

HOW TO  
UNIVERSAL  
**LASERS!**

FRESH 12 MARCH 2020

# 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 [LinkedIn Learning](#) (was lynda.com, also free to Columbian students.) “Illustrator CC 2019 One-on-One: Fundamentals” is a good place to start.

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

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.

(I'm not sure how or why  
you would, but art students  
do strange things.)

# 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.



Fire extinguisher



First Aid Kit



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

+ Life-threatening:

call 911

+ Physical safety:

UPD 202-994-6111

+ Toxic spill:

Health & Safety 202-994-4347

The Safety Data Sheets (SDSs) are stored in a binder next to the first aid kit. As we add new materials to the ‘safe’ list, we will add the SDSs so that if faculty or students have questions about a material, we’ll have the info on hand.

# Materials

Starting Spring 2020 the school will be providing materials for class projects.

This ensures we are only using safe, appropriate materials for the lab.

IA:STUDIO I

IA: STUDIO I

IA: STUDIO IV

INTERACTION  
FOUNDATIONS

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))

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Not sure if the material you want to use will generate poisonous gasses? Ask BEFORE cutting.

# 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. See  
hours posted over the lasers.

The rule of thumb: if you can  
burn it with a cigarette lighter,  
you can cut it with the laser.

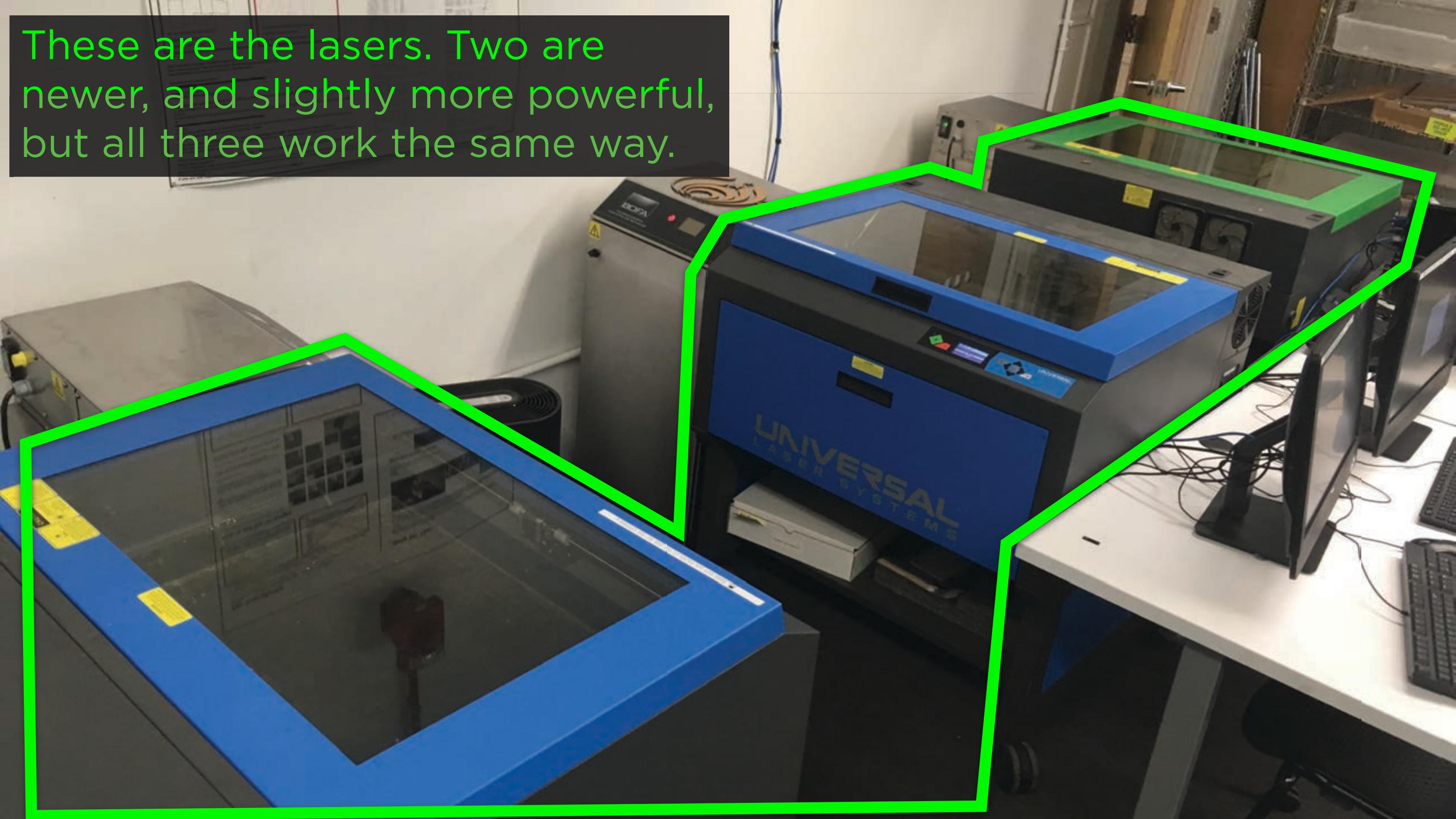
Rules of the road

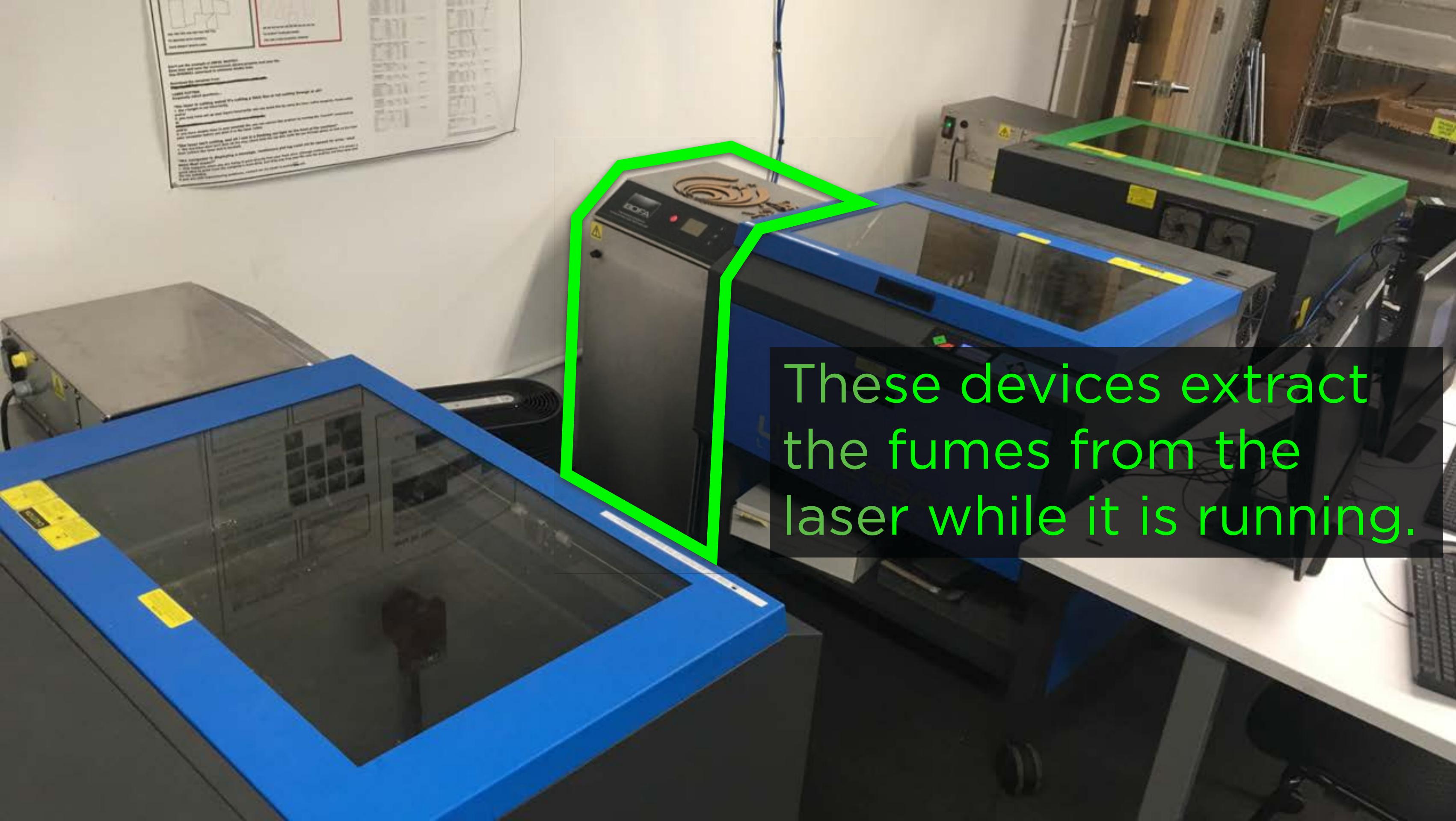
**Clean up after yourself.**

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.

the laser stations

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





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



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 the the laser, and jump off when done, so you're not holding up other people.

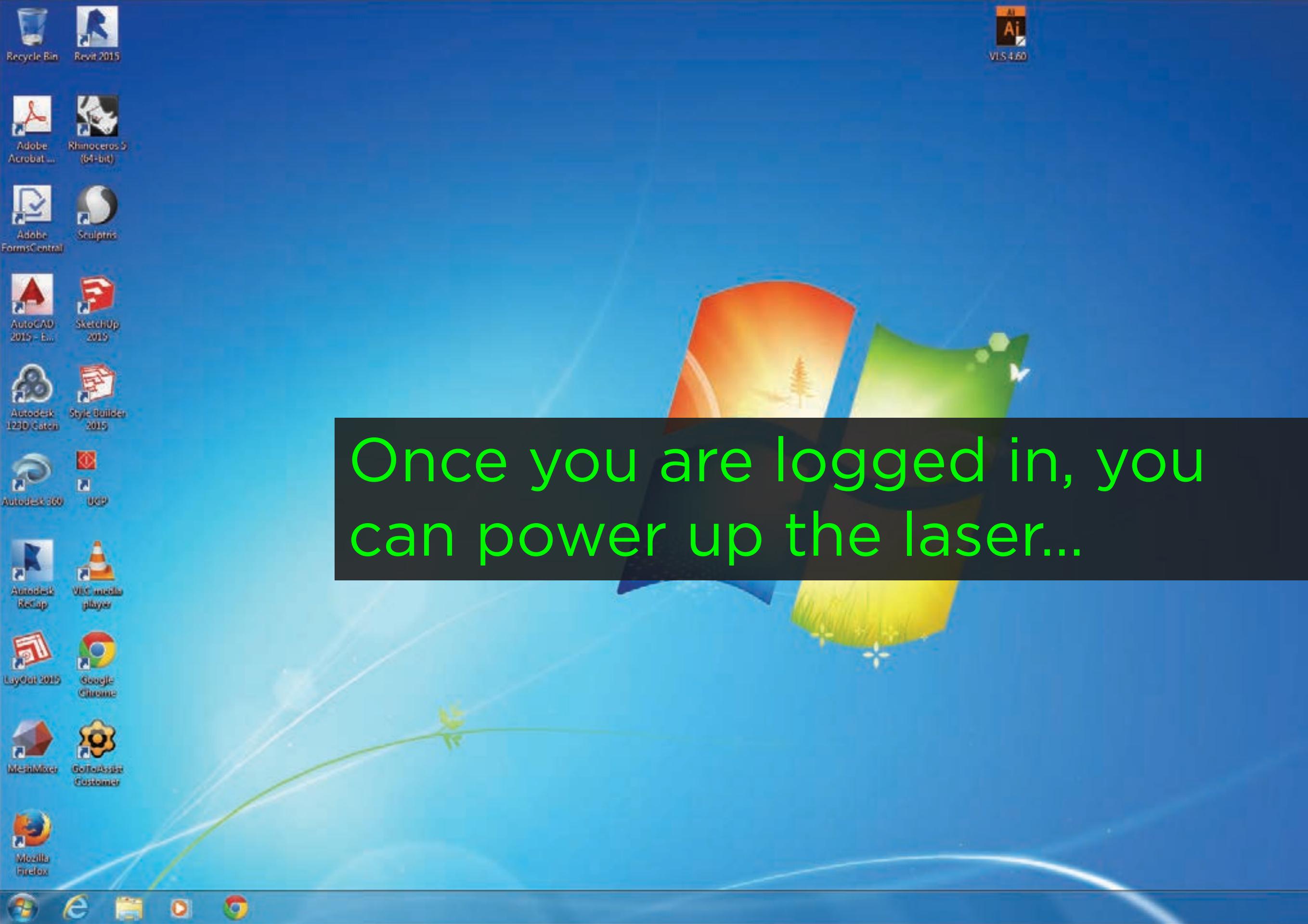
workflow

Press CTRL + ALT + DELETE to log on

Log into the laser workstation.



Windows 7 Enterprise



Recycle Bin

Revit 2015

Ai  
VLS 4.60

Adobe  
Acrobat...

Rhinoceros 5  
(64-bit)

Adobe  
FormsCentral

Sculptris

AutoCAD  
2015 - Em...

SketchUp  
2015

Autodesk  
123D Catch

Style Builder  
2015

Autodesk 360

UGP

Autodesk  
ReCap

VLC media  
player

LayOut 2015

Google  
Chrome

MeshMixer

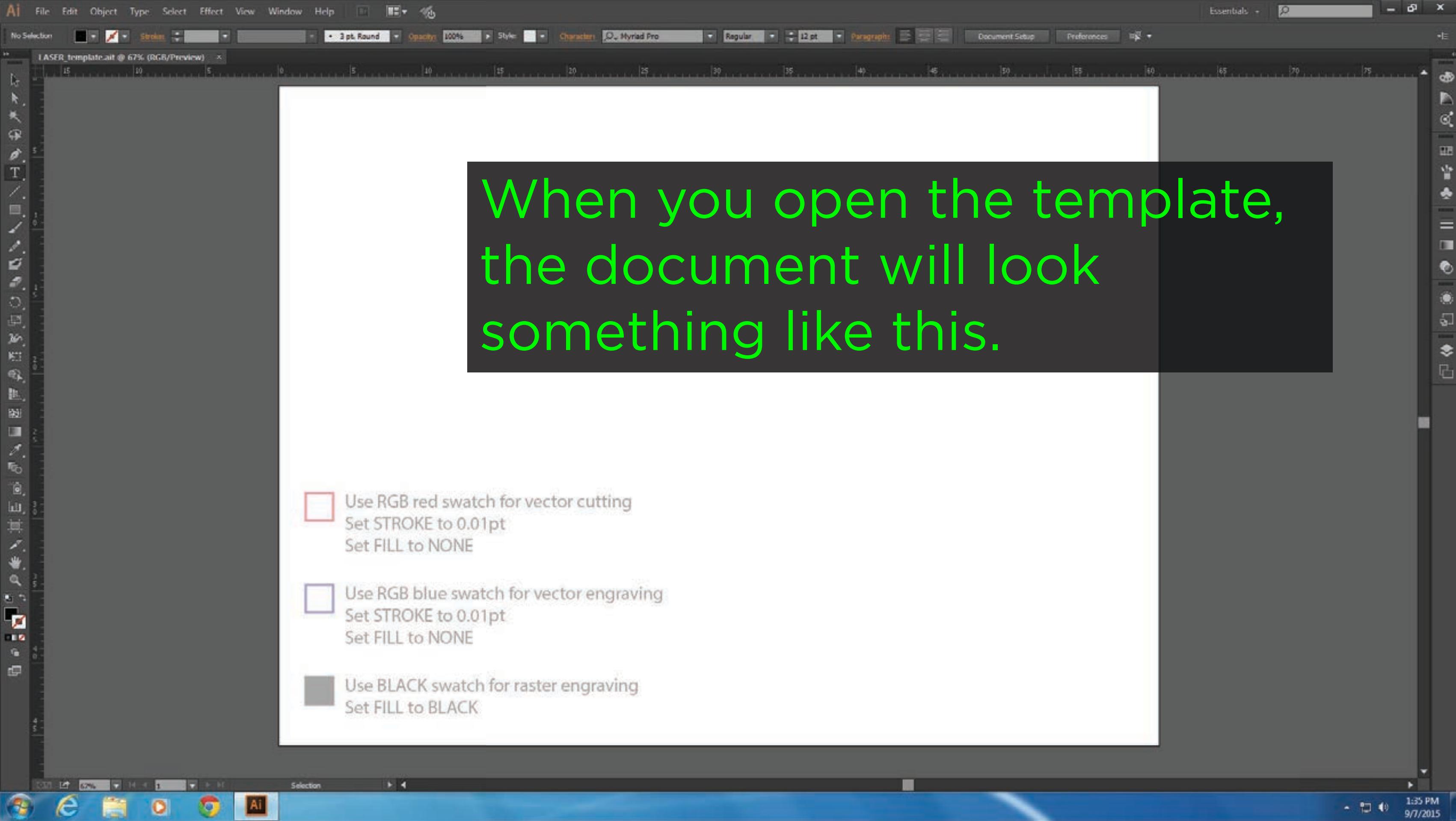
Gaffer's Assistant  
Customer

Mozilla  
Firefox

e

12:22 PM  
9/6/2015

For general use, it's easiest to print from **Adobe Illustrator**. We've created an Illustrator **template file** that's set up with stuff that's handy for the laser. Get the template from your instructor, or download a copy from the [lab's wordpress blog](#).

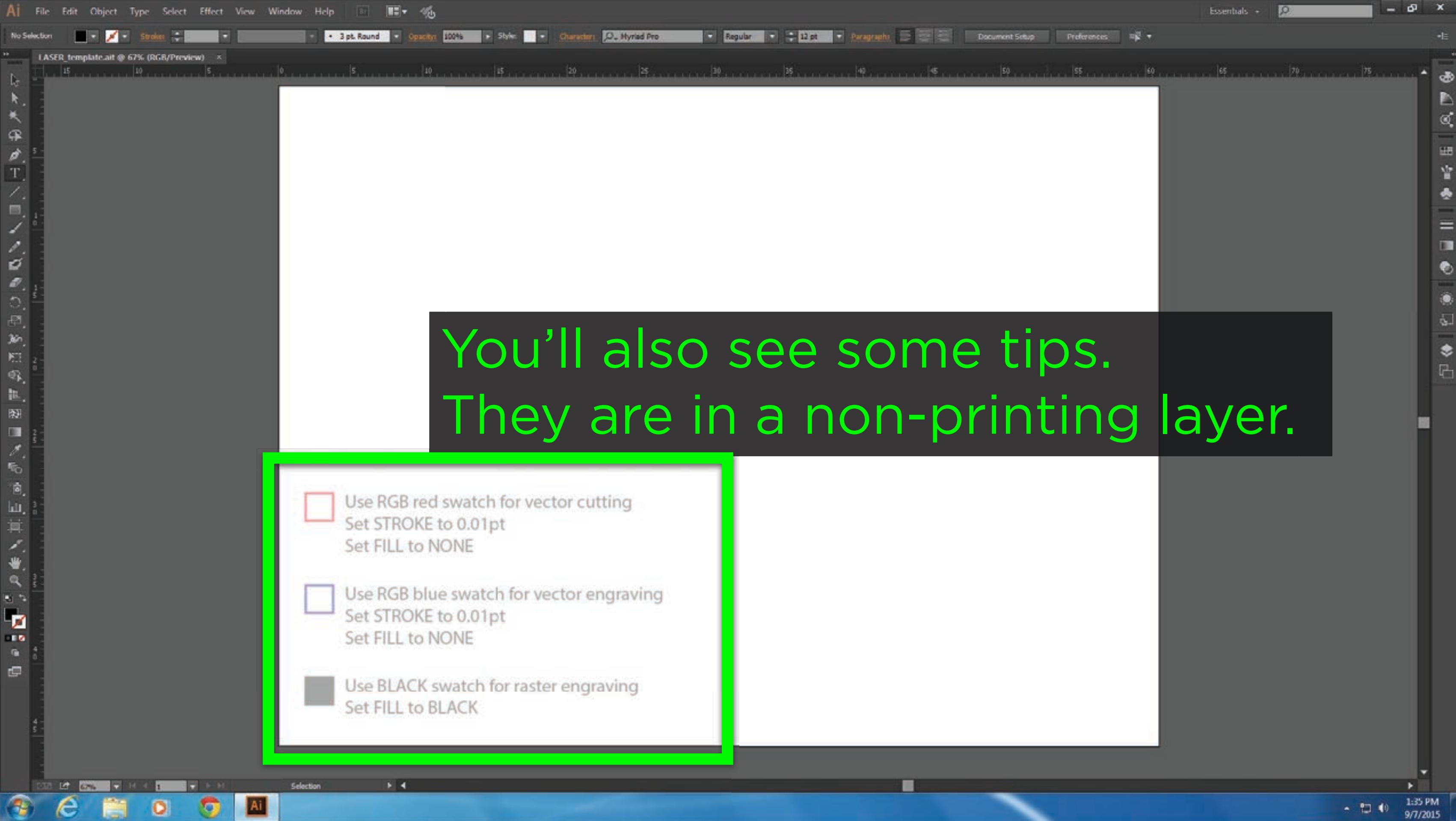


It is sized to 18" x 24"  
(the size of the cutting table.)

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'll also see some tips.  
They are in a non-printing layer.

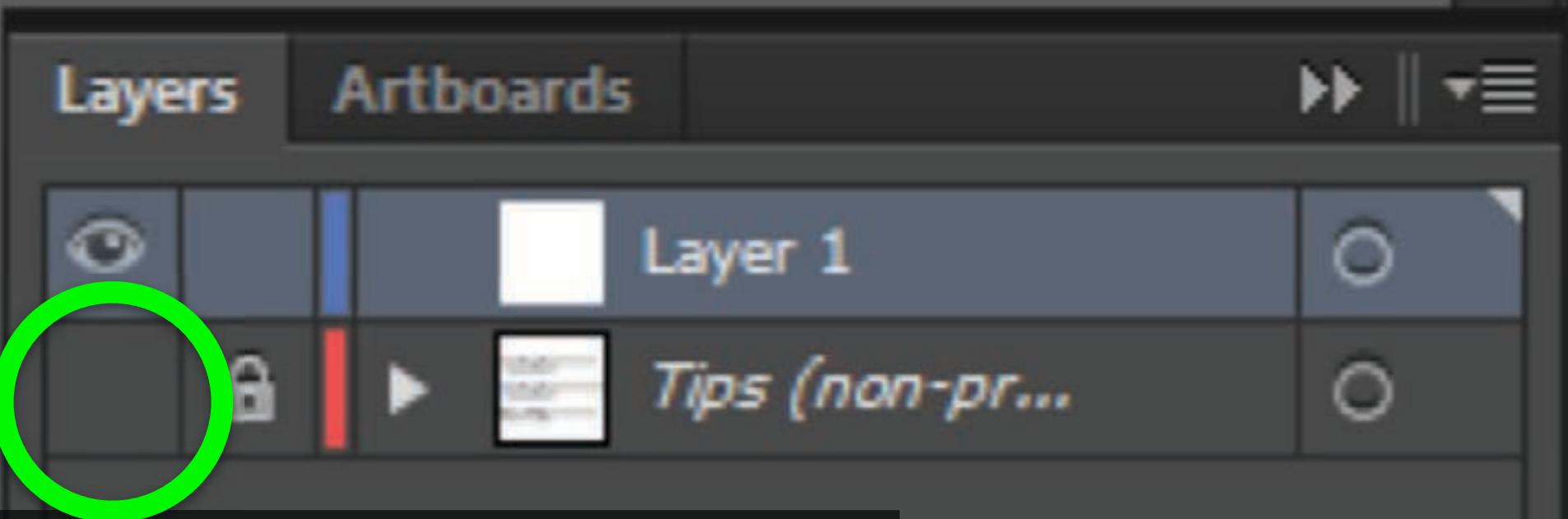
Use RGB red swatch for vector cutting  
Set STROKE to 0.01pt  
Set FILL to NONE

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

The tips let you know which specific colors tell the laser to perform specific functions.

- 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 (the eyeball) 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:

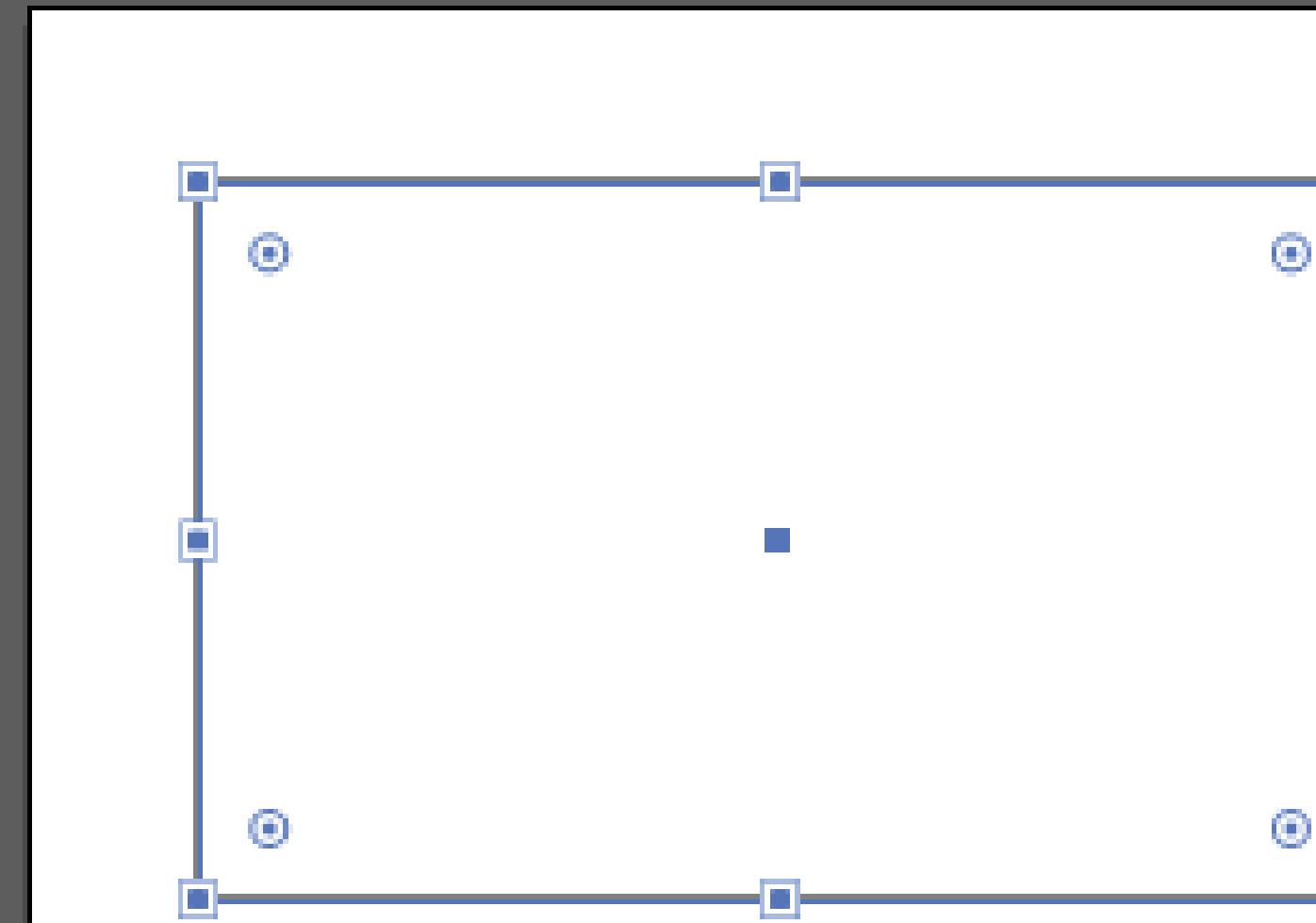
100%

Style:



Shape:

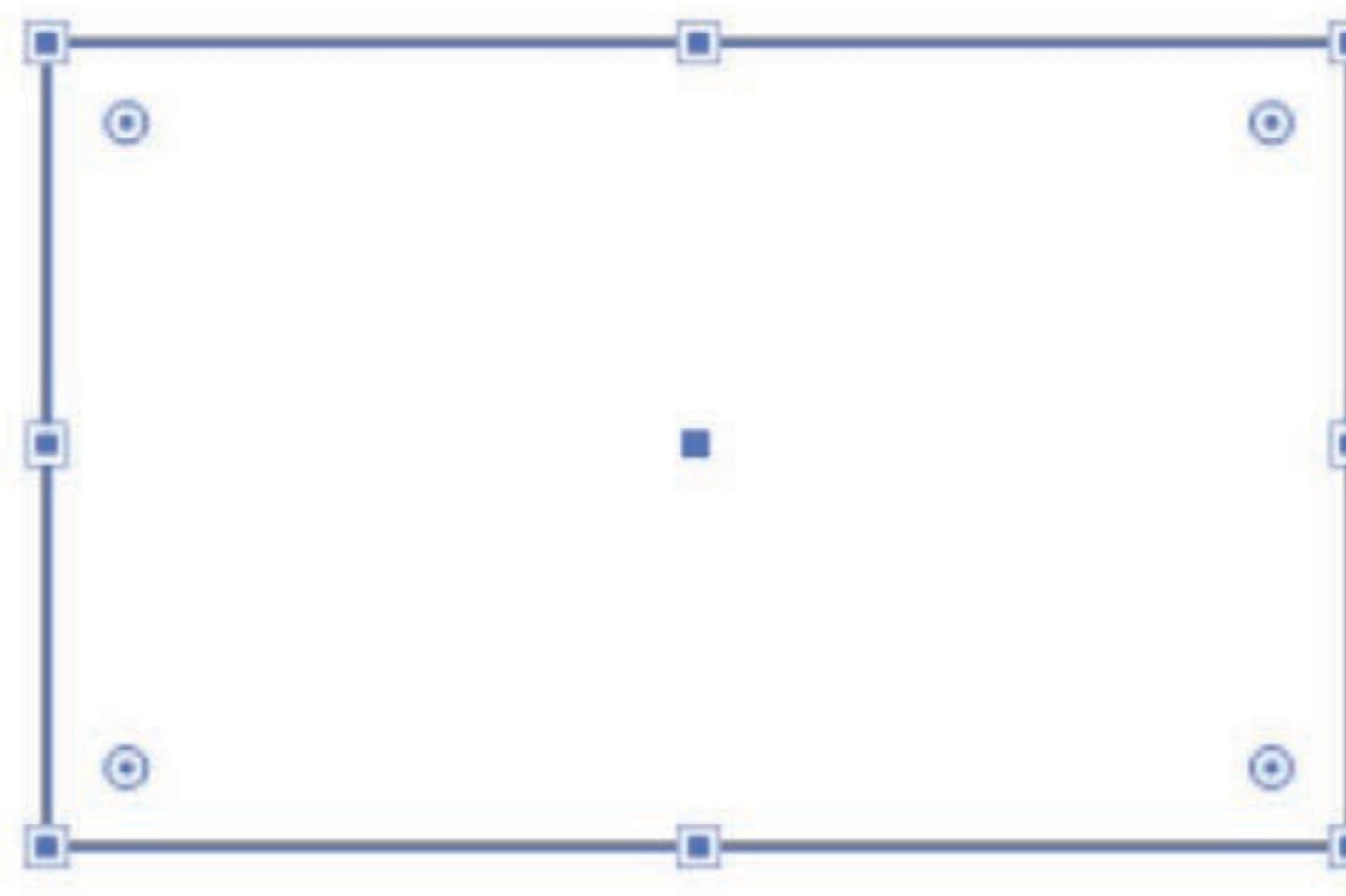
3/Preview) X



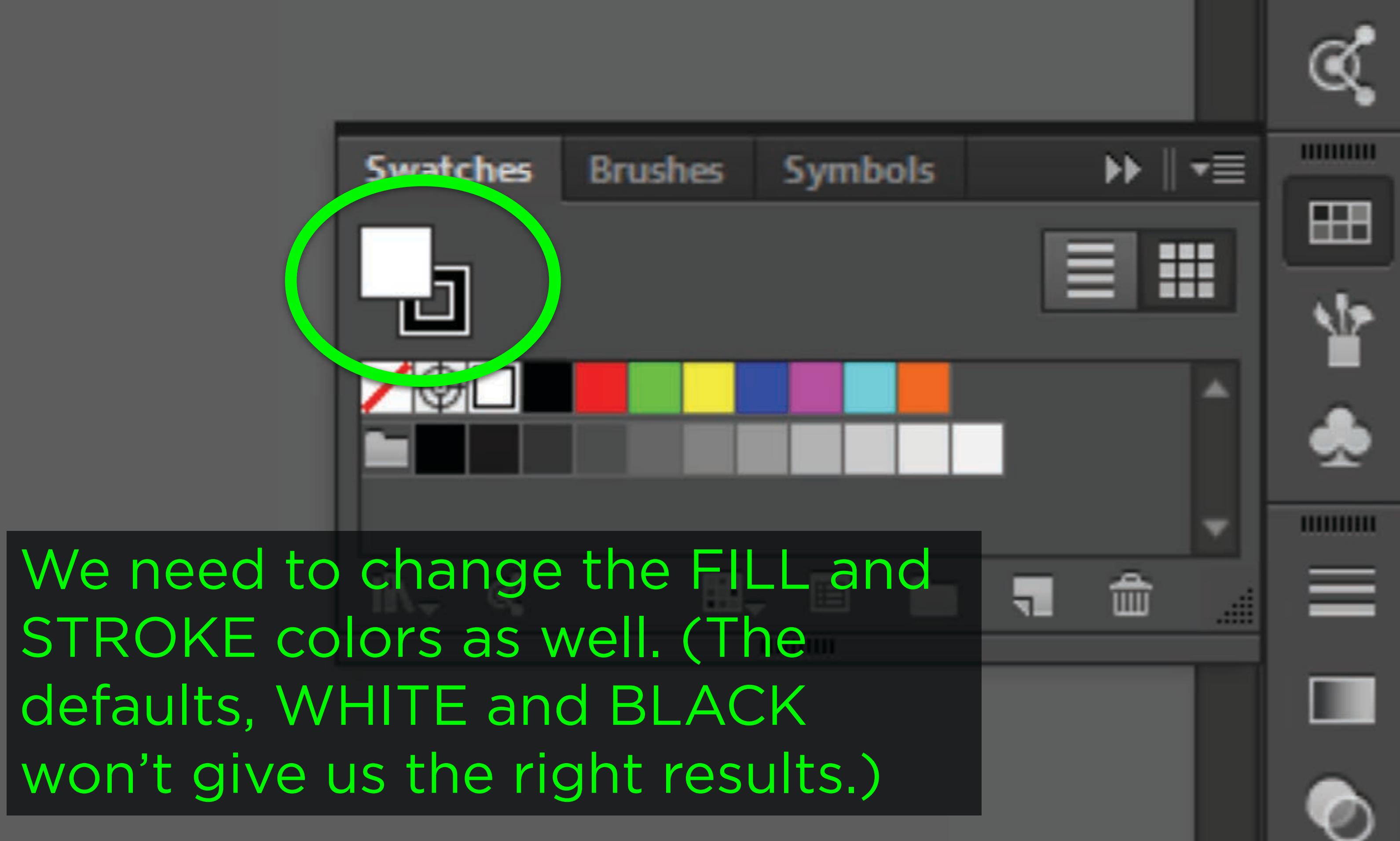
I'll start by drawing a rectangle...

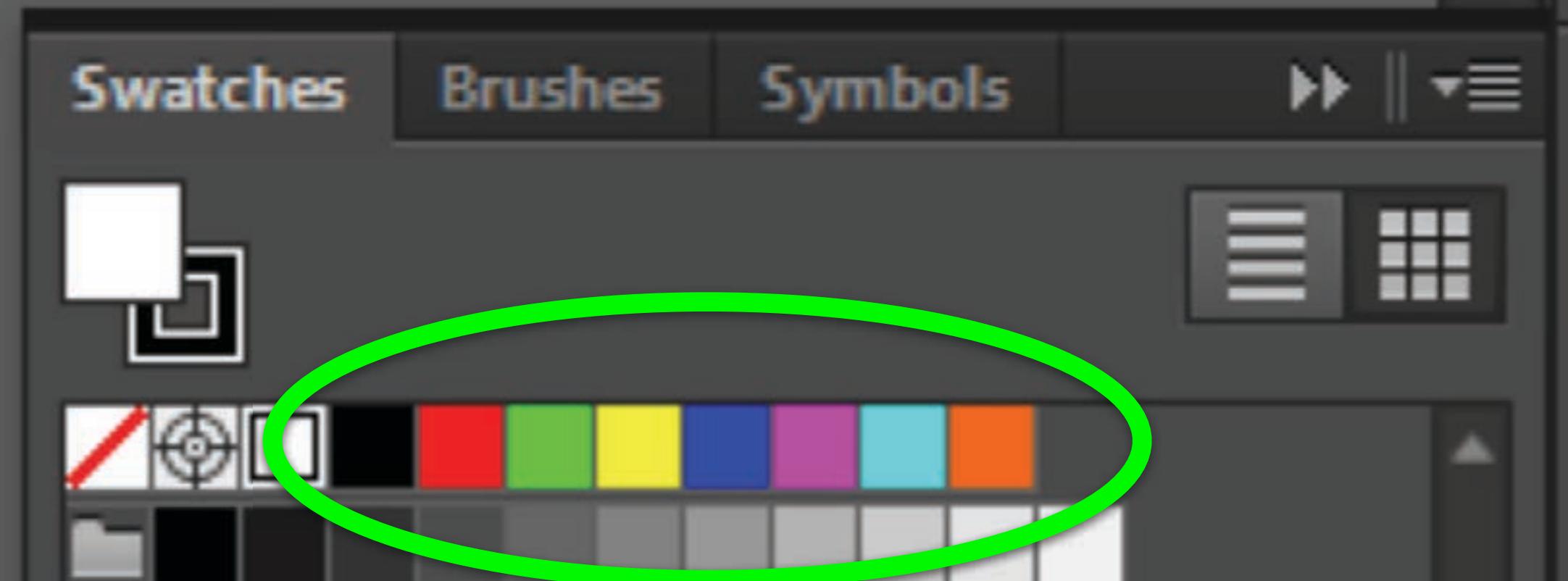
Stroke: 0.01 pt Uniform Basic Opacity: 100% Style:

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

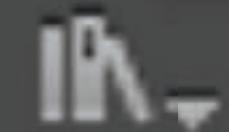
Symbols



For cutting, set the FILL to NONE.

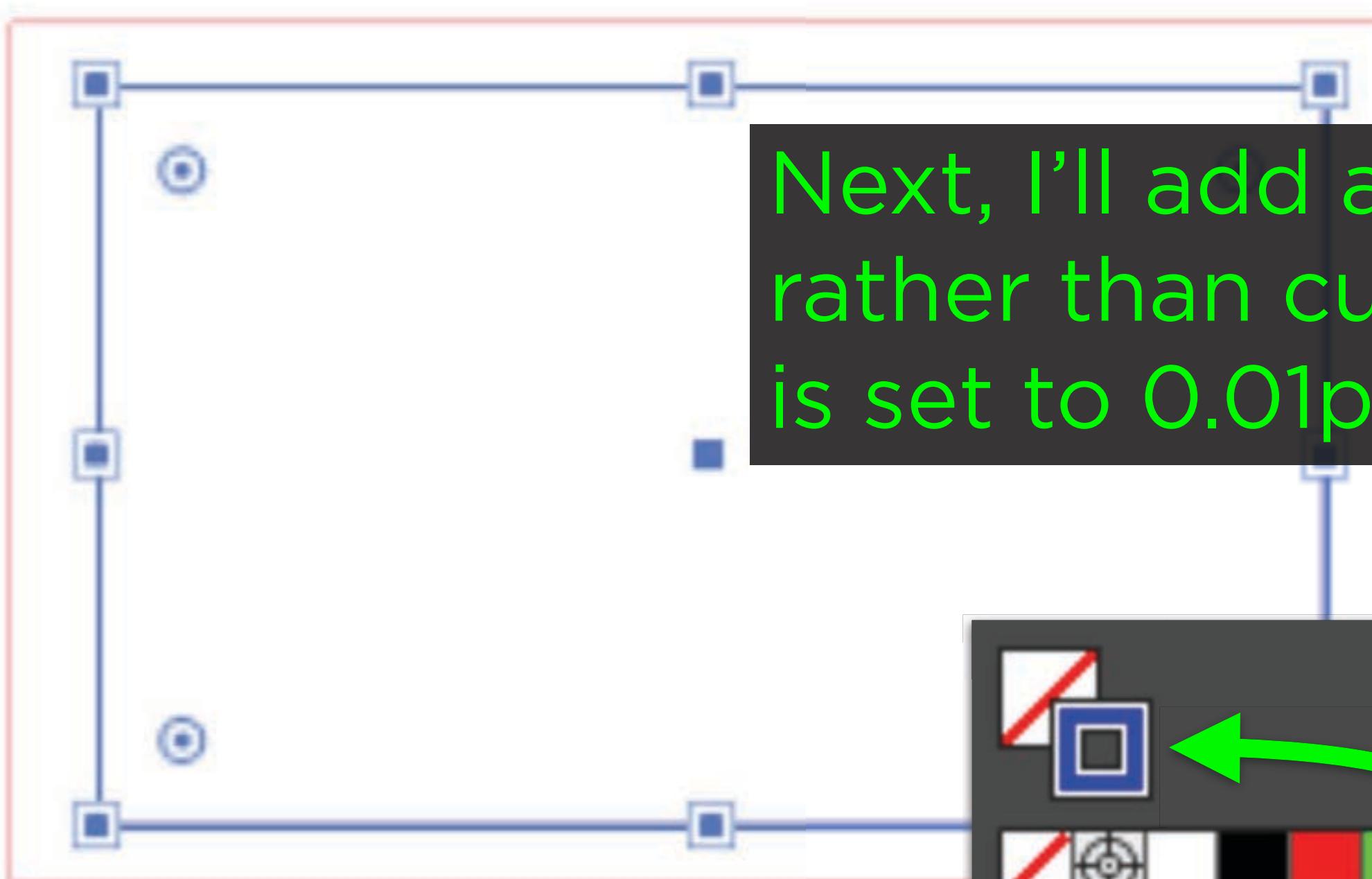


[None]





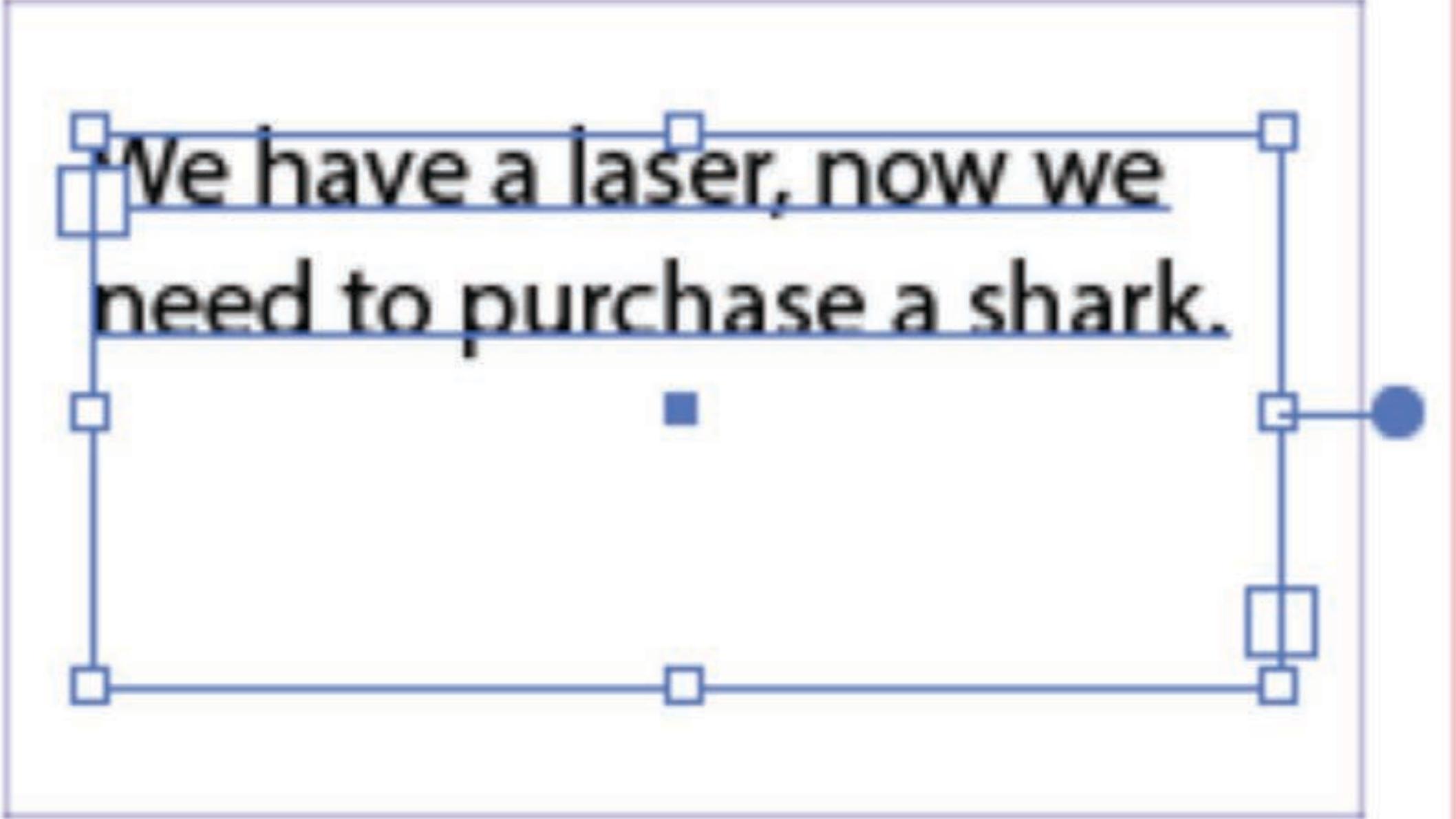
And set the STROKE to RGB RED.



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



... and set the **STROKE** to RGB BLUE.

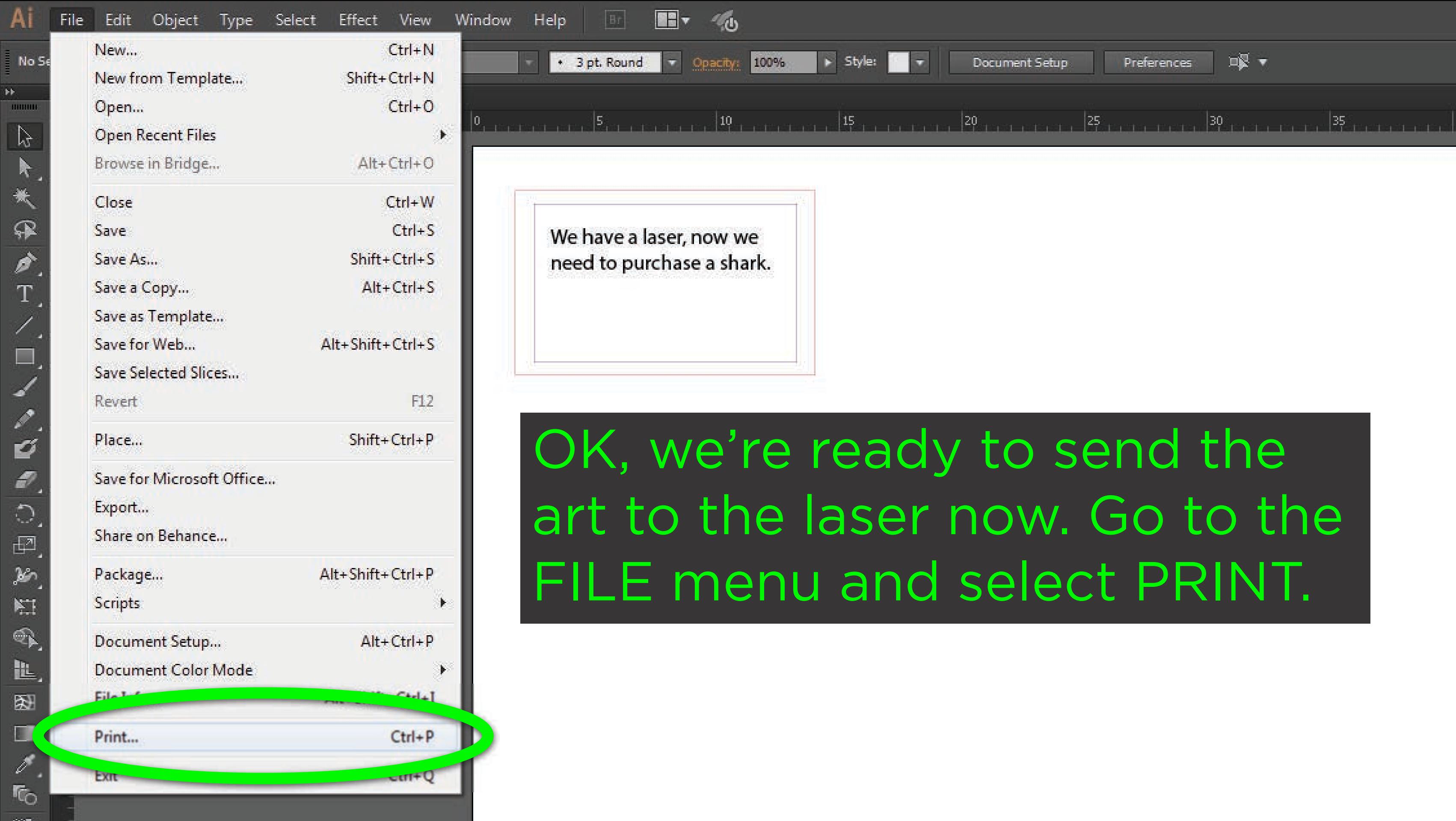


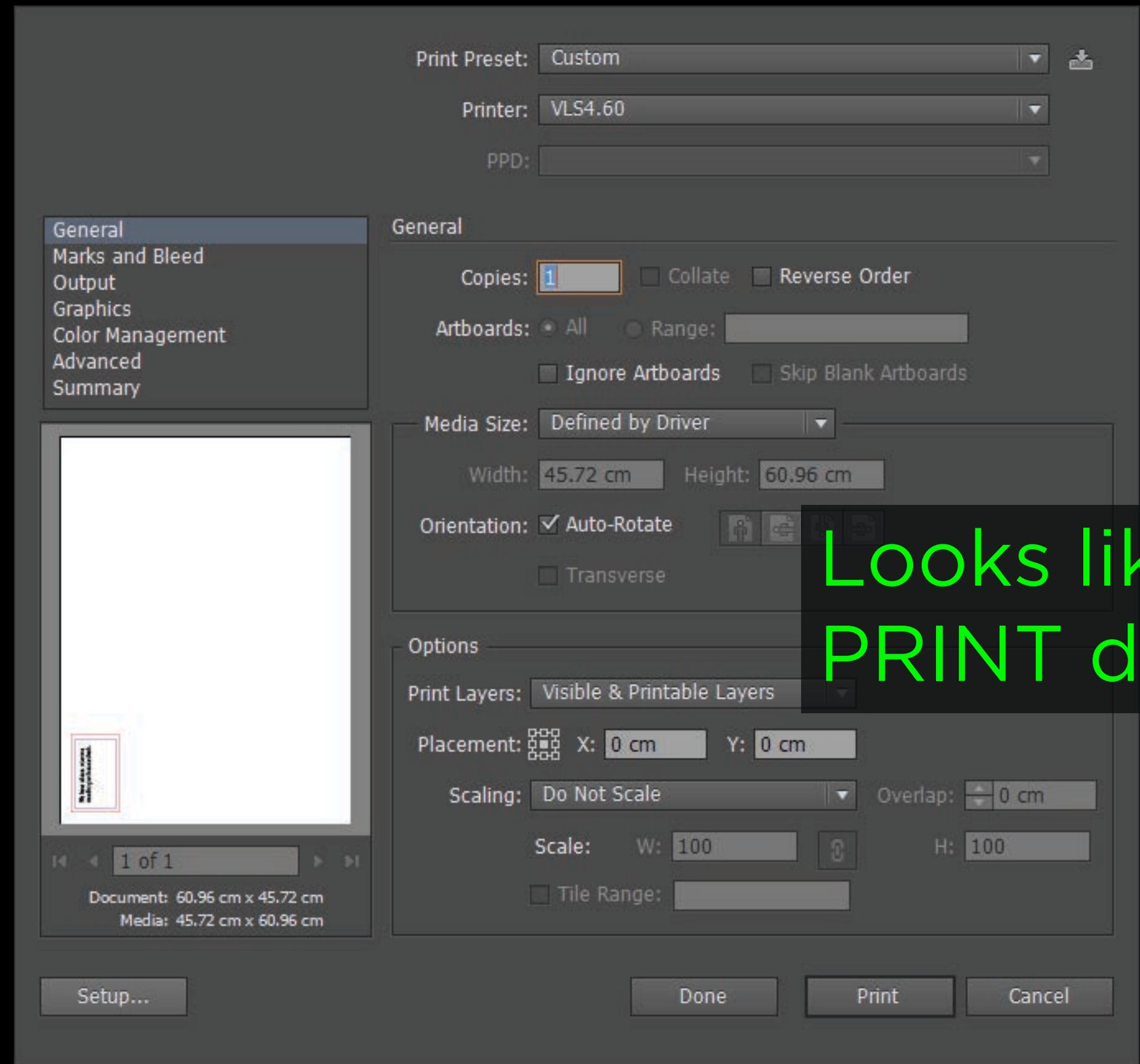
We have a laser, now we  
need to purchase a shark.

- 

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.



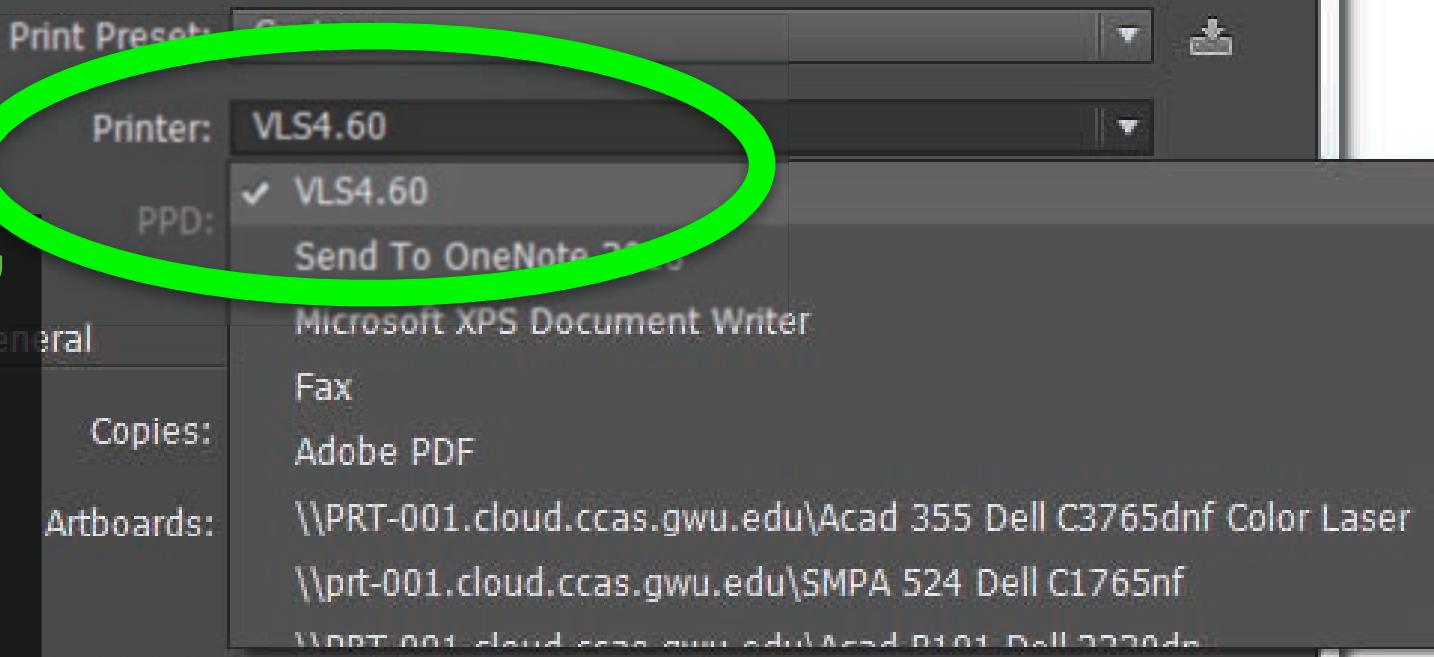


Print

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 cmScaling: **Do Not Scale**

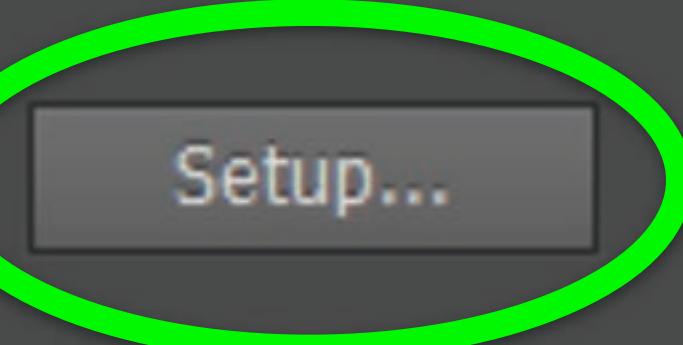
Scale: W: 100

 Tile Range:

1 of 1

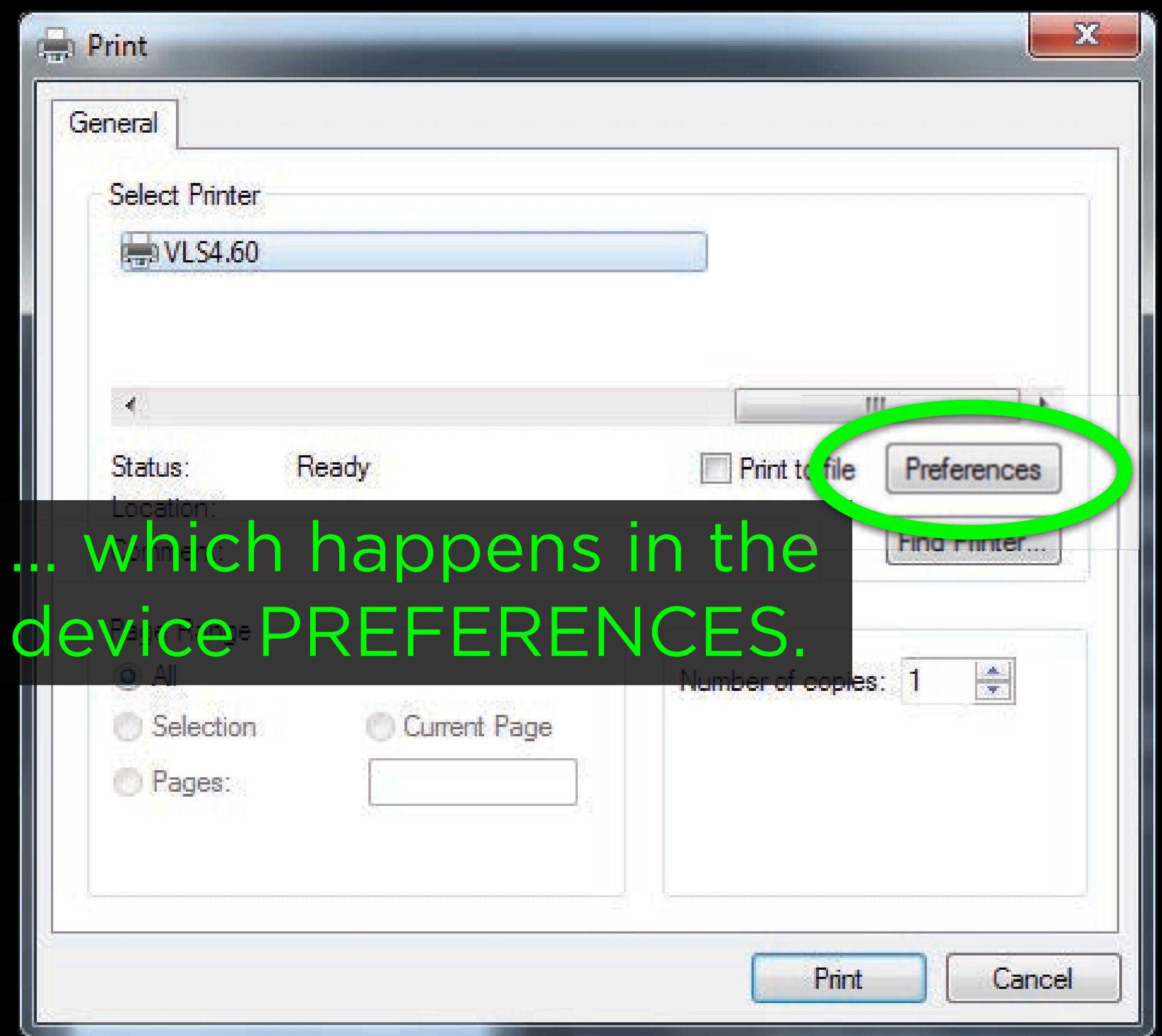
Document: 60.96 cm x 45.72 cm

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**

Material Thickness

 Merge Pages

Print Direction



Vector Performance

Standard

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.

**Apply****Defaults****Load****Save****OK****Cancel**

## 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 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.

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.

Not sure?

Ask your instructor!



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 thickness is left over from a previous job. Is it correct? Important, because the laser needs to know what depth to focus on.

Units

- Metric
- inches

Vector Perform

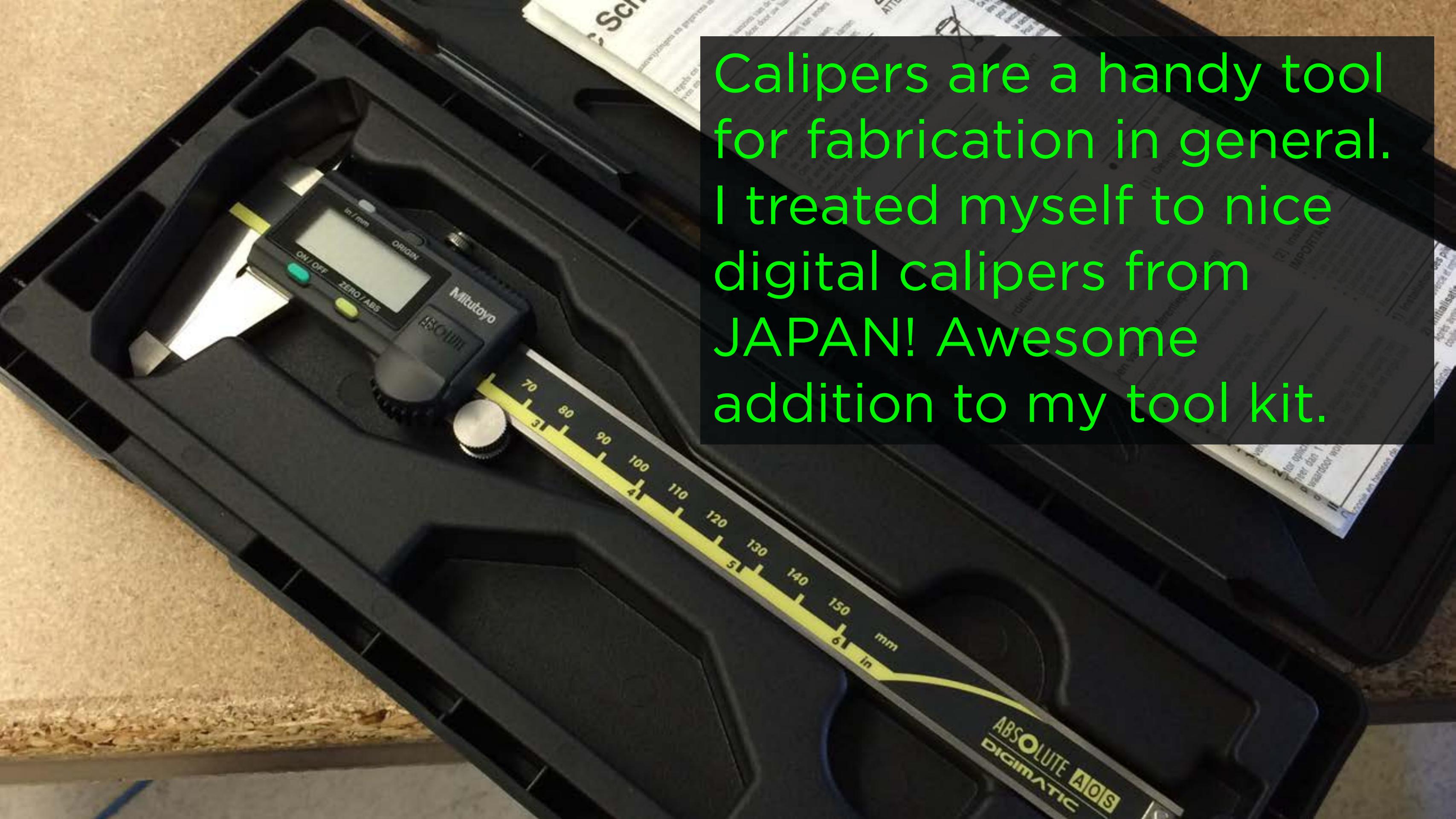


Standard

Fixture Type

NONE

Calipers are a handy tool for fabrication in general. I treated myself to nice digital calipers from JAPAN! Awesome addition to my tool kit.



Precise to 4 decimal places!



Notes:

Print Special Effects

Normal

Material Thickness

0.051 "

Merge Pages (Manual)

Print  
Direction



Punched it. The software  
rounds to 3 decimal places.

Units

Metric

inches

Fixture Type

NONE

Vector Perf

Stand

click for other commands.

## Vector Performance



Standard

### Fixture Type

NONE



OK!

Apply

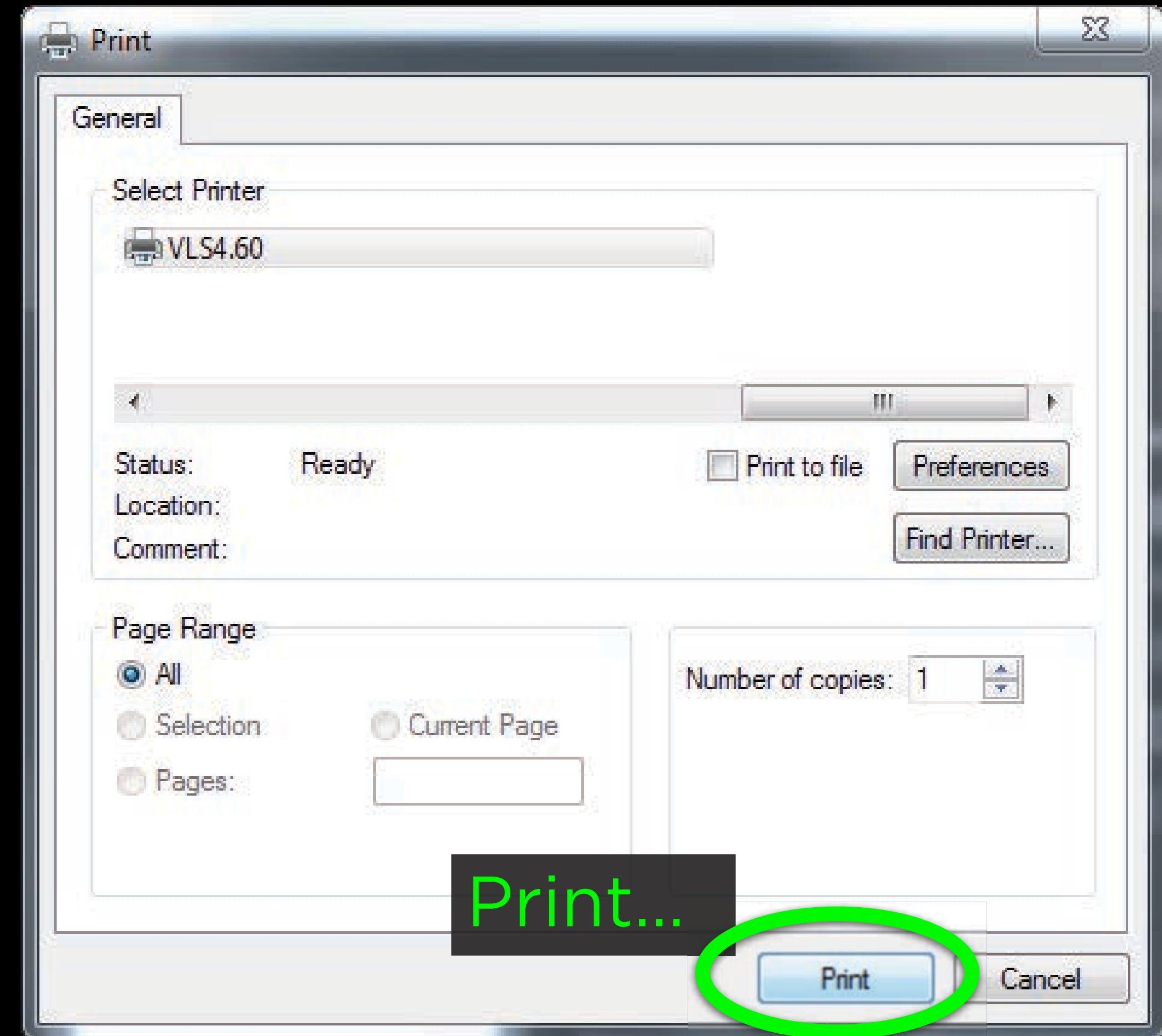
Load

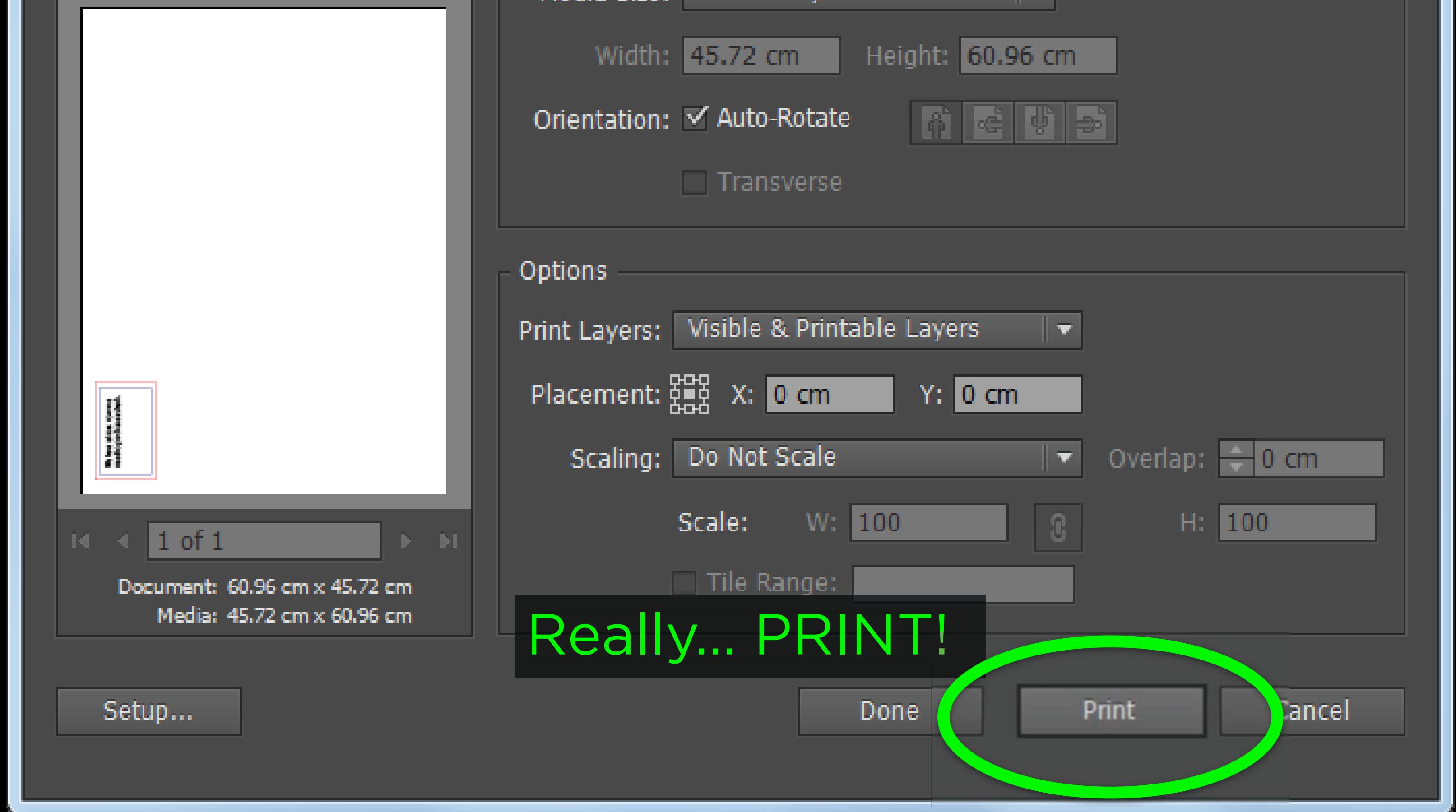
OK

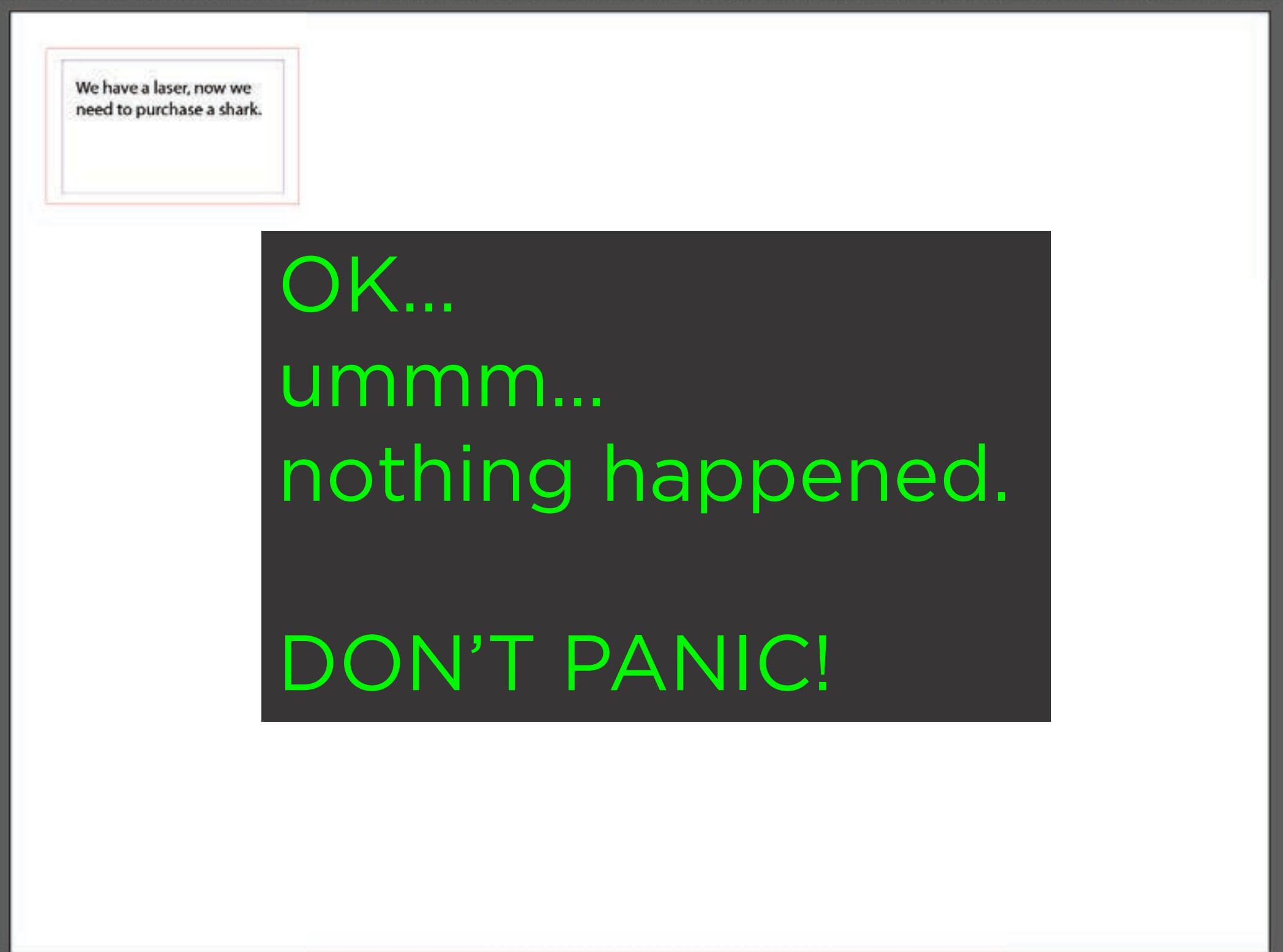
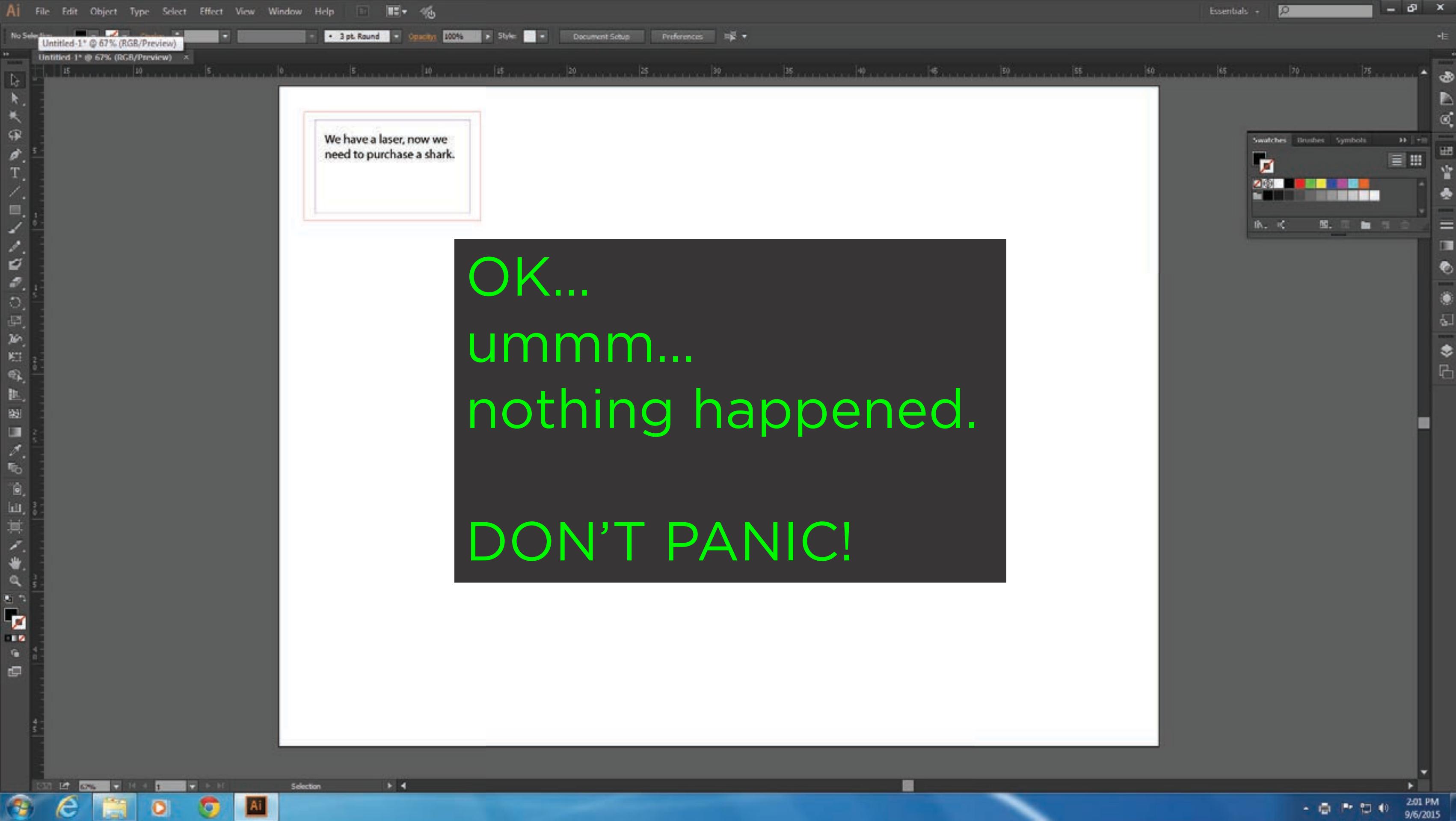
Defaults

Save

Cancel

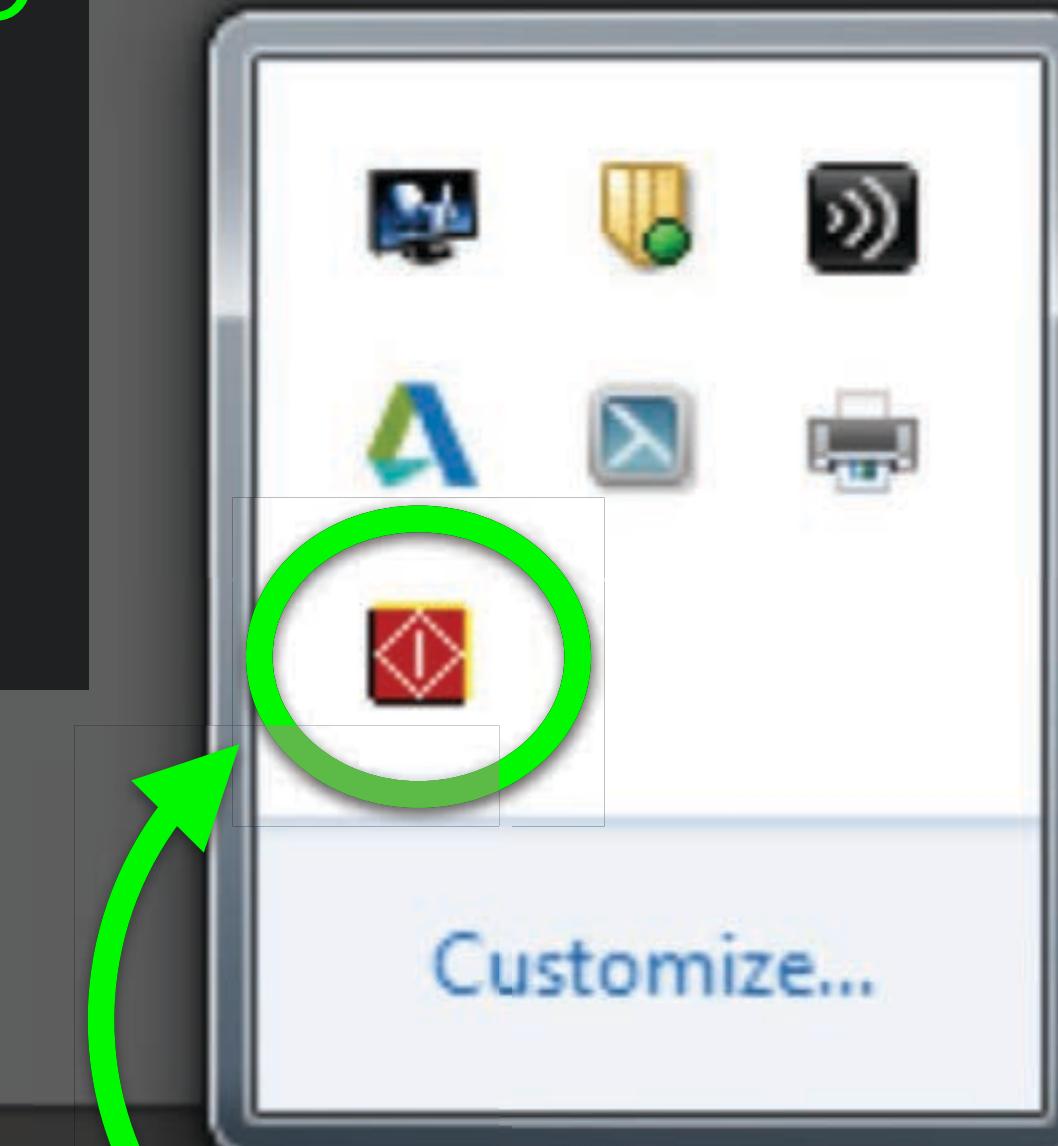






Selection

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



2:02 PM  
9/6/2015

Viewer

System

Diagnostics

VLS4.60 Control Panel 5.30.57.46 VLS4.60 Document 60W CO2 (10.6μ)

File: 1. Untitled-1

1 of 1

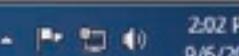
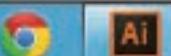
Created on: Sun 6 Sep 2015, 2:01pm

Copies: 0 Runtime: 0:00:00



Zoom: 100.0%

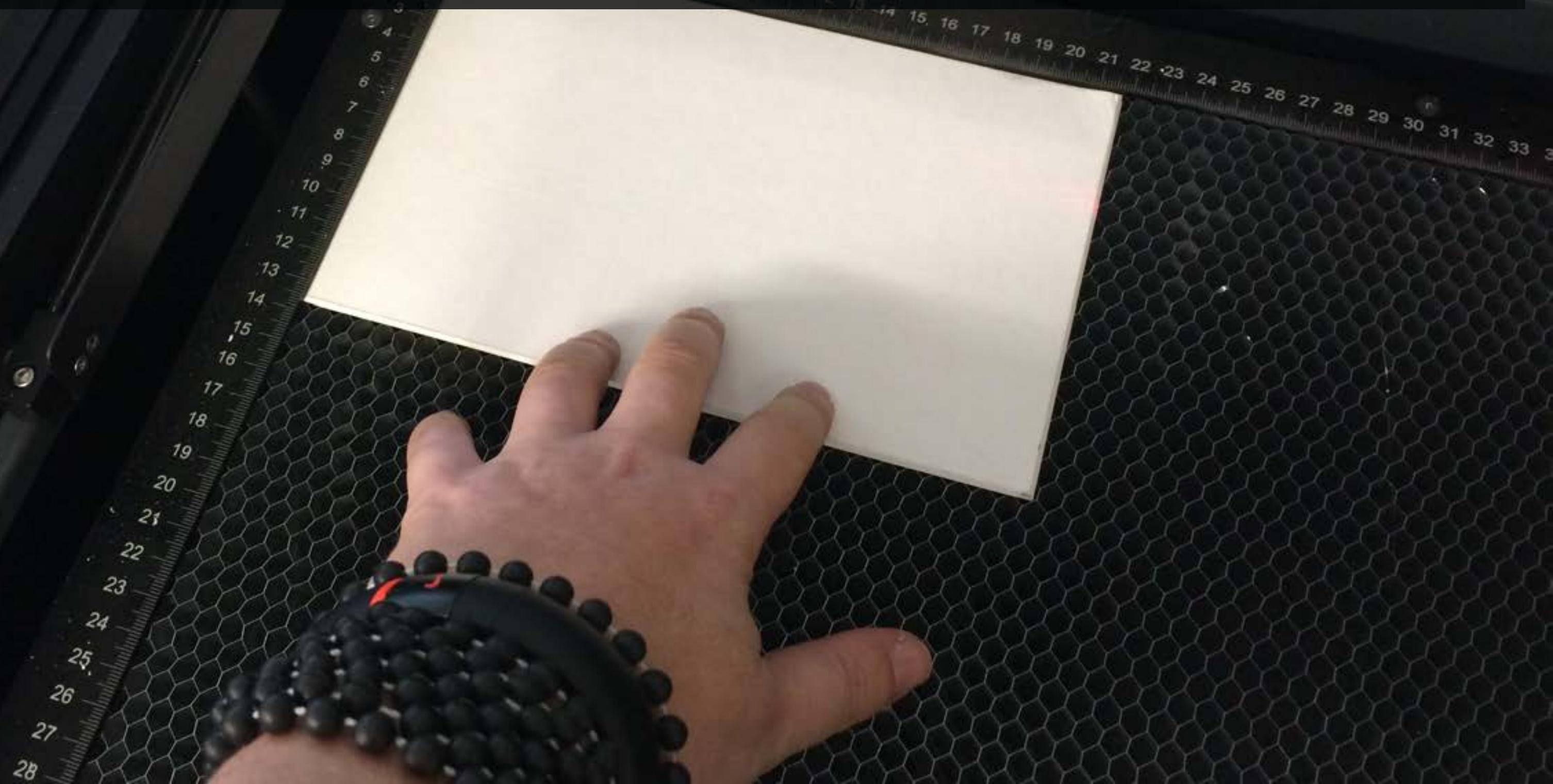
Idle

2:02 PM  
9/6/2015



Gently lift the top of the laser.

Place the material to be cut on the cutting table.  
For the moment leave the top of the laser open.



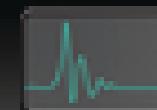
15 16 17 18 19 20 21 22 23

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





Viewer



System



Diagnostics

VLS4.60

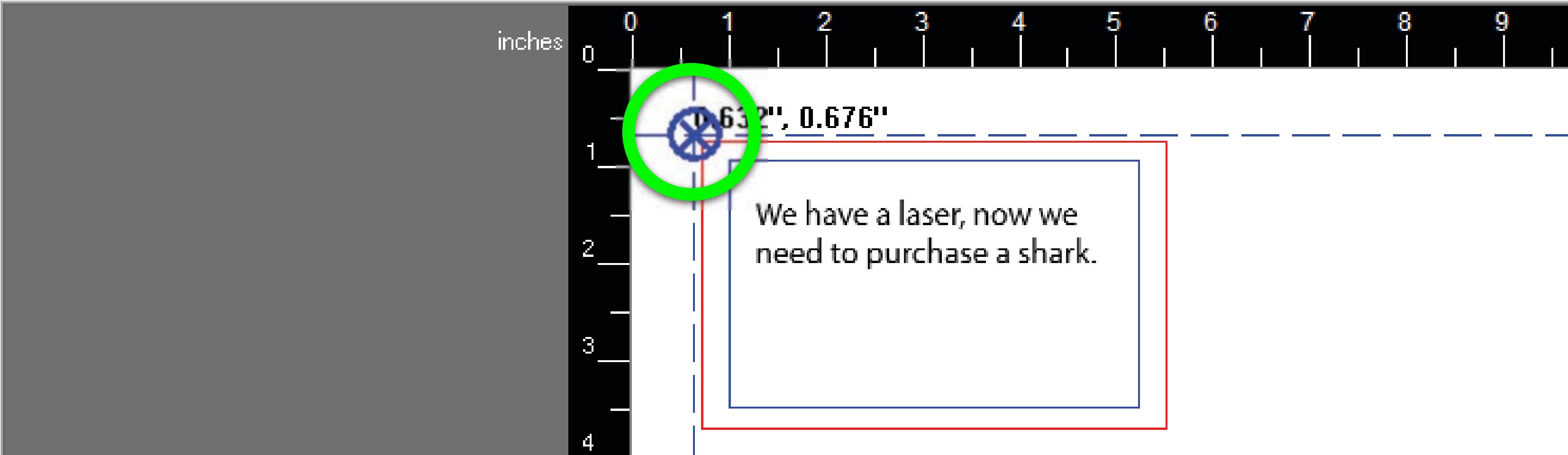
File: 1. Untitled-1

1 of 1

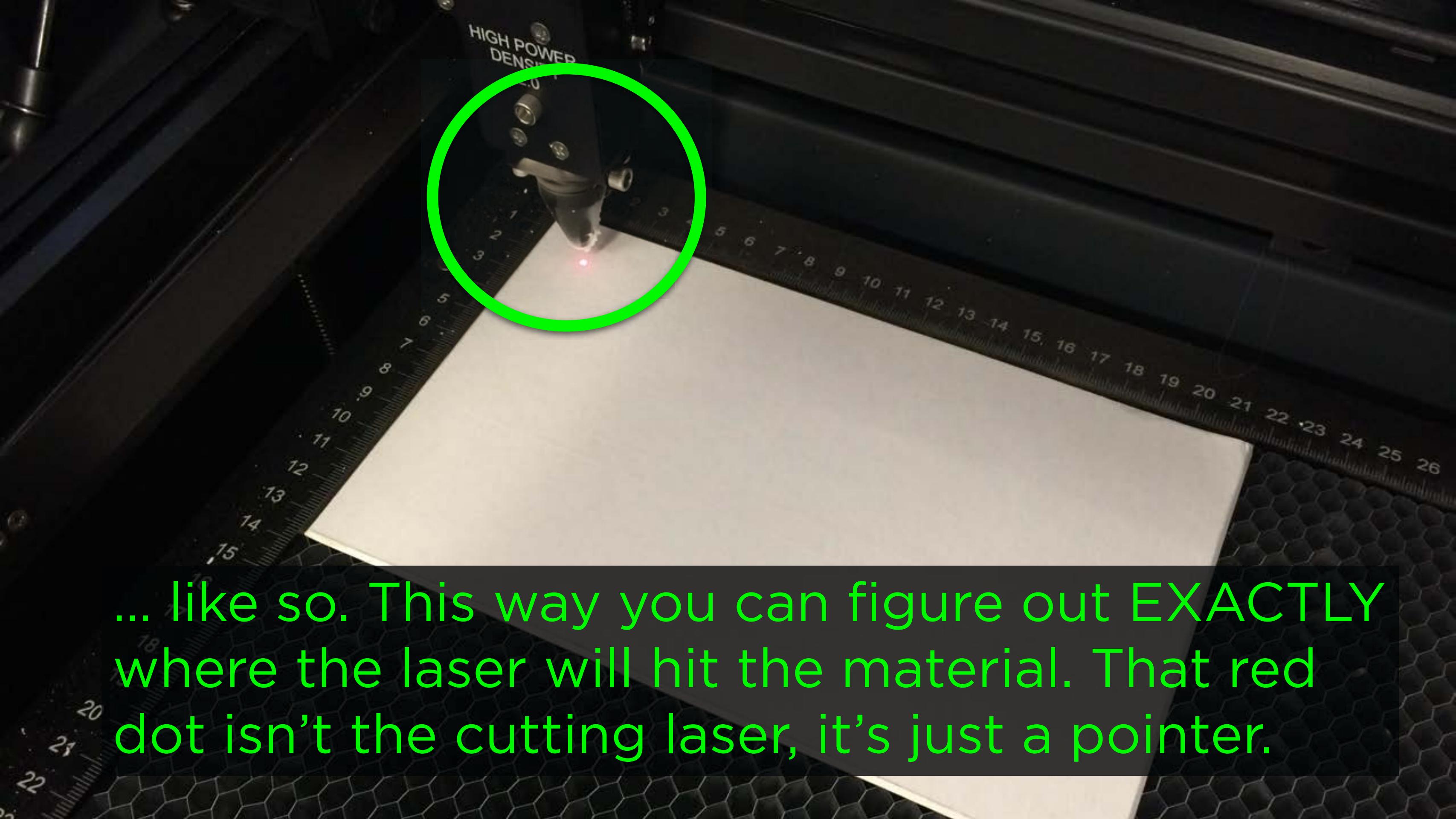


Created on:

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.



Viewer



System



Diagnostics

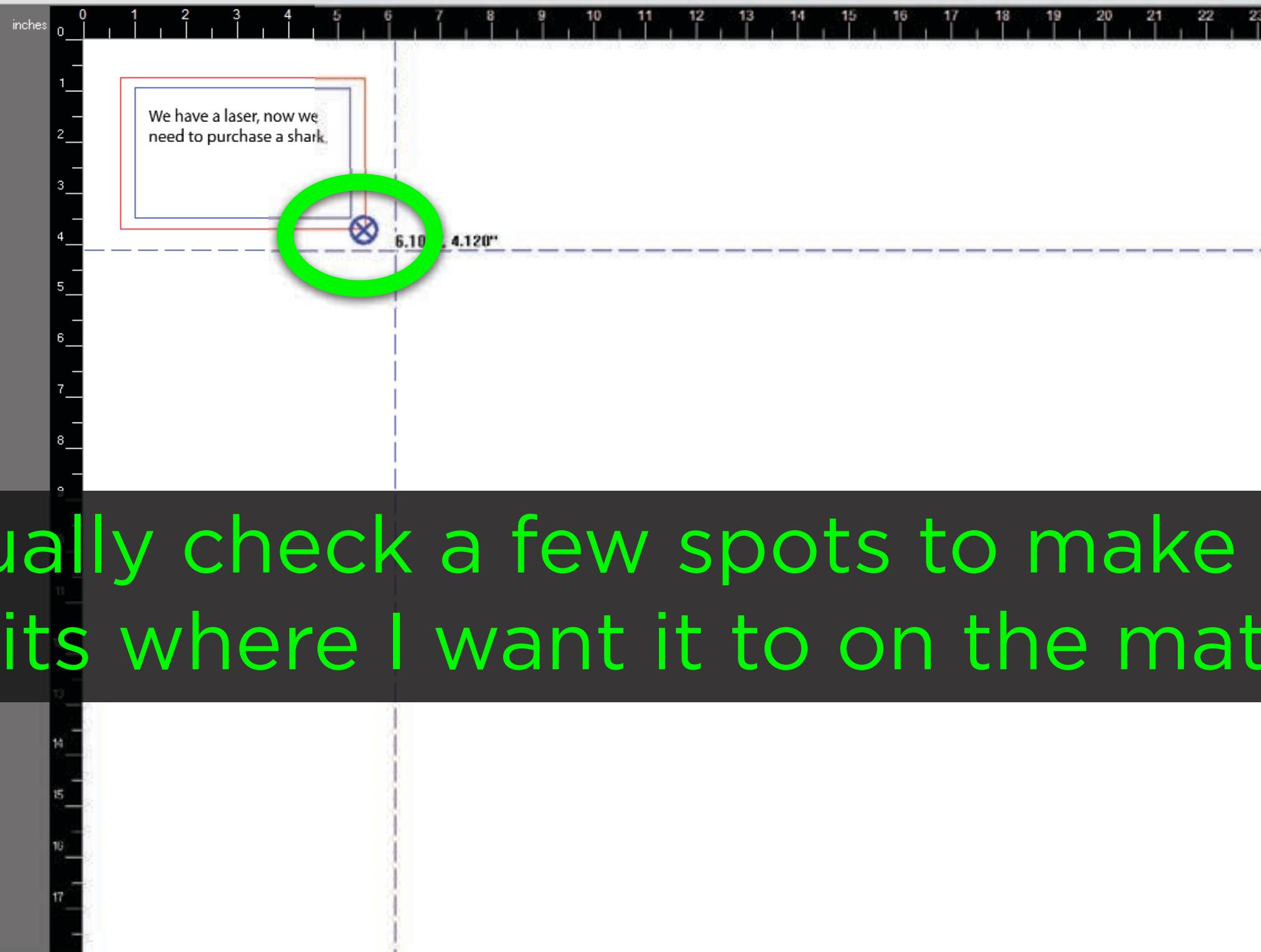
VLS4.60 Control Panel 5.30.57.46 VLS4.60 Document, 60W CO2 (10.6μ)

File: 1. Untitled-1

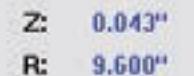
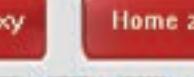
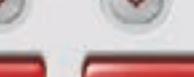
1 of 1

Created on: Sun 6 Sep 2015, 2:01pm

Copies: 1 Runtime: 0:00:00



I usually check a few spots to make sure my art fits where I want it to on the material.



X: 5.493"

Y: 3.720"

Z: 0.043"

R: 9.600"



Zoom: 100.0%

Door Open





Viewer



System



Diagnostics

VLS4.60 Control Panel 5.30.57.46 VLS4.60 Document 60W CO2 (10.6μ)

File: 1. Untitled-1

1 of 1

Created on: Sun 6 Sep 2015, 2:01pm

Copies: 0 Runtime: 0:00:00



Home xy

Relocate View

X: 6.000"  
Y: 1.707"  
Z: 0.043"  
R: 9.600"

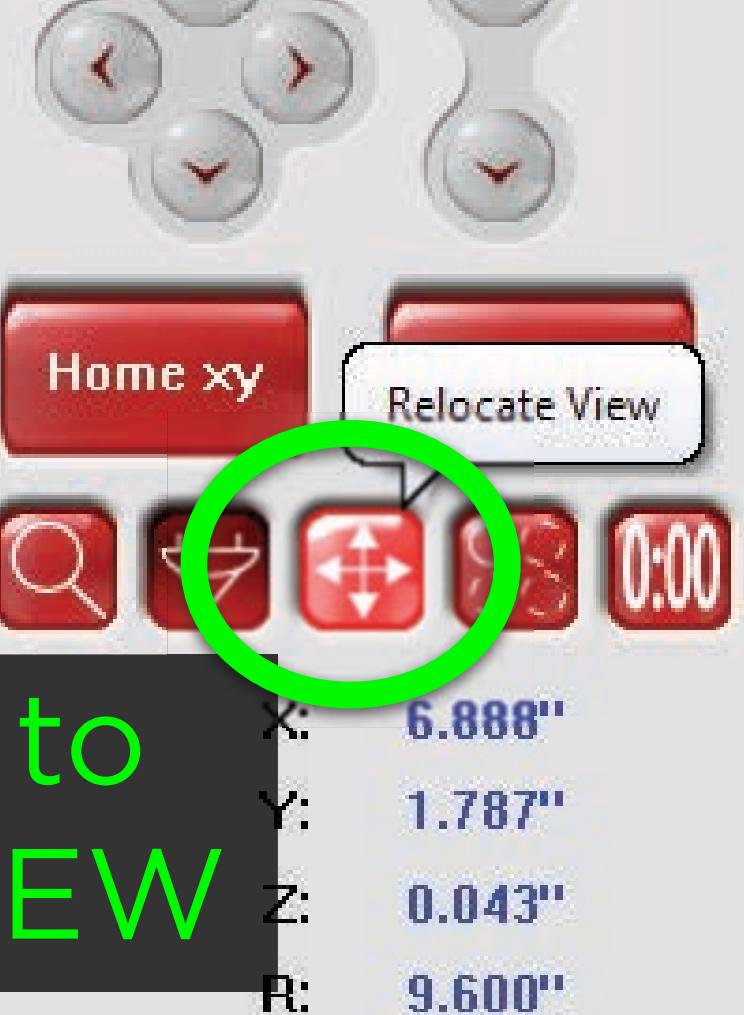
Go...

Settings

Close

Zoom, 100.0%

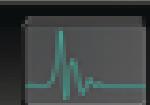
Door Open



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



Viewer



System



Diagnostics

VLS4.60 Control Panel 5.38.5

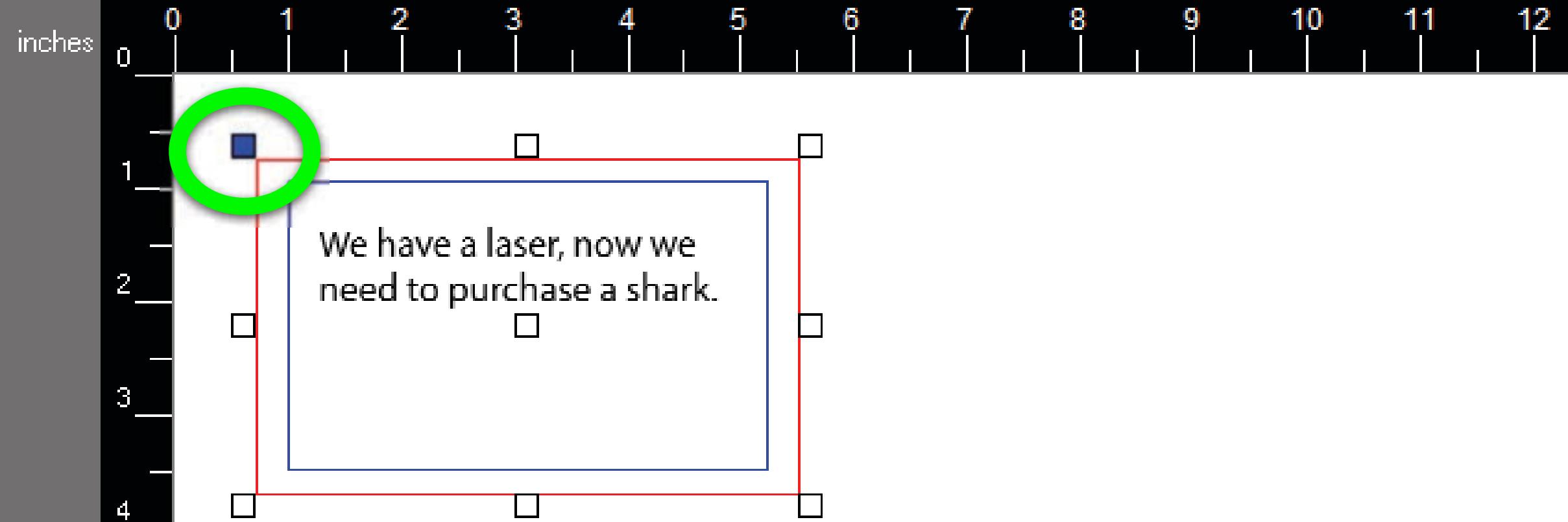
File: 1. Untitled-1

1 of 1



Created on:

Sun 6 Sep 2015, 2:01pm



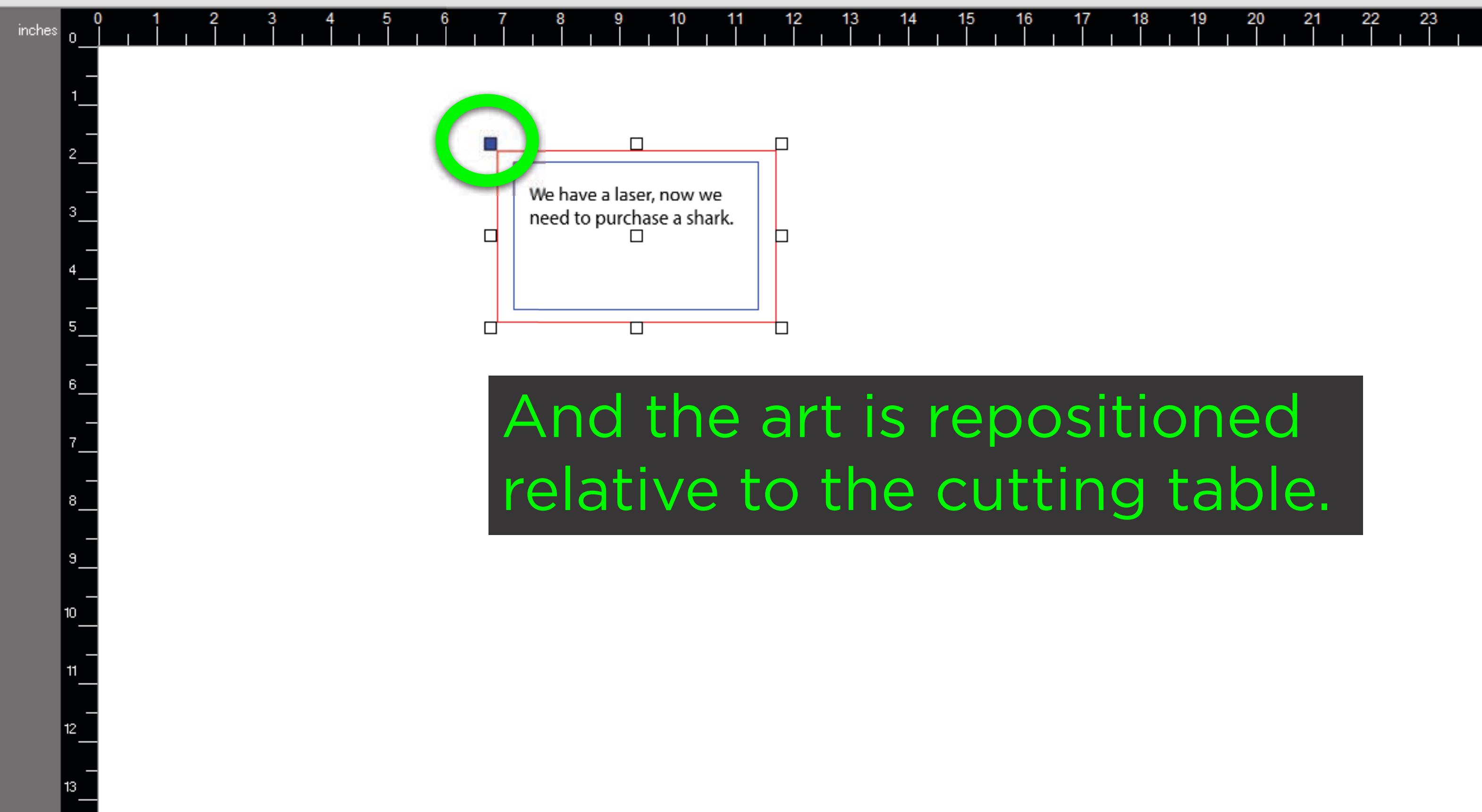
Click on a corner tab of the art to align  
to the current location of the lens  
(default is upper-left, usually fine.)

Then click on TO POINTER.



1 of 1

Created on: Sun 6 Sep 2015, 2:01pm



And the art is repositioned  
relative to the cutting table.

Copies: 0

Runtime: 0:00:00

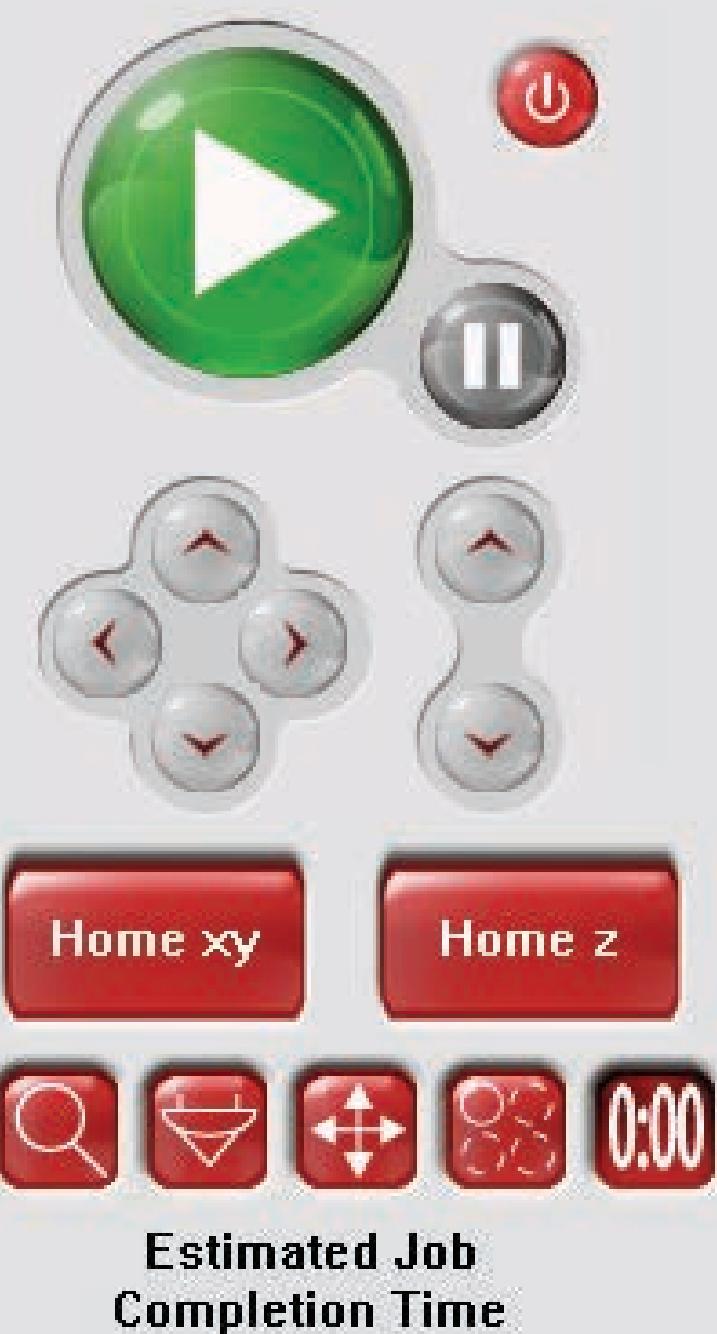
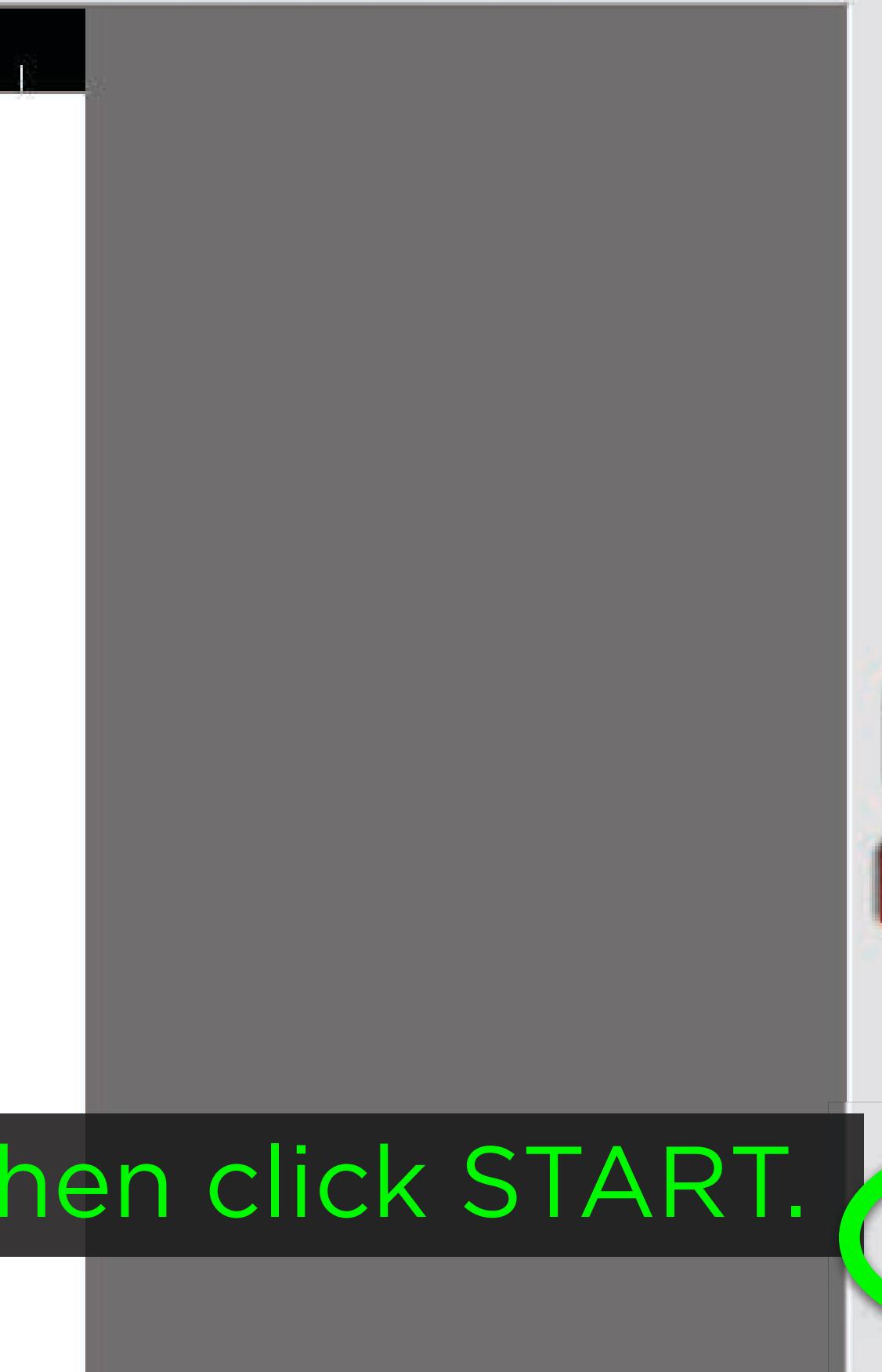
15 16 17 18 19 20 21 22 23

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

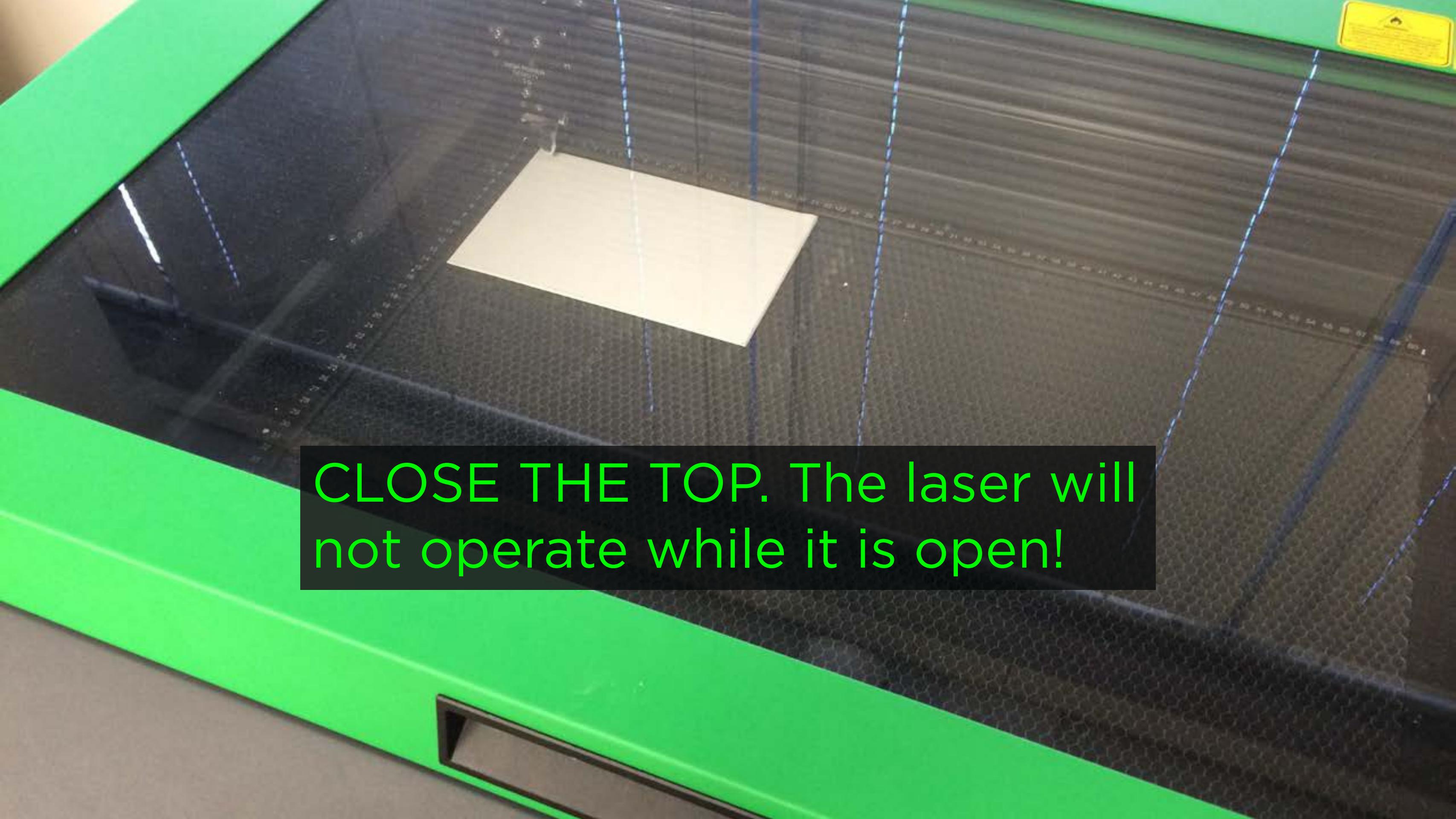


Then click START.



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



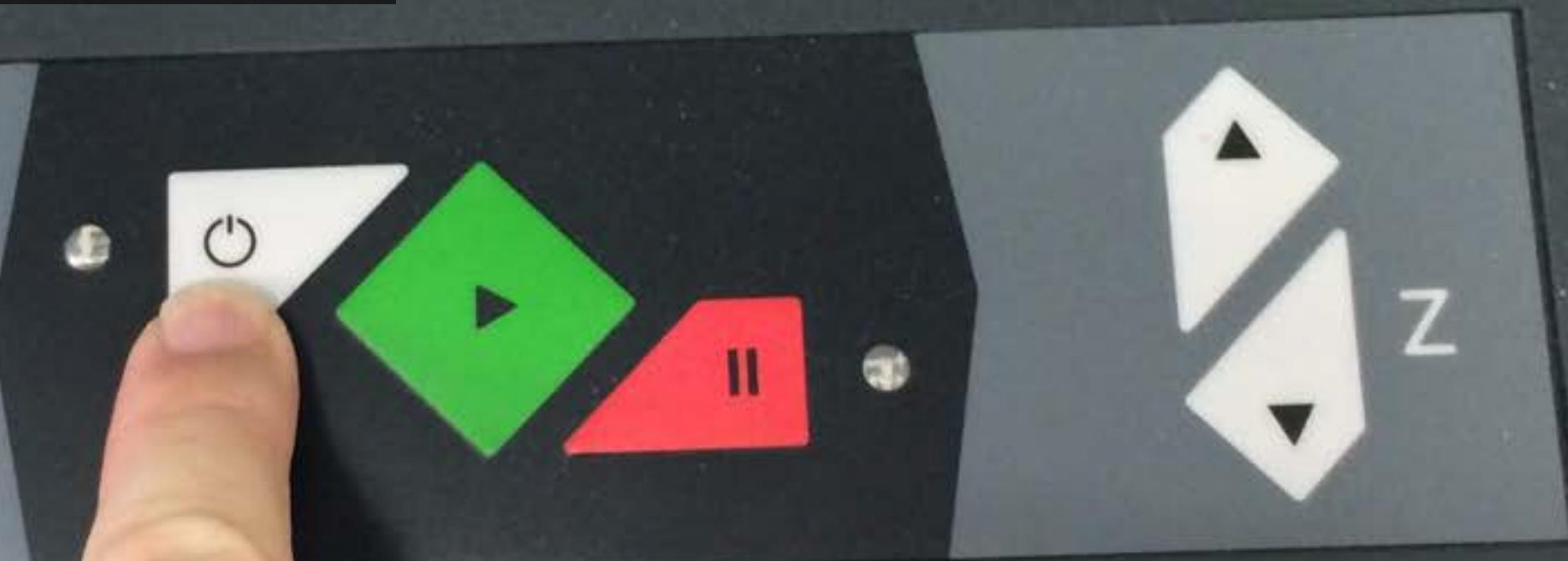
A close-up photograph of the top cover of a green industrial laser machine. The cover is made of a textured, dark grey material. A bright yellow rectangular warning label is visible in the top right corner. In the center, there is a small, light-colored rectangular component. A black rectangular overlay contains the text.

**CLOSE THE TOP.** The laser will  
not operate while it is open!

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



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



Copies: 0

Rename: 0:00:00

20 21 22 23

Now hit the ginormous  
START BUTTON.

Start engraving this print job.



Home xy

Home z



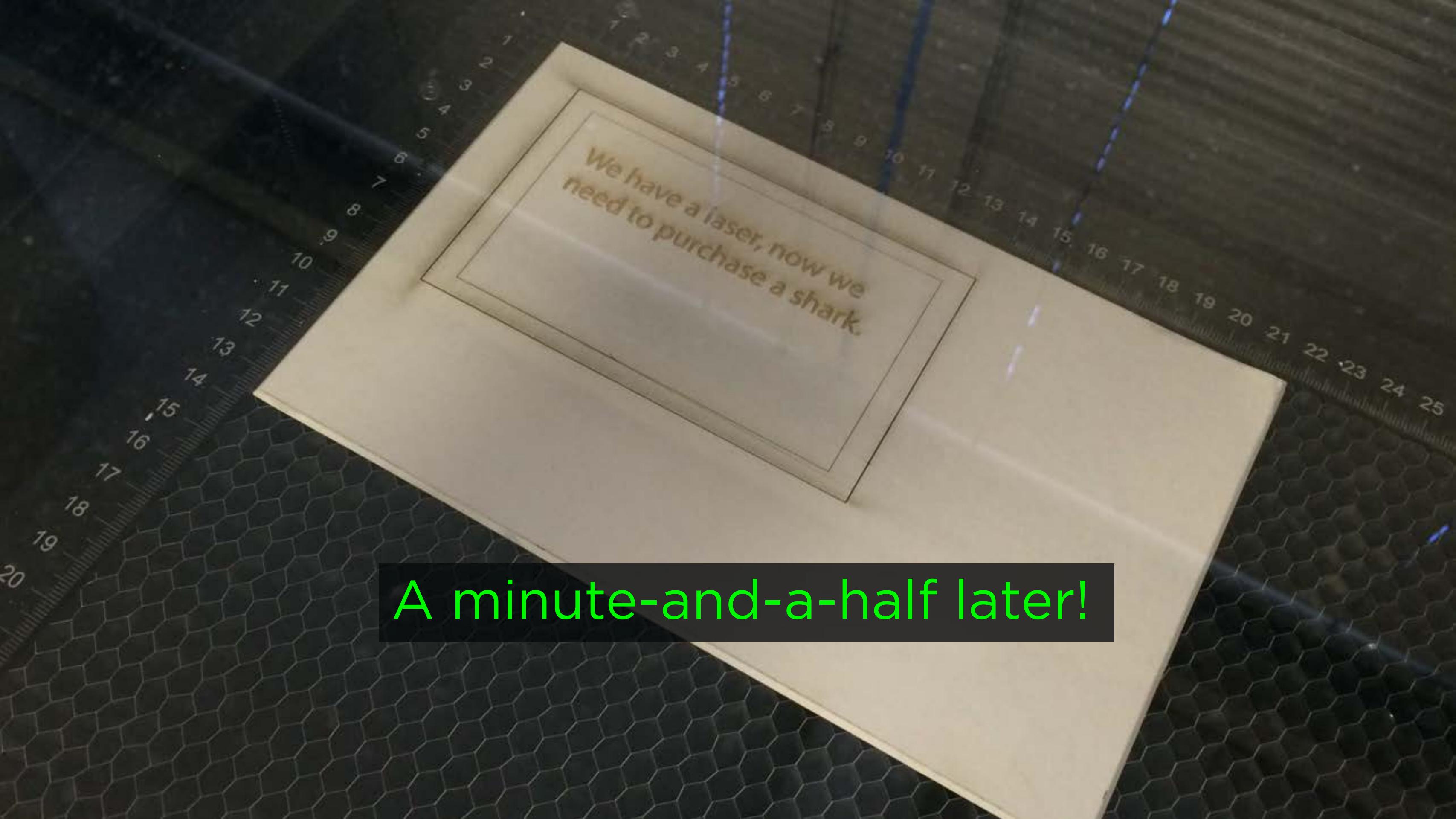
0:00

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 won't get out  
of control. Get the lab tech: s/he 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. 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

Select

Export...

Import...

Delete

Purge

Close

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

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

### Purge

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

Yes

No

DO IT!

Filename:  
Untitled-1

Created on:  
Fri Feb 2016, 10:23am  
Runtime:  
0:00:00

Fixture:  
Standard Table

Material:  
Cardboard

Thickness:  
4mm

Select

Export...

Import...

Delete

Purge

Close

## Select A Print Job

Select

Export...

Import...

Delete

Purge

Cool, we're done.

Filename:

Created on:

Runtime:

Fixture:

Material:

Thickness:

Permanent

**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



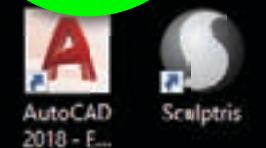
Recycle Bin Mudbox 2018



3ds Max 2019 RapidWork...  
3.5.1



Adobe Creati...



AutoCAD  
2018 - E...  
Sculptris



Autodesk  
Netfabb...  
UCP



Autodesk  
ReCap Photo  
VLC media  
player



Autodesk  
ReCap



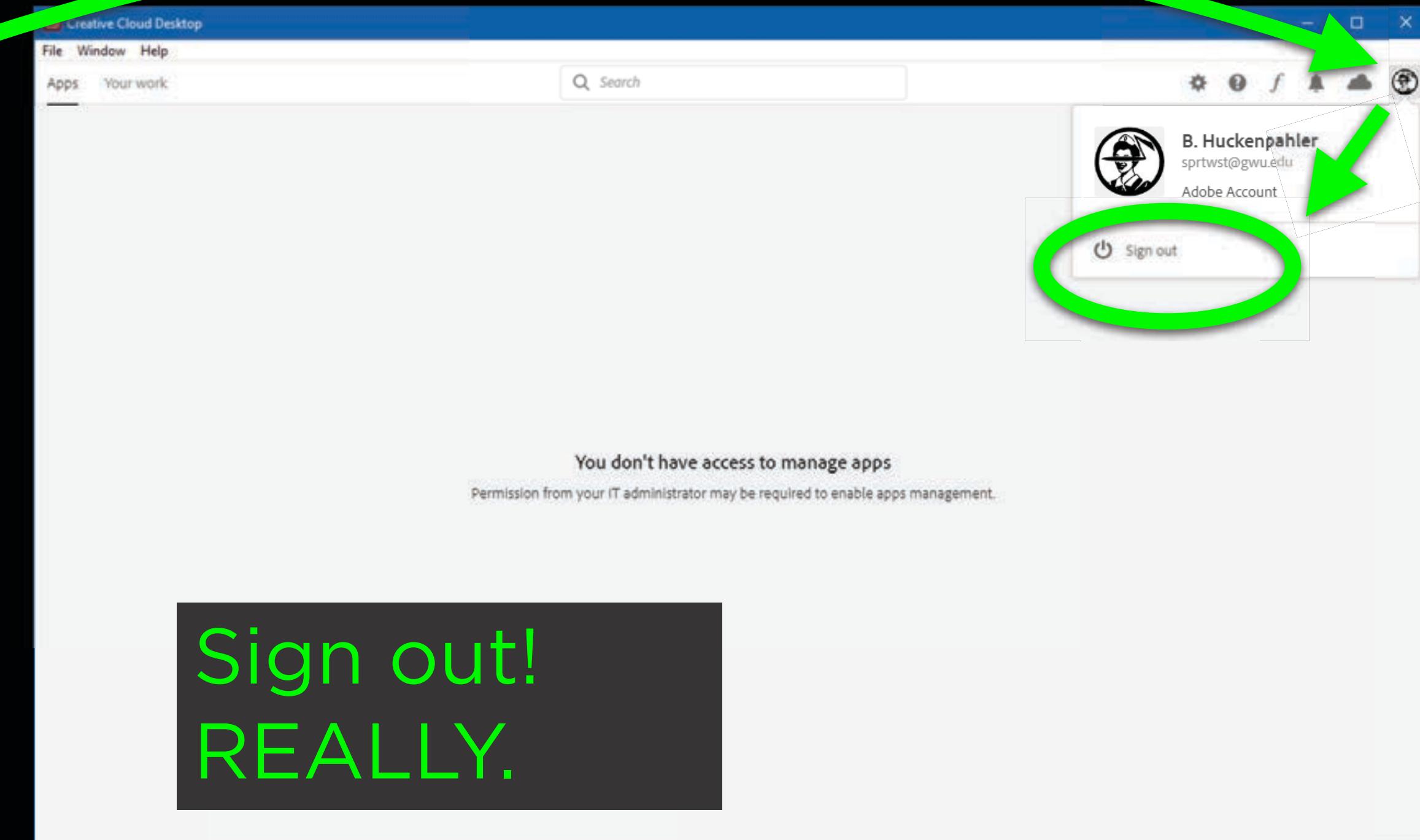
Firefox



Google  
Chrome



MakerBot  
Print

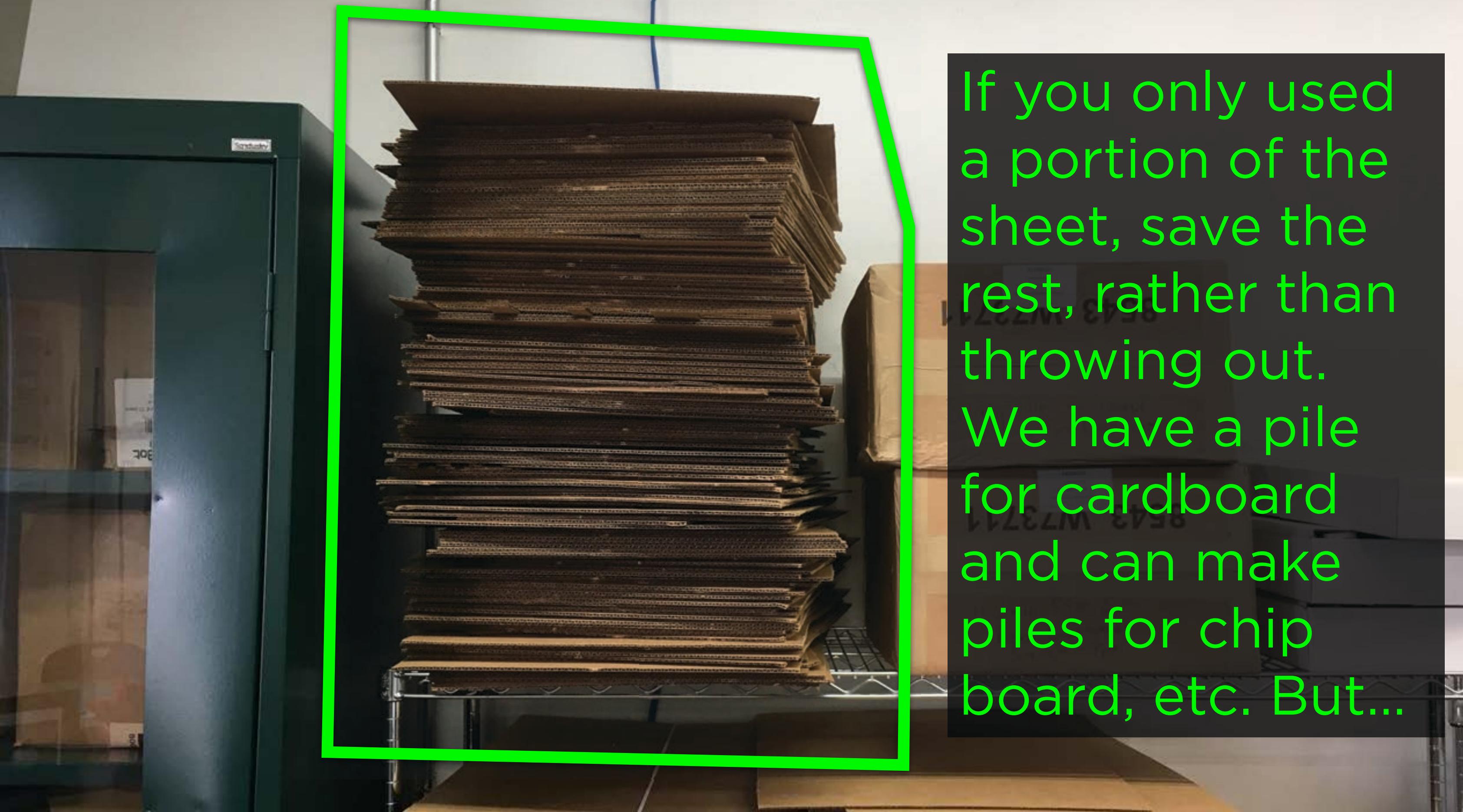


Sign out!  
REALLY.

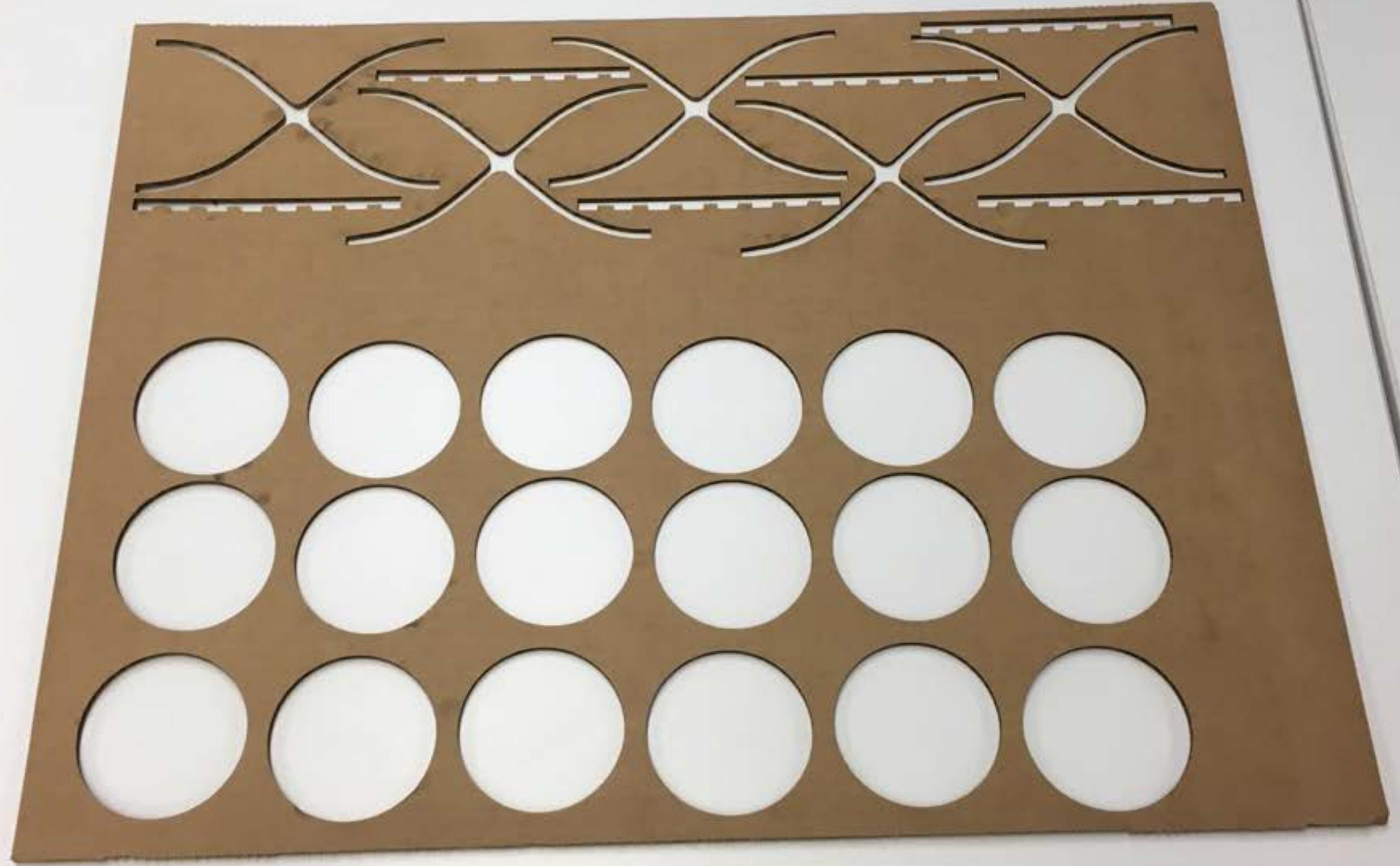
**CLEAN UP!!!!**



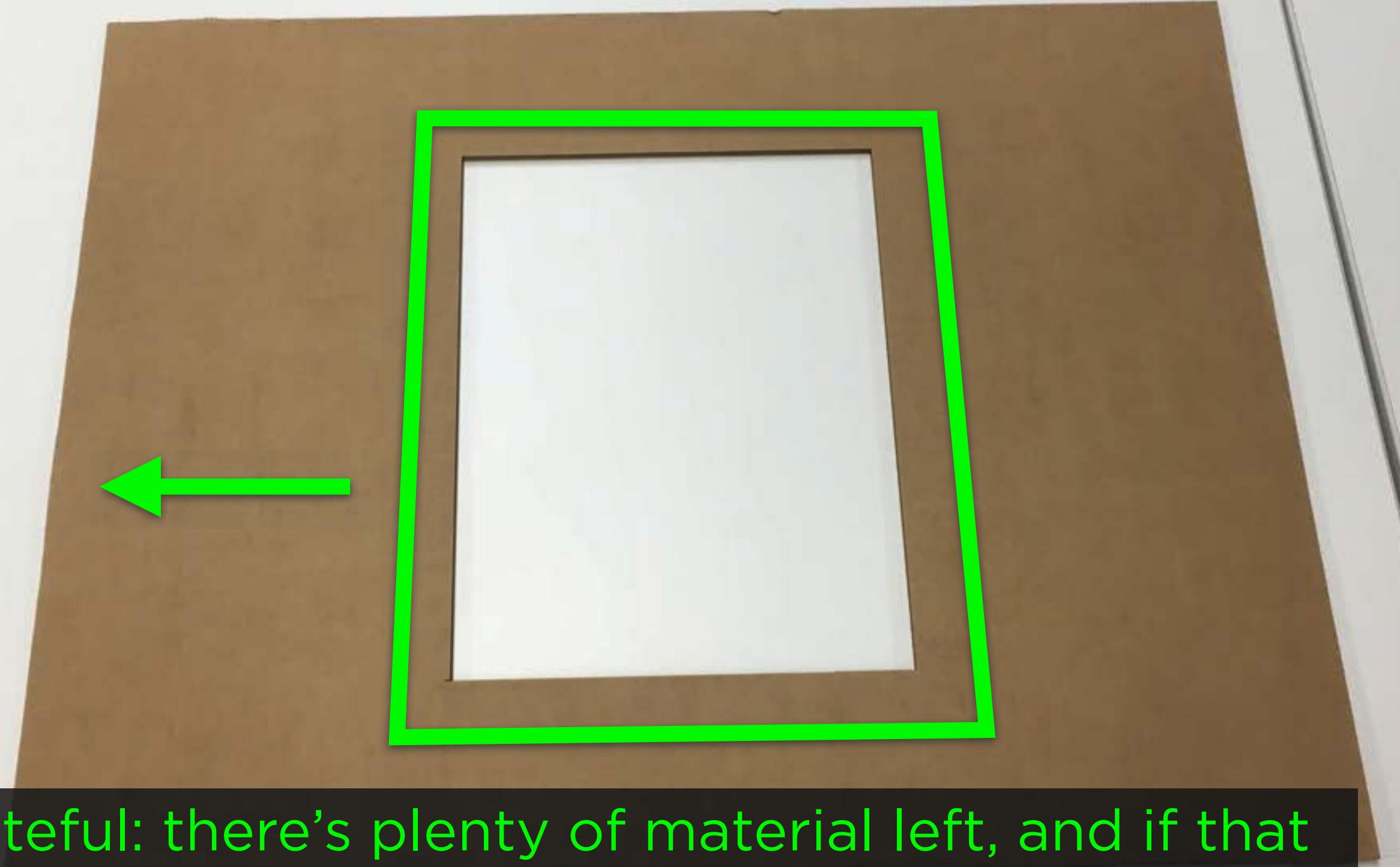
This is AWFUL. Never leave materials lying around, ESPECIALLY not on top of equipment.



If you only used a portion 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...

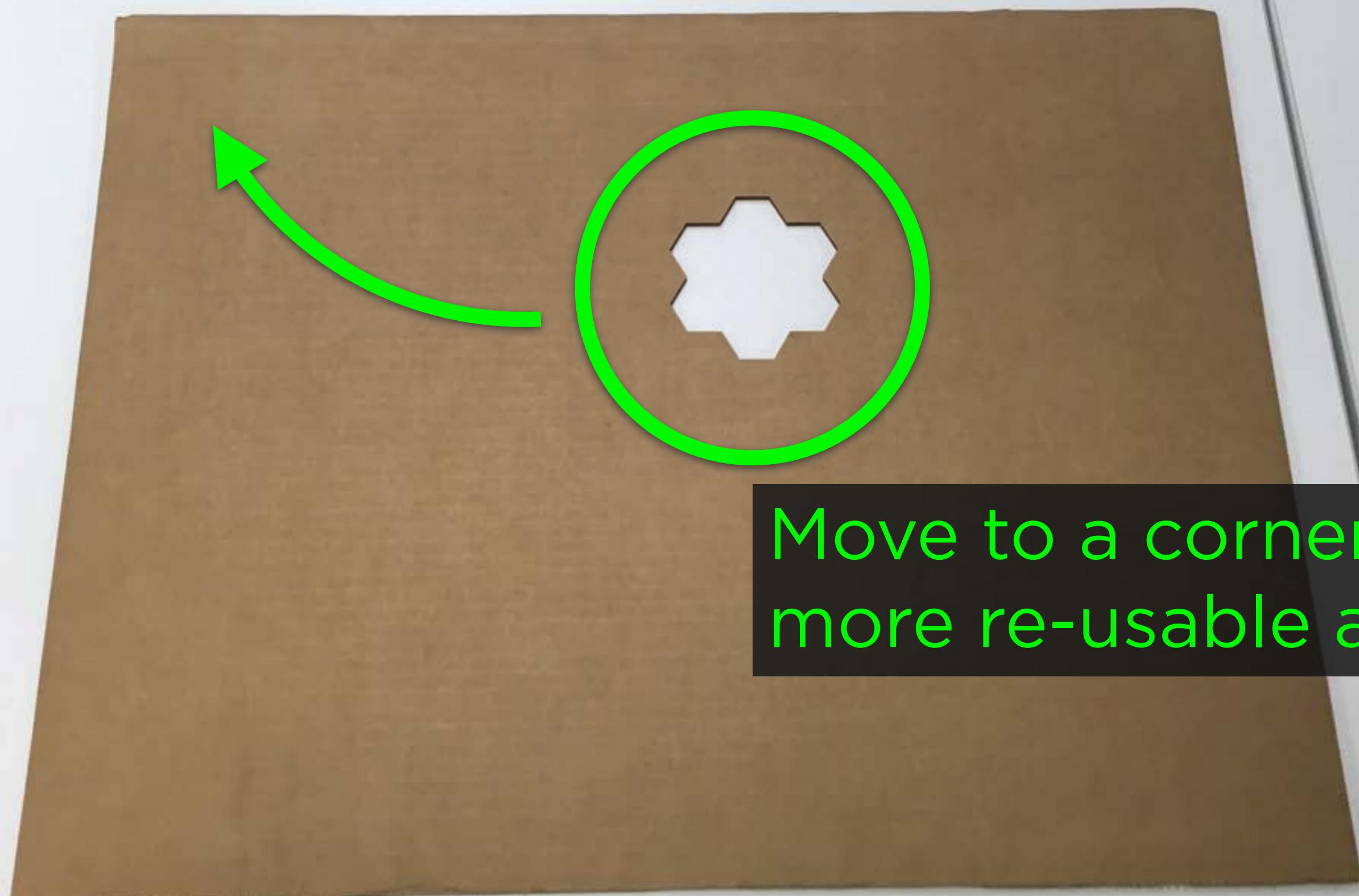


I see sheets like this in the pile  
ALL THE TIME. Really? Trash.



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.