality, since the pen-lift servo motor does introduce vibration.
5. When making multiple-color plots, you can get better registration when switching pens by making sure that each pen is set to the same height above the paper. A good way to do this is to rest the tip of the pen on a spacer when tightening the pen in place. Use a small, flat piece of wood, plastic, or metal.
6. It is possible to completely detach the NextDraw pen holder, and affix other types of tools to the front of the Y carriage. Tapped M4 holes are provided for mounting other types of tool heads there. We also sell a "rigid end effector" accessory, for specialized use cases: bantam.tools/ree
7. Certain types of pens can "dry up" if left in the pen-up position for a minute or two. This can lead to an awkward situation where ink does not start flowing until after the machine has already been drawing for a bit. With pens like this, it may be helpful to "bleed" out the tip with a bit of scratch paper before printing.
8. Styles applied to paths (width, color, etc) are normally ignored by the NextDraw software. If you have a dashed line and want it to plot with the dashes visible, you can use **Extensions > Modify Path > Convert to Dashes** to convert the dashes into separate path segments.
9. One of the simplest things that you can do to improve the quality of your output is to use a good quality pen. For handwriting applications, a medium or broad-nibbed fountain pen, such as the Lamy Safari is an excellent starter choice.
10. Inkscape has a keyboard shortcut, **Alt-Q** (**Option-Q** on Macs), which will execute the last Inkscape extension once again. This is frequently useful when repeating a command, such as making one additional copy of a plot, without having to open the NextDraw Control panel again.

11. You can also add your own keyboard shortcuts within Inkscape – for example, maybe you want a shortcut for running the Disable XY Motors extension, or to open the NextDraw Control panel. To begin, open up **Edit>Preferences** (Windows, Linux) or **Inkscape>Preferences** (Mac), and select **Interface>Keyboard Shortcuts** from the left-hand column.
12. When saving graphics in SVG format from CorelDRAW, a helpful tip is to select the "Presentation attributes" option in the SVG export options. This typically helps to make the formatting work better in Inkscape.
13. The order in which objects on your page will plot is generally determined by the order in which they were initially drawn. "Lower" objects on the same layer will print before "higher" objects on the same layer. You can use the **Object > Raise** and **Object > Lower** commands to re-order objects. For more about plot order, see §6.11 Plot order and optimization, on page 78.
14. A range of Bantam Tools NextDraw accessories are available, including larger-size pen holders, extra easel boards, magnetic easels, mounting hardware and more. For details, please see bantam.tools/ndacc

Extended online documentation
& resources for NextDraw:

bantam.tools/nddocs

BANTAM TOOLS®

Store: store.bantamtools.com

Docs: bantam.tools/nddocs

Support chat: bantam.tools/chat

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