Cutting Plotter

GRAPHTEC FC9000-140

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MODE

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FabLab security and good practices regulation

- Wearing of closed shoes recommended.
- Wear appropriate clothing for handling machines and tools (not too loose clothing, too long jewelry, tie your hair back if necessary).
- Never use a machine without first being trained on it.
- Be fully aware of your actions.
    - Do not use machines if you are tired or ill.
- Do not consume alcohol or drugs before using the machines and tools. Do not distract or surprise other users while using the fablab machines and tools.
- Never leave a machine running unattended, use only one machine at a time.
- Warn the fabmanagers of any danger.
- Never open a machine, warn the fabmanager present in the area for any technical problems related to the machines (malfunction, breakage, etc.).
- Keep the work area clean and tidy after use.
- Store materials and tools in their place.
- Prepare files before occupying the machine workstation.
- Do not apply force to the machines: ask for help, that's what fabmanageuses are there for!
- Turn off the machines after use.
- Do not eat or drink in the Fablab.

Security related to the cutting plotter

The FC9000 plotter is a machine comprising moving parts, belts and a cutter tool. The machine's main danger is injury by catching or cutting. The user can also be a danger to the machine if he or she misuses it.

- **Never leave your hands in the machine's working area during operation.**
- **Never leave any object lying around in the machine's working area during operation.**
- **Never move the cutting head during operation.**
- **Never force any part of the machine.**

The process of shaping certain materials with a cutting plotter may involve the use of a thermal press. The main danger of this machine is burn injury.

- **Never leave your hands in the heat zone of the machine.**
- **Never leave the hot press unattended.**
- **Do not use the heat press with more than one person.**

Principle of cutting plotter technique

The cutting plotter is a computer-controlled machine that cuts different materials by incising the material using a blade holder, a kind of micro-cutter. Cutting can be carried out in half-flesh, i.e. on half the thickness of the material, or in full-flesh, i.e. cutting the entire thickness of the material.

The machine features a tool-holding head that moves from left to right (x-axis movements) and bearings that rotate back and forth (y-axis movements). The combined action of x- and y-axis movements enables the machine to follow any design with straight or curved lines.

The machine is commonly referred to as a "cutting plotter", but it also features a mechanical pencil. The plotter can also be used to draw with a felt-tip or pen.

Cutting plotter process diagram

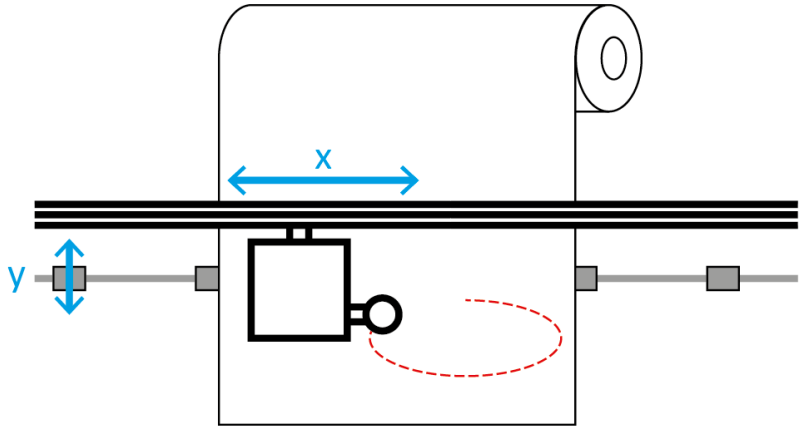
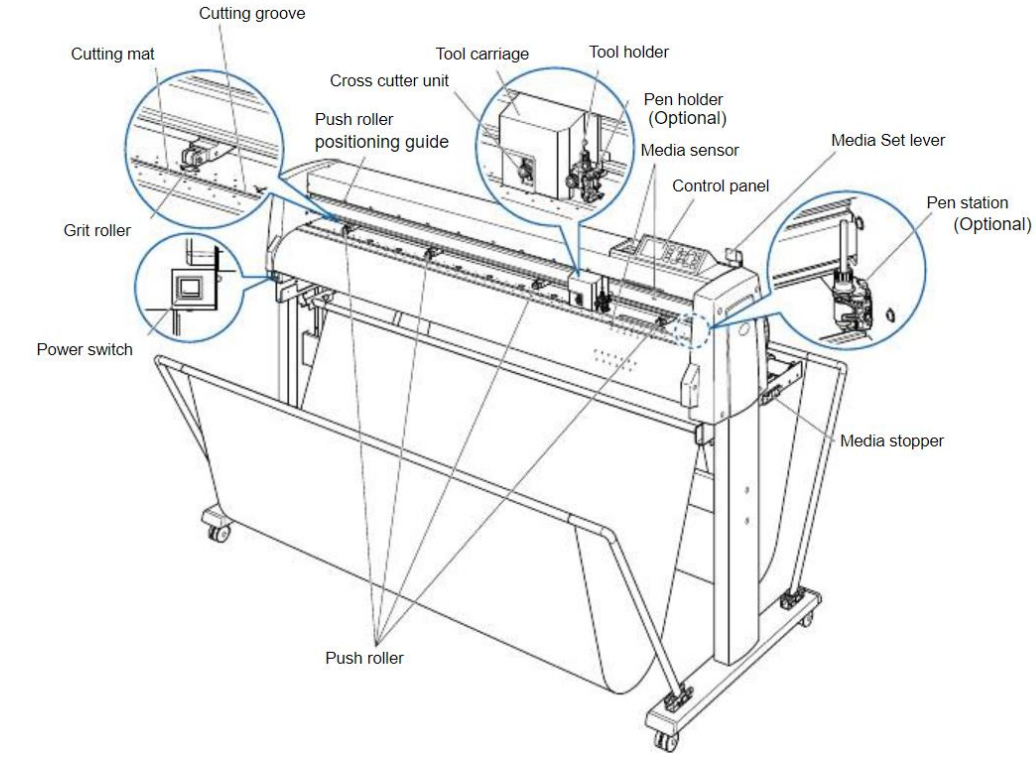


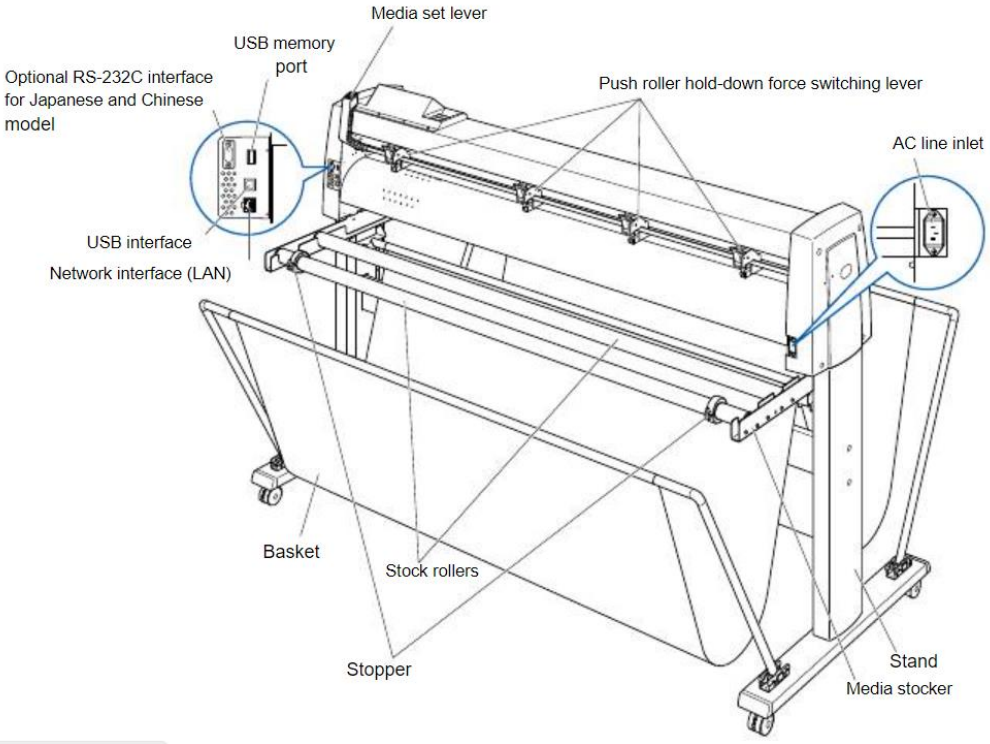
Diagram of cutting types

Half-cutting Full cutting

Description of cutting plotter machine

1. Diagram of Graphtec FC9000 plotter





2. Features

The Graphtec FC9000-140 is a large-format plotter.

Technical datas:

- Maximum cutting size: 1372 mm x 50 m
- Guaranteed dimensional accuracy: 1352 mm x 10 m
- Material widths supported: Min. 50 mm Max. 1529 mm
- Minimum typographic characteristics supported: Helvetica med. H. 5 mm
- 1 tool holder
- 3 tools: 1 CB09UB cutter (blue tool) / 1 CB15UB cutter (red tool) / 1 water-based felt-tip pen
- 2 cutting positions: half-cutting/ full-cutting
- Compatible materials: Adhesive and iron-on vinyl, PVC, paper from 0.06 to 0.13 mm thick

Cutting plotter process

1. Diagram of the steps

Cutting plotter is a multi-step technique which may require the use of several machines (plotter and thermal press). It is essential to follow all the steps in the process to achieve a successful result.

PREPARATION OF THE FILE TO BE CUT

Know and check the characteristics required before cutting.

↓

PREPARATION OF THE PLOTTER

Knowing how to set up the machine for successful cutting.

↓

CUTTING PARAMETERS

Know how to set cutting parameters in the software.

↓

CUTTING

Correctly run a task.

↓

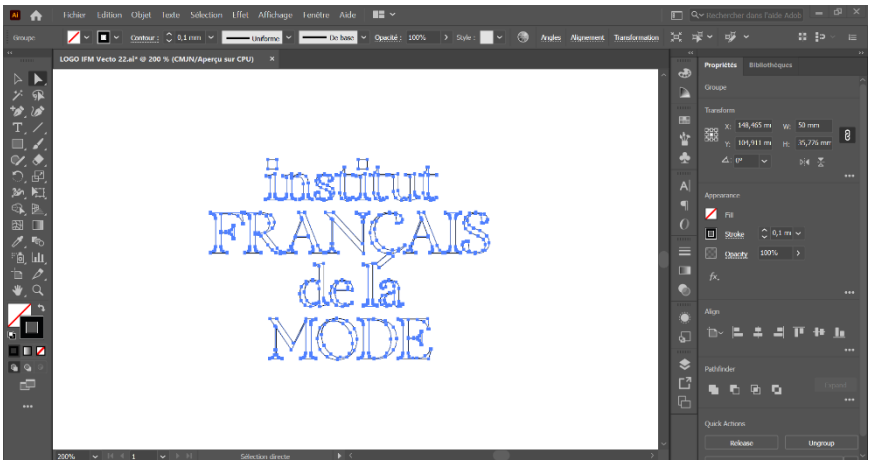
AFTER CUTTING

Know how to process cut material according to its type.

2. Preparation of the cutting file

- **MAKE A VECTOR DESIGN**

Like many machines whose work processes follow paths, the cutting plotter requires a vector file, created using Adobe Illustator for example:

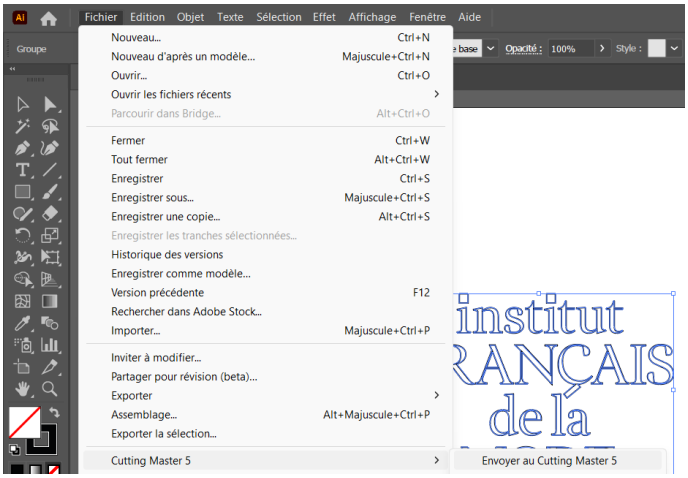


Recommended features:

- Create a **document** of the size of the material
- Set drawing to **exact size**
- Choose **only contours (stroke)** for the drawing.

! If you want to create cut-outs with different characteristics (half-cutting/full-cutting) in the same file, use different contour colors.

- **SEND FILE TO CUTTER**



Select paths and go to
FILE > CUTTING MASTER 5 > SEND TO CUTTING MASTER 5

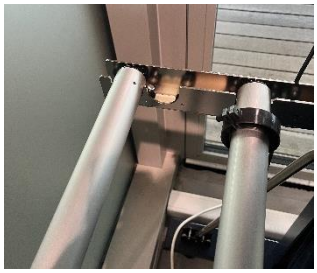
To use positioning markers, refer to annex n.1.

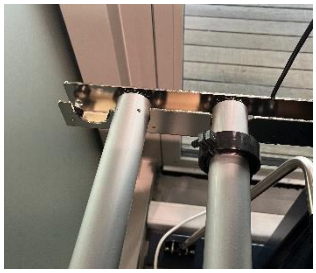
3. Preparing the cutting plotter

- **SWITCH ON THE MACHINE** by pressing the **ON/OFF button** on the left front panel

- **SET THE MEDIA**

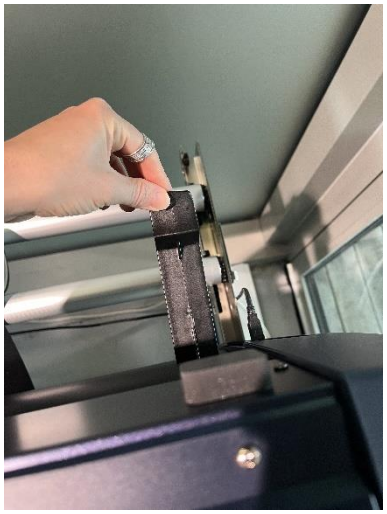
- **Get the media**, here a roll of iron-on vinyl.



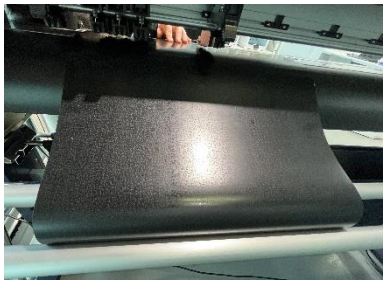


- **Adapt the media support bars** to the diameter of the roll so that they can support it.

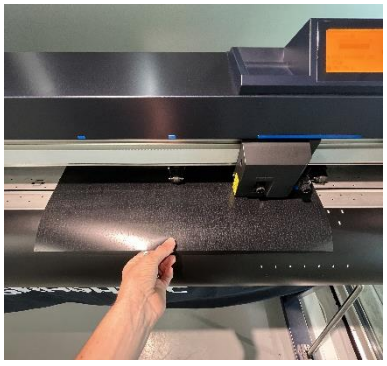
- **Place media on bars.**



- **Check that the media lock lever is open (lever down position).**

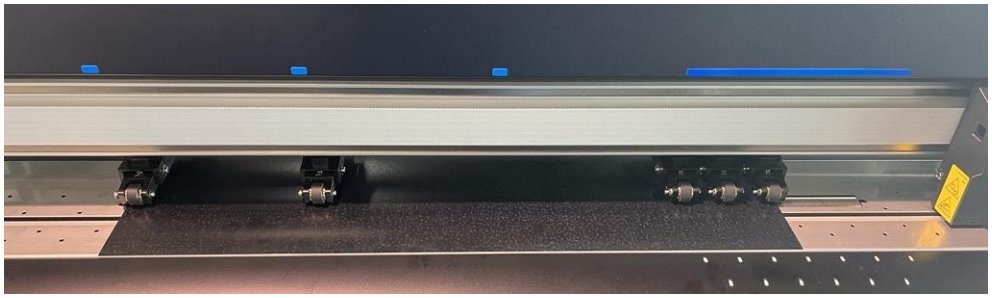


- **Slide the media** into the system from **the rear of the machine**



- **Retrieve the media from the front of the machine.**

! Pulling the media from the center gives it the correct tension and ensures that it is unwound in a straight line. This guarantees quality work.



- **Adjust pinchrollers to the media.**

  ! The pinch roller lever must be in the down position (open) before handling the pinch rollers..

  The machine is equipped with 5 pinchrollers to ensure that media of all widths are held securely.

  The pinchrollers also help the machine to measure the exact width of the media used, thanks to their sensors. By detecting the distance between each pinchroller, the machine can determine the full width of the media. It is therefore essential to position the pinchrollers correctly.

  The machine works from right (origin or point 0) to left.

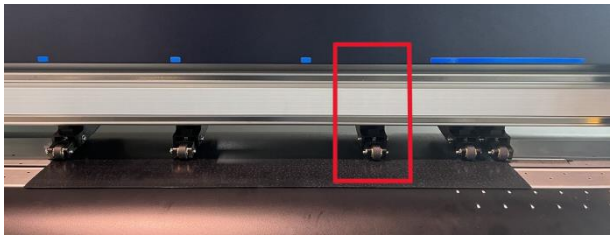
  Placement of pinchrollers must comply with the following rules:

  - pinchrollers must be positioned **at blue markings only.**

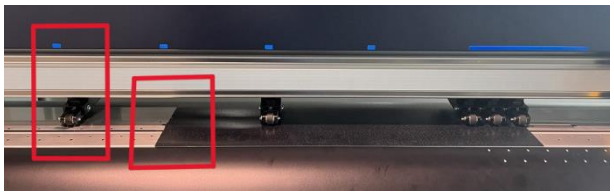
  If a pinchroller is placed outside a marking, the machine will detect an error.

  - at least **1 pinchroller must be placed in the large (rightmost) blue marking**
  - both **ends of the media must be blocked** by pinchrollers.

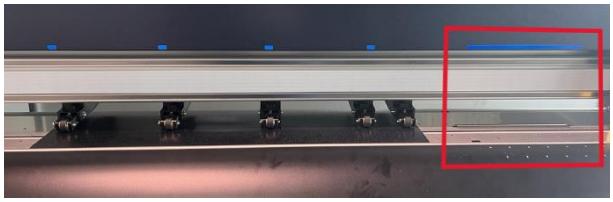
Examples of incorrect positioning:



X because one of the pinchrollers is outside the blue marking.

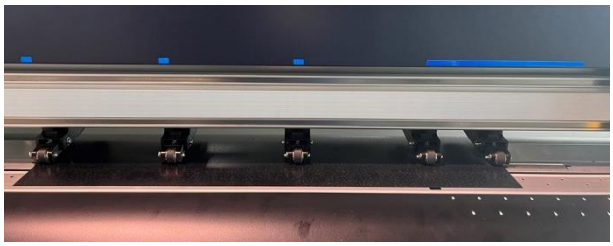


X because one of the pinchrollers is outside the media.



X because none of the pinchrollers are in the 1st blue marking.

Examples of correct positioning:



V because all the pinchrollers are positioned above the media, each at a blue marking (including 2 in the 1st marking).

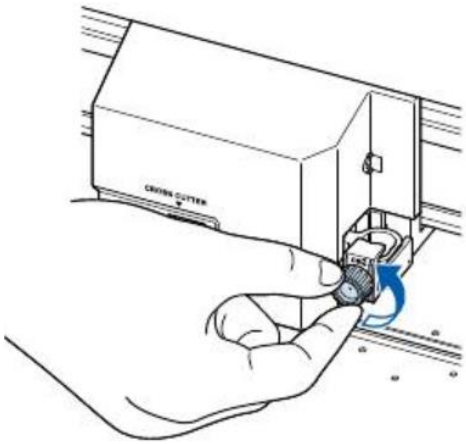
- **Close the media lock lever (top position)** so that it stays in place.

- **Select the appropriate media detection mode** by clicking on 1, 2 or 3.

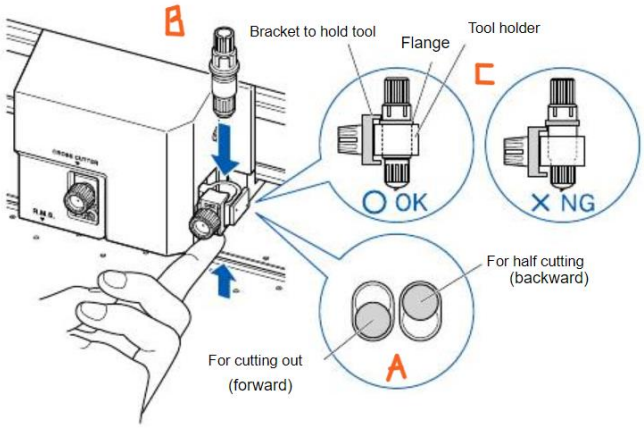
1- ROULEAU LIMITE AVANT : the machine will detect the front of the media and position the cutterhead at the origin (lowest position on the right of the media).
2- ROULEAU POS. CHARGEE : the machine takes as its origin the depth at which the media has been placed (useful if a cut has already been made on the media).
3-FEUILLE : the machine will measure the width and depth of the media sheet.

To use positioning markers, refer to annex n.1.

- **PREPARE TOOL HOLDER** (if not already installed)



- **Unscrew the tool holder** by turning the wheel to the left.



- **Choose the right tool*** related to the task

CB09UB
For materials thinner than 0.5 mm

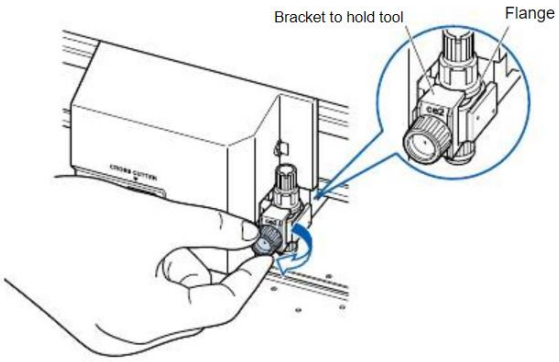
CB15UB
For materials thicker than 0.5 mm

* ask the fabmanagers for the felt tool

- **Get the tool** and **choose the right position** for the job **A** :
  - backward (= **position 1**) > **half-cutting**
  - forward (= **position 3**) > **full cutting**

- **Place tool in tool holder B**

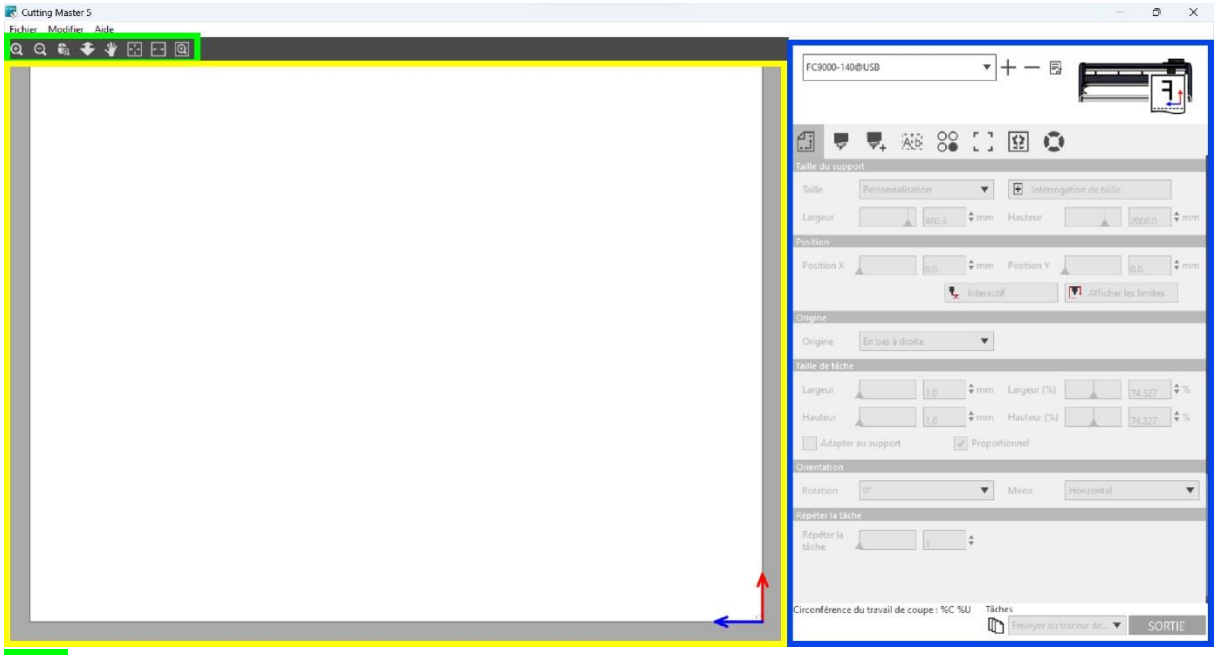
- **Check that the clamping lug** fits securely **over the tool ring C**.



- **Screw on the toolholder** by turning the wheel to the right.

4. Settings of the cutting

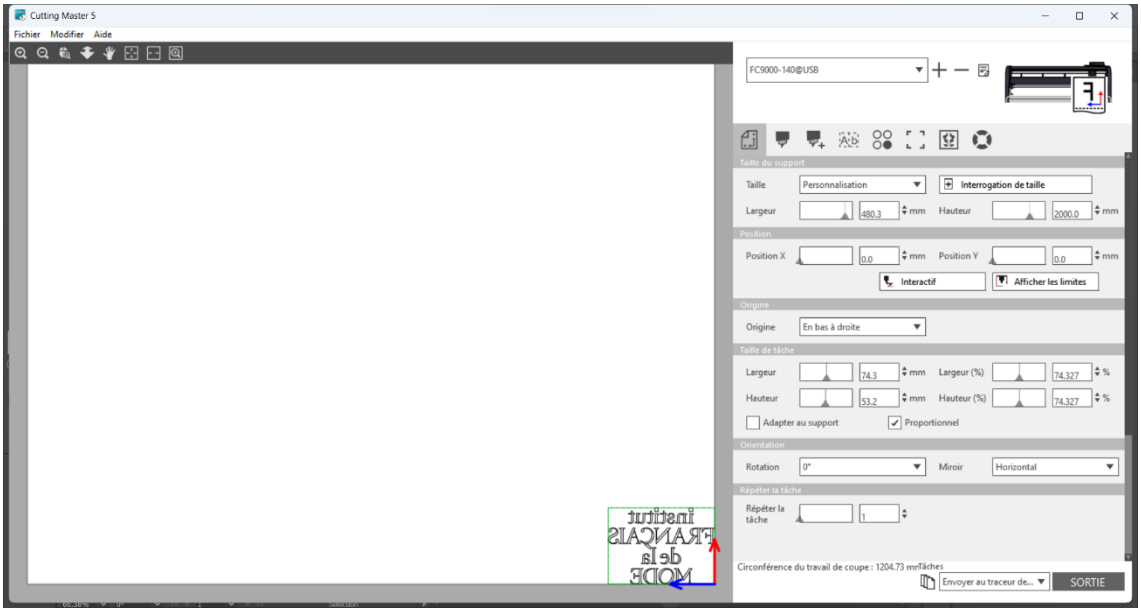
Introduction to Cutting Master 5



Tools
Job visualization
Setting tabs

Using of Cutting Master 5

- After sending the file from Adobe Illustrator, **Cutting Master 5 automatically opens with the drawing**



! Tip : Using multiple colors in the vector file enables Cutting Master 5 to differentiate between cutting lines, and therefore to create different types of cut.

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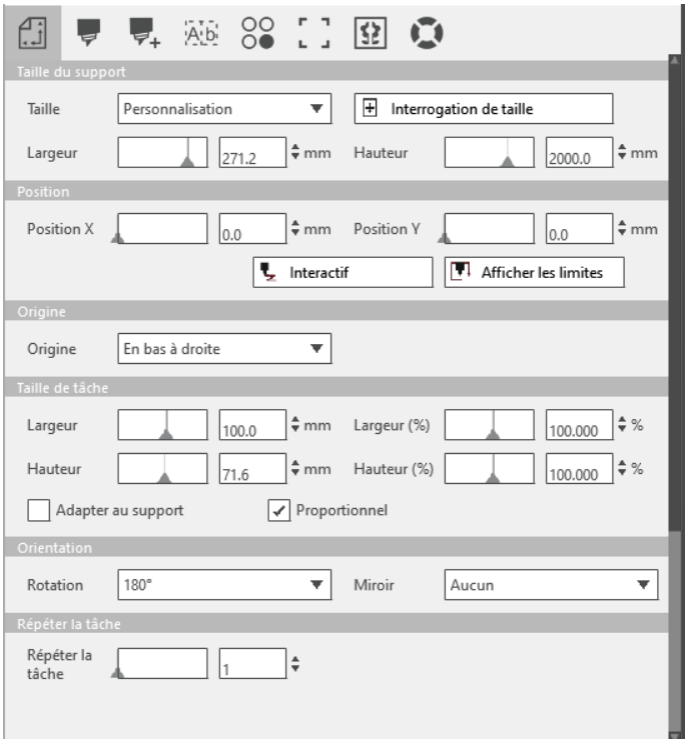
- **SET MEDIA SETTINGS** by clicking on 
  The tab gives access to the following parameters:



- ***Taille du support*** defines the size of the media installed in the machine

> CLICK on 

so that the software interrogates the machine.

- ***Position*** defines drawing position relative to origin 0 (bottom right)

- ***Taille de tâche*** defines drawing size *(! **Proportionnel** must be checked)*

- ***Orientation*** defines the drawing direction *(! Chose **Miroir** for transfer materials)*

- ***Répéter la tâche*** to duplicate

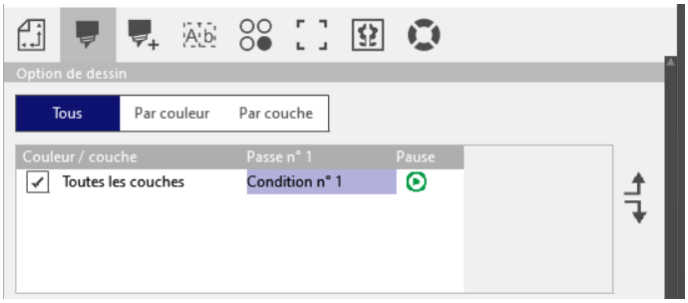
- **SET CUTTING CONDITIONS** by clicking on 

Introduction to cutting conditions:

- ***Vitesse :*** tool travel speed in cm/s (from 1 to 105)
- ***Accélération :*** travel speed multiplier (from 1 to 8)
- ***Force :*** pressure force of tool on media (from 1 to 48)
- ***Type de ligne :*** type of line traced by the tool (solid / dotted line)

>> It's the Speed/Force balance that adjusts the cut (or the fatness of the line when using a felt-tip pen) **and thus guarantees a good cut on a variety of media.**

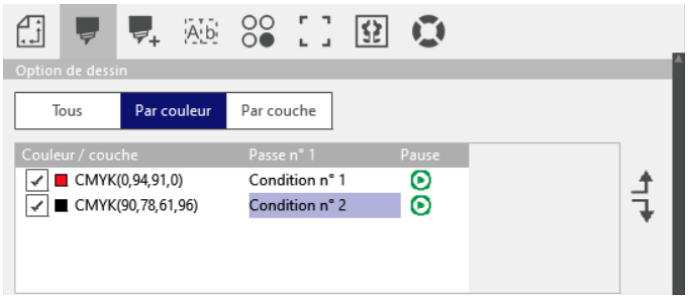
Ex: If you want to cut iron-on vinyl in a half-flesh cut for flocking, the balance should be [high speed/medium force]. On the other hand, if you want to cut leather, as the material is thicker and harder, you'll need to set the scale to [low speed/high force].



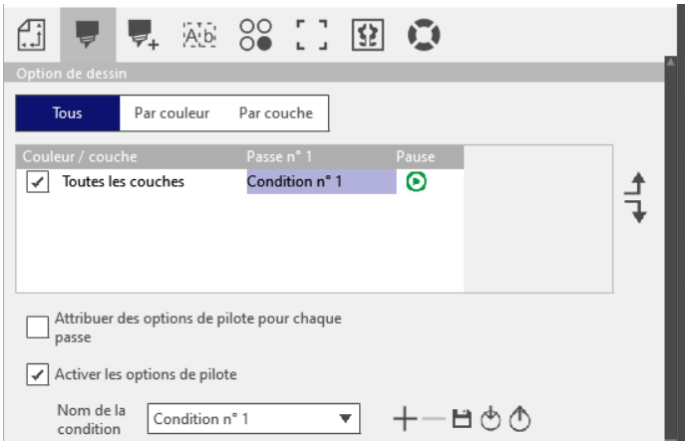
Option de dessin to select the type of drawing reading

> CLICK on 

All colors/layers are visible in the frame below.



Here we see an example of a design using 2 colors.



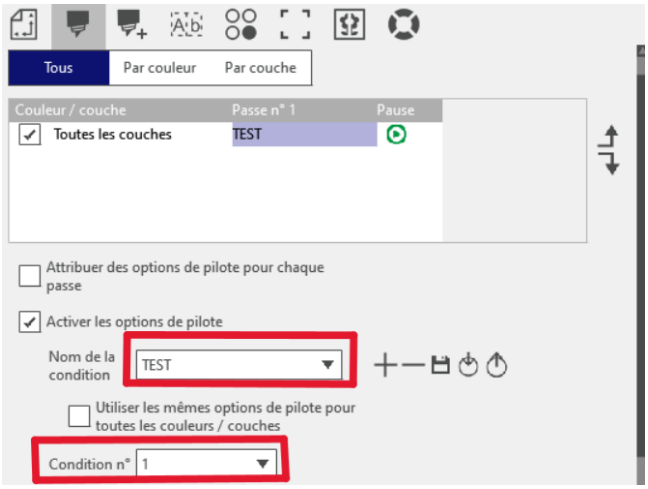
If the ***Activer les options de pilote*** is checked, the software uses the presets set in the machine.

SEE EXISTING CONDITIONS IN APPENDICES ANNEXES

! If no preset exists for the other materials, you need to carry out tests!

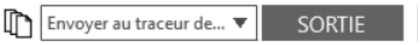
TESTING A NEW MATERIAL:

- Open the ***CUTTING TEST*** folder on your desktop
- Open the ***TriangleTest.ai*** or ***LetterTest.ai*** file, depending on the type of layout required
- Send the file to ***Cutting Master 5*** from Adobe Illustrator
- In the **Option de dessin** tab, select the **TEST** condition
- Choose one of **the existing conditions as "base" according to the condition's preset characteristics**
  Ex : **TEST + Condition n°1** if I want to make a continuous half-cut

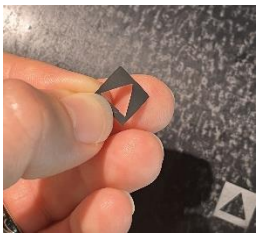


- Change the **Vitesse** and **Force** values (never both at the same time) as well as **Type de ligne**

- Select **Envoyer au traceur de découpe** and click on **Sortie** to test



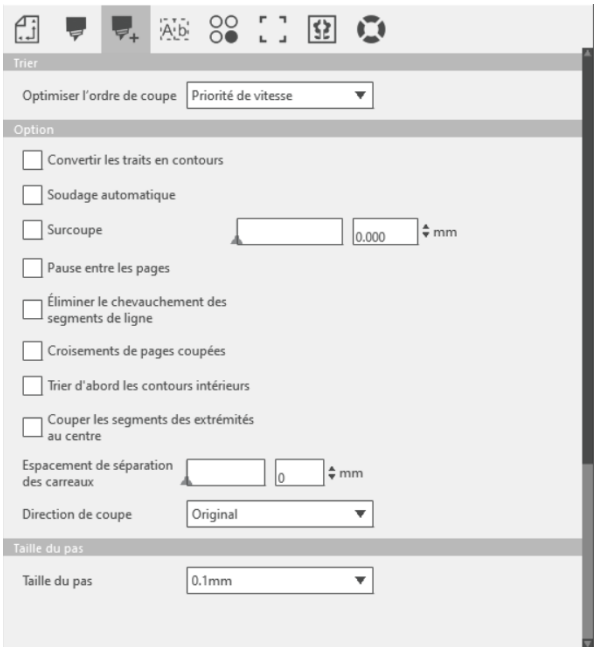
- Check cutting quality on media



If the cut is clean and the yoke separates easily from the media, the cutting parameters should be retained.

- Repeat tests if cut does not conform.

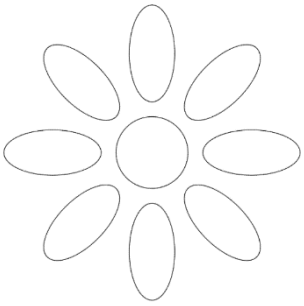
- **SET CUTTING OPTIONS** by clicking on 



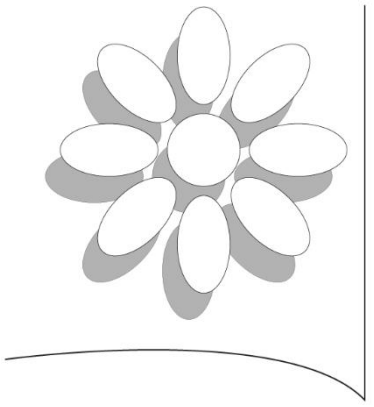
Option de dessin allows you to apply various options to cutting

- ***Convertir les traits en contours*** transforms a single stroke into a double stroke.

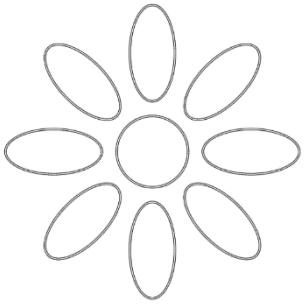
→ Original drawing



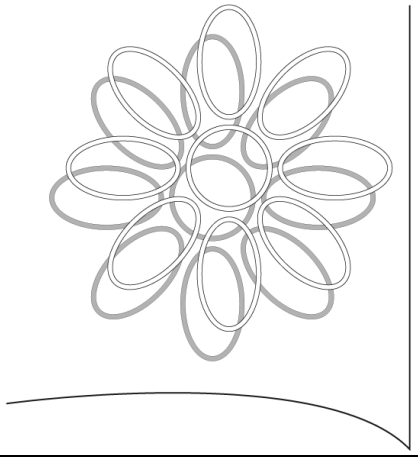
→ Cutting



→ Drawing with option



→ Cutting with option



- ***Soudage automatique*** eliminates traces within other traces:

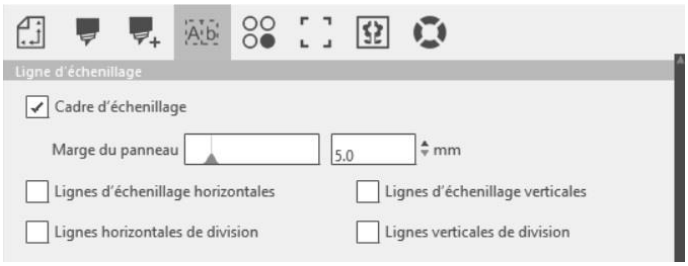
→ Original drawing

→ Result

- ***Trier d'abord les contours intérieurs*** allows you to prioritize the order in which lines are cut, starting with all inner lines to avoid cutting offsets on the media.

- ***Eliminer le chevauchement des segments de lignes*** merges overlapping paths so you don't cut twice in the same place.

- If needed, **SET "LIGNE D'ECHENILLAGE"** by clicking on 

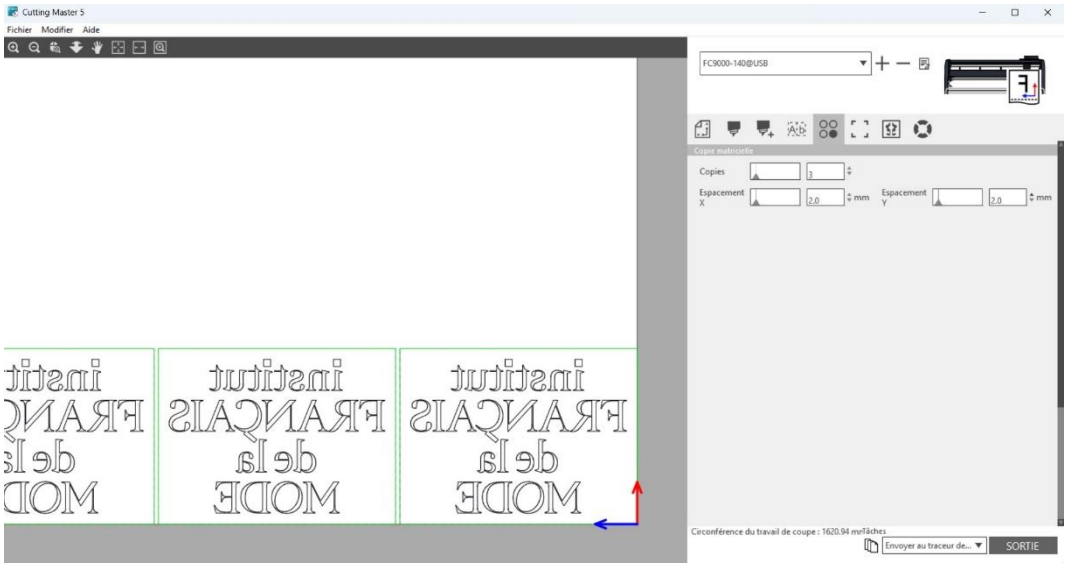


Ligne d'échenillage generates a cutting frame around the trace to separate the cut part more easily from the media.

You can choose the margin around the design, or define other cutting lines within this frame.

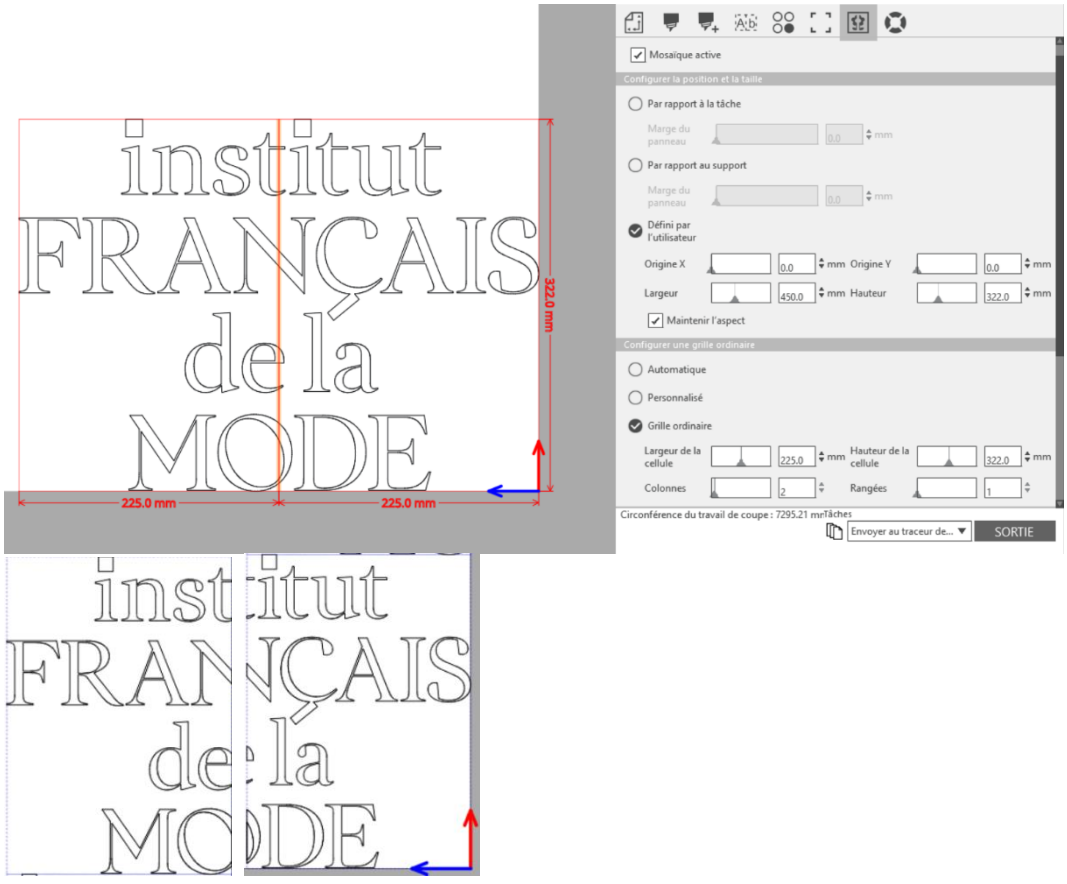
- If needed, **SET "COPIE MATRICIELLE"** by clicking on 

  Copie matricielle duplicates the object to be cut by multiplying the number of copies required. You can also choose the spacing of these copies on the media in *x* and *y* directions.



- If needed, **SET "REGLER MOSAIQUE ACTIVE"** by clicking on 

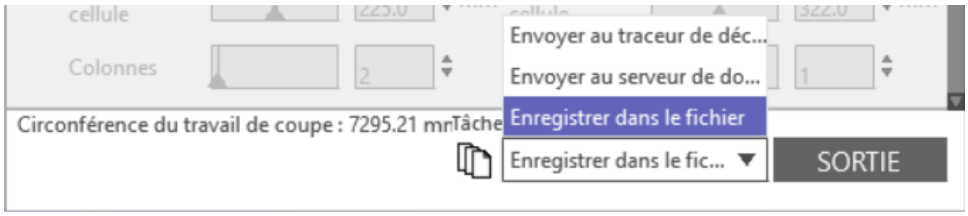
  Mosaïque active creates subdivisions of the path to be cut, to create a pattern in 2 or more parts.



- **SAVE THE SETTINGS FILE**

  It is essential to save the settings file in order to keep track of all the settings that have been applied to a job.

  - **SELECT *Enregistrer dans le fichier*** in the dedicated menu and **CLICK on *Sortie*** to open the saving window.

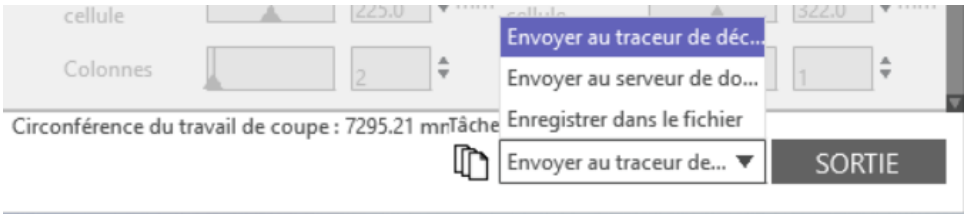


  - **CHOOSE THE DESTINATION FILE for saving.**

5. Cutting

Once all the parameters have been set, all that remains is to start cutting.

- **SELECT *Envoyer au traceur de découpe*** in the dedicated menu and **CLICK on *Sortie*** to start the cutting.



6. After the cutting

The use of certain media requires special post-cutting operations.

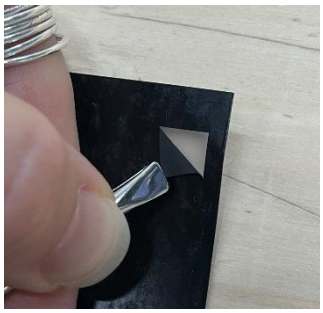
PEELING

Peeling is the process of removing unnecessary media, leaving only the cut-out design on the backing layer (paper in the case of self-adhesive vinyl, or transparent film in the case of iron-on vinyl). Once pelled, the pattern can be applied to the final support (a textile in the case of iron-on vinyl).

- **GET THE MEDIA** and **SPOT THE AREAS TO BE REMOVED**

- **PEEL THE MEDIA**

Pinch the media to lift the corner of an area to be removed.



Use a pair of peeling pliers to gently pull on the media.

Pull the media along the contour of the areas to be preserved.

Once the outer zone of the media to be removed has been removed, remove the inner zones.

Using pointed pliers, prick the center of an area to be removed to avoid damaging the cut edges.

Continue until all unnecessary media has been removed.

HEAT TRANSFER

! CAUTION: DANGER OF BURNS! You're about to handle a hot machine that could injure you. Be careful!

- **USE ONE OF THE TWO PRESSES** depending on the fabric:

For flat textiles

Garments

- **SET TEMPERATURE AND TIME.**

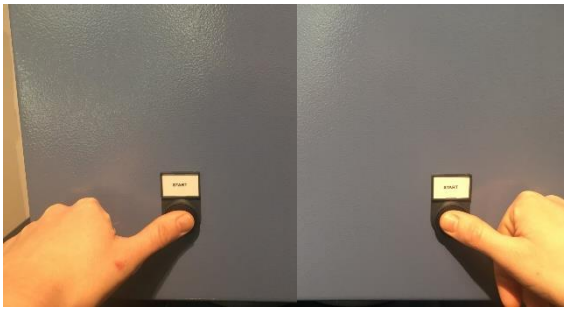
! Refer to the temperatures and times indicated by the suppliers for each material.

- **PLACE FABRIC + VINYL IN THE PRESS**

Place the fabric on the protective paper. Make sure the fabric lies flat, without folds. Then add the vinyl with its transparent film to the fabric (transparent film on top).

Cover with protective paper. The result should be a "sandwich". Make sure there are no tools lying around on the tray.

- **MOVE THE TRAY and PRESS by pushing both buttons at the same time.**



Make sure no one leaves their hands lying around

IT IS MANDATORY TO WAIT IN FRONT OF THE PRESS TO ACTIVATE THE EMERGENCY BUTTON IF NECESSARY.

- **AT THE "BEEP", THE PRESS OPENS.**

  ! Caution: the combination of baking paper + print + fabric is very hot. Wait a few seconds before removing

- **ADMIRE THE RESULT!**

  Congratulations! You've just flocked a motif.

Cleaning and tidying up after cutting

It's vital that everyone contributes to the upkeep of the fablab and its machines, to ensure quality and comfort for all. Each time a machine is used, it must be cleaned and tidied up.

1. Cleaning

- **DISPOSE OF ALL MATERIAL FALLS in the fablab's waste garbage cans.**

- **CHECK THE PRESS PROTECTION PAPER. Change if necessary.**

2. Storage

- **ARRANGE TOOLS (pliers, scissors, rulers, etc.) in their proper places.**
- **Be sure to LEAVE THE WORKING SPACE as you found it when you arrived.**

! Inform the fabmanageuse in the fablab if the workspace is not in order, clean and tidy, when you arrive on the machine.

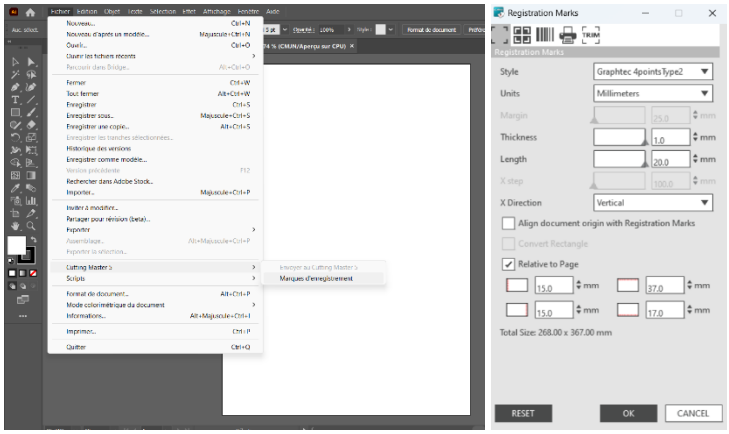
ANNEXES

ANNEX n.1

Positioning markers: Advanced Marker Detection System (ARMS)

- **ON ILLUSTRATOR SOFTWARE**

  FICHIER > CUTTING MASTER 5 > MARQUES D'ENREGISTREMENT

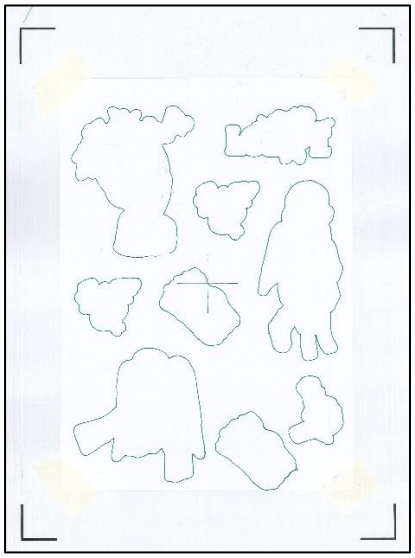


Recommended features ::

- Style: Graphtec 4points **Type 2**
- Distances: minimum 15mm on the sides, 17mm on the front and 37mm on the back

! Margins can be printed directly on the file to be cut.

- **POSITION THE MATERIAL ON THE BASE**



Direction of media movement

- **To test marker detection on the machine: PAUSE/MENU > ARMS > TEST CAPTEUR ARMS**

  And position the tool in the bottom right-hand corner:

ANNEX n.2

CONDITION	*Condition n°1*	*Condition n°2*	*Condition n°3*
TOOL TYPE	Blade tool CB09U	Felt tool	Blade tool CB09U
TOOL POSITION	Position 1	Position 3	Position 3
CUT TYPE	Half-flesh-cut	Full-flesh-cut	Full-flesh-cut
CUTTING LINE TYPE	Solid line	Solid line	Dashed line
SPEED	60 cm/s	30 cm/s	20 cm/s
FORCE	10	4	12
ACCELERATION	1	1	1
APPLICATIONS	▪ Adhesive vinyl cutting ▪ Iron-on vinyl cutting	▪ Drawing ▪ Pattern	▪ Thin paper cutting

CONDITION	*Condition n°4*
TOOL TYPE	Blade tool CB09U
TOOL POSITION	Position 1
CUT TYPE	Half-flesh-cut
CUTTING LINE TYPE	Solid line
SPEED	60 cm/s
FORCE	20
ACCELERATION	1
APPLICATIONS	▪ Thick adhesive vinyl cutting ▪ Thick iron-on vinyl cutting