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MAKERSPACE

LASER ETCHER GUIDE

xTool S1

What is laser etching/cutting?

It is the process of using a high-performance laser (in our case a diode laser) attached to a computer programed chasis to etch/score/cut precise designs into various materials including wood, metal, acrylic and paper.
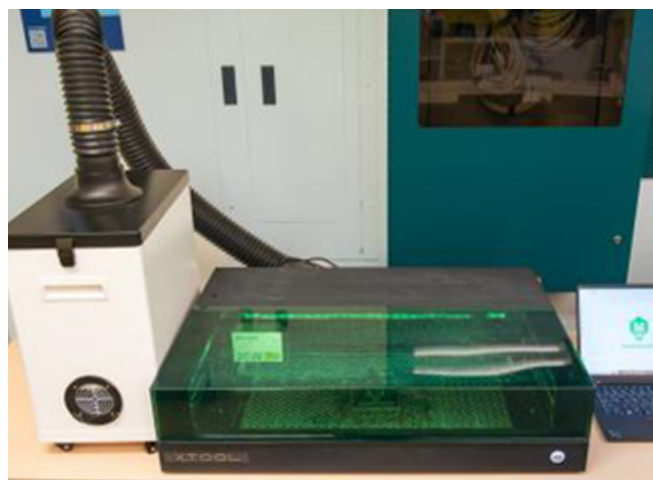
This guide includes:

Machine Specifications

Our Laser Etcher/Cutter

The Makerspace has a xTool S1 Enclosed Diode Laser Cutter

- **Max Cutting Area:** 19.6"× 12.5"

- **Max Material Thickness:** 10mm

- **Laser Power:** 20W

- **Working Speed:** 600mm/s

- **Supported File Types:** SVG/DXF/JPG/JPEG/PNG/BMP/TIF

- **Class 1 Safety:** 5-direction flame detection, emergency stop, lid-open safety stop and laser key lock.
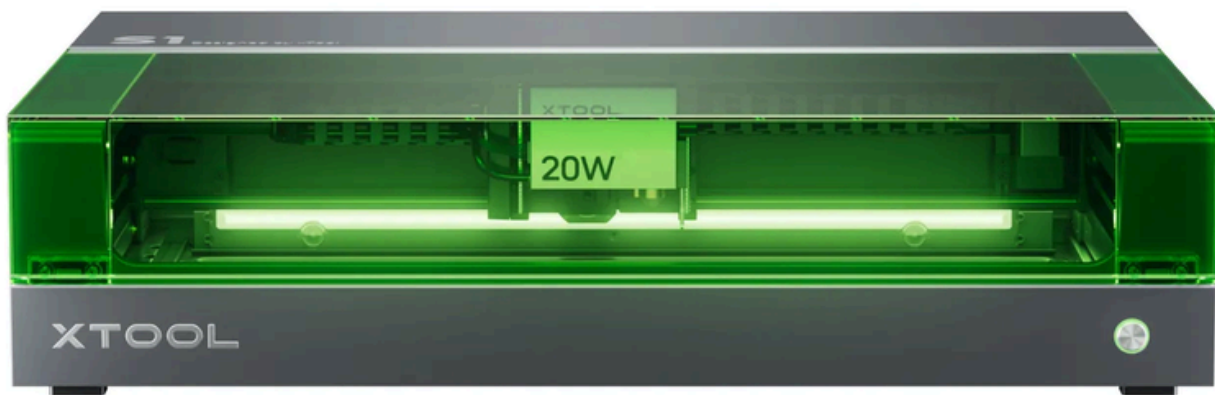
See the official manual here

Photo Credit: xTool
https://www.xtool.com/products/xtool-s1-laser-cutter?variant=44483097592047

Safety

DO NOT etch on electronic devices, vinyl or PVC.
These can release toxic fumes or cause fires.

Never leave the laser unattended.
Fires can start if materials ignite. Always monitor the job.

Use proper ventilation.
Turn on the ventilation system before etching or cutting. Fumes and smoke can be dangerous.

Ensure the lid is closed during use.
The laser will not turn on if the lid is not closed since it serves as a shielding device. Wait a few seconds for the fumes to dissipate before opening the lid after completing a job.

Emergency stop button.
In the case of an emergency like a fire immediately press and hold the red emergency stop button located on the right side of the machine until the power switches off. After the emergency is over, turn the button clockwise about 45° to release it, and then restart the machine.

Allow cooling time between jobs.
If using the laser etcher/cutter for a sustained period of time allow for machine cooling before starting another job to avoid overheating the module or electronics.

Fire Extinguisher
In case of fire be aware there is a fire extinguisher located on the wall across from the Makerspace.

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Terminology

Term	Definition
Diode Laser	A compact, energy-efficient laser type used in the xTool S1, typically operating at 455nm wavelength.
Engraving	Etching or marking the surface of a material without cutting through it.
Cutting	Using the laser to slice through material completely. There are limitations of materials and thicknesses for our laser due to ventilation concerns.
Passes	The number of times the laser goes over the same area. Multiple passes are used for thicker or harder materials.
Power	The intensity of the laser beam (usually in percentage). Higher power cuts deeper but may burn edges.
Speed	The rate at which the laser head moves. Slower speeds allow deeper cuts but can cause higher risk of fire depending on material.
Focus	The correct distance between the laser module and the material surface for best results.
Z-Axis Adjustment	Raising or lowering the laser head to set focus manually or automatically.
Frame	A preview outline of the design to show where it will engrave or cut. Helps with alignment.
Air Assist	A stream of air that clears smoke and debris during cutting, improving performance and reducing flare-ups.
Honeycomb Panel	The metal grid platform that supports materials and allows clean cuts by reducing laser reflection.

Materials

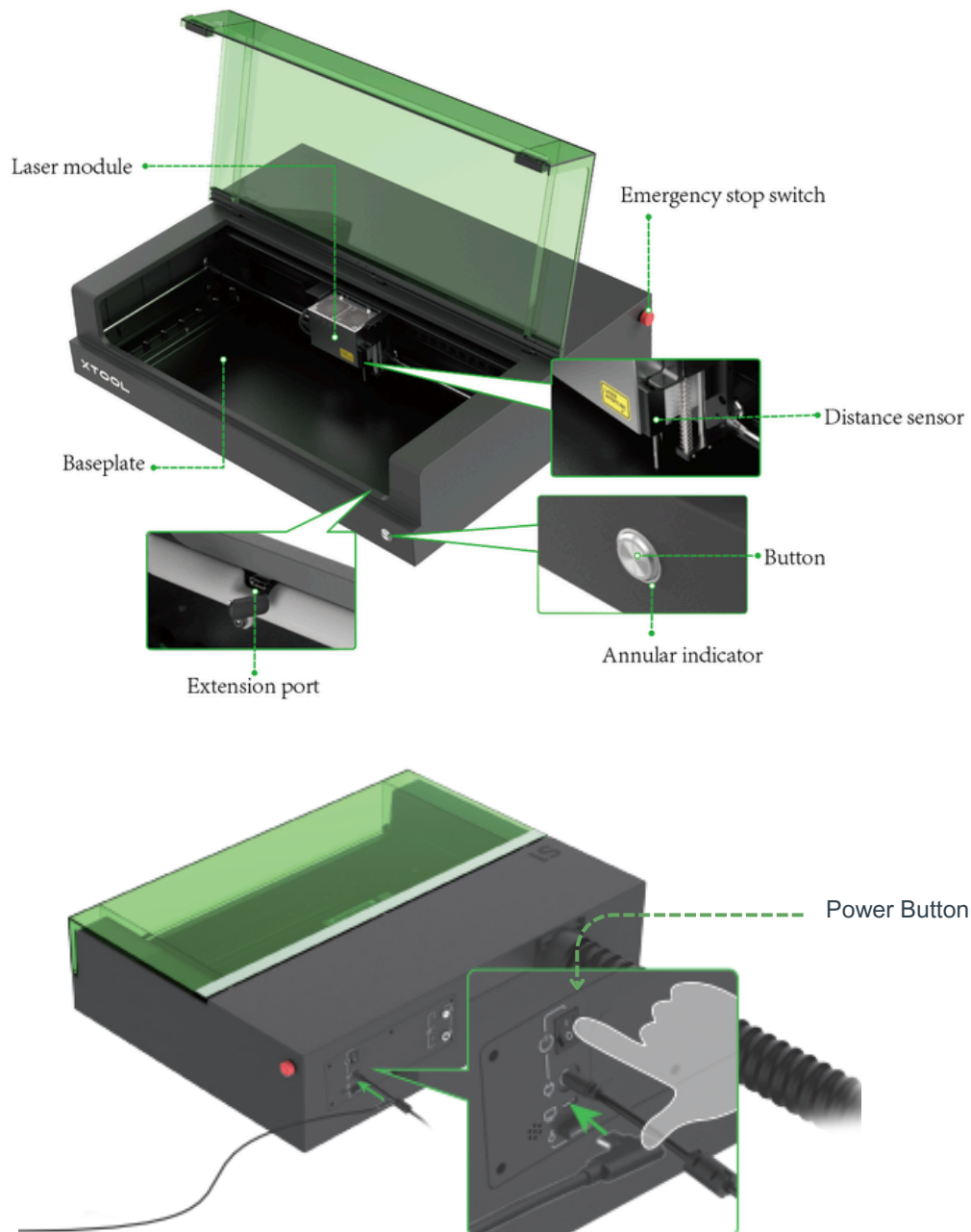| Type	Cut	Engrave	Notes
Paper	✓	✓	Cuts easily; ideal for intricate designs
Leather	✓	✓	engraves well; can have an odor
Opaque Acrylic	✗	✓	Can engrave coated surfaces
Wood (e.g., basswood or balsa)	✗	✓	Ideal for engraving; use test passes to avoid burning
MDF	✗	✓	Engraves well but produces a lot of smoke
Stainless Steel	✗	✓	Requires coating for engraving.
Painted Metal	✗	✓	Laser removes paint to reveal the metal underneath
Dark Glass	✗	✓	Works best on painted/coated or frosted surfaces
Fabric	✗	✓	Natural fabrics (cotton, denim) are best; avoid synthetics
Ceramic	✗	✓	Use darker or coated ceramics for better contrast
Slate/Shale	✗	✓	Ideal for photo engraving; high contrast results
Marble	✗	✓	Produces light engraving on dark stone
Cement/Concrete	✗	✓	Requires higher power settings; limited detail
Brick	✗	✓	Best for large, bold designs

Diagrams

Laser module

Emergency stop switch

Distance sensor

Baseplate

Button

Extension port

Annular indicator

Power Button

Photo Credit: xTool Support
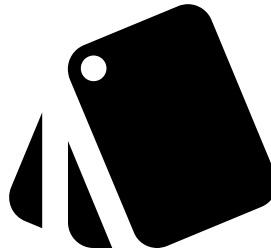https://support.xtool.com/article/1106

Checklist for Use

Follow this helpful overview of steps

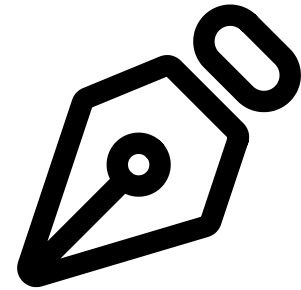**6 Easy Steps** **for using the laser etcher/cutter**
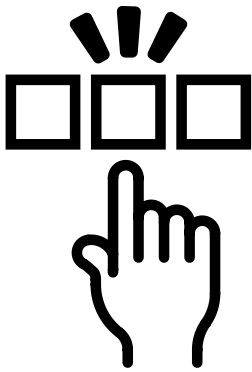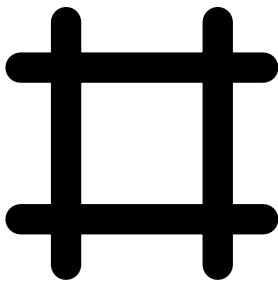
1. Select
Choose or create your design

2. Material Placement
Arrange and configure selected material

3. Design
Set up image for etching/cutting in XCS software

4. Framing
Ensure that the placement of your design is correct.

5. Ventilation
Ensure that fumes and smoke are prevented.

6. Etch/Cut/ Score
Close the lid and start the job.

Beginning to Laser Etch/Cut

1. Select

    a. Pick an image to etch into your chosen surface. Aim for higher quality images, at least 300 DPI, for images smaller than 4" x 4". See pg.12 and 13 for more detailed instructions on choosing images.

2. Material Placement

    a. Open the lid and place your chosen material flat on the honeycomb base or platform. If you are concerned about exact placement of the etched image line up your work piece in the corner. Otherwise eyeball placing the material balanced in the center of the honeycomb base.

    b. Use the autofocus feature by moving the laser module above the material and click the "focusing button" on the XCS software to get the focal length.
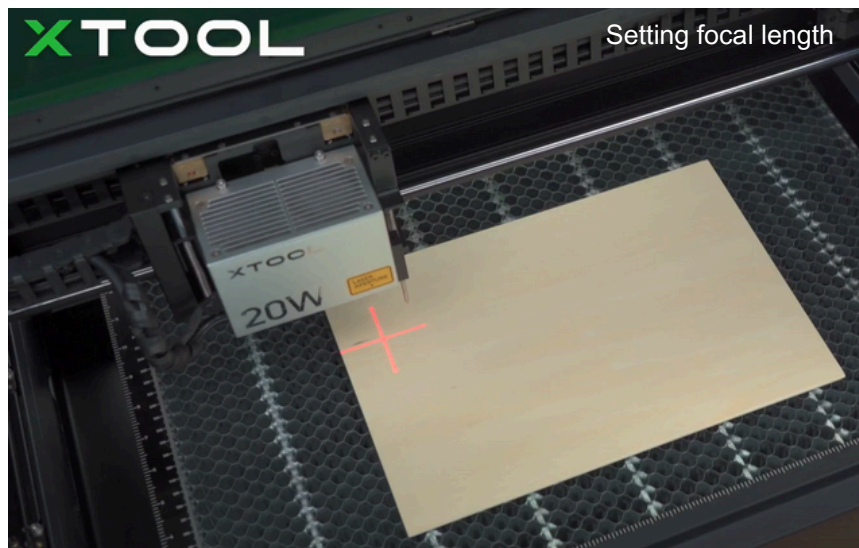

Setting focal length

Photo Credit: xTool
https://www.youtube.com/watchv=qMahDuBwt2c&list=PLybe2Md_qVsObgGziWFEmK1SM
9t3rzey&index=13

YouTube Video Tutorial

Operation of laser etcher/cutter

Beginning to Laser Etch/Cut

2. Material Placement Continued

    c. Define the size of the material in the XCS software using the measure function

    d. Follow the prompts in the XCS software. based on the shape of the material to triangulate its size and position.

    e. The material size will now be shown in the software.

3. Design

    a. Import or create your design in xTool Creative Space (.svg, .png, .jpg, etc.).

    b. Move this into the intended position on the defined material.

    c. Set material type

    d. Select the processing type between either "score", "engrave", or "cut". See pg. for more information on what materials are safe to cut.

    e. This should auto populate the correct laser power, speed, and number of passes. You can also manually adjust these settings.

Safety Note: For flammable materials be considerate of the combination of these settings as this can affect how easy it is for the material to ignite. For example a slow speed and high power on paper would be more likely to ignite.
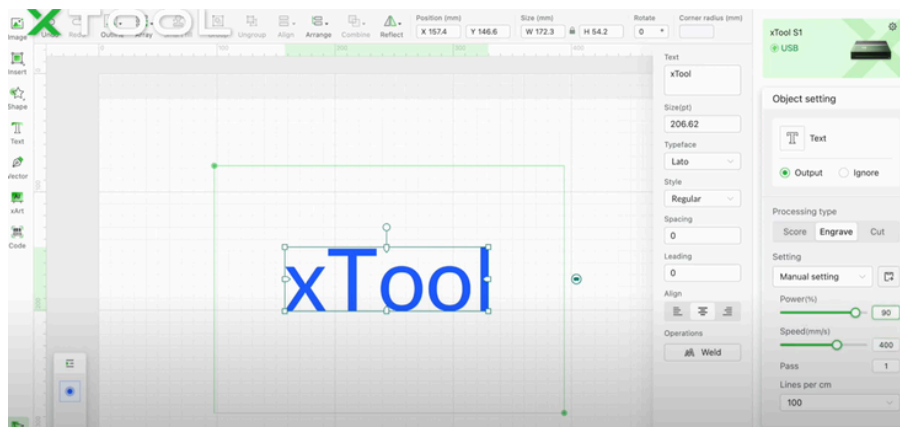
xTool Creative Space (XCS)

Beginning to Laser Etch/Cut

4. Framing
    a. Use the framing function in the XCS software and press the front button on the machine.
    b. Watch the xTool bed as the size and placement of your design is projected onto your material.
    c. Confirm that this placement is correct. If it isn't adjust your design placement and redo the framing step.

5. Ventilation
    a. **Before starting any job reach down and turn on the ventilation system** located below the table with the laser etcher/cutter. This is a critical safety step to prevent fumes and smoke.

6. Etch/Cut/Score
    a. Ensure the lid of the machine is closed and press the "Start" button.
    b. Follow the computer guide and press the button on the machine to start the job.
    c. Monitor till complete to ensure safe use.
    d. Wait for a few seconds after job completes before removing your work piece to allow smoke and fumes to disapate. Clean up any debris left on the honeycomb bed.
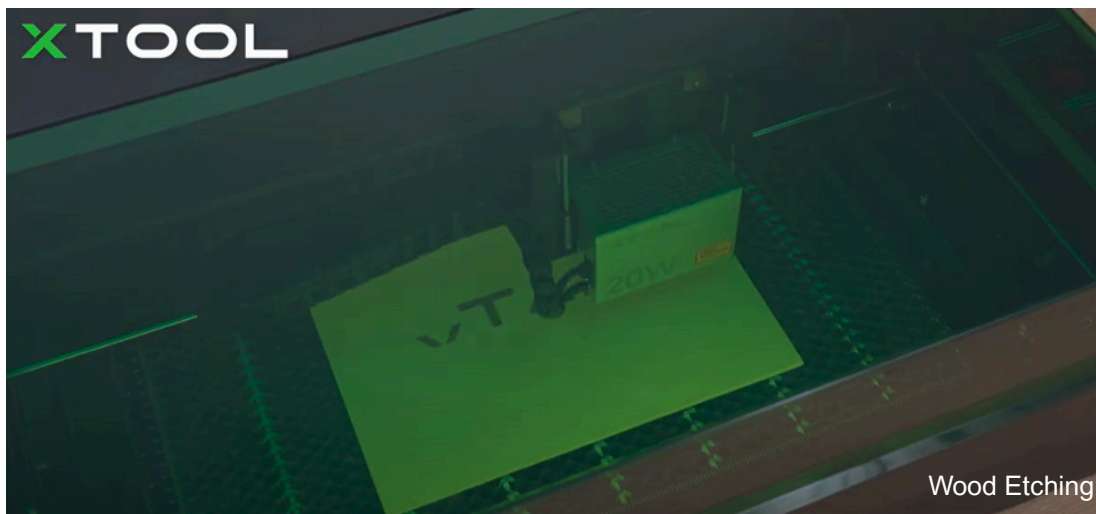

Wood Etching

Photo Credit: xTool
https://www.youtube.com/watchv=qMahDuBwt2c&list=PLybe2Md_qVsObgGziWFEmK1SM9t3rzey&index=13

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Image Guide

What types of images work best?
- High contrast: Light and dark areas are distinct.
- Minimal background clutter: Simpler backgrounds reduce visual noise.
- Clear subject: Faces or logos should be sharp and centered.
- Strong edges: Outlines and borders enhance detail in the final result.

What images should I avoid?
- Low-resolution or blurry photos
- Detailed images with low contrast (poor for wood)
- Complex color gradients (won't translate well)

How does resolution affect the etching process?
- Aim for at least 300 DPI (dots per inch) for images smaller than 4" x 4".
- Lower DPI (150–200) may work for larger pieces or rougher materials (e.g., wood).
- Higher resolution = more detail, but also longer engraving time.

Do I need to edit the images before using the laser etcher/cutter?
The XCS software that the laser etcher/cutter uses does a good job converting jpgs or pngs into etching or cutting files. However if you wanted to do initial editing to improve quality and clarity you edit your images with Adobe Photoshop (available on the desktop computer in the Makerspace).

Some areas you may want to consider.
- Convert to Grayscale – Removes color info and focuses on contrast.
- Adjust Brightness/Contrast – Make details more defined; avoid flat areas.
- Resize Appropriately – Match your image size to the intended engraving area.
- Sharpen Edges – Helps with clearer detail in engraving.
- Apply Dithering (for photos) – Dithering turns grayscale into patterns of black/white dots that simulate shading.

Image Guide

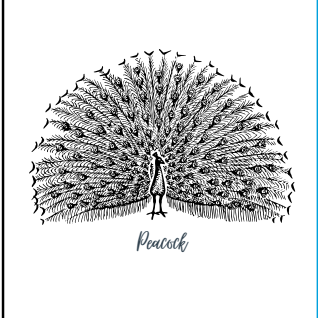| Photographs		
✗	✗	✔
• High Resolution • Simple background • High contrast • Sharp edges	• Low contrast • Competing background	• High Resolution • Simple background • High contrast • Sharp edges

Photo Credit: Canva

Line Art, Vectors and Logos	
✗	✔
• Complex • Small text • Gradients	• Simple • Clear • No Gradients

Photo Credit: Canva

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Troubleshooting

Common Issues		
Problem	**Likely Cause**	**Fix**
Laser not firing	Loose cable, safety lid open, or focus not set	Check all connections; ensure lid is closed; re-calibrate focus
Inconsistent cutting depth	Material not flat, wrong focus, or dirty lens	Use flat, secure materials; refocus; clean lens
Charring or burning	Power too high or speed too low	Reduce power or increase speed; enable air assist
Poor engraving quality	Dirty lens or incorrect material settings	Clean optics; adjust power and speed for material
Smoke buildup inside	Inadequate ventilation or fan issue	Check fan/filter and ventilation hose; clean or replace as needed
Laser won't focus properly	Lens dirty or Z-height not calibrated	Clean focus lens; perform autofocus or manual height calibration
Misaligned cuts	Material shifted or frame not used	Secure material with magnets or tape; use framing feature

Understand the annular indicator

Buzzer	Annular indicator	Machine state	Button operation
/	Solid white	Standby	/
	Blinking purple	Network setting (device disconnected from the software)	Long press to set the network
	Solid purple	Standby, connected to the software via Wi-Fi	/
	Blinking white slowly	Starting	/
		Auto focusing	Long press to cancel auto focus
		Measuring curved surface	Long press to cancel curved surface measurement
		Framing	/
	Solid blue	Locating the material	Short press to mark a vertex; long press to cancel material locating
	Blinking green slowly	Performing a task	Short press to pause the processing; long press to cancel the processing
	Blinking purple slowly	Firmware updating	/
	Blinking yellow for 3 times	TF card exceptions occur	/
Buzzing for once	Solid blue	Ready for framing	Short press to start framing; long press to cancel framing
		Ready to work	Short press to start the processing; long press to cancel the processing
	Blinking blue slowly	Task paused	Short press to continue the processing; long press to cancel the processing
	Blinking red	Exceptions occur on movement	Short press to stop the warning
	Blinking yellow	The lid is not fully closed during operation.	/
Buzzing for 3 seconds	Blinking yellow	Exceptions occur	Short press to stop the warning
	Blinking red	Exceptions occur on Wi-Fi communication	/
Keeping buzzing	Blinking red	Flame detected	Short press to stop the warning

Photo Credit: xTool Support

https://storageus.xtool.com/resource/xtool/supportattachment/xTool%20S1%20%E7%94%B5%E5%AD%90%E6%A1%A3/English%20%20xTool%20S1%20Quick%20Start%20Guide.pdf

References

xTool Support. (2025a). Quick start guide. https://storage-us.xtool.com/resource/xtool/support-attachment/xTool%20S1%20%E7%94%B5%E5%AD%90%E6%A1%A3/English%20-%20xTool%20S1%20Quick%20Start%20Guide.pdf

xTool Support. (2025b, January 2). XTool S1 User Guide - xTool Support Center. xTool S1 User Guide - xTool Support Center. https://support.xtool.com/article/1106

xTool. (2024). Use xTool Creative Space (XCS) to Operate xTool S1. YouTube. https://www.youtube.com/watch?v=qMahDuBwt2c&list=PLybe2Md_qVs-ObgGziWFEmK1SM9t3rzey&index=12

I acknowledge the use of ChatGPT (https://chat.openai.com/) to help develop this instructional guide.