

# FILE PREPARATION FOR CNC MACHINES

## 2018

ROUTER

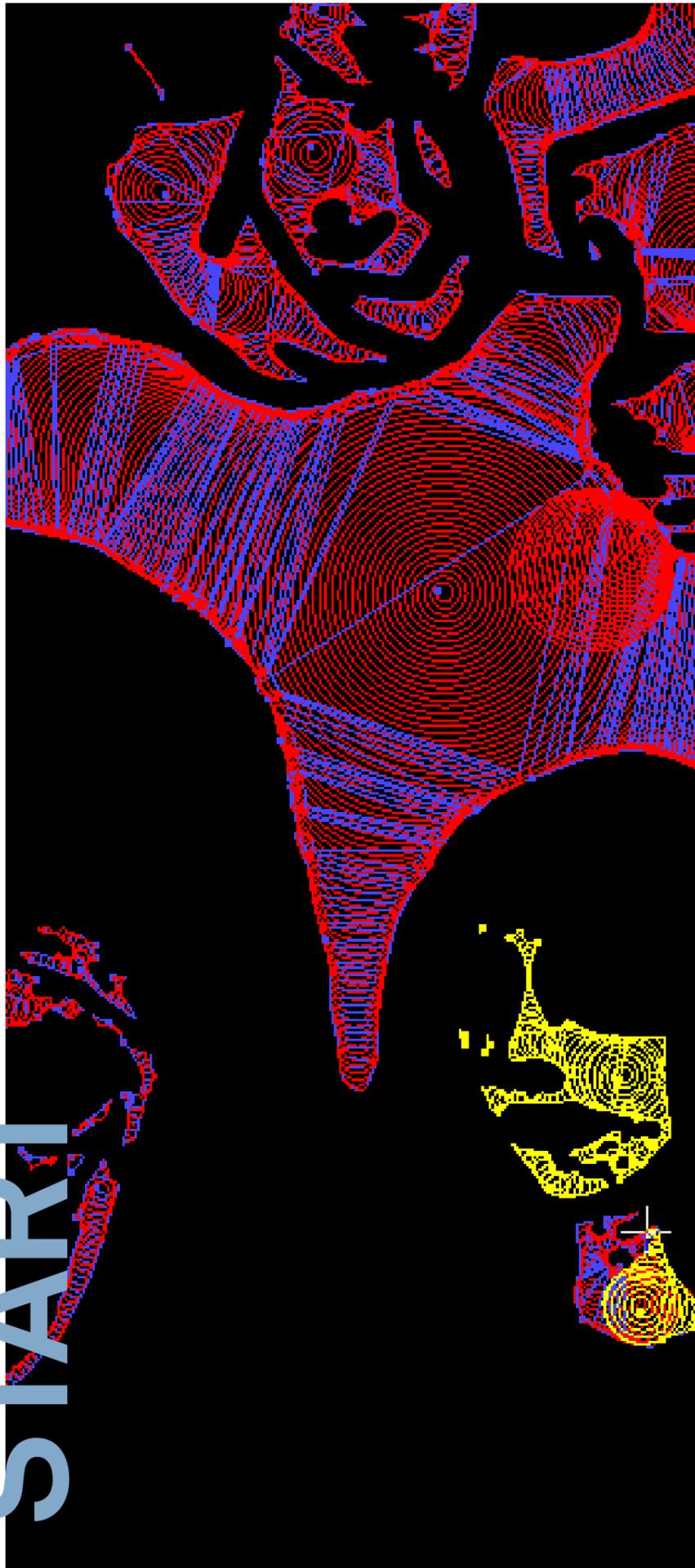


LASER



WATERJET





## COMPUTER NUMERIC CONTROL

CNC machines are just tools. They might seem daunting at first but they are just that.

CNC stands for computer numeric control. So the real powerful part in this equation is the digital modeling software.

We mainly use Rhino 3d and a CAM plug-in called RhinoCAM. The CNC workshop and the CNC machine at the graphic department are operated by this. In general the program produces clean files for the CNC operations.

Illustrator works for normal vector work well too, but it is very important to work consistently and precisely. It becomes a bit more tricky if you want to trace an image (transform a picture into a stylized vector file) but that works too.

There is a ton of other choices out there. (autocad, Solid works, 3dmax, Blender, Moi, Inkscape...) So any program that produces vector files can be used. From there often the

best result is when you export it as a .dxf file. Trial and error with settings and export functions will help get the best result.

This can be imported into Rhino 3D to be processed for the CNC operation.

To be able to translate a vector file to a toolpath you need a CAM program, in our case as mentioned before we use RhinoCAM. This translates a line into coordinates. These files are most often called G-codes, which tells the machine where and how to operate.

```

M90
G90
G71
G75
G00 T1
M21
G00 X422.261 Y1.641
M11
G01 X422.159 Y1.594
G01 X2.292
G01 X2.217 Y1.614
G01 X2.162 Y1.669
G01 X2.142 Y1.744
G01 Y325.544
G01 X2.162 Y325.619
G01 X2.217 Y325.674
G01 X2.292 Y325.694
G01 X422.159
G01 X422.234 Y325.674
G01 X422.288 Y325.619
G01 X422.309 Y325.544
G01 Y1.744
G01 X422.261 Y1.641
M21
G00
M11
M21
G00 X58.665 Y20.629
M11
G01 X57.755 Y20.092
G01 X57.637 Y20.129
G01 X57.029 Y20.674

M90
G90
G70
G97 S3209
G00 T1
M12
G00 X160.9735 Y325.5 Z-19.
G01 Z-12.0589 F 5.43
G01 Z-11.4589 F 8.15
G01 Y325.82 F 10.87
G01 X161.9235 Z-11.1676
G01 X162.8735 Z-10.8838
G01 X165.7235 Z-10.0762
G01 X168.5735 Z-9.3335
G01 X169.5235 Z-9.0995
G01 X171.4235 Z-8.6473
G01 X172.3735 Z-8.4271
G01 X175.2235 Z-7.8119
G01 X178.0735 Z-7.2574
G01 X179.0235 Z-7.0852
G01 X180.9235 Z-6.7573
G01 X181.8735 Z-6.5987
G01 X184.7235 Z-6.1672
G01 X187.5735 Z-5.7942
G01 X188.5235 Z-5.6828
G01 X190.4235 Z-5.4741
G01 X191.3735 Z-5.3765
G01 X194.2235 Z-5.1232
G01 X197.0735 Z-4.9259
G01 X199.9235 Z-4.7823
G01 X200.8735 Z-4.7519
G01 X204.525 Z-4.6812

100 info_string Mild Steel (A36)
101 info_string Thickness 1.0 mm
102 info_string Quality 3
0 PU
1 0.000000 153 set_port_ex
508.000000 F
3 846.666667 151 set_port_ex
3 846.666667 155 set_port_ex
412.018049 61.386317 AC
1 120.000000 277 set_port_ex
0 0.0 276 set_port_ex
1 0.0 275 set_port_ex
1 0.0 278 set_port_ex
1 0.0 279 set_port_ex
0 0.0 258 set_port_ex
0 0.0 152 set_port_ex
0 PD
10.551667 F
412.098924 72.716707 AC
1 delay
442.380506 78.788076 AC
1 delay
443.645180 80.456069 AC
1 delay
444.896149 82.204785 AC
1 delay
446.034962 83.904376 AC
1 delay
446.560377 84.732701 AC
1 delay
447.058469 85.549794 AC
1 delay

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## WHAT WE GOT

We have 4 machines (excluding the laser at Dform, which runs on illustrator files)

There is a waterjet with a work area of 2000mm x 1000mm. This machine can only cut through but it can cut through most materials. From stone to foam.

There is a big laser with a work area of 1100mm x 1450mm. This machine can cut a number of thinner materials like Plexiglas, plywood, mdf, cardboard or fabrics. No PVC because chlorine gasses are produced when you laser it, which is very bad. That's why I always need to know what kind of material it is. Which also means that I sometimes won't be able to cut it for you.

You can also use the laser to engrave on a wide variety of materials. It is smart to do some testing since the outcome isn't always easy to predict.

Then work area of the large router is 2440mm x 1220mm x 150mm. Although the height is more determent by what you want to do and what tool we can use. This machine can also do 3d shapes and can work in softer metals like aluminum, brass and the likes.

The cost of using these three machines is 4,- NOK per minute or 240,- NOK per hour. You pay for the time the machine is actually running. This pays for all the sacrificial material we use while running the machine. The underplates, the sand, the router bits and such.

The last machine is the small router at the graphic department. Which has a working area of 900mm x 600mm

The costs involved in that machine you have to get from the department.



## WHAT ?

BE EXACT, what you want the outcome or the process to be. 'About this wide' doesn't work. The clearer you state your question and explanation of what it is you want to accomplish the easier it is for us to assist you in realizing a desirable result. It is *about* being specific mainly to yourself. Even if you want an unspecific result you still can be specific in your method or system to get there. By being specific there is going to be enough surprises to cater to your need for creative uncertainty...

## HOW ?

You provide a file, preferably by mail so it is easily found and cataloged. There is hundreds of students coming by us so names and projects will be forgotten more often than not.

A folder with the date and your name is created for later reference if needed. (and believe me I have pulled up files from at least 4 years ago so that way they are easy to find again.)

You name the file as follows:

**YYMMDD-QQ-description.**

*(yearmonthday-initials-description)*

Be precise in your description. Give it a recognizable title or describe what it is. For example 180121-FE-butterfly.

If you want to laser an image put the exact size of the image and the dpi in the name

so for example 180121-FE-21x30-150dpi-butterfly.jpg (or .png if you want an halftone like effect.)

It is a small effort but will make the workflow a bit easier.

**HAVE A LOOK WHERE YOU ARE IN YOUR PROCESS**

the last two segments is where the cnc-workshop comes in.

**IDEA**



**SKETCH**



**VECTOR**



**PROCESSING**



**MACHINING** →

Sketch on paper  
Find out your measurements  
Choice of material  
Make a simple mock up

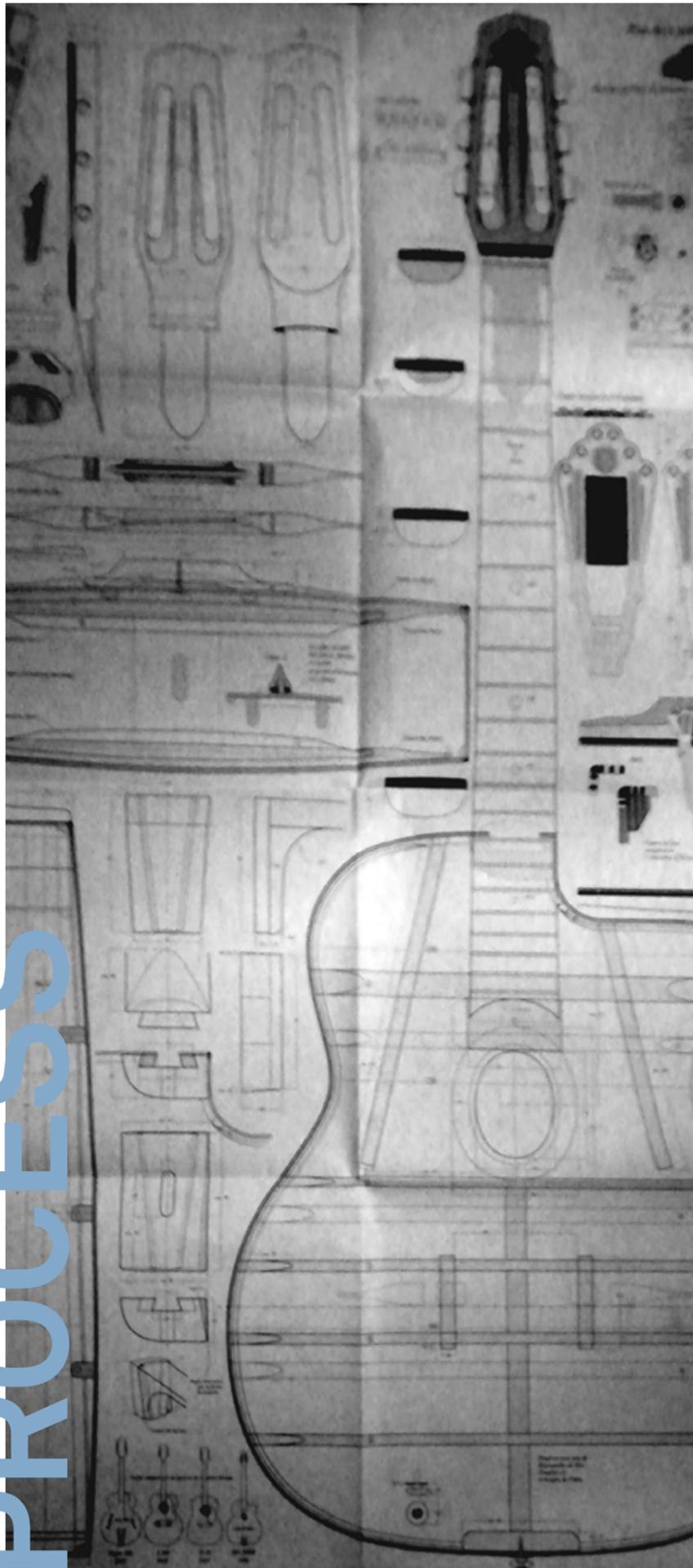
Transfer your idea to a digital representation.



Which tools to use  
G-Code is created  
Prepare material

After the machining there is often a lot of work left to do. It is very rare that you get a finished product straight out of the machine.

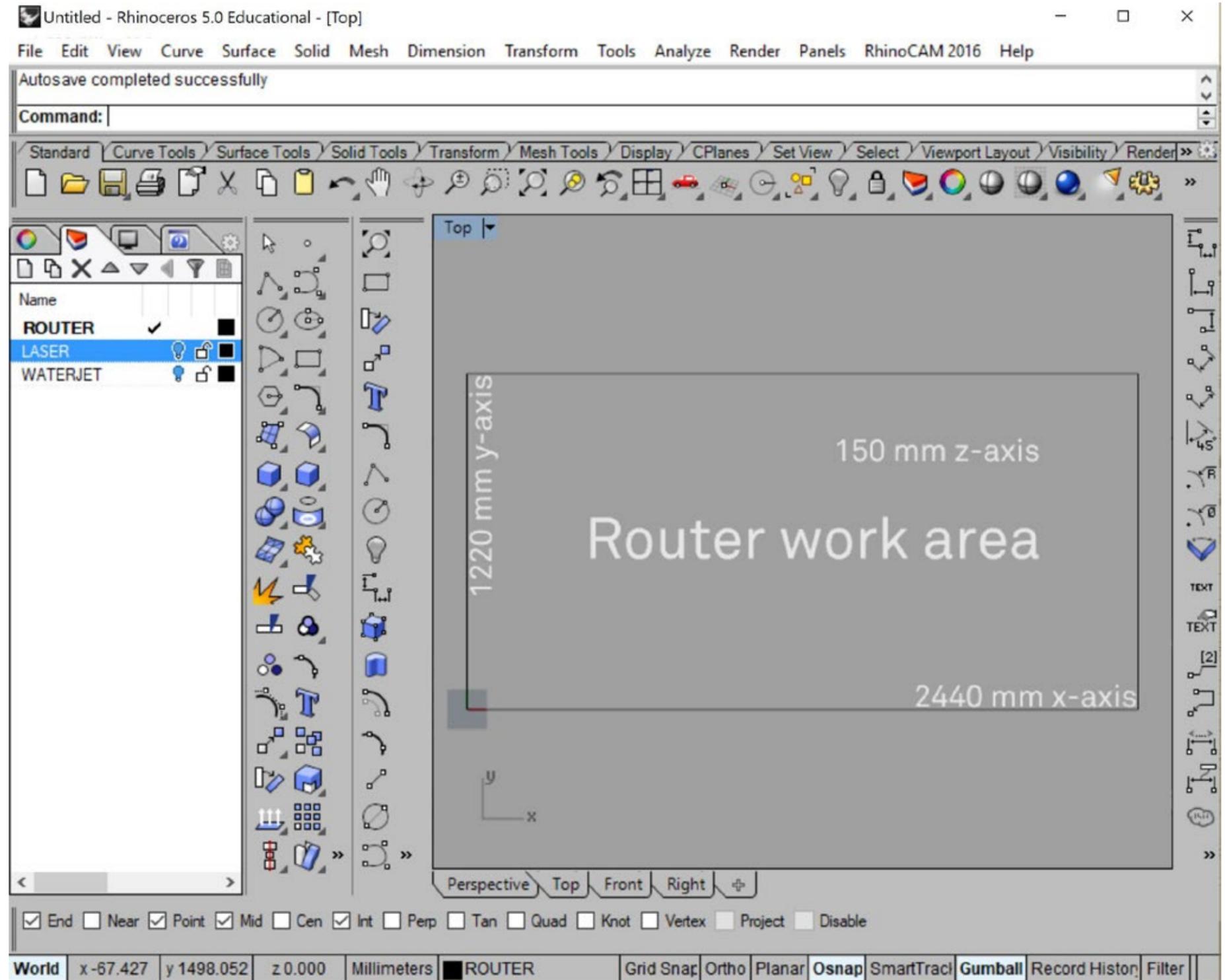
**PROCESS**



## START WITH A FRAME

Everything that needs to be cut with any of the cnc machines should be placed in a specific area. This is different from machine to machine. If what is planned to cut exceeds this area you have to chop it up in smaller parts and divide it over as many layers as needed.

You start at  $x,y,z=0$  on the top view. Work in millimeters.



*oh yeah, this is Rhino 3d by the way...*

ROUTER

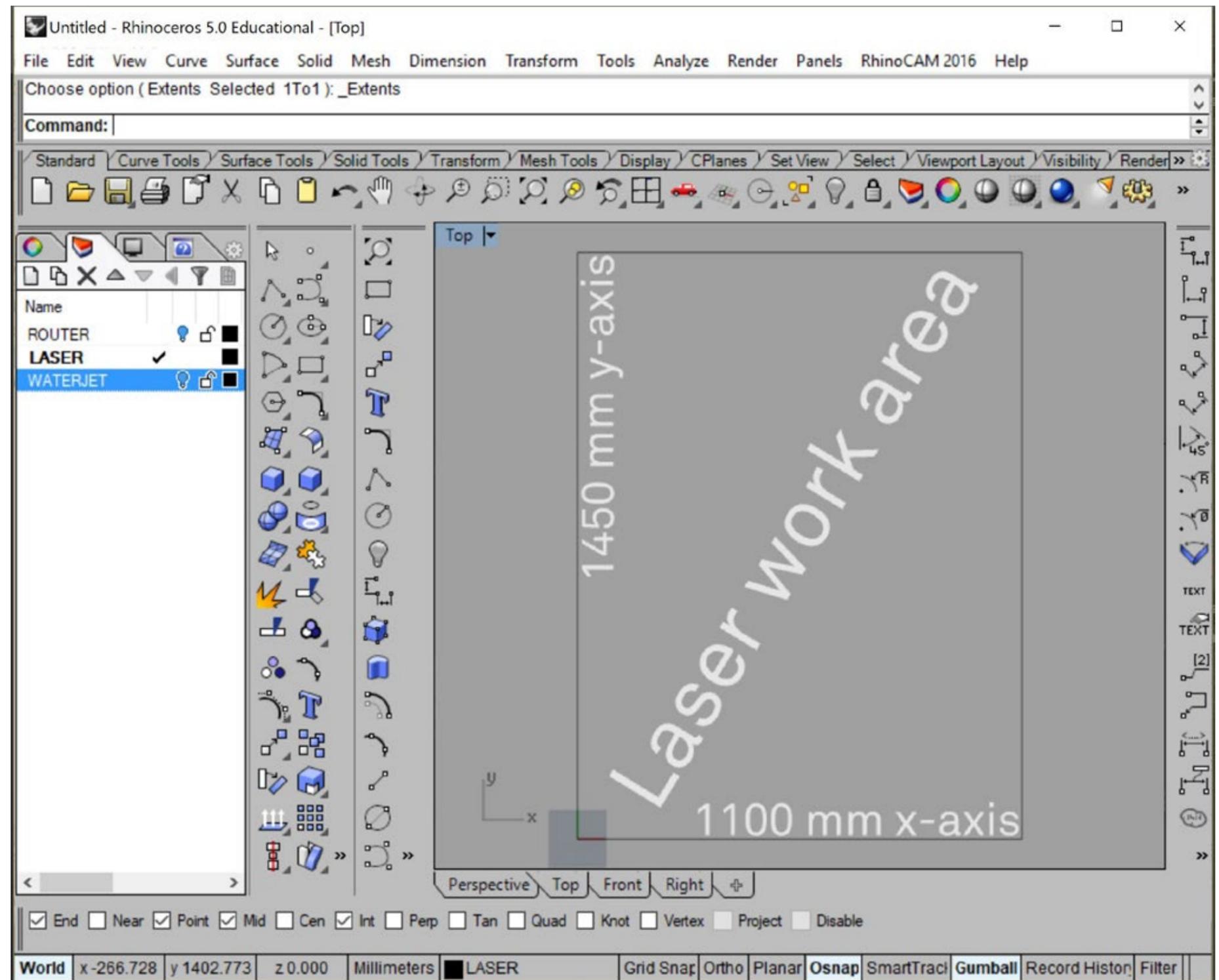


## PLACE YOUR WORK

The laser, even though it is small makes a cut of circa 0.3mm wide. This should also be adjusted for. In general leave a 4mm gap around the edge of your material and about 2mm between the objects.

The laser can engrave .jpg and .png files. It does this for some reason from the center of the image. This has to be manually set on the machine. So if you want to engrave and cut out shapes on the same material it is important to have the exact measurements easily available.

Engraving can quickly take a lot of time especially on higher dpi settings of your image. an image of 1m<sup>2</sup> at 72dpi takes around an hour. at 150dpi takes about double that.



LASER

## TO BE PROCESSED FOR CNC

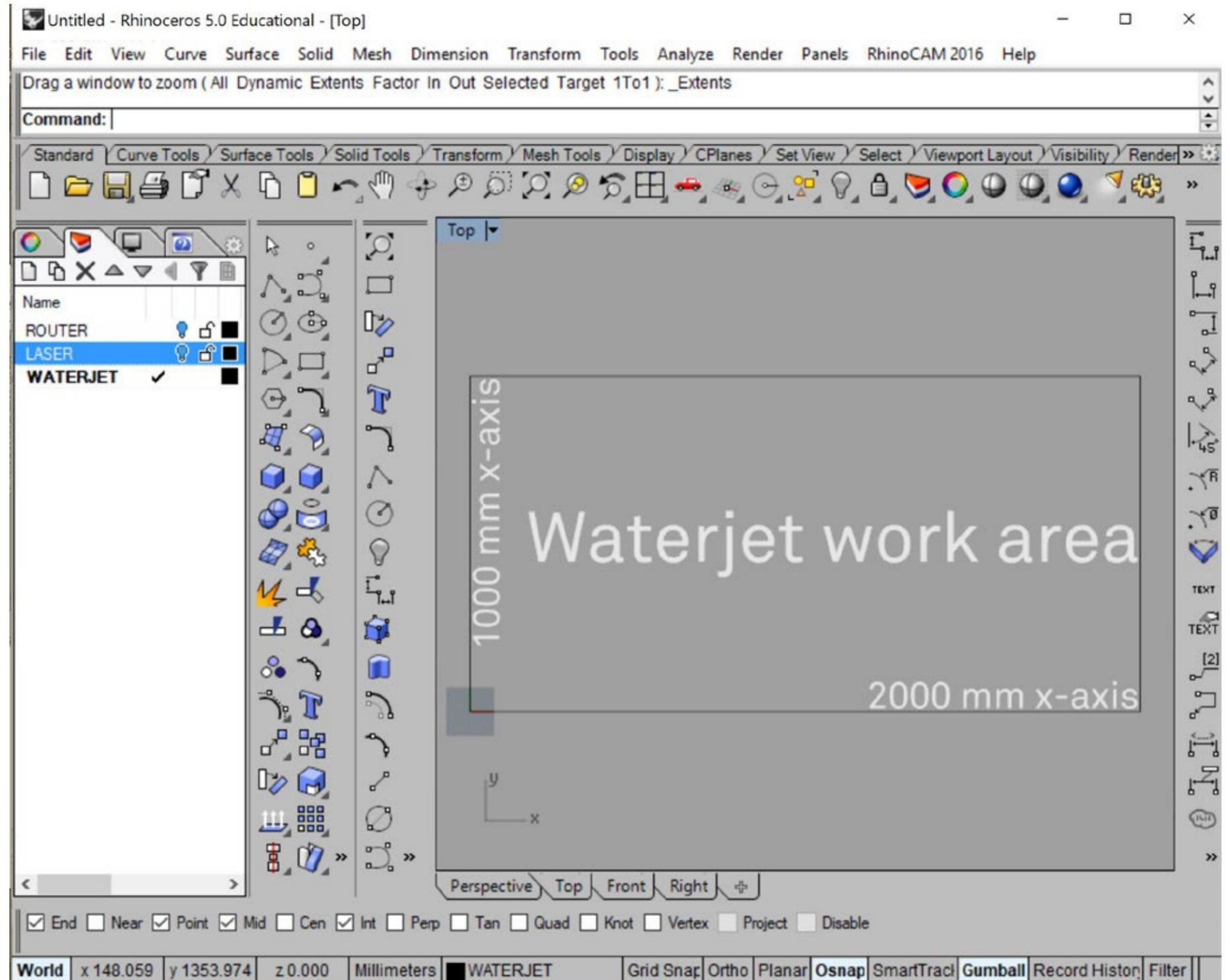
The waterjet creates a cutwidth of circa 1mm.

The waterjet cuts with pressure and sand. Water is jetted at around 50000 PSI and mixed with sand to cut through almost everything. Hardened glass just shatters though and paper can be cut but will obviously be ruined...

It is great for cutting material that could otherwise deform

because of the heat produced by normal cutting methods. But also foam or plaster board that otherwise are very hard to shape into complex forms.

A thing you might have to consider is if you are cutting smaller pieces that you make tabs of 1mm to prevent the parts from being displaced by the cutting force of the water.



***you'd have to place the tabs on strategic places so the parts are easy to wriggle loose.***

WATERJET