

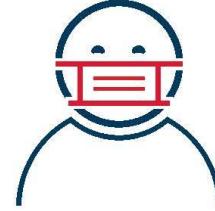
HOW TO  
UNIVERSAL

LASERS!

FRESH 23 AUGUST 2021

You are required to follow all current university guidelines for wearing masks while in the lab.

You are responsible for keeping our community safe!

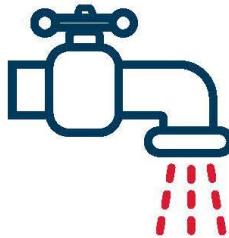


**COVER**

wear a mask  
when required  
on campus

THE GEORGE  
WASHINGTON  
UNIVERSITY  
WASHINGTON, DC

Visit [go.gwu.edu/covid19](http://go.gwu.edu/covid19) for the latest updates and information about how the university is responding to COVID-19.



**CLEAN**

wash and sanitize  
hands often



**CONTAIN**

stay home  
if you're sick



# NOTE

This document is NOT  
a substitute for hands-on training.  
Ask your teacher  
or a lab tech for a tutorial.

This tutorial assumes you already have basic working knowledge of Adobe Illustrator.

If you've never worked with Illustrator before, a good place to start is to download it via Creative Cloud Desktop app (all Columbian students get this for free) and brush up on it in [Linked in Learning](#) (was lynda.com, also free to Columbian students). Search for courses on the more recent editions of illustrator.

The laser is quite safe to use, but it  
is powerful; using it requires your  
full caution, attention and respect.

Some rules of the road:

Rules of the road

No food or drink in the lab.

Rules of the road

**Clean up after yourself.**

If you brought it in with you, take it back out. Store materials and projects in your locker, in your studio, or someplace designated by your faculty. Keep the lab clean and uncluttered.

Rules of the road

If you're not sure...

DON'T!

Get the help you need,  
even if it means waiting.

Rules of the road

Don't bypass or disable any  
of the safety features.

These are Class 4 lasers which can instantly  
burn or blind you, even from reflections.

# Rules of the road

**Work in pairs.** It always helps to have a second set of eyes in case you miss a detail.

Rules of the road

**NEVER LEAVE THE LASER  
UNATTENDED WHILE CUTTING!**

If your material catches fire, the  
laser will shut down, but that  
doesn't put the fire out...

# Know where the fire extinguisher is located.

This is critical for the lasers. As you enter the room, it's right next to the door. Generally the on-duty lab tech will decide whether the fire extinguisher is called for, but you should know where it is.



**Know where the first aid kit is.** If an emergency occurs:

Life-threatening:

**call 911**

Physical safety:

**UPD 202-994-6111** (46111 from university phones)

Toxic spill:

**Health & Safety 202-994-4347** (44347 from university phones)

# Materials

The school will be providing common materials for class projects. This ensures we are only using safe, appropriate materials for the lab.

If you are working on a personal project outside of a class and need to source safe materials, contact Devin ([PaceD@gwu.edu](mailto:PaceD@gwu.edu))

The rule of thumb: if you can burn it with a cigarette lighter, it can be cut it with the laser (but that doesn't mean it's safe). All materials need to be approved by Devin ([PaceD@gwu.edu](mailto:PaceD@gwu.edu)) before you use them on the laser!!!!

# GOOD

| Material                        | Raster Engraving | Vector Engraving | Vector Cut |
|---------------------------------|------------------|------------------|------------|
| Corrugated Cardboard            | OK               | OK               | OK         |
| Uncoated Paper                  | OK               | OK               | OK         |
| Chipboard/Matboard/Museum board | OK               | OK               | OK         |
| Resale Acrylic                  | OK               | OK               | OK         |
| Interior Plywood                | OK               | OK               | OK         |
| Balsa Wood / Basswood           | OK               | OK               | OK         |
| Hardwoods (Domestic Only)       | OK               | OK               | OK         |
| Arries Board (Resale MDF)       | OK               | OK               | OK         |
| Masonite                        | OK               | OK               | OK         |
| Resale Cork                     | OK               | OK               | OK         |
| Resale Vegetable tanned leather | OK               | OK               | OK         |
| Resale Muslin                   | OK               | OK               | OK         |
| Unmounted Linoleum              | OK               | OK               | OK         |

# BAD

| Material           | Banned Reason  |
|--------------------|--|
| PETG, PET          | Along with other emissions, is known to emit Benzene which is known to cause cancer. |
| Polystyrene        | Known to emit styrene fumes.   |
| ABS                | Emits cyanide gas and tends to melt.   |
| PVC                | Emits chlorine gas during a cut.   |
| Bending Plywood    | Bends into the path of the laser carriage during operation.                          |
| Tropical Hardwoods | A lot of tropical hardwoods have toxins in the wood.                                 |
| Corian             | Creates a fine grit inside the laser bed and will grind down equipment               |
| Casting Wax        | Melts a lot.   |
| Nylon              | Emits toxic fumes.   |
| Vinyl              | Emits chlorine gas during a cut  |
| Delrin             | Along with other emissions, is known to emit Benzene which is known to cause cancer. |
| Foamcore           | Foamcore is an expanded polystyrene and is known to emit styrene fumes when cut.     |

**Bring extra material for testing.**

Especially if you are new to the laser, or are trying a material you've never used before, it may take some trial and error to get the settings right.

Oversized material for the laser?  
Cut it down to 18" x 24" BEFORE  
you bring it into the lab.

This includes cardboard, chipboard, wood,  
EVERYTHING. Not trained in the woodshop?  
The woodshop techs are happy to train you  
OR cut your materials down for you.

What about glass and metal? Our laser isn't powerful enough to cut metal,\* but can mark metal using a special compound applied to the surface. It can't cut glass either, but can engrave it by creating micro-fractures.

\*There are caveats to both of these, but beyond the scope of this tutorial.

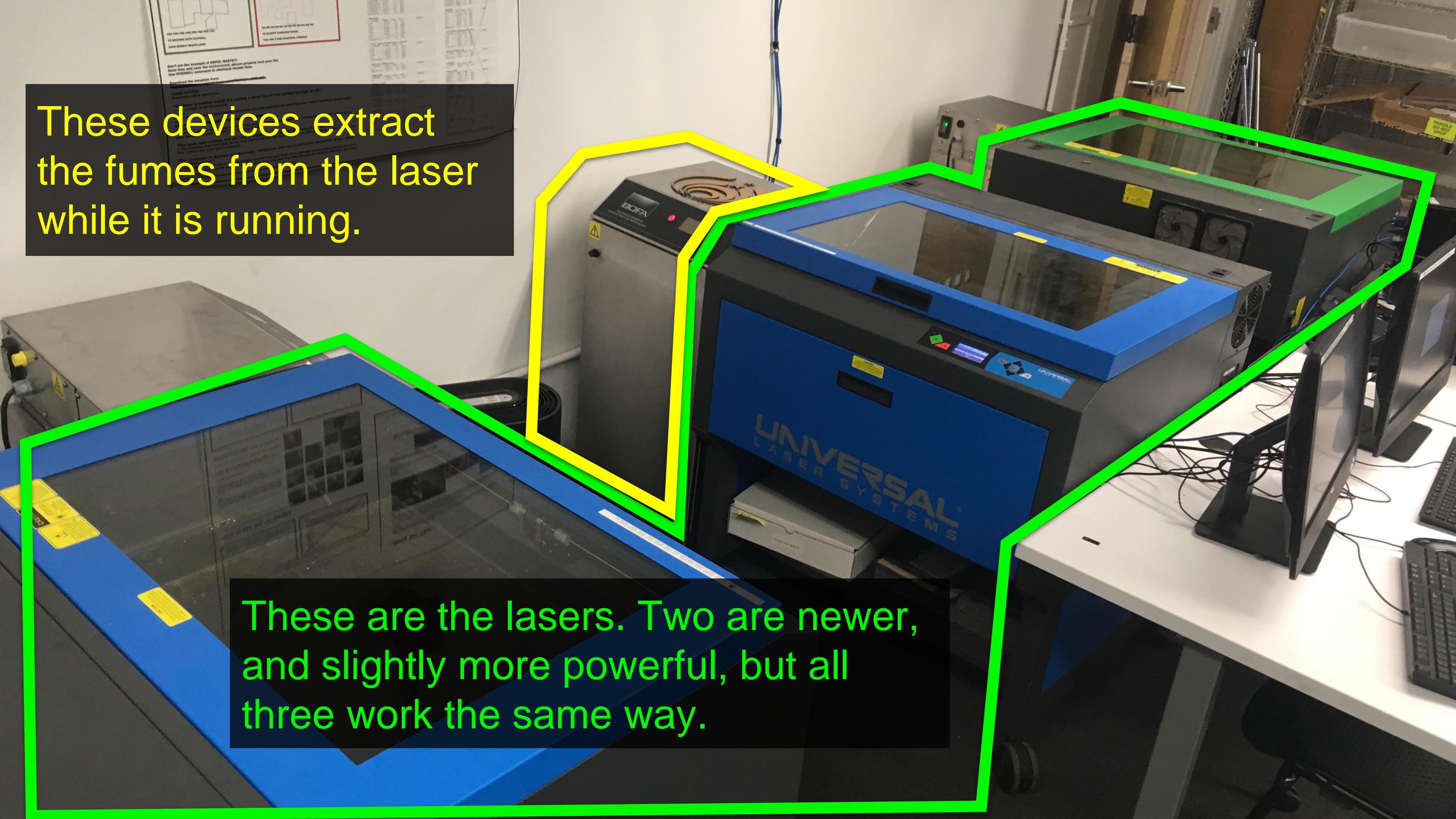
Not sure?

Ask your instructor, the lab tech, or  
contact Devin ([PaceD@gwu.edu](mailto:PaceD@gwu.edu)).

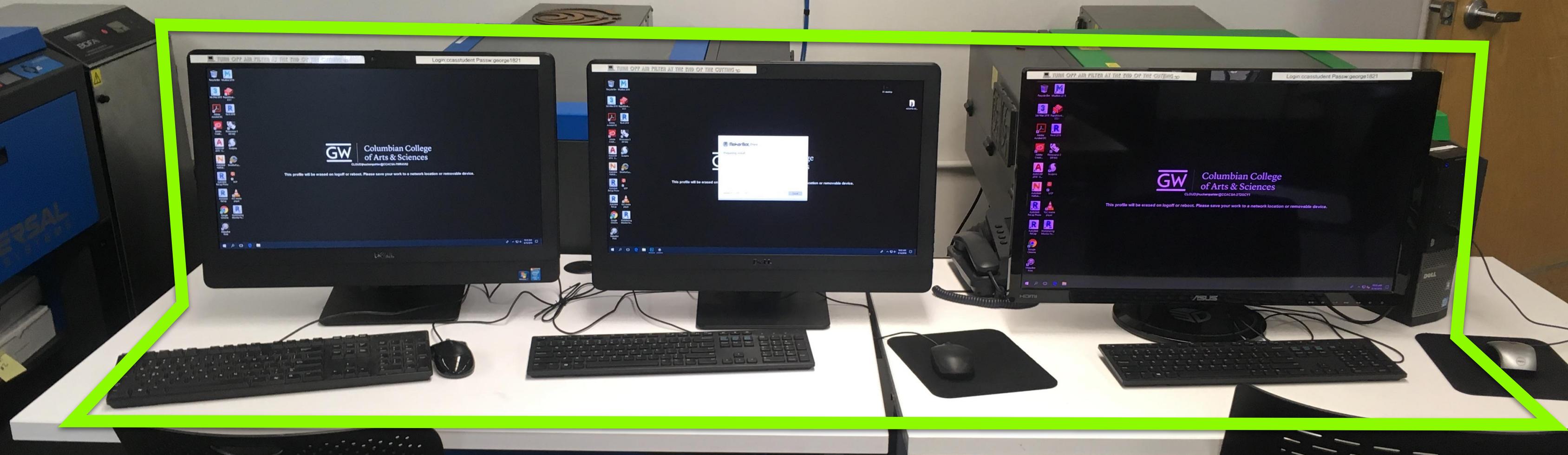
the laser stations

These devices extract  
the fumes from the laser  
while it is running.

These are the lasers. Two are newer,  
and slightly more powerful, but all  
three work the same way.



These three computers have the software for the laser; they are the only ones that can send jobs.



Prep your files on other machines,  
not on the computers connected to  
the lasers. You should be ready to  
open a finished file, send to the  
laser, and jump off when done so  
you're not holding up other people.

# Workflow



Recycle Bin



Revit 2015



VLS 4.60



Adobe Acrobat ...

Rhinoceros 5  
(64-bit)

Adobe FormsCentral



Sculptris

AutoCAD  
2015 - E...SketchUp  
2015Autodesk  
123D CatchStyle Builder  
2015

Autodesk 360



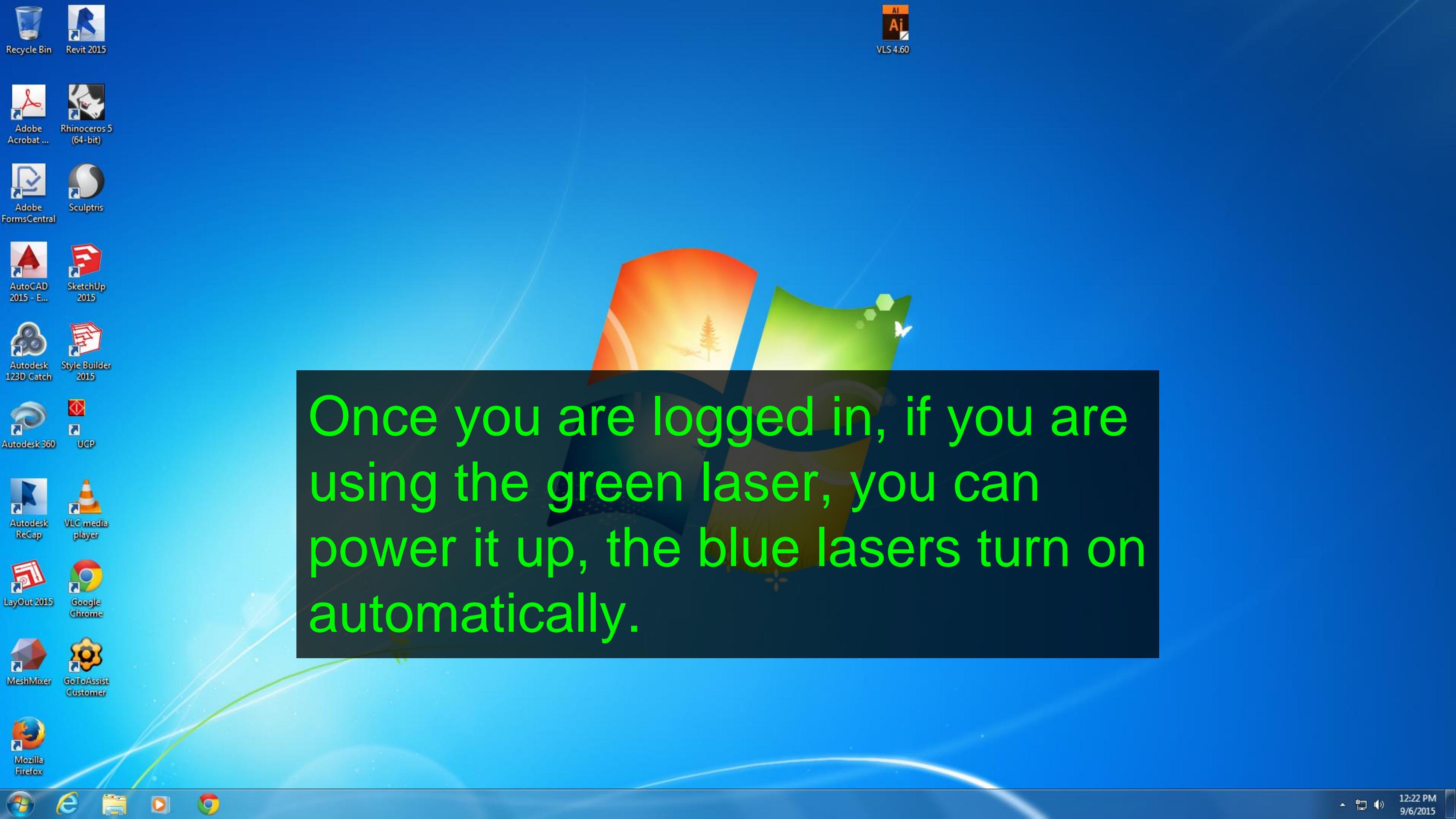
UCP

Autodesk  
ReCapVLC media  
player

LayOut 2015

Google  
Chrome

MeshMixer

GoToAssist  
CustomerMozilla  
Firefox

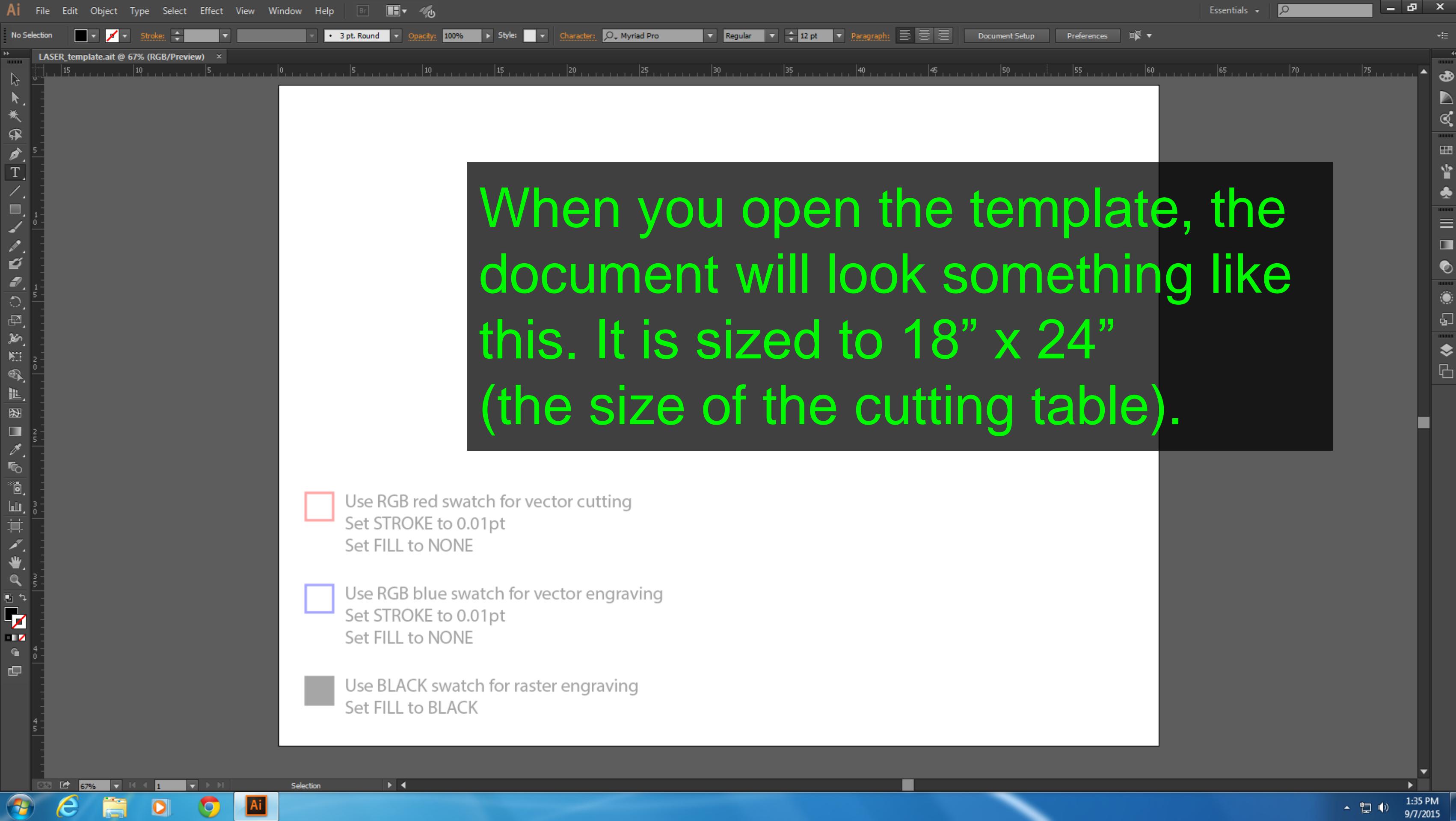
Once you are logged in, if you are using the green laser, you can power it up, the blue lasers turn on automatically.

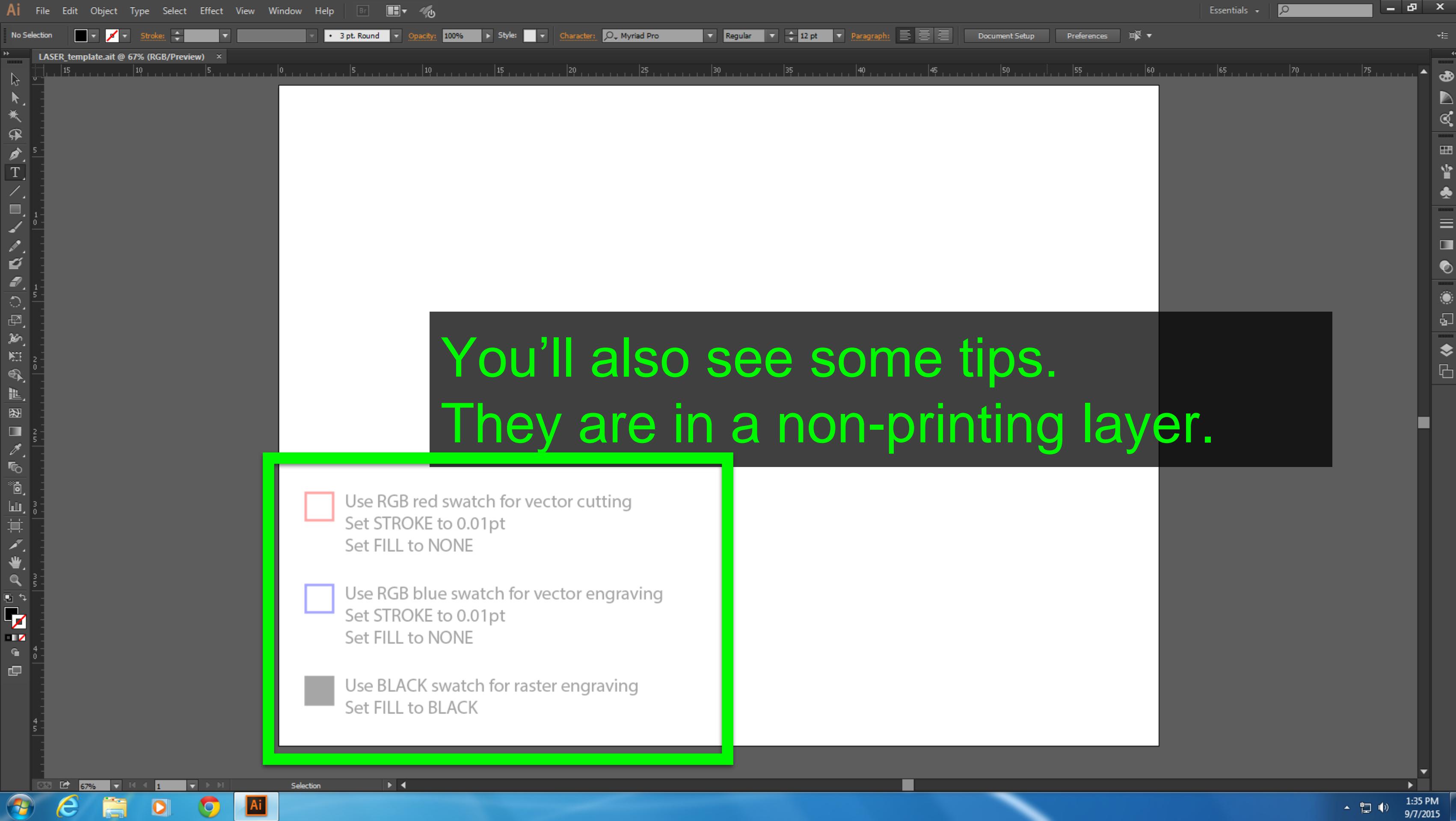
Power on the laser if it's not already on.



For general use, it's easiest to print from **Adobe Illustrator**. We've created an Illustrator **template file** that's set up to work with the laser. The template should be on the desktop. Ask a lab tech if you need help.

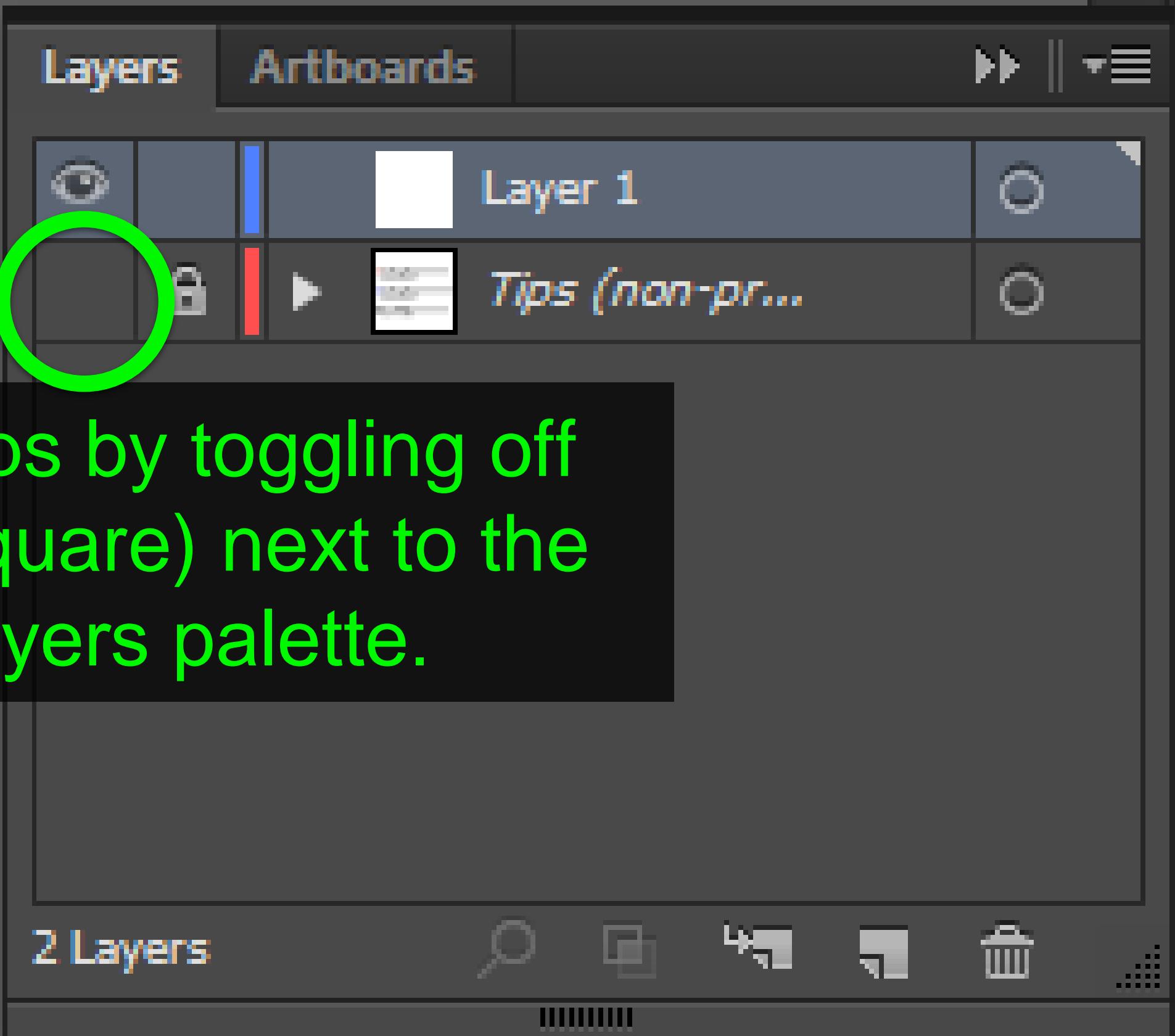
<https://go.gwu.edu/csadlasertemplate>





The tips let you know which specific colors tell the laser to perform specific functions. These colors are very important. The whole document needs to be set to RGB (which the template is).

- Use RGB red swatch for vector cutting  
Set STROKE to 0.01pt  
Set FILL to NONE
- Use RGB blue swatch for vector engraving  
Set STROKE to 0.01pt  
Set FILL to NONE
- Use BLACK swatch for raster engraving  
Set FILL to BLACK



You can hide the tips by toggling off the 'view' icon (a square) next to the 'Tips' layer in the layers palette.

The laser can do  
**three basic things:**

vector cut

vector engrave

raster engrave

If you want to **cut clean through a material**, you use vector art to specify a path that the laser will follow. Vector art is typically created in programs like Adobe Illustrator.

If you want a clean hairline that is engraved on the material, but not cutting all the way through, you will vector engrave. Again, you are specifying a path that the laser will follow using vector art.

If you want to mark a material with anything other than a hairline without cutting through, you will raster engrave. Any vector art that has a fill, a stroke greater than 0.01pt, or raster art (anything with pixels) will raster engrave.)

Let's see all three in action...

Stroke:

1 pt

Uniform

Basic

Opacity:

100%

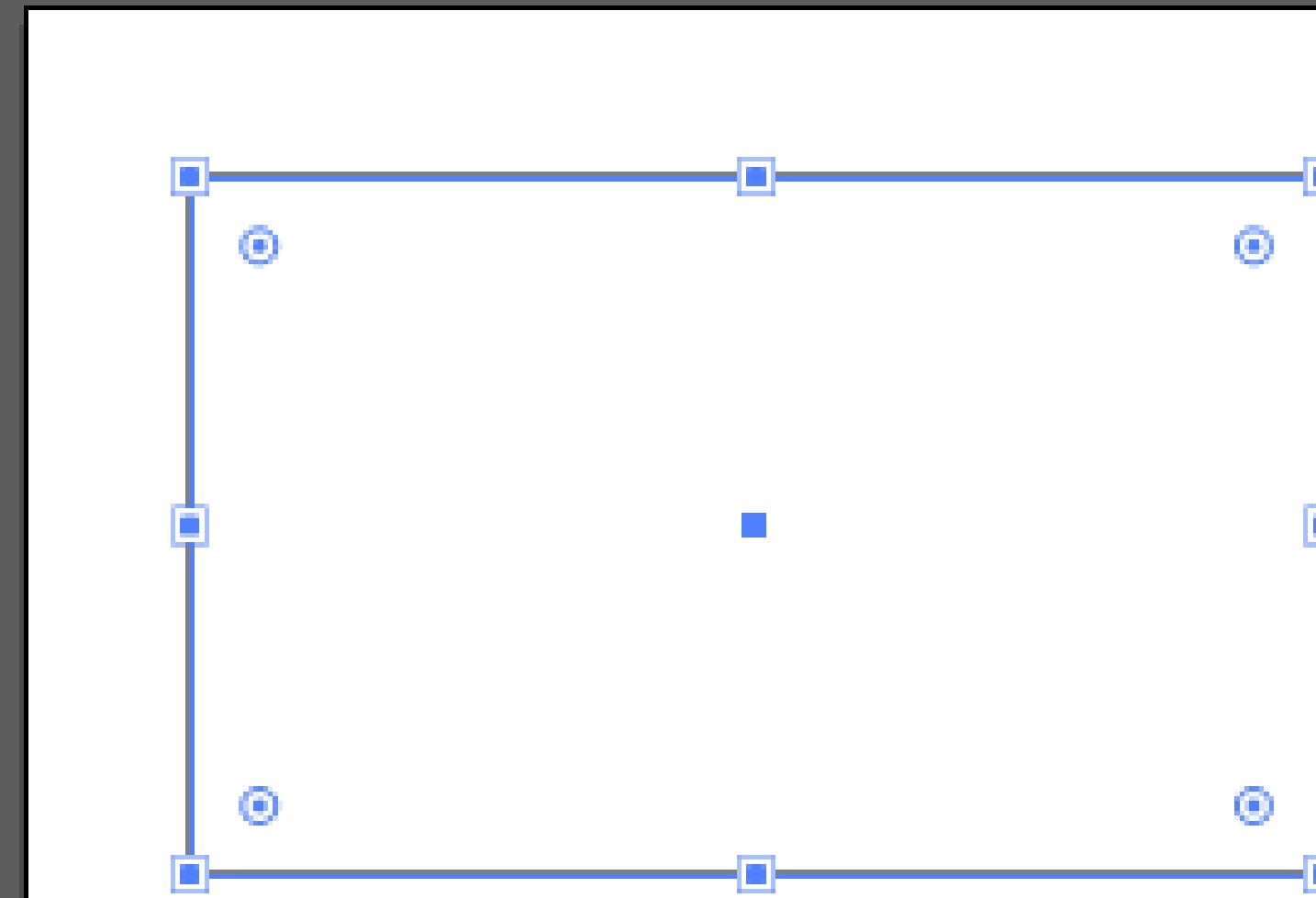
Style:



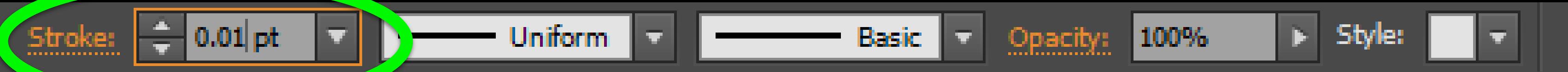
Shape:

3/Preview) X

10 5 0 5 10 15 20

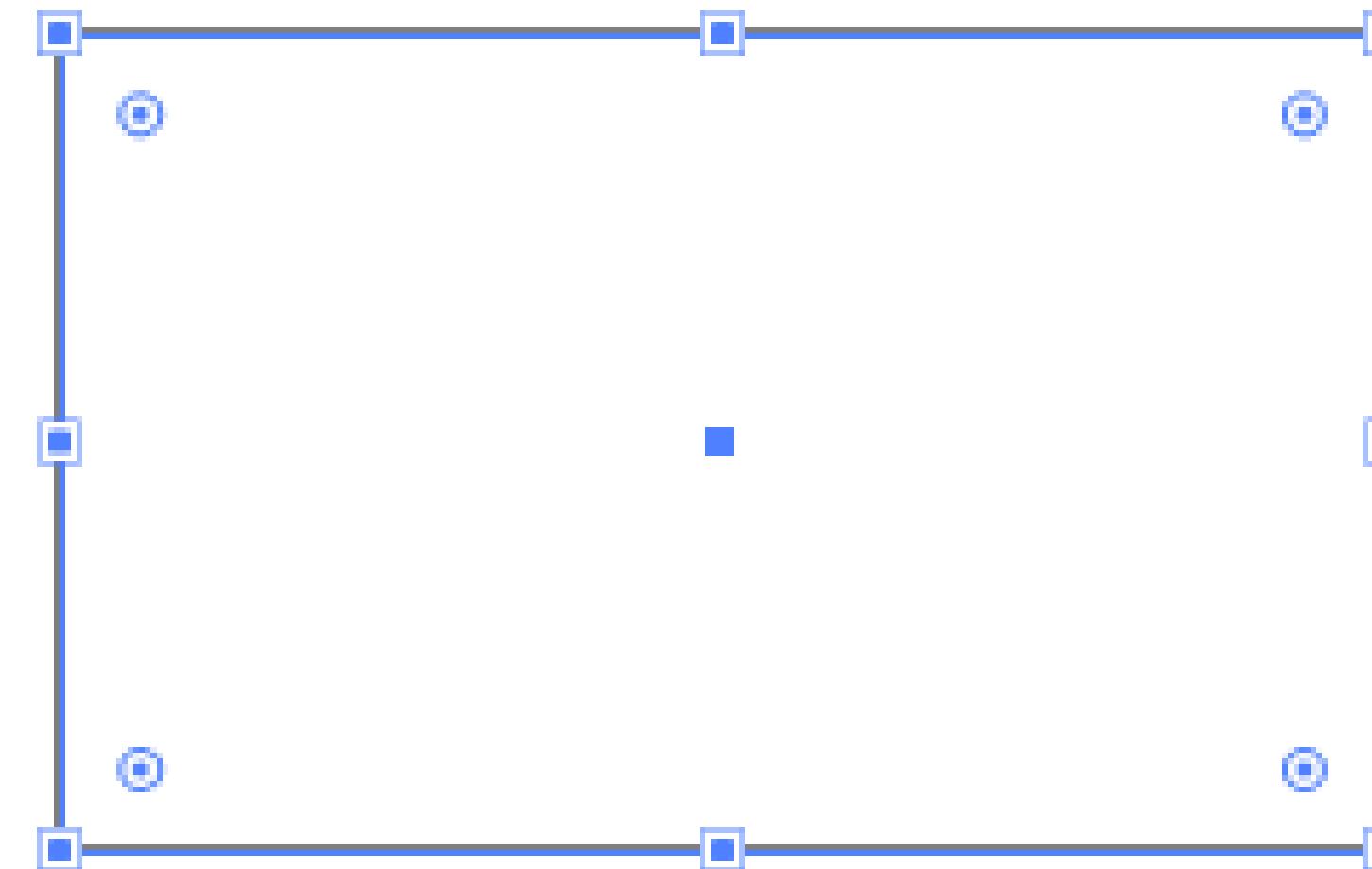


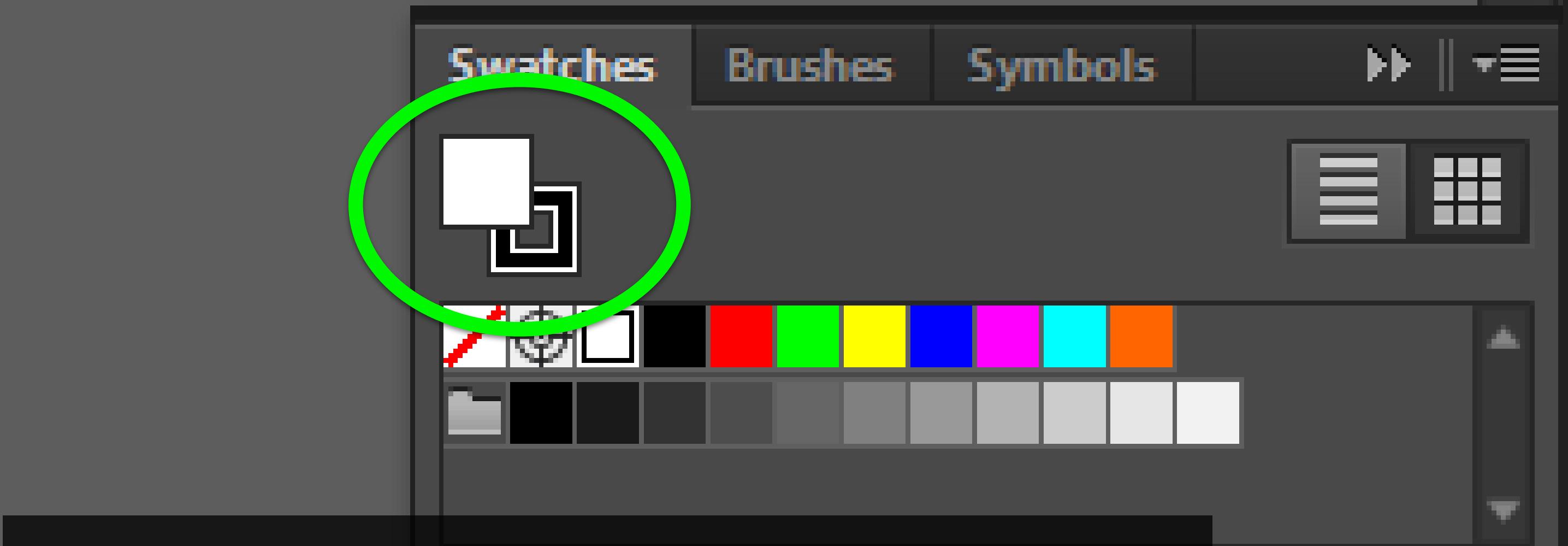
I'll start by drawing a rectangle...



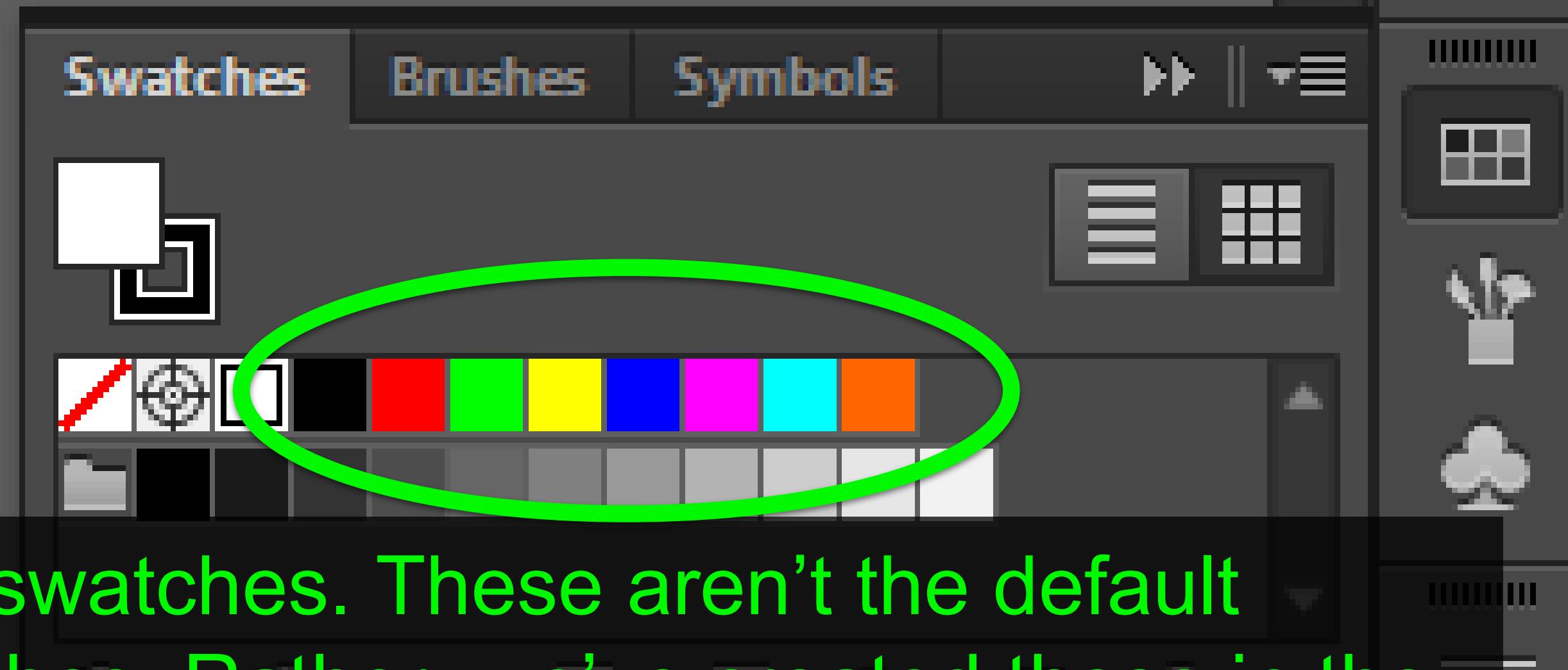
(/Preview) 10 5 15

We want this to be a cut, so we'll set the STROKE to 0.01pt.





We need to change the FILL and STROKE colors as well. (The defaults, WHITE and BLACK won't give us the right results.)

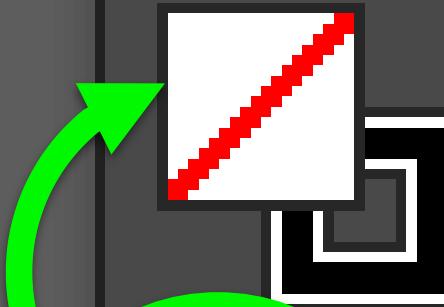
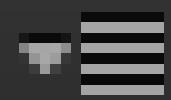


Notice these 8 swatches. These aren't the default illustrator swatches. Rather, we've created these in the template file because they are specific RGB values that the laser software knows. For the purposes of this tutorial, the specific swatches you care about are RED, BLUE, and BLACK.

**Swatches**

**Brushes**

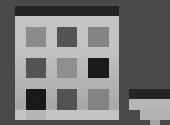
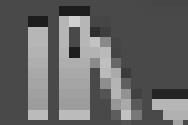
**Symbols**



For cutting, set the FILL to **NONE**.

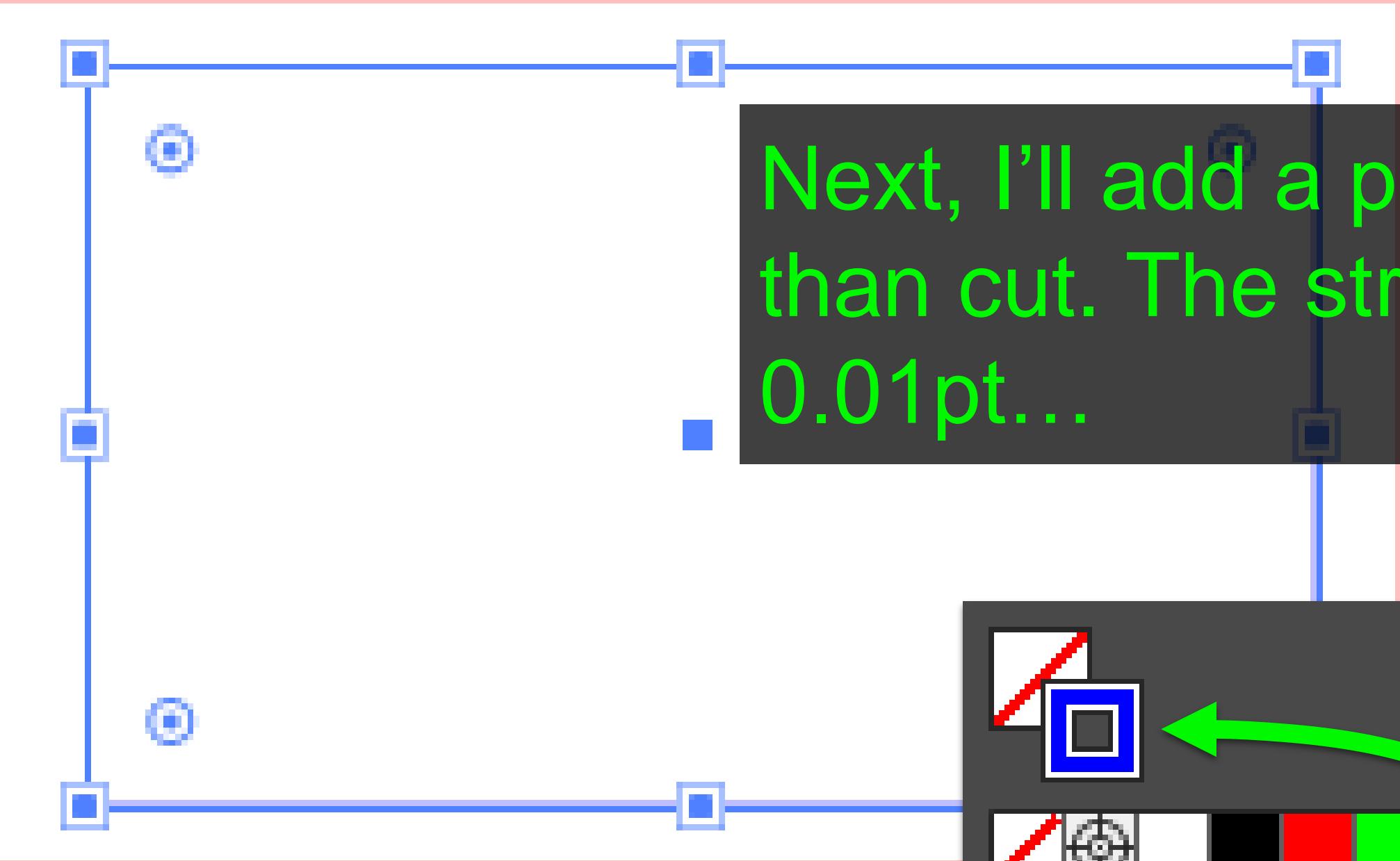


**[None]**





And set the **STROKE** to **RGB RED**.



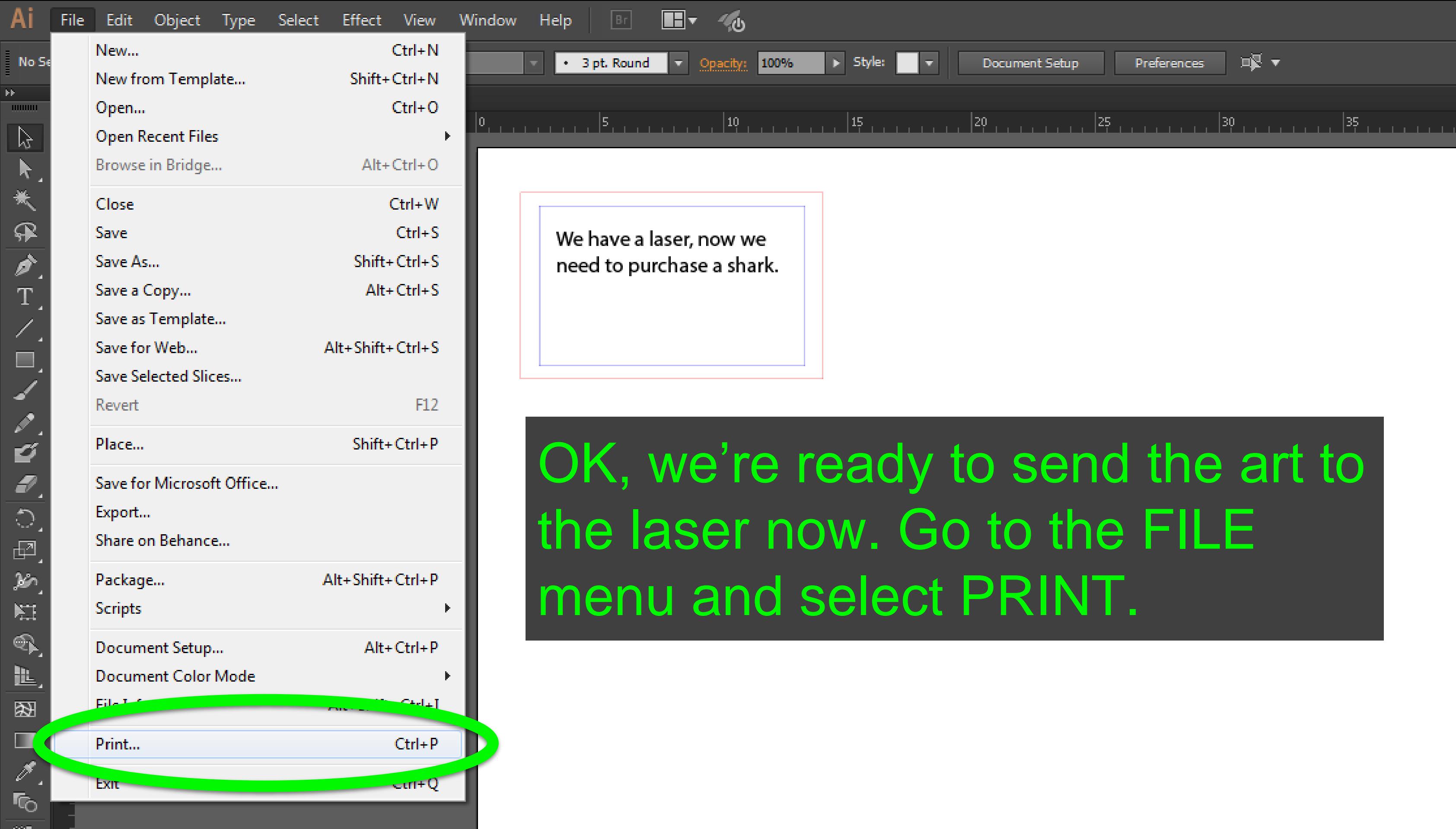
Next, I'll add a path to engrave, rather than cut. The stroke width is set to 0.01pt...

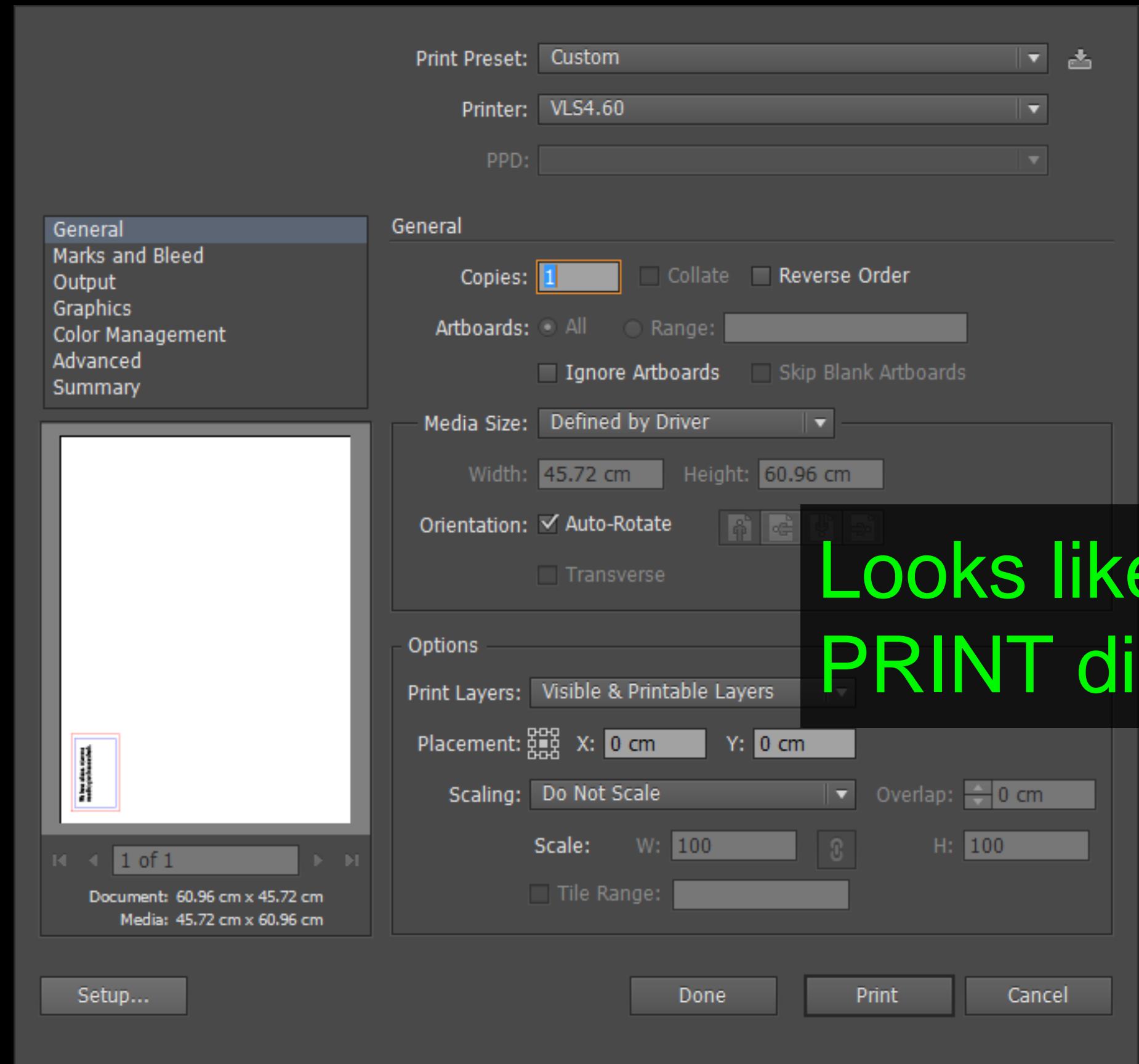


We have a laser, now we  
need to purchase a shark.

Finally, I'll add some text. It has a  
BLACK fill and no stroke.

Remember, anything with a FILL,  
no matter what color, will  
automatically turn into a raster  
engraving. Same goes for anything  
with a stroke greater than 0.01pt.





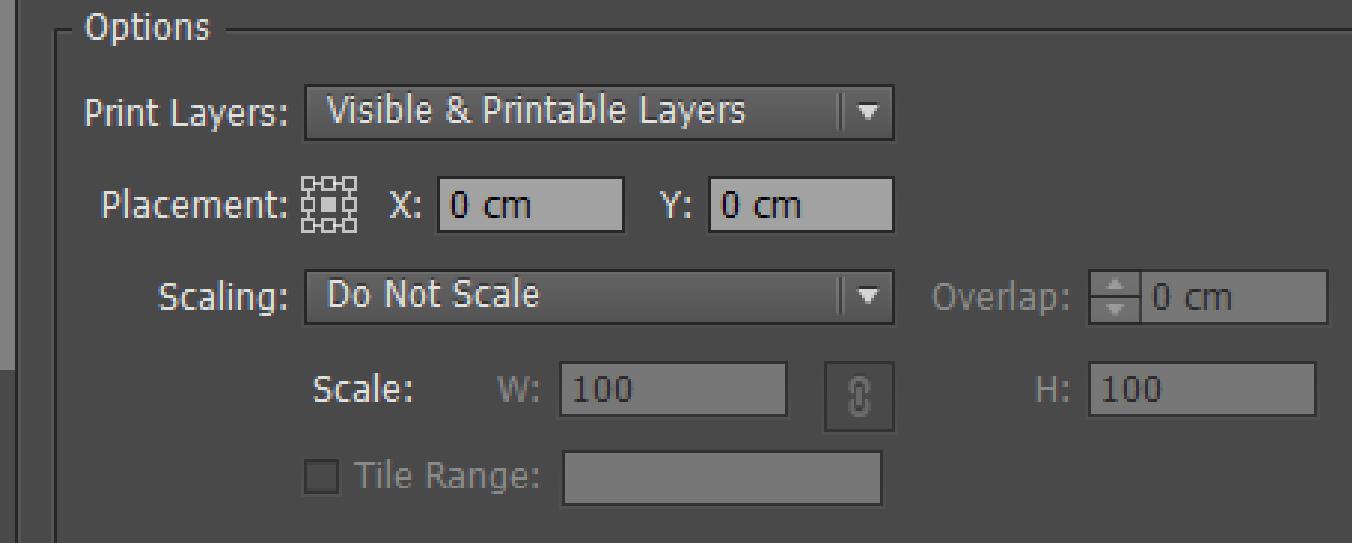
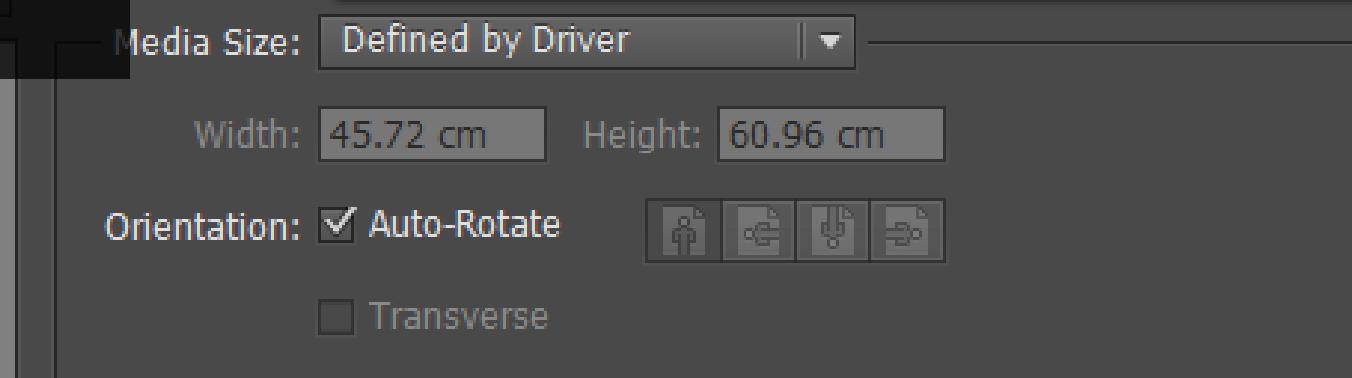
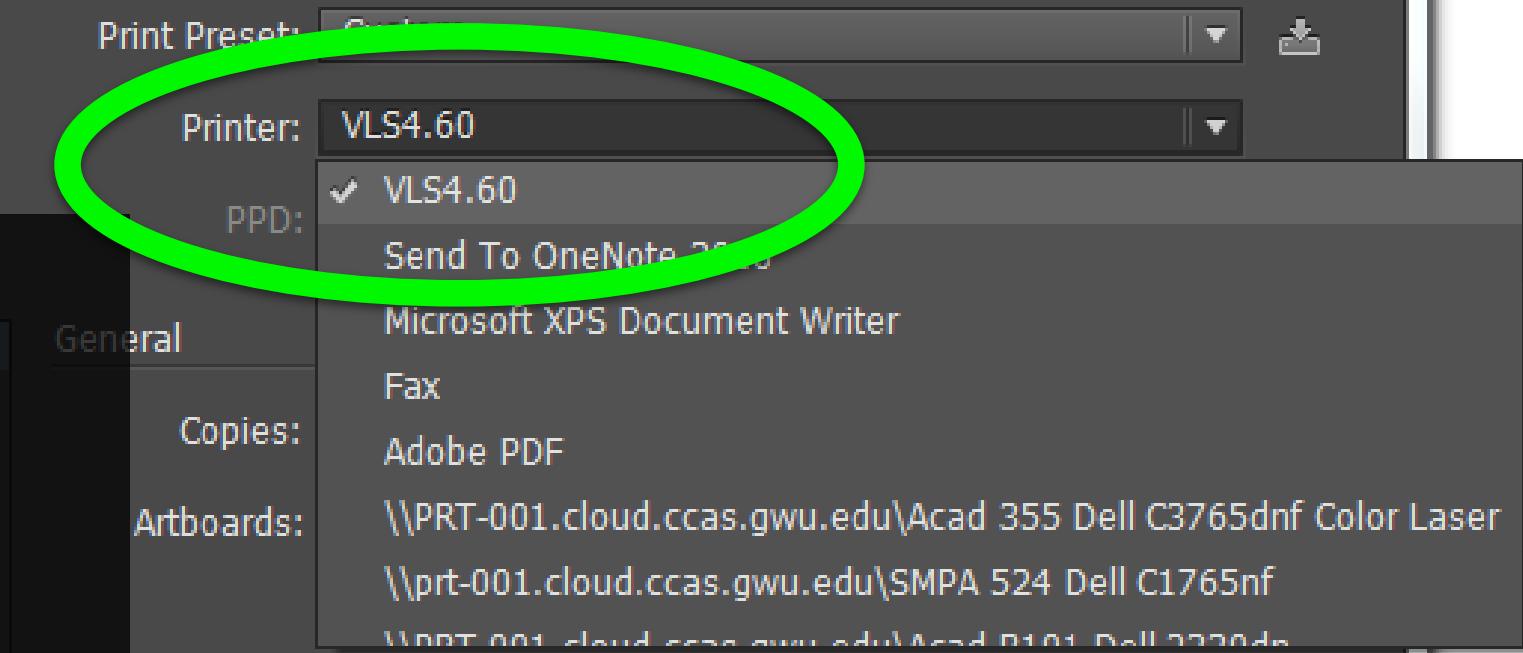
Looks like a normal  
PRINT dialog.

Print

Make sure 'Printer' is set to one of the lasers.

Use RGB red swatch  
Set STROKE to 0.0  
Set FILL to NONE

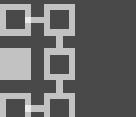
Use RGB blue swatch  
Set STROKE to 0.0



Transverse

## Options

Print Layers: **Visible & Printable Layers** | ▾

Placement:  X: 0 cm Y: 0 cm

Scaling: **Do Not Scale** | ▾

Scale: W: 100

Tile Range:

◀ ▶ 1 of 1

Document: 60.96 cm x 45.72 cm

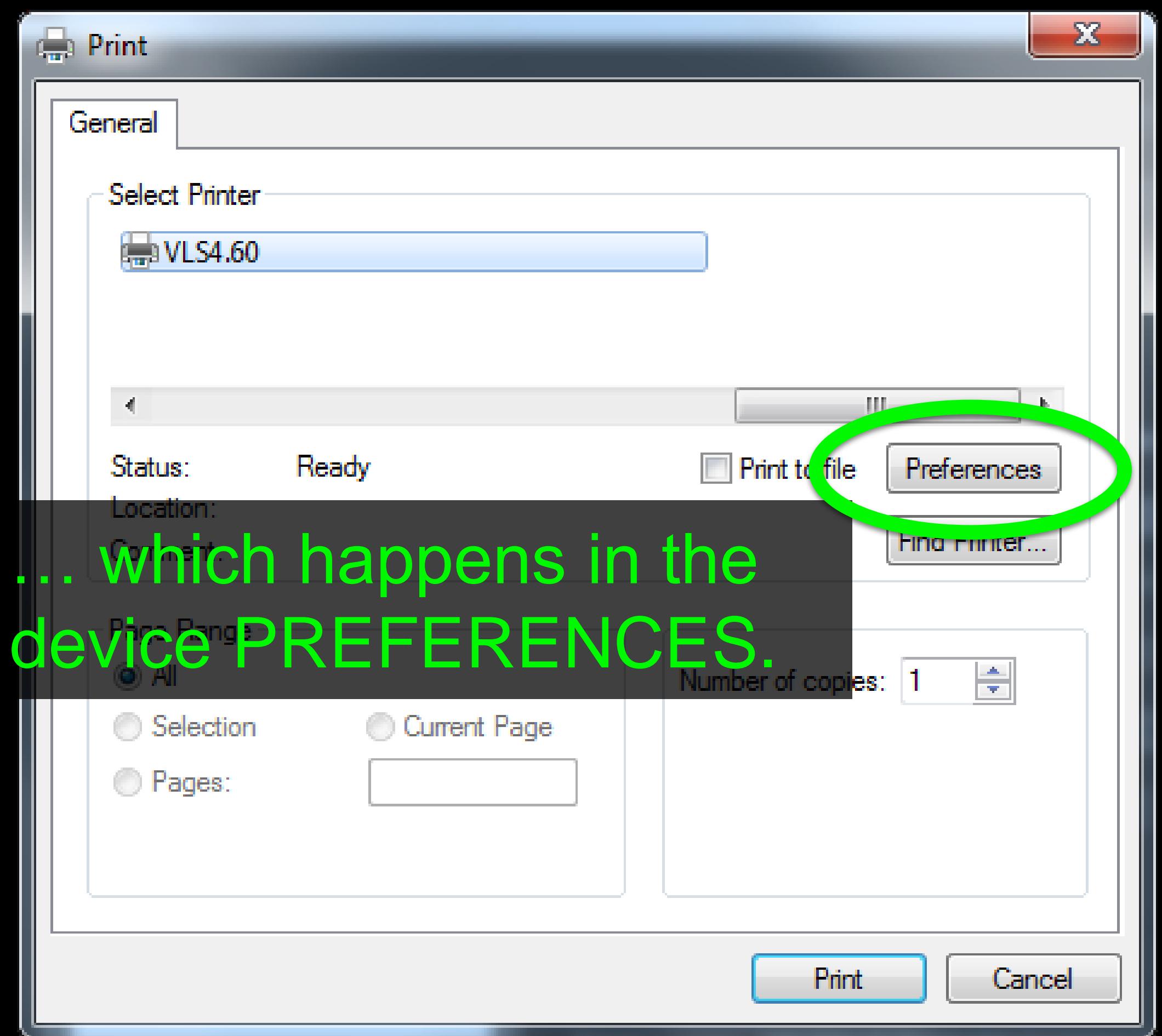
Media: 45.72 cm x 60.96 cm

Setup...

But we need to change  
the SETUP...

Done

Print



## Laser Settings for VLS4.60

Selected:

**Find****Next**

- Materials Database
  - + Ceramic
  - + Fabric
  - + Foam
  - + Glass
  - + Metal
  - + Natural
  - + Plastic
  - + Rubber

Click to select material, double-click to edit, right-click for other commands.

Notes:

## Print Special Effects

3D

**Setup**

## Print Direction



## Material Properties

Standard

## Material Thickness

 Merge Pages

## Units

- Metric
- inches

## Fixture Type

NONE

## Intensity Adjustment

## Raster



## Vector Engraving



## Vector Cutting



This SETTINGS window is where you specify the material you are using, and its thickness.

## Laser Settings for VLS4.60

Selected:

**Find****Next**

- Materials Database
  - + Ceramic
  - + Fabric
  - + Foam
  - + Glass
  - + Metal
  - + Natural
  - + Plastic
  - + Rubber

Click to select material, double-click to edit, right-click for other commands.

Notes:

Print Special Effects

3D

**Setup****Print Direction**

Standard

Vector Performance

## Intensity Adjustment

## Raster



## Vector Engraving

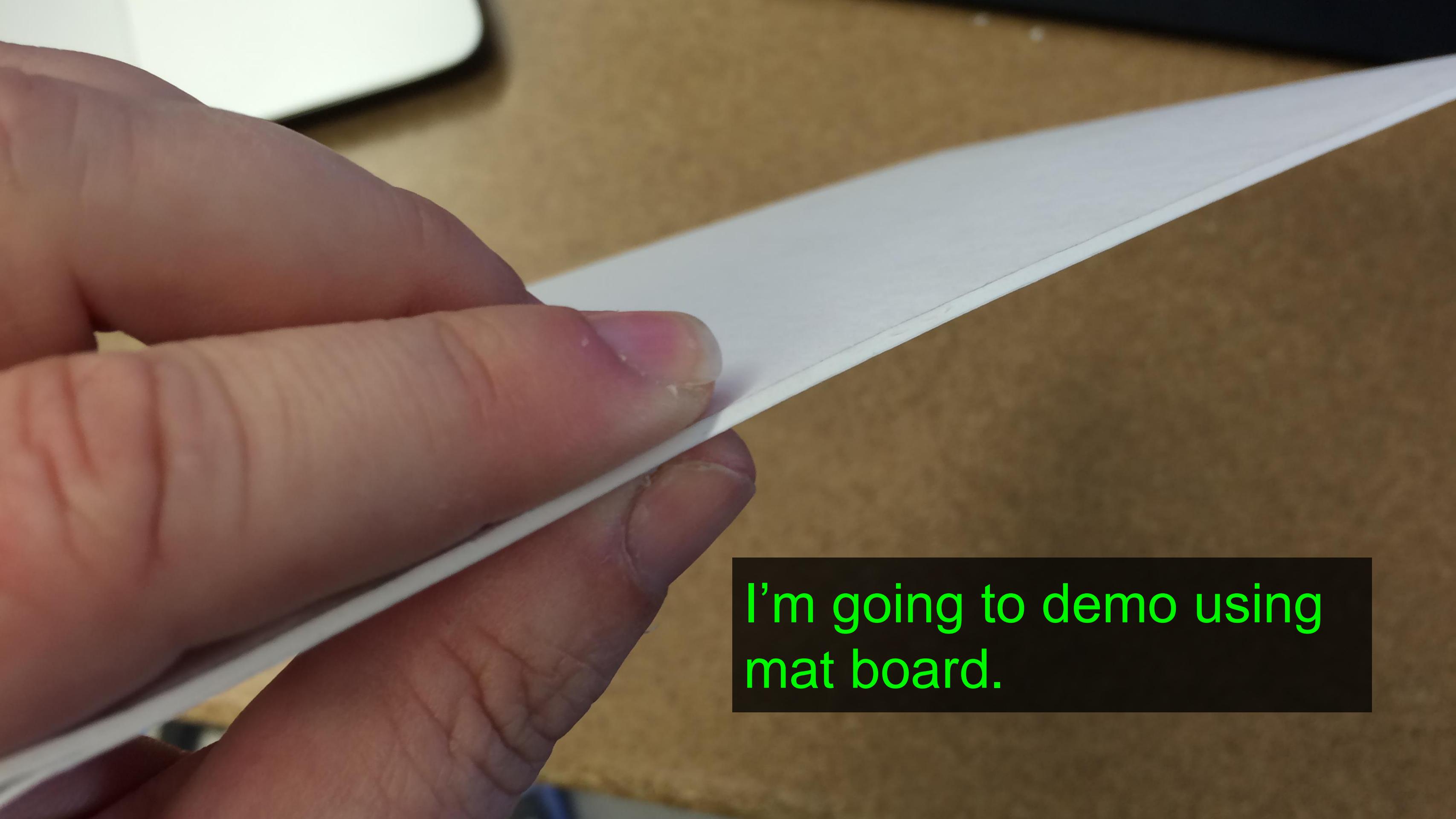


## Vector Cutting



**Here are the materials  
you can work with.**

What about other materials that aren't in the database? Custom settings can be created for other materials, but that's beyond the scope of this tutorial.

A close-up photograph showing a person's hands holding a long, thin, white rectangular strip, possibly a piece of mat board or a ruler, at an angle. The hands are positioned in the lower-left foreground, with fingers gripping the white edge. The background is a solid, warm-toned brown surface.

I'm going to demo using  
mat board.

## Laser Settings for VLS4.60

Selected: Standard Material Mat Board 350250

**Find****Next**

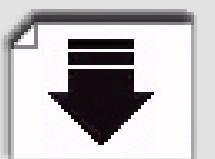
- Natural
  - Cork Board
  - Leather
  - Mat Board
  - Mother of Pearl
- + Paper
- + Stone
- Vellum
- + Wood
- + Plastic

It turns out mat board is in  
the database.

Click to select material, double-click to edit, right-click for other commands.

**Notes:****Print Special Effects**

Normal

**Print  
Direction****Vector Performance**

Standard

**Intensity Adjustment****Raster****Vector Engraving****Vector Cutting**

Click to select material, double-click to edit, right-click for other commands.

Notes:

Print Special Effects

Normal

Material Thickness

0.063 "

Merge Pages

This is the default thickness. Is it correct? Important, because the laser needs to know what depth to focus on.

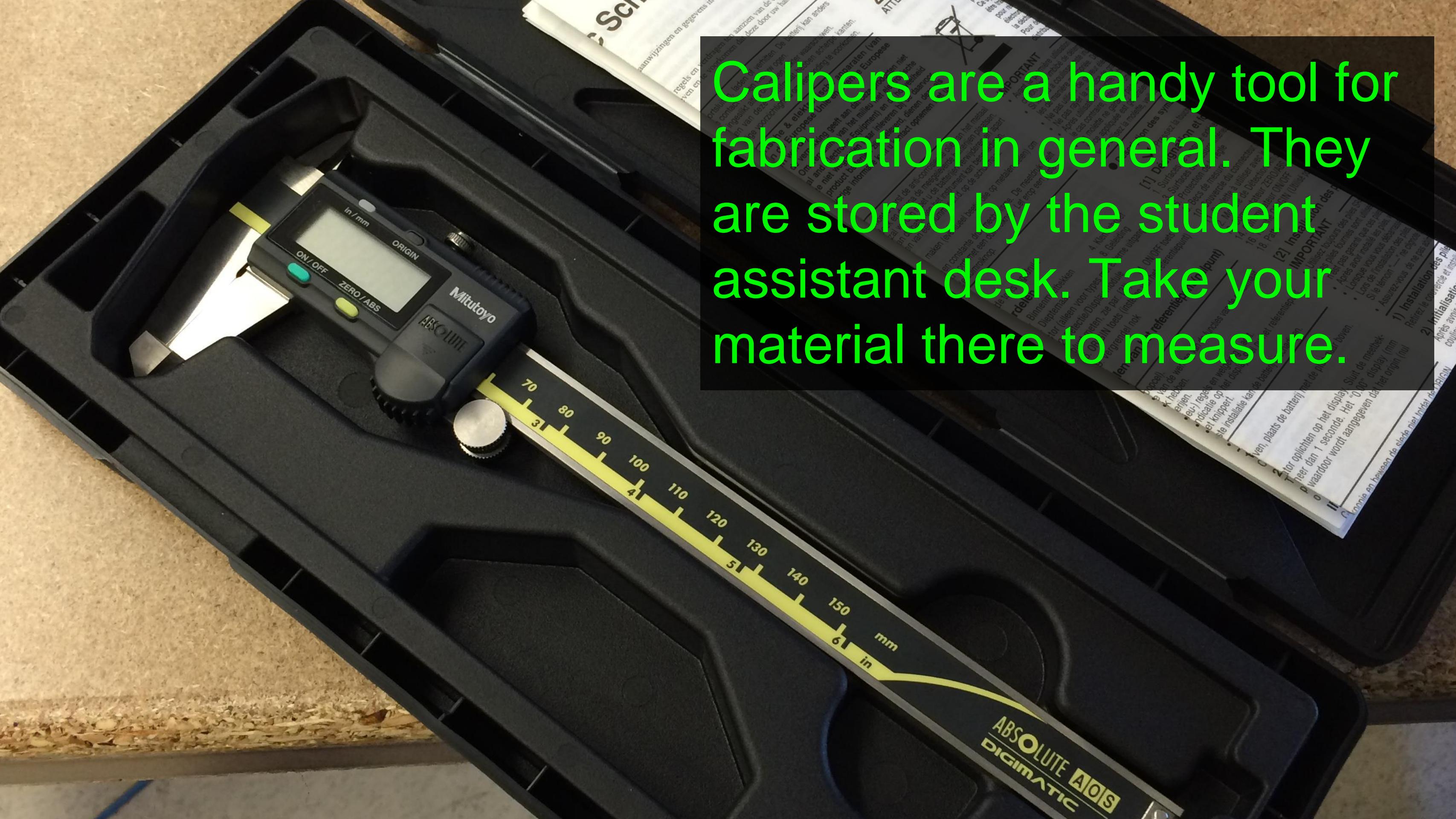
Units

- Metric
- inches

Fixture Type

NONE

Calipers are a handy tool for fabrication in general. They are stored by the student assistant desk. Take your material there to measure.



Precise to 0.0005" or 0.01mm



Notes:

Print Special Effects

Normal

Material Thickness

0.051 "

Merge Pages (Manual)

Put in the correct thickness.  
The software rounds to 3 decimal places for inches and two for millimeters. (Notice you can change units.)

Units

Metric

inches

Fixture Type

NONE

click for other commands.

## Vector Performance



Standard



### Fixture Type

NONE



OK!

Apply

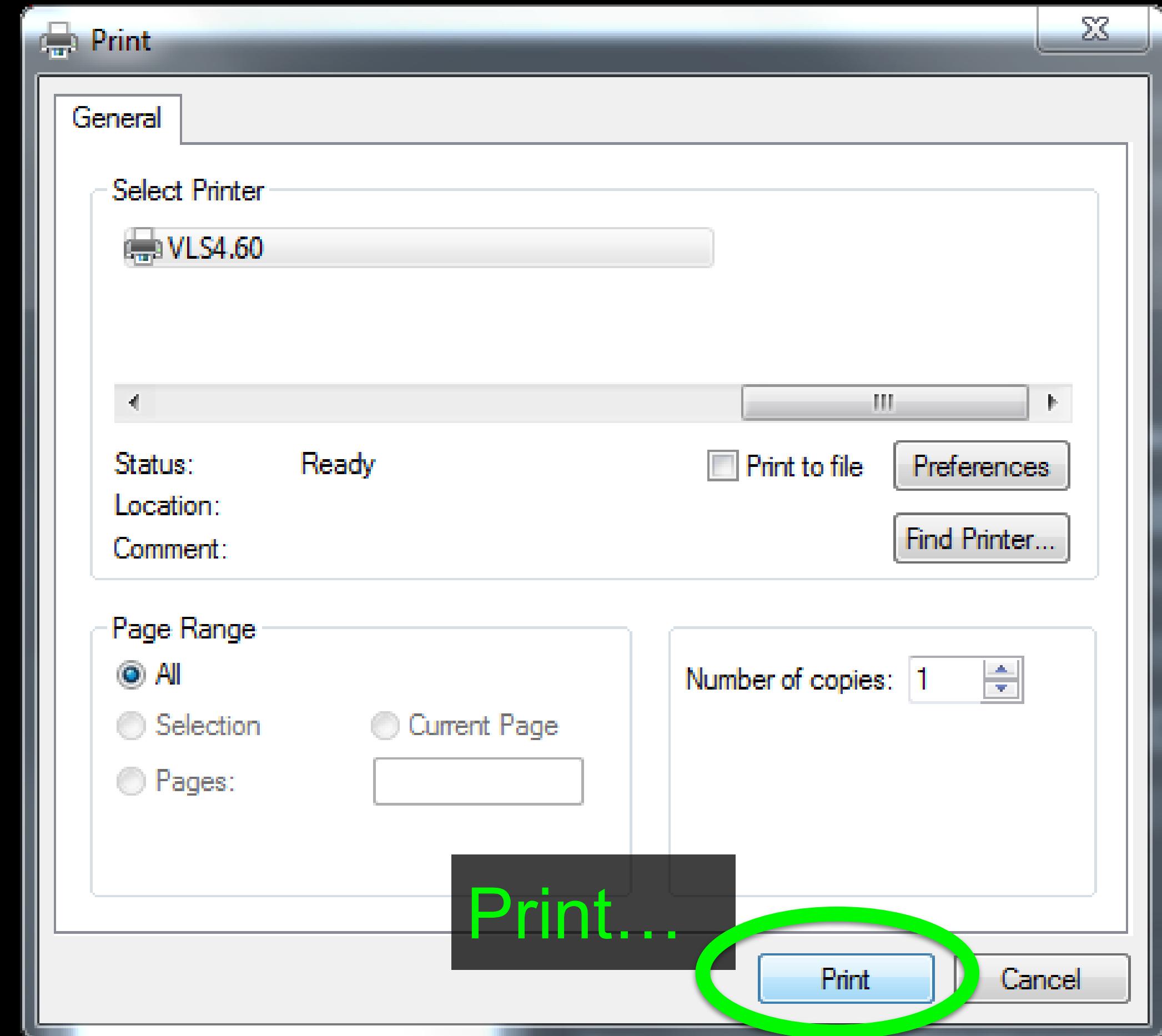
Load

OK

Defaults

Save

Cancel



Width: 45.72 cm

Height: 60.96 cm

Orientation:  Auto-Rotate



Transverse

### Options

Print Layers: Visible & Printable Layers

Placement: X: 0 cm Y: 0 cm

Scaling: Do Not Scale

Overlap: 0 cm

Scale: W: 100

H: 100

Tile Range:

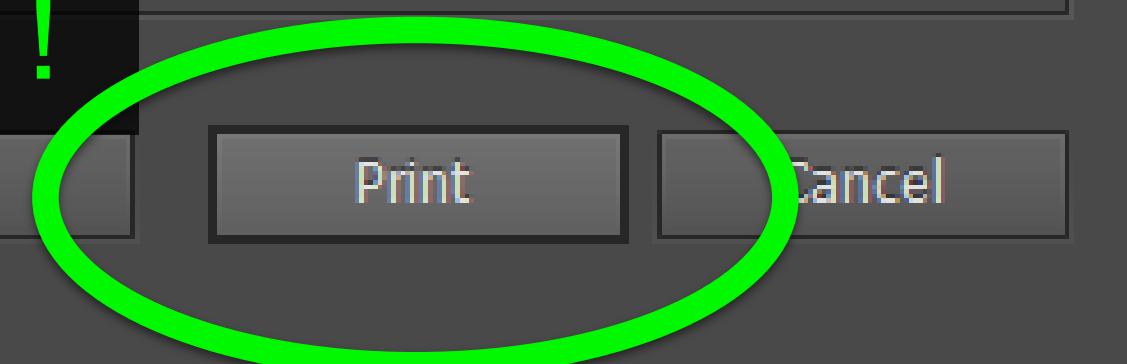
Really... PRINT!

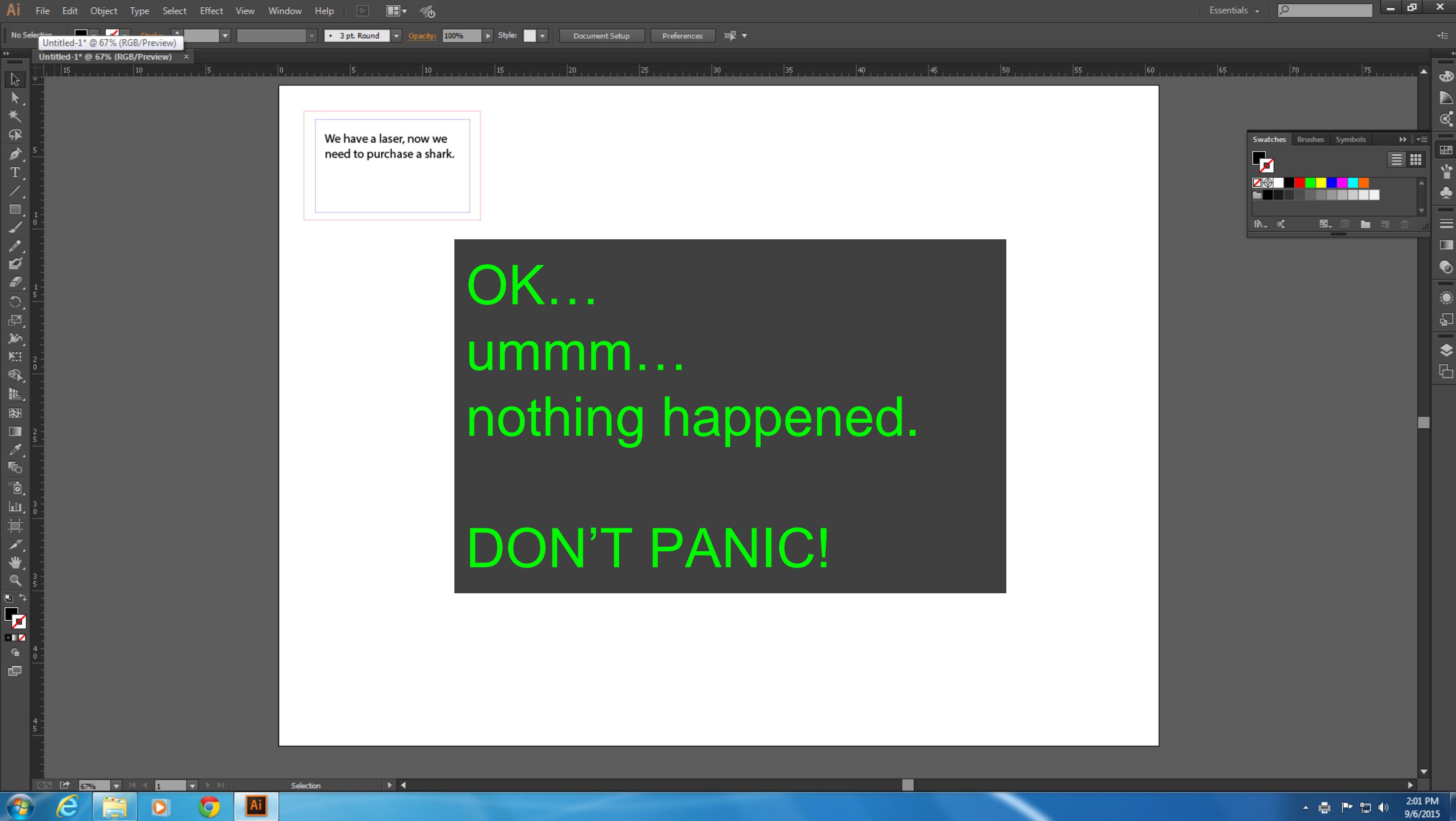
Setup...

Done

Print

Cancel



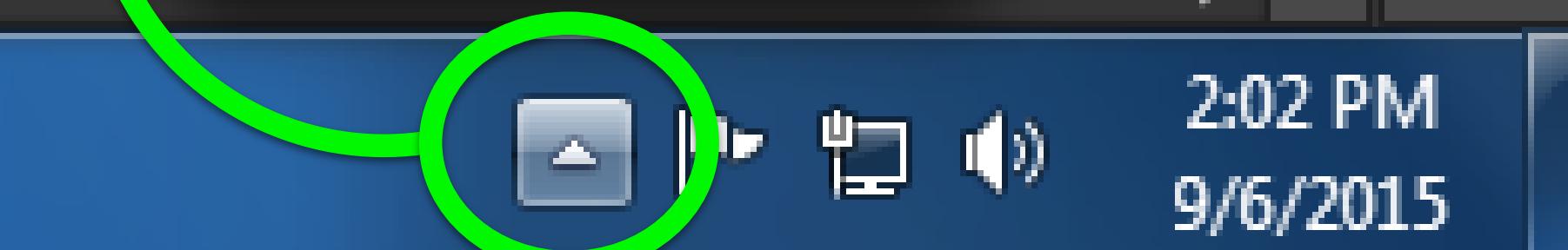
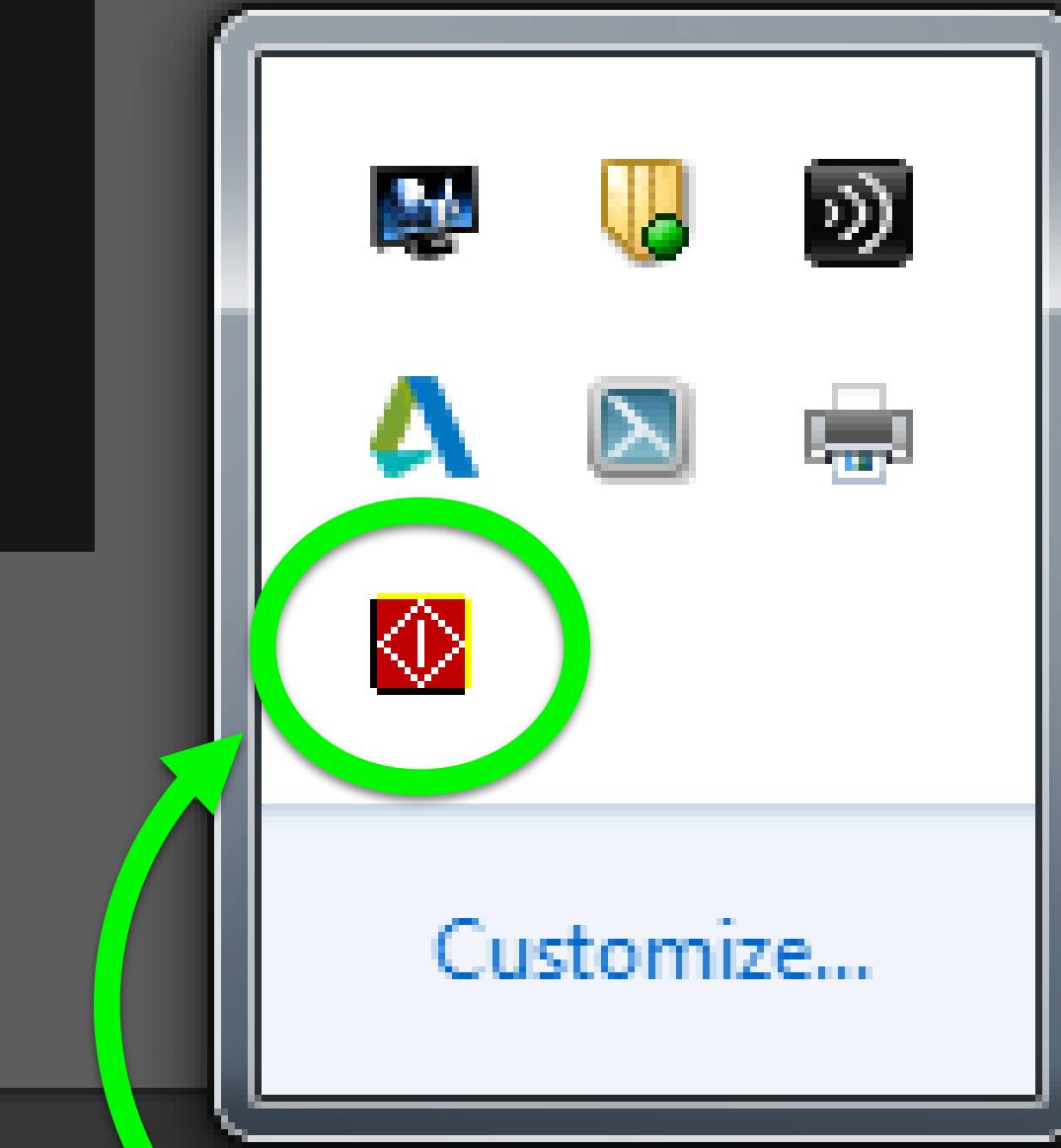


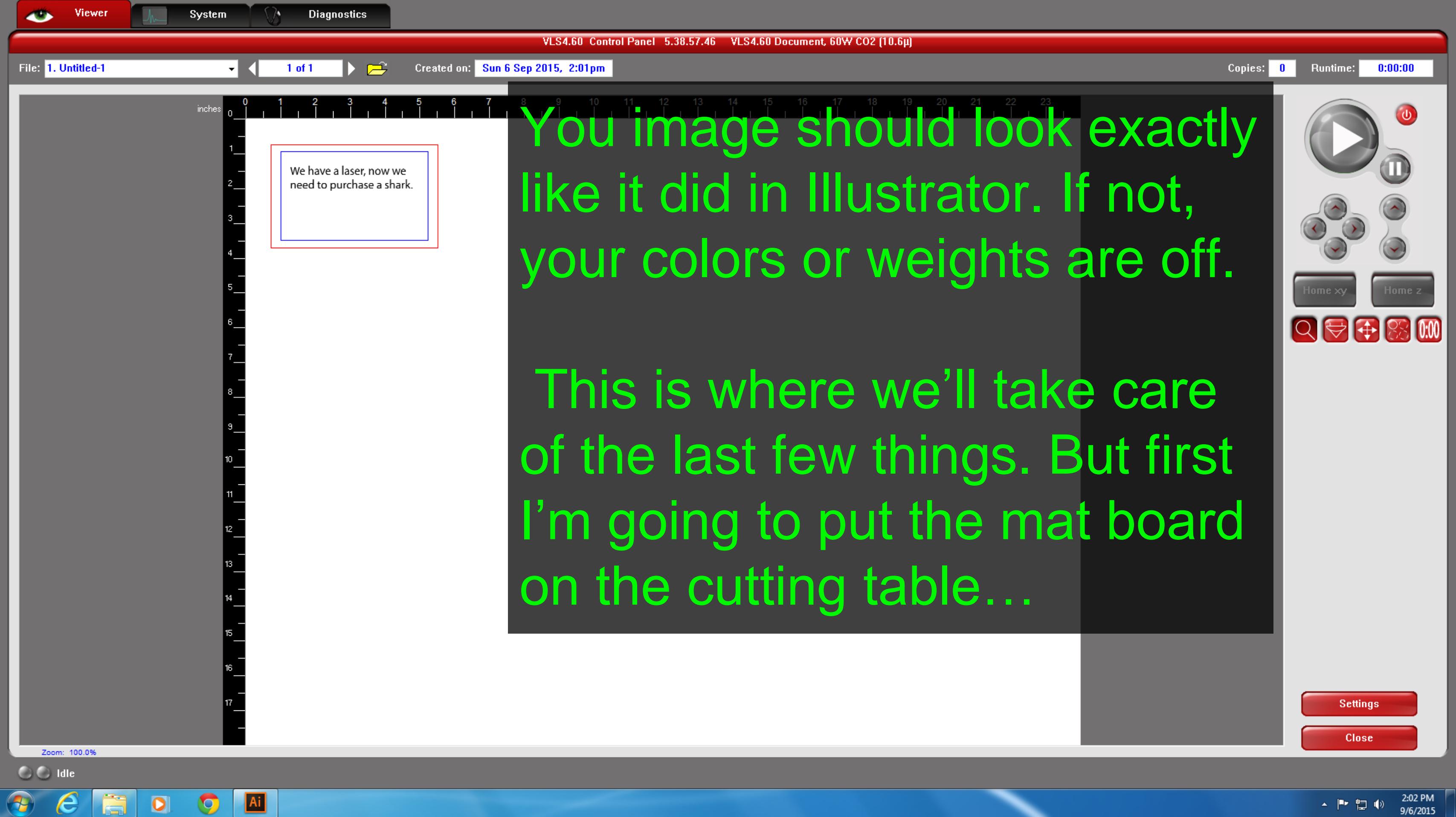
We have a laser, now we  
need to purchase a shark.

OK...  
ummm...  
nothing happened.

DON'T PANIC!

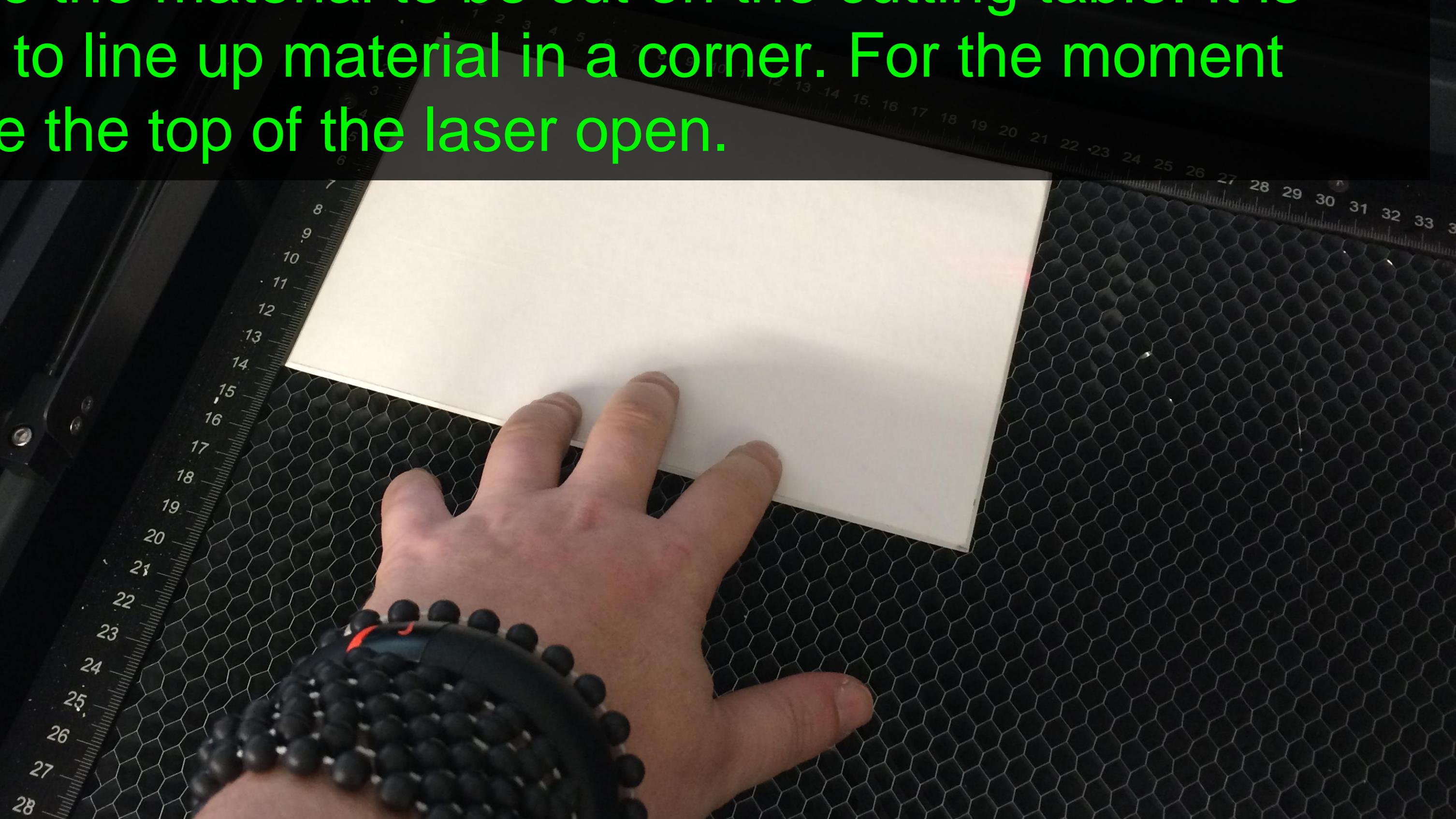
Because we need to go  
the laser's control panel.  
It's found in the dock at  
the bottom of the screen.





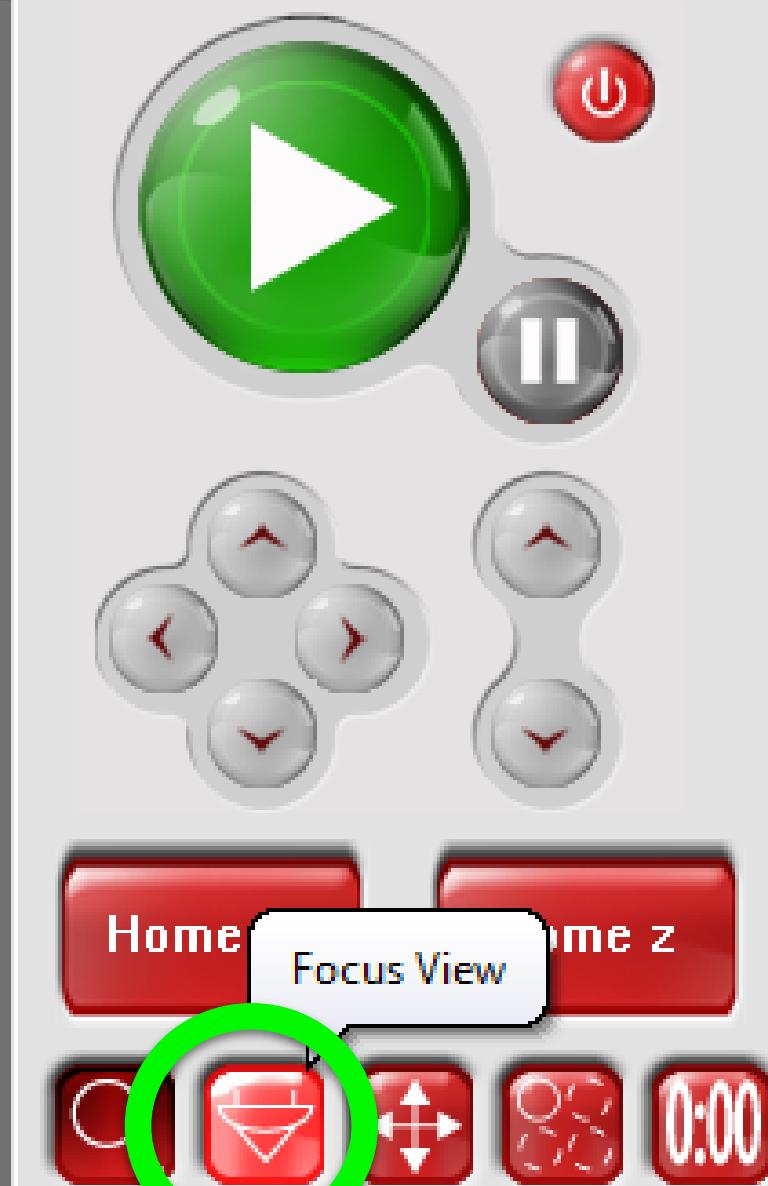
Gently lift the top of the laser.

Place the material to be cut on the cutting table. It is best to line up material in a corner. For the moment leave the top of the laser open.



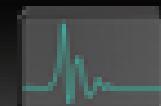
15 16 17 18 19 20 21 22 23

Back in the control panel, click on the FOCUS VIEW button.





Viewer



System



Diagnostics

VLS4.60

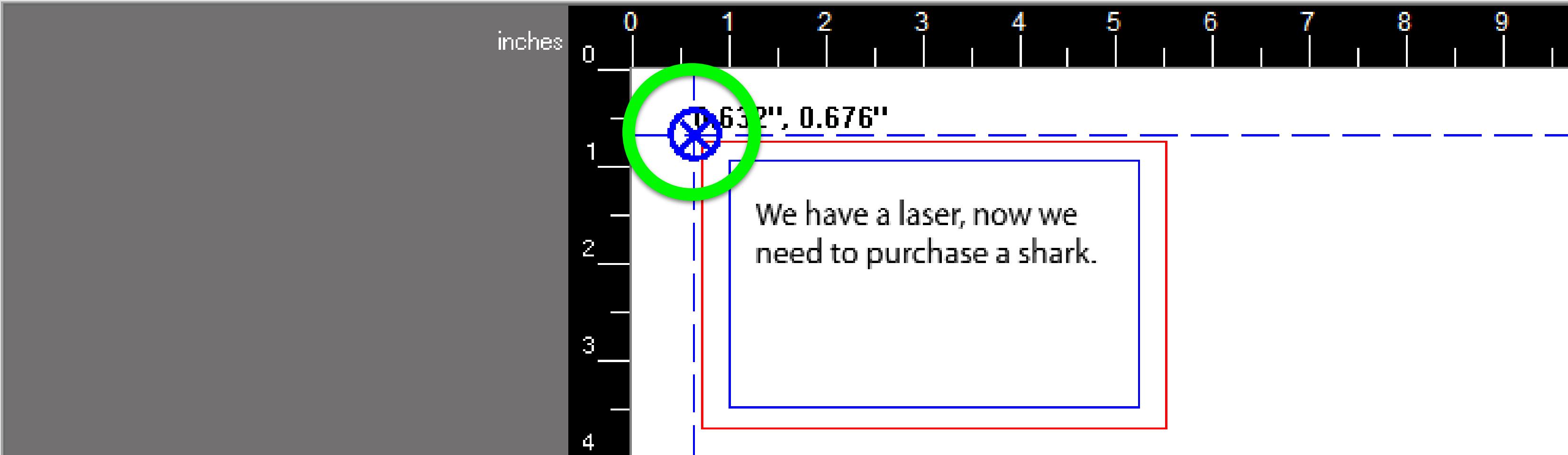
File: 1. Untitled-1

1 of 1

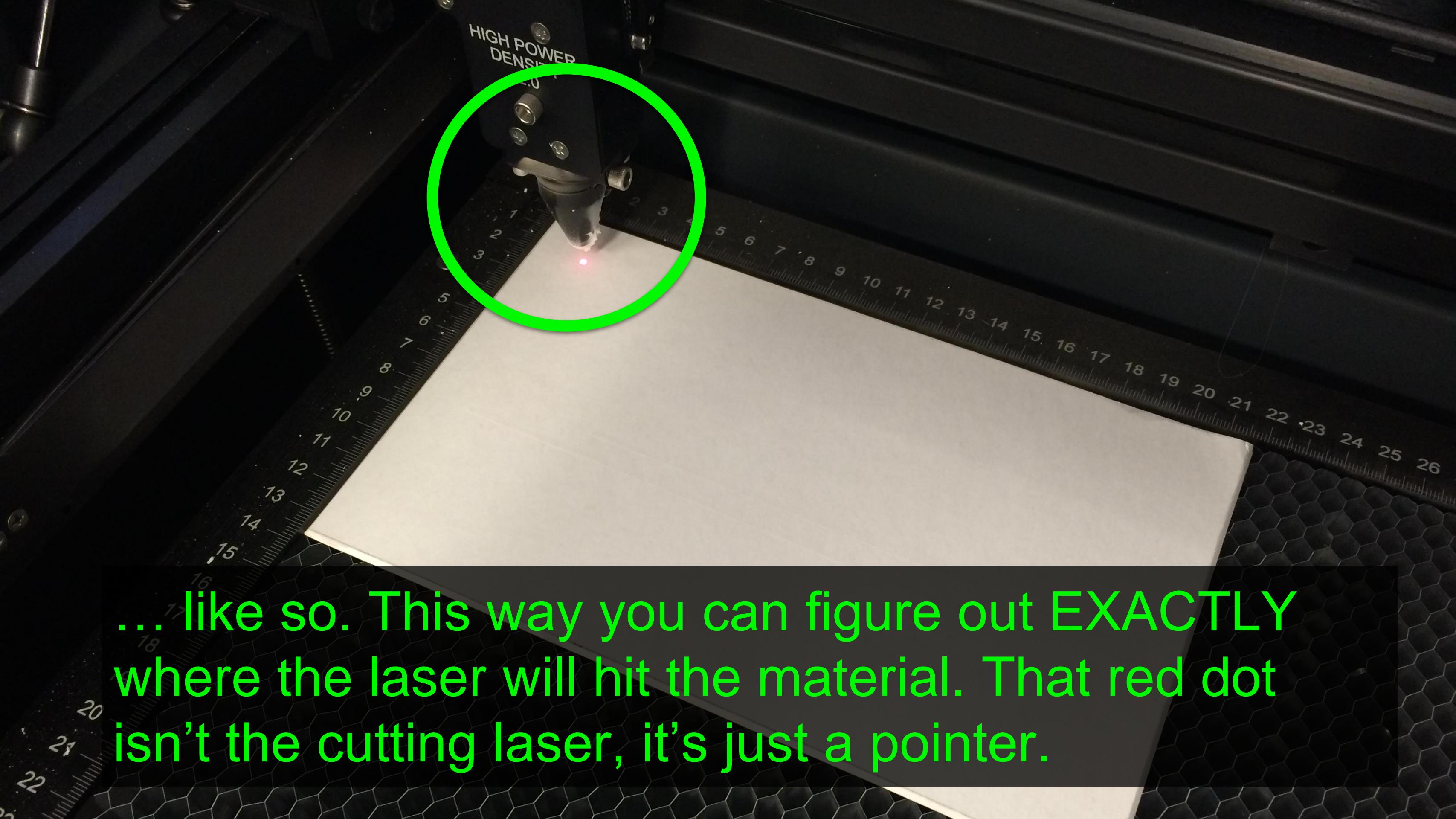


Created on:

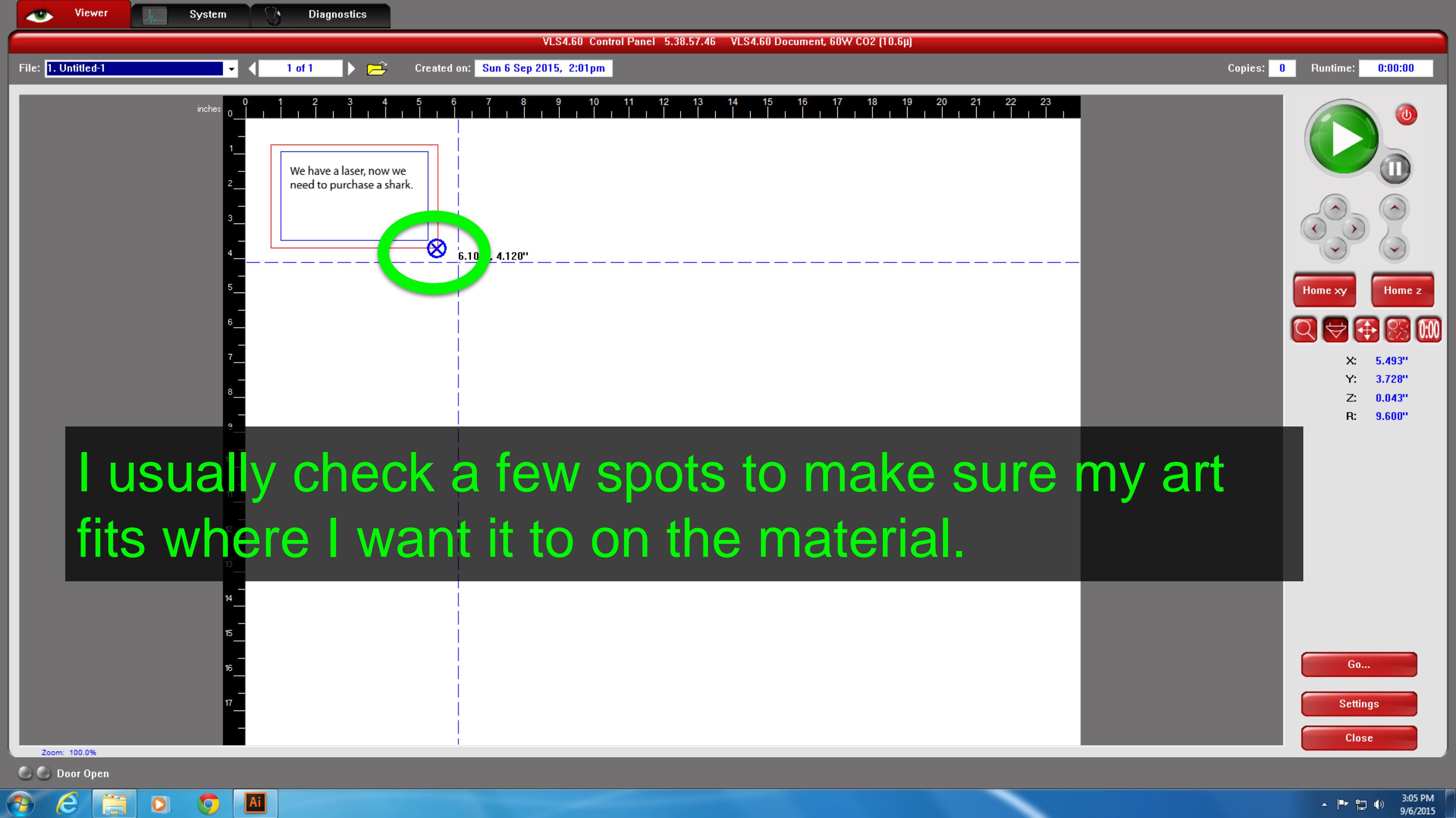
Sun 6 Sep 2015, 2:0

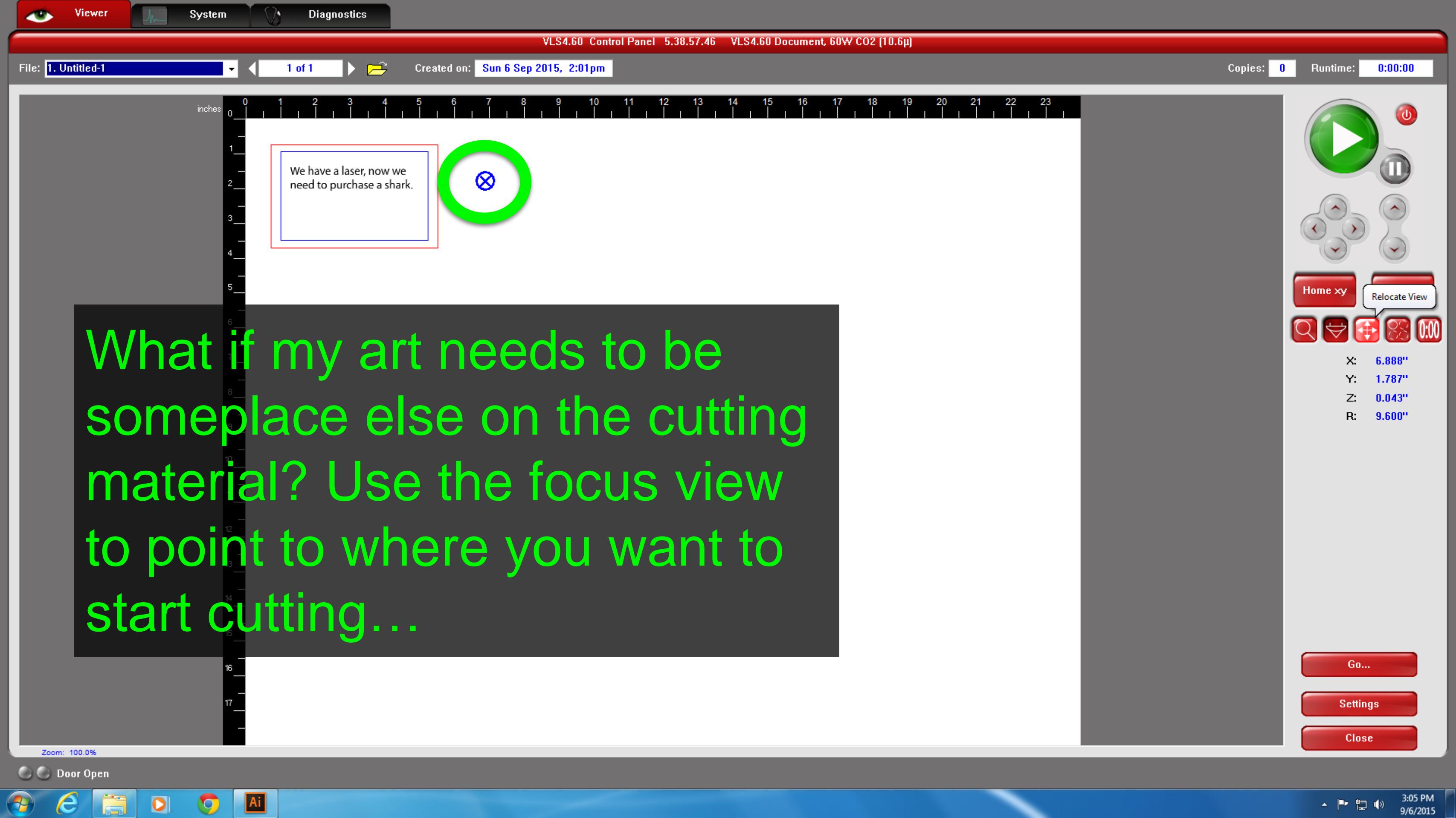


Clicking on the image area moves the  
lens around the cutting table...

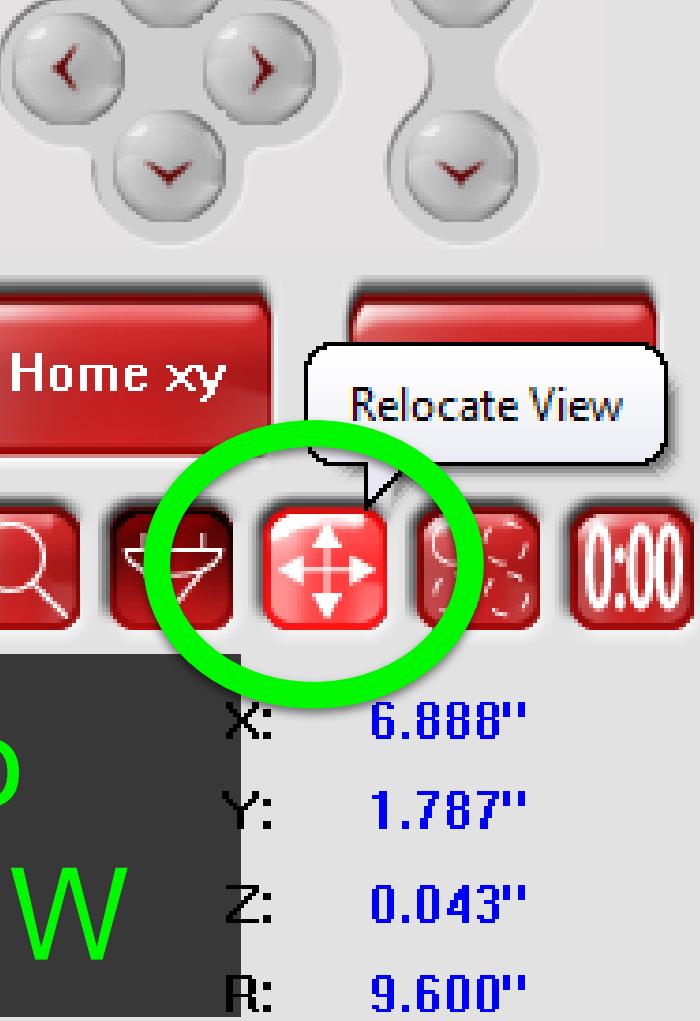


...like so. This way you can figure out EXACTLY where the laser will hit the material. That red dot isn't the cutting laser, it's just a pointer.



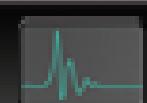


... then switch to  
**RELOCATE VIEW**





Viewer



System



Diagnostics

VLS4.60 Control Panel 5.38.5

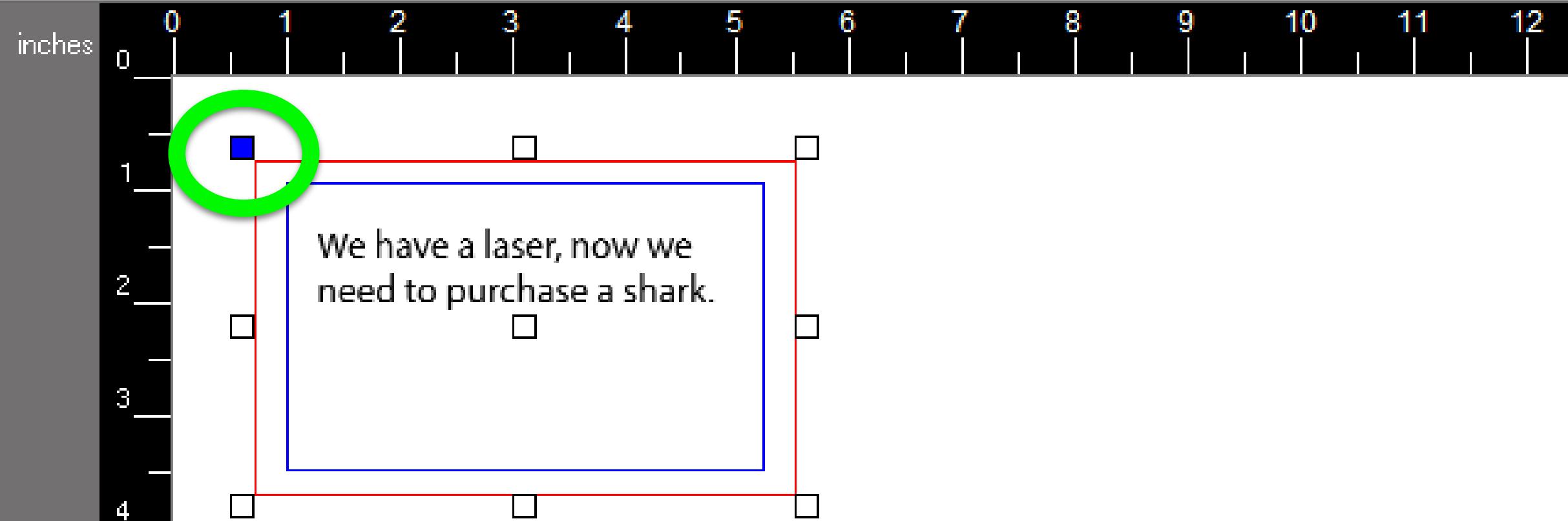
File: 1. Untitled-1

1 of 1



Created on:

Sun 6 Sep 2015, 2:01pm

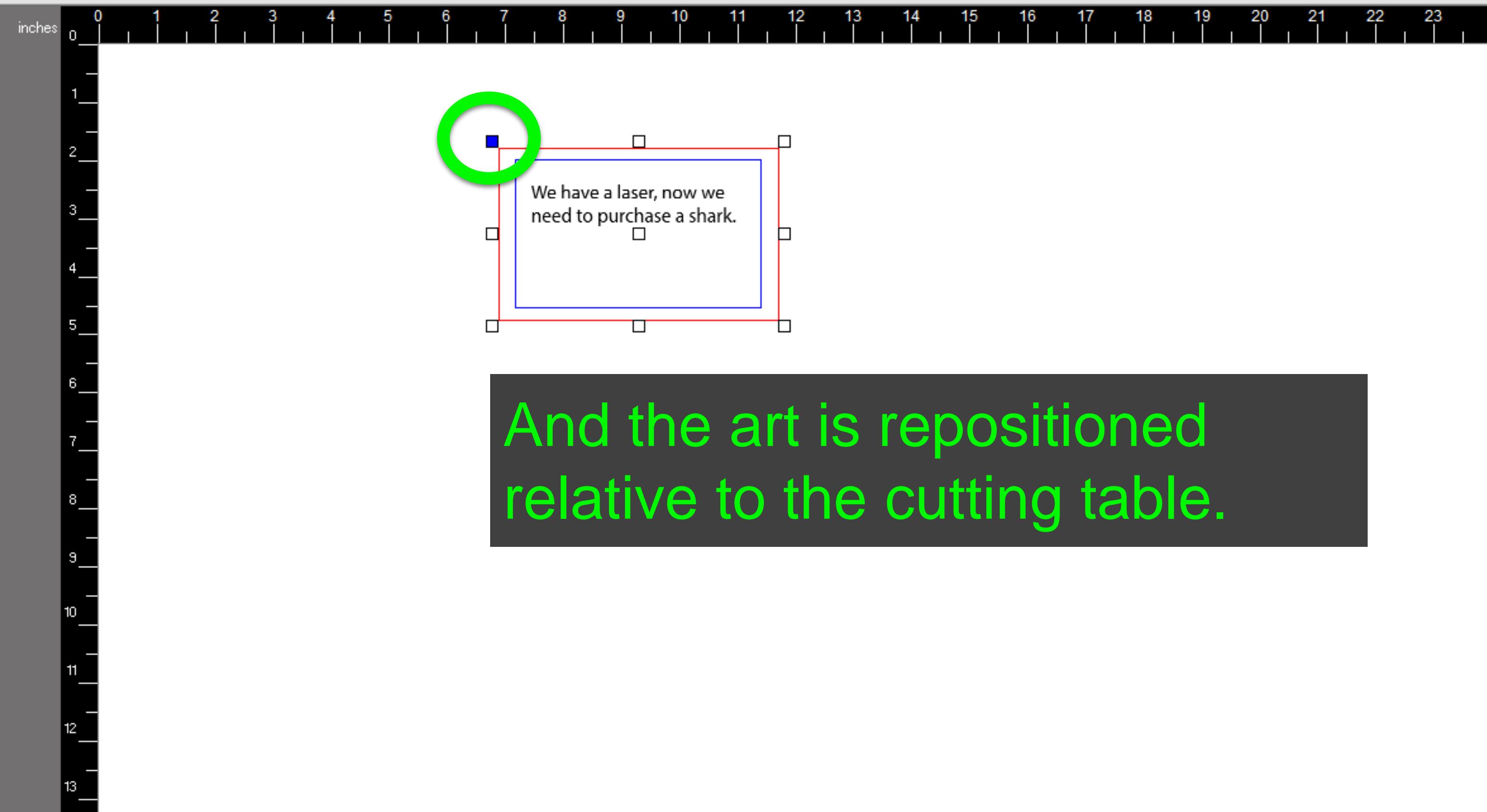


We have a laser, now we  
need to purchase a shark.

Click on a corner tab of the art to align to  
the current location of the lens (default is  
upper-left, usually fine.)

Then click on TO POINTER.





And the art is repositioned  
relative to the cutting table.

Copies: 0

Runtime: 0:00:00

15 16 17 18 19 20 21 22 23

How long will it take to run the job? Click on that last button to switch to this view...



Copies: 0

Runtime: 0:00:00

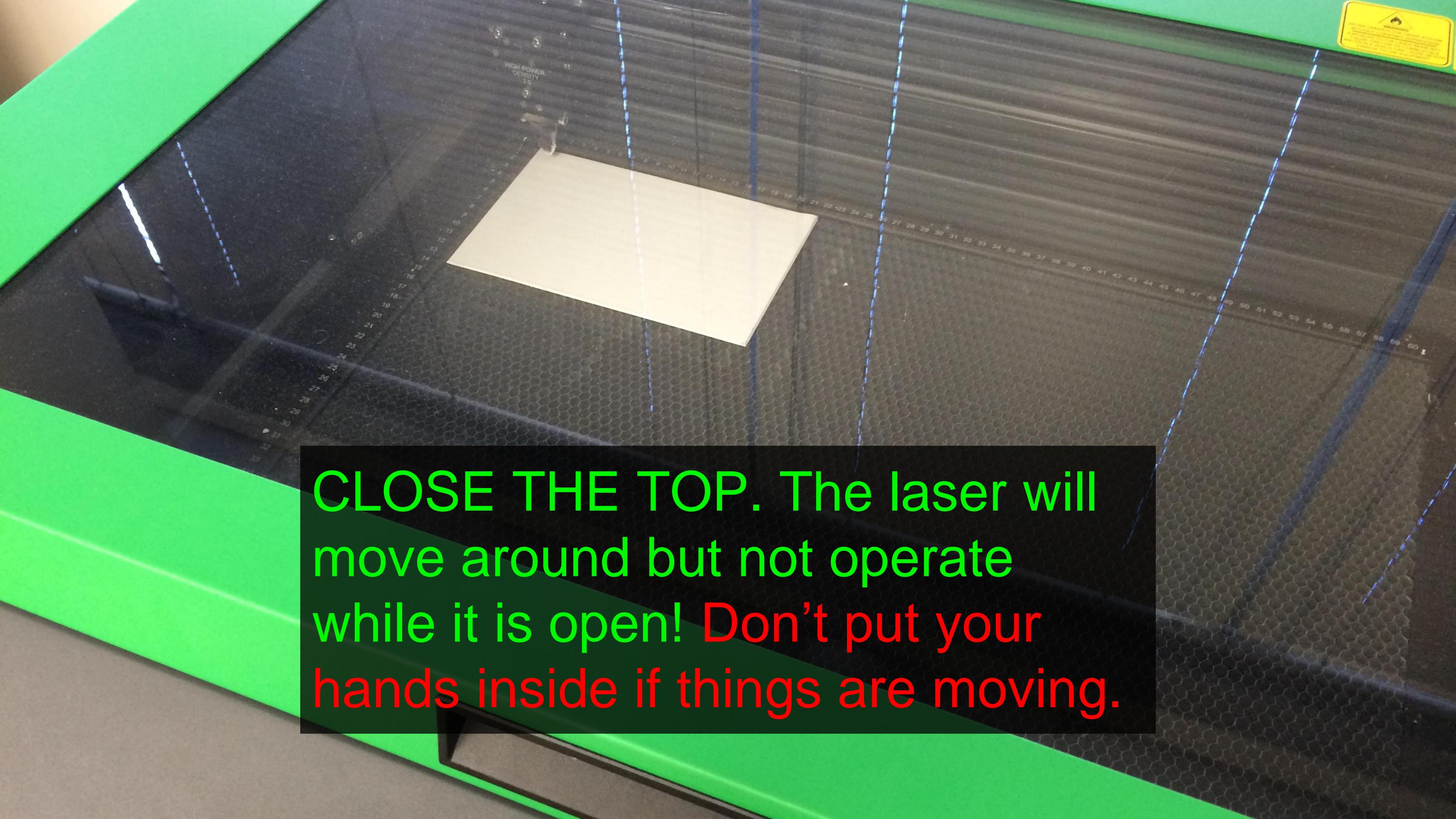
15 16 17 18 19 20 21 22 23

Then click START.



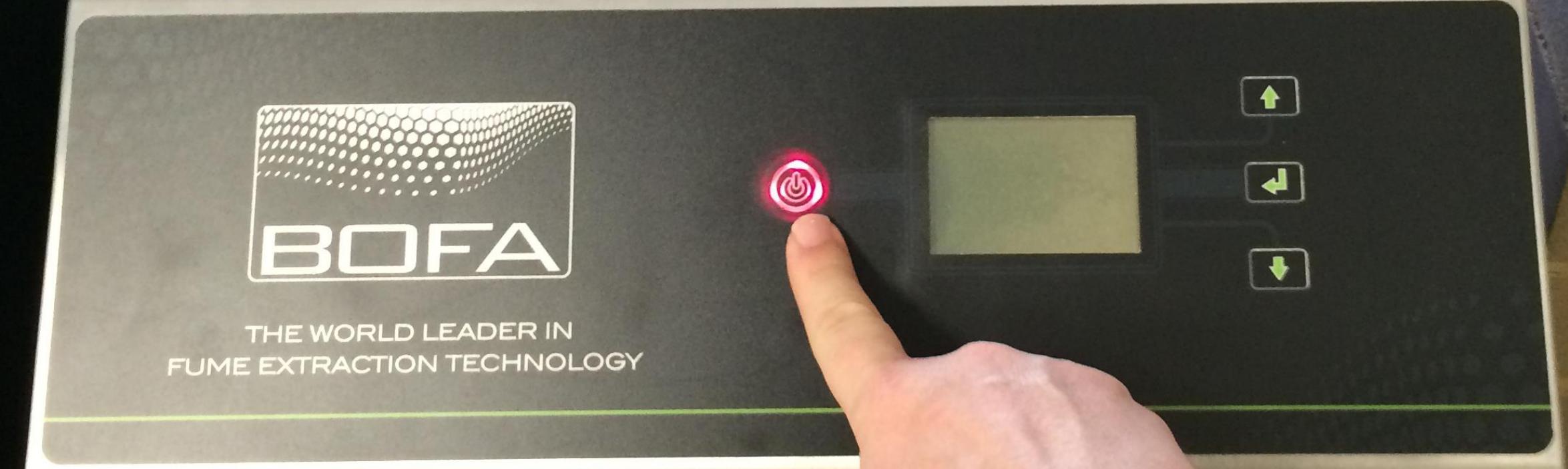
Estimated time is 1 minute  
and 20 seconds... FAST!





**CLOSE THE TOP.** The laser will move around but not operate while it is open! Don't put your hands inside if things are moving.

Power on the fume extractor next to the laser you are using.



Copies:

0

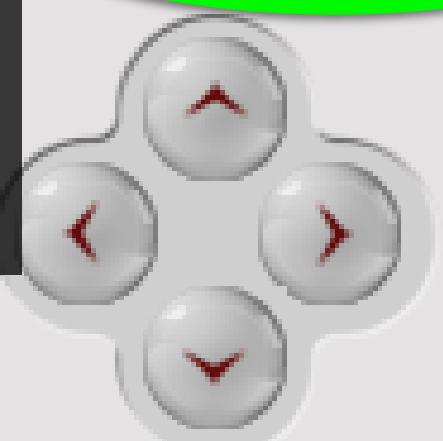
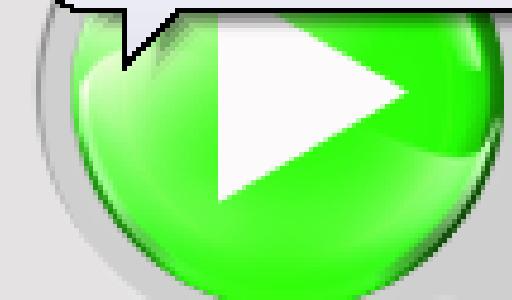
Runname:

0:00:00

20 21 22 23

Now hit the ginormous  
START BUTTON.

Start engraving this print job.



Home xy

Home z



Once you start the job, **DO NOT**  
**LEAVE THE LASER UNATTENDED!** If  
the material you are cutting catches  
fire, stop the job; if **YOU** need to put  
out the fire. Know where the fire  
extinguisher is!

If there is a small fire on the laser,  
**DON'T PANIC!** It's contained in the  
cutting chamber, so it shouldn't get out  
of control. Get the lab tech: they will  
decide if using the fire extinguisher is  
necessary. **IF** for some reason you use  
the fire extinguisher, the lab tech on duty  
should call UPD and email Devin.

TIP: if your job takes a long time,  
**make sure the computer doesn't fall asleep.** If the computer falls asleep the laser will shut down in the middle of the job and you will have to restart from the beginning. Move the mouse every few minutes.

**Starting to cook!**

We have a laser, now we  
need to purchase a shark.

A minute-and-a-half later!

After the job is done, wait 30-60 seconds before opening the top.

This gives the system time to vent any fumes and allows your material to cool.

We have a laser, now we  
need to purchase a shark.

DONE!

File: 19. Untitled-1

19 of 19



Created on: Fri 5 Feb 2016, 10:23am

Once you are finished cutting, clear the job queue to save space on the computer for other folks. To do that, click on this little open folder icon....

## Select A Print Job

- 1. penpot-3
- 2. penpot-2
- 3. penpot-2
- 4. penpot-4
- 5. penpot-5
- 6. Untitled-1
- 7. cucalorus\_plakas
- 8. cucalorus\_plakas
- 9. cucalorus\_plakas
- 10. cucalorus\_plakas
- 11. cucalorus\_plakas
- 12. Hologram
- 13. Hologram
- 14. Hologram
- 15. Hologram
- 16. Hologram
- 17. Untitled-1
- 18. moon
- 19. Untitled-1

You'll see a list of the recent jobs on the left. To clear everything out, click the 'Purge' button.

Select

Export...

Import...

Delete

Purge

Close

Filename:

Untitled-1

Created on:

Fri 5 Feb 2016, 10:23am

Runtime:

0:00:00

Fixture:

Standard Table

Material:

Cardboard

Thickness:

4mm

Permanent

## Select A Print Job

- 1. penpot-3
- 2. penpot-2
- 3. penpot-2
- 4. penpot-4
- 5. penpot-5
- 6. Untitled-1
- 7. cucalorus\_plakas
- 8. cucalorus\_plakas
- 9. cucalorus\_plakas
- 10. cucalorus\_plakas
- 11. cucalorus\_plakas
- 12. Hologram
- 13. Hologram
- 14. Hologram
- 15. Hologram
- 16. Hologram
- 17. Untitled-1
- 18. moon
- 19. Untitled-1

Permanent

Select

Export...

Import...

Delete

Purge

DO IT!

Created on:  
Fri Feb 01, 11:23am

Filename:  
Untitled-1

Runtime:  
0:00:00

Fixture:  
Standard Table

Material:  
Cardboard

Thickness:  
4mm

Close

Purge

This will delete all the non-Permanent  
print jobs.  
Are you sure you want to do this?

Yes

No

## Select A Print Job

Select

Export...

Import...

Delete

Purge

Cool, we're done.

Filename:

Fixture:

Permanent

Material:

Thickness:

**Close**

When you are done:

clear any debris from the cutting table

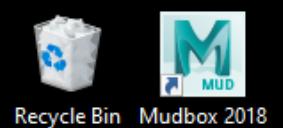
purge files from the queue

close the laser control panel

quit out of Illustrator

log out of Creative Cloud

log out of the computer (which shuts off the laser) and power down the fume extractor



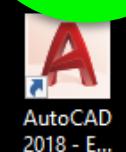
Recycle Bin Mudbox 2018



3ds Max 2019 RapidWork...  
3.5.1



Adobe Creative...



AutoCAD  
2018 - E...



Autodesk  
Netfab...



Autodesk  
ReCap Photo



Autodesk  
ReCap



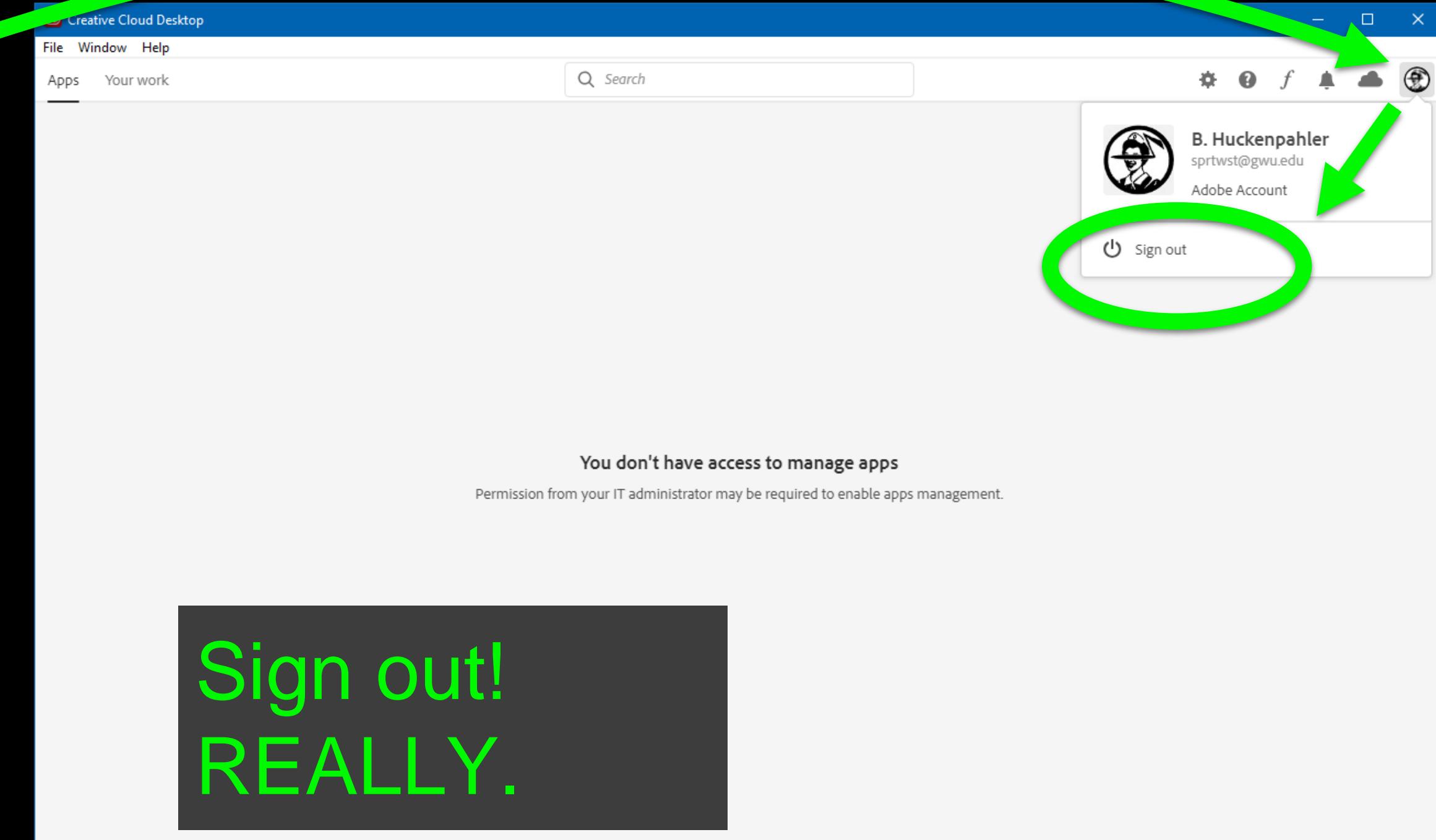
Firefox



Google  
Chrome



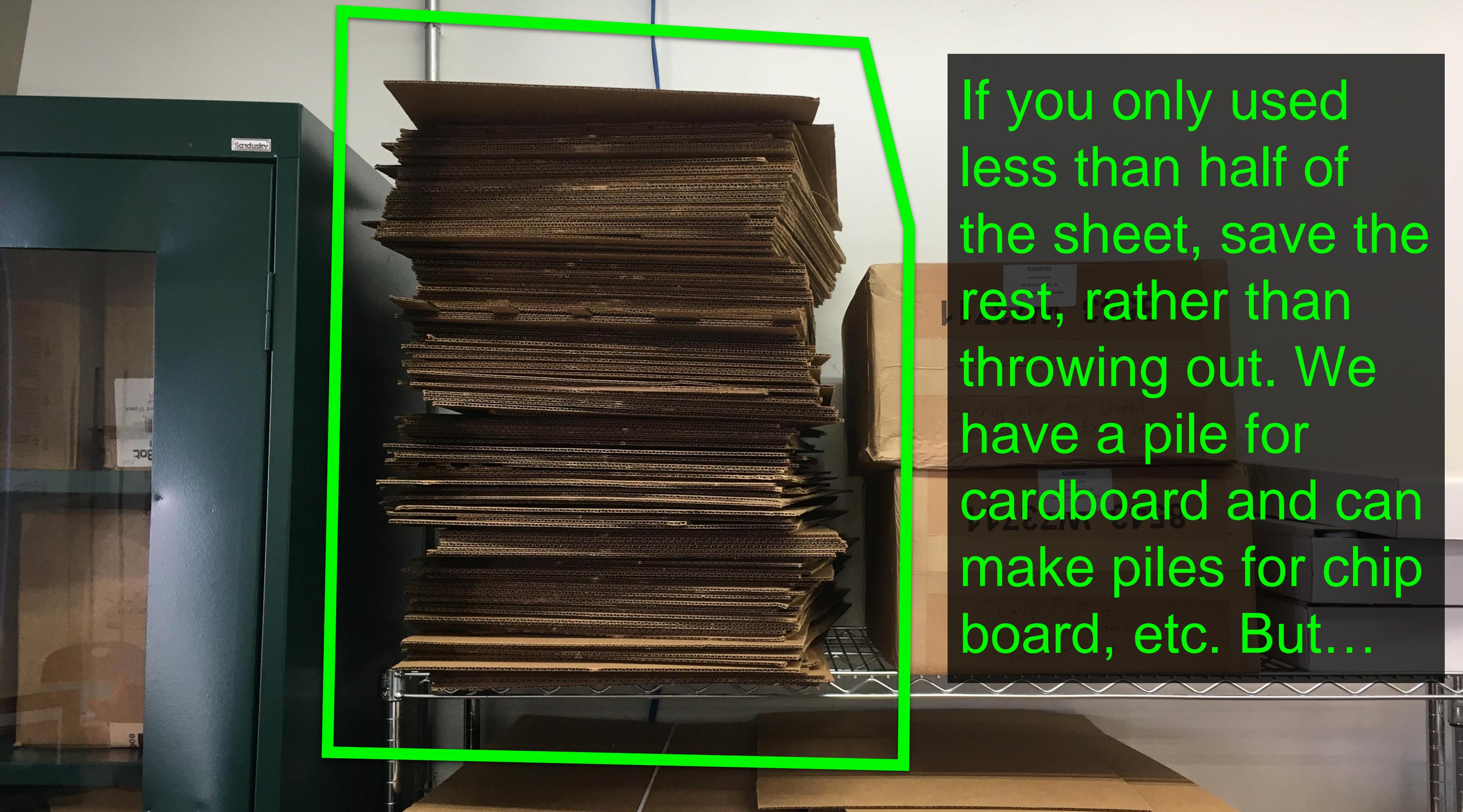
MakerBot  
Print



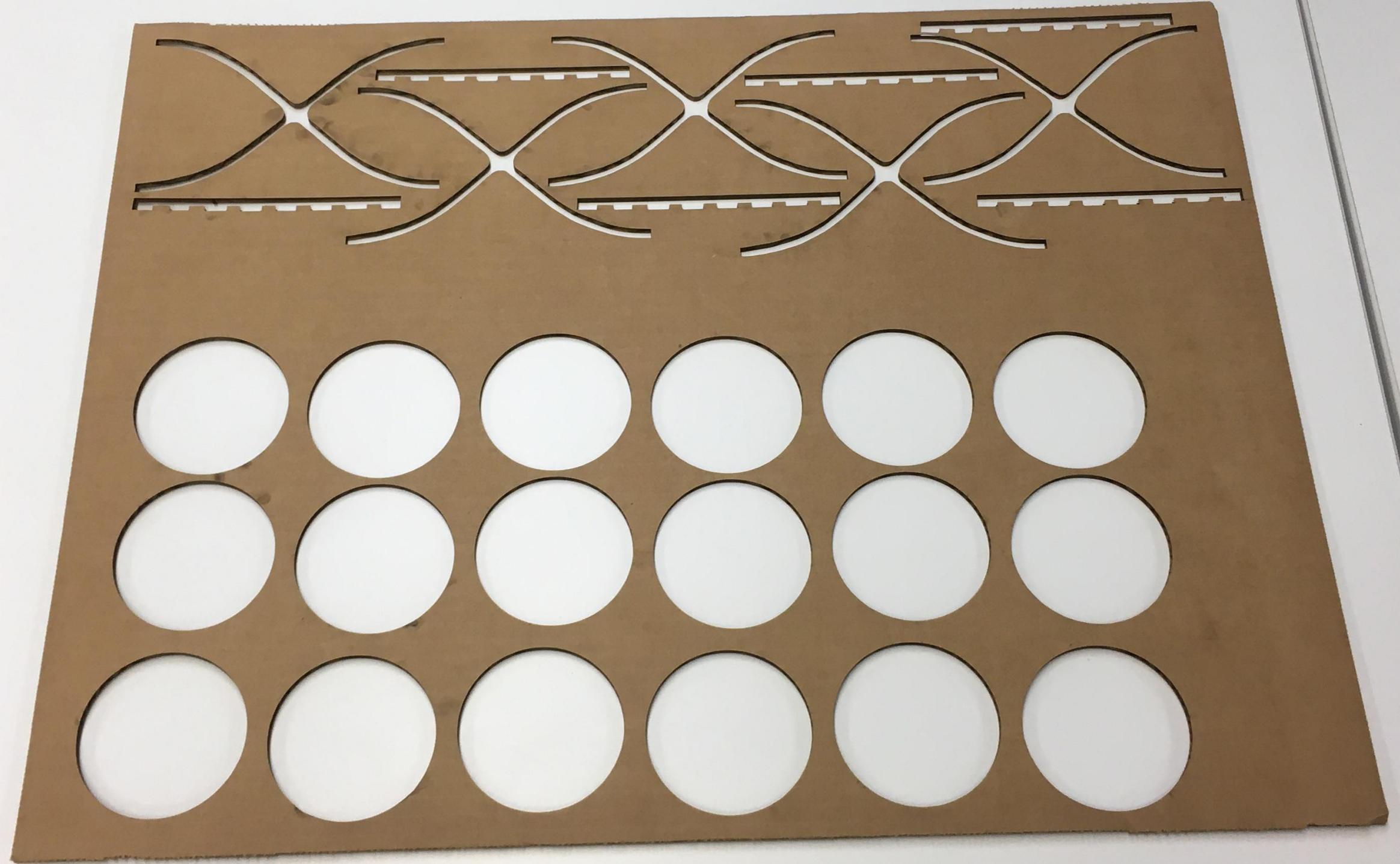
**CLEAN UP!!!!**



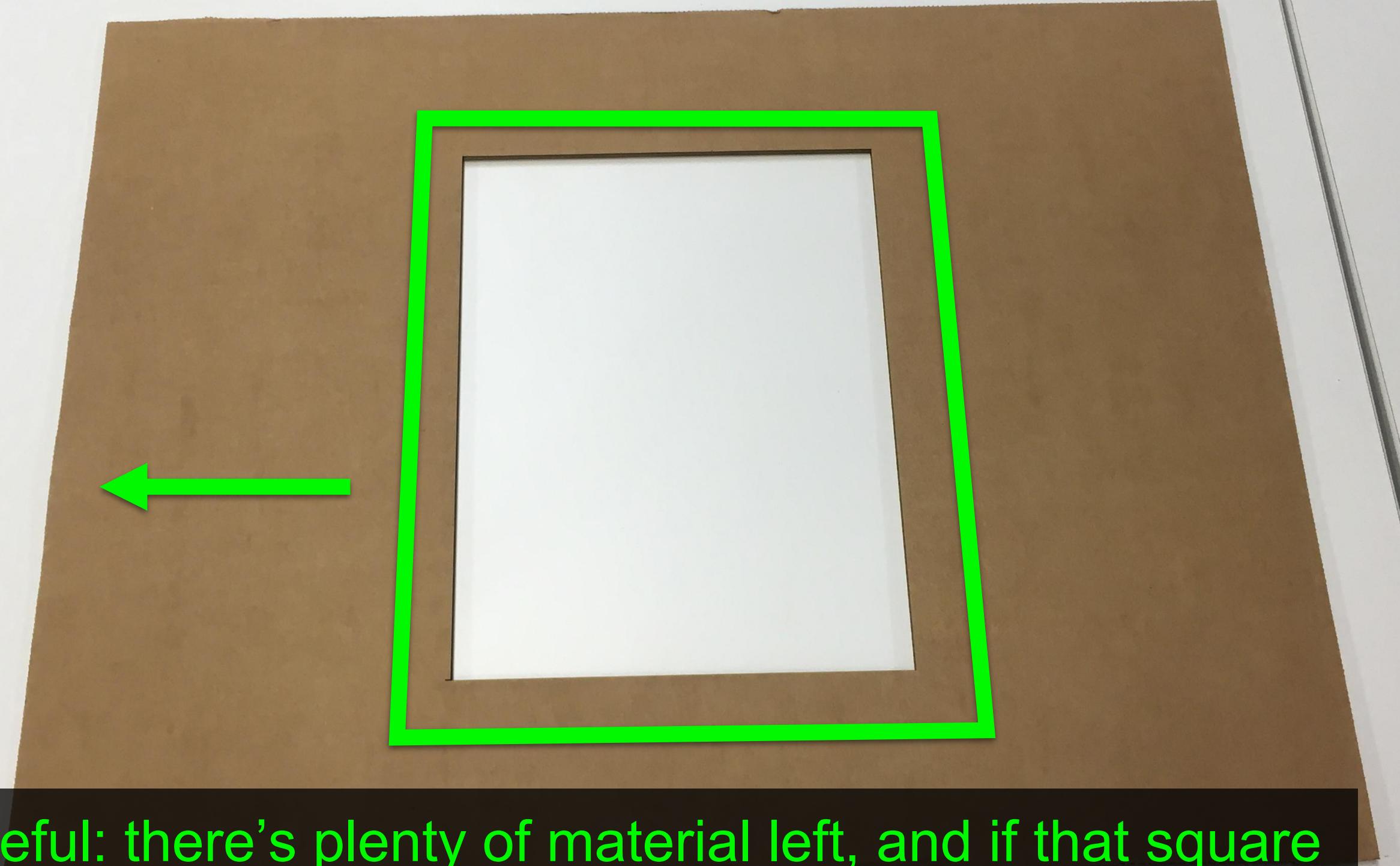
This is AWFUL. Never leave materials lying around,  
**ESPECIALLY** not on top of equipment.



If you only used less than half of the sheet, save the rest, rather than throwing out. We have a pile for cardboard and can make piles for chip board, etc. But...

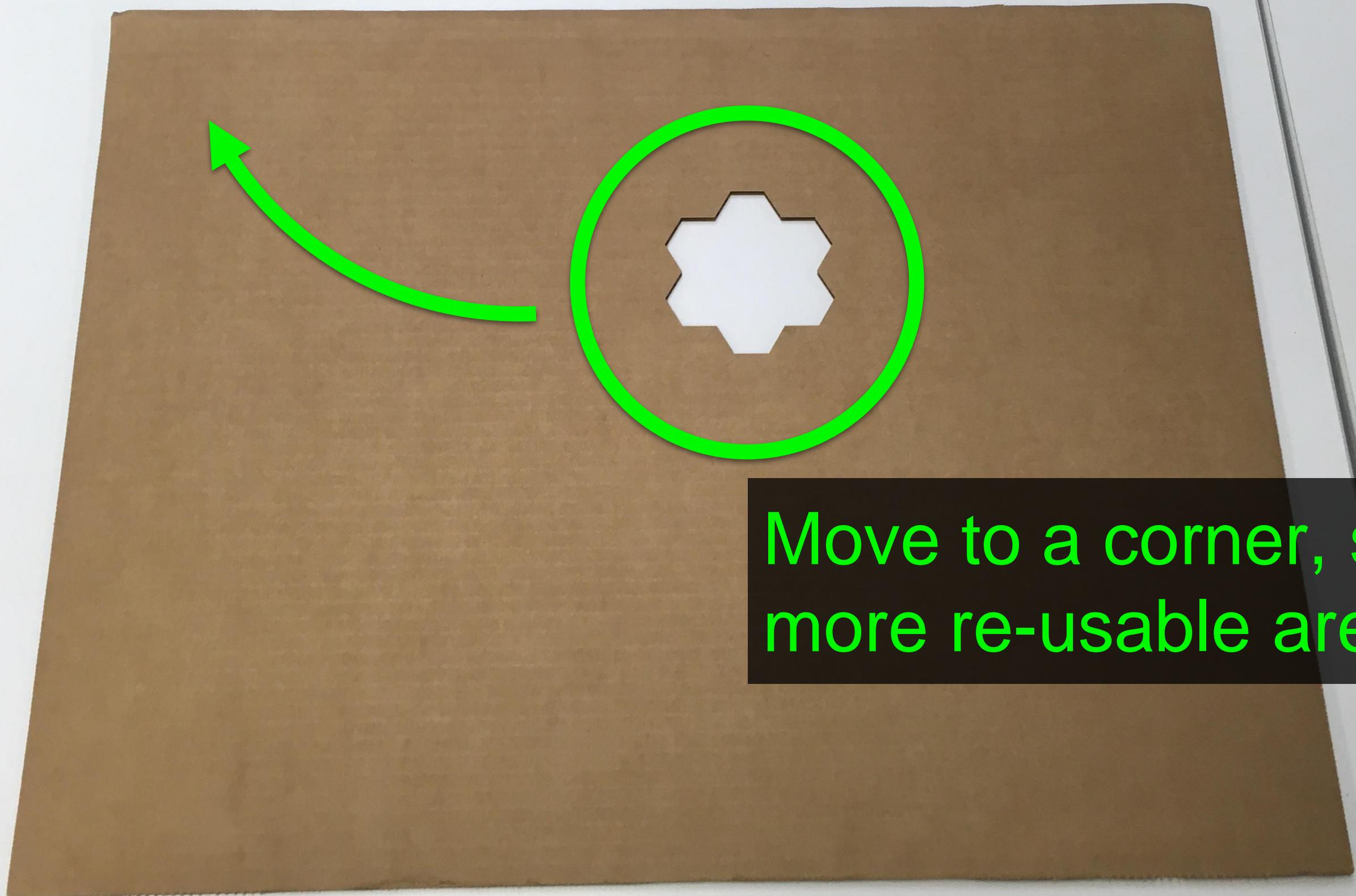


I see sheets like this in the pile  
ALL THE TIME. Really? Trash.



This is wasteful: there's plenty of material left, and if that square had been cut on one end, rather than the center, there would be a larger re-usable space.

Good grief.



Move to a corner, so  
more re-usable area.

More information can be found on our GitHub (look under the ‘Tutorials and Templates’ folder):

<https://go.gwu.edu/CSADFabGit>

The laser template can be found here:

<https://go.gwu.edu/CSADLaserTemplate>