

# Technical Use Guidance for Engraving with a FiberMark Epilog Laser Engraver



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Radioisotope Science and Technology Division

**TECHNICAL USE GUIDANCE FOR ENGRAVING WITH A FIBERMARK EPILOG  
LASER ENGRAVER**

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September 2022

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## Acronyms

ABS	Acrylonitrile butadiene styrene
PET	Polyethylene terephthalate
SME	Subject Matter Expert
USB	Universal Serial Bus

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## ABSTRACT

The FiberMark Epilog Laser Engraver is useful tool having the ability to etch and mark a wide variety of metals and plastics. This laser engraver is capable of creating different marks including annealing metal, etching metal, metal polishing, and plastic marking. Annealing metal is a process in which the metal is heated to a high temperature creating a permanent oxide layer on the surface resulting in a high contrast mark. The benefit of annealing is this type of mark is created without changing the surface finish of the metal. Annealing is the best choice for marking targets used in the Pu238 program due to the high contrast mark it is easily visible throughout the production process. Metal engraving is a process in which the metal is removed from the surface by vaporization. To make a deep metal engraving multiple passes may be required particularly if the metal has a high hardness level (such as stainless steel). Metal polishing is a process in which the surface of the metal is heated quickly causing the color to change and take on a mirror-like finish. This process is best for metals that are darker or have a matte finish. Plastic marking occurs with engineered plastics which undergo a color change in the surface without the surface being damaged. The plastics that are most compatible with the laser engraver's 1065 nm wavelength of light are PET, ABS, polycarbonate and colored Delrin.

### 1. IMPORTANT SAFETY INFORMATION

The laser engraver is identified as a class 2 laser; however, the laser is fully contained in the laser cabinet. Additionally, the laser cabinet has built in safety interlocks which prevents damage to the eye or skin from direct contact with the laser beam. Upon opening the front door or top window the laser is turned off preventing injury. The top window which is green in color is made from acrylic that blocks the infrared wavelength of light produced by the laser which means viewing the laser through this window will not be harmful. Although the user's manual does recommend limited viewing while in operation.



*Figure 1: Epilog FiberMark Laser Engraver*

Training is comprised of two parts in which a subject matter expert (SME) will demonstrate the use and safety features and then in a different session the trainee will demonstrate the use and safety features without interruption from the SME. Records of training completion will be maintained. When operating a laser engraving system, it is very important to follow a few safety precautions.

1. Any laser system represents an inherent fire hazard and should never be left operational while unattended.
2. To ensure proper ventilation inside the laser engraver and filtration of the air exiting it, never operate the laser engraver without the filtration unit and air pump turned on and functioning properly.
3. Never modify the system in any way that may allow its operation while the top window or front door are open or could result in light from the laser exiting the enclosure as it was received from the factory.

In case of an emergency the laser engraver has a large red emergency stop button located on the front of the instrument. Pressing this button will immediately stop the laser and the motion control system from moving. To restart the laser, it must first be turned off at the main power switch and then the emergency stop button can be reset by twisting it in a clockwise direction. Once the emergency stop button has been reset the instrument can be turned on with the main power switch.



*Figure 2: Emergency Stop*

## **2. INSTALLATION AND SET-UP**

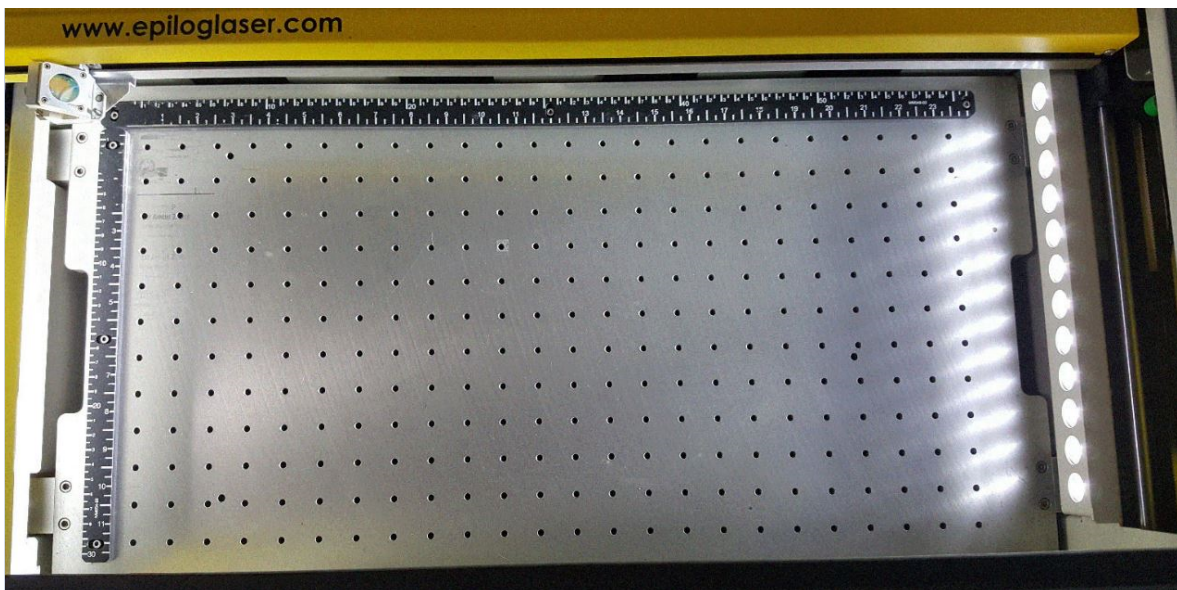
It is important to identify a good working space for the FiberMark Epilog laser engraver. The area it is placed in should have enough space to house the laser engraver, a separate table with the computer and monitor, a pump, and the filtration unit. Other information pertaining to the equipment set-up should be taken into consideration as followed:

- When the FiberMark Epilog laser engraver is in operation the laser tubes generate excess heat and therefore must be cooled for the laser engraver to work properly. There are cooling fans located on the top of the cabinet and cooling vents located in the back. It is important to never let these become covered or blocked while operating the laser engraver.

- The laser engraver should also never be operated in a room where the ambient air temperature is more than 90 ° F.
- The laser engraver needs to have an exhaust system connected to a filtration unit which provides a method for removal of the dust, debris and fumes created in the engraving cabinet. The laser engraver should always be operated in conjunction with the exhaust system for this purpose.
- Use the USB cable provided with the laser engraver to connect to the computer but be sure to first have the laser engraver turned off. Once you turn the laser engraver back on the computer will recognize a new device having been connected.
- Follow the usual directions provided by the computer system to complete the print driver installation for the laser engraver, referencing the user's manual as needed.
- The Epilog job manager is a tool which may be installed but is not necessary to use the laser engraver, reference the user's manual as needed to install this on the computer.

## 2.1 SETTING-UP THE LASER ENGRAVER

Inspect the item to be engraved and ensure that the dimensions of the object will fit into the laser engraving cabinet. The laser engraver has a maximum engraving area of 24 inches by 12 inches. The laser engraver can engrave up to a maximum material thickness of 5 inches, anything larger than that will need to be done on a different laser engraver. The laser engraver has what is called an “open architecture” which means it can be run from virtually any Windows based software. The instruction provided in this report will focus on using Excel, but other programs can be used.



*Figure 3: Laser Engraving Area*

Next identify the type of material the item to be engraved is made of. Knowing the material type will identify the necessary settings that will work best for the material and allow for less trial and error when setting up. Figure 4 is a list of compatible materials that work well with the FiberMark Epilog laser engraver.

<ul style="list-style-type: none"> <li>• 17-4 PH stainless steel</li> <li>• 303 stainless</li> <li>• 4043 steel</li> <li>• 6061 Aluminum</li> <li>• ABS (black/white)</li> <li>• Aluminum, 6061</li> <li>• Aluminum, yellow chromate</li> <li>• Bayer 2807 Makrolon polycarbonate</li> <li>• Bayers bayblend FR110</li> <li>• Black/white ABS</li> <li>• Black/white polycarbonate</li> <li>• Brass</li> <li>• Brushed aluminum</li> <li>• Carbon fiber</li> <li>• Carbon nanotube</li> <li>• Ceramics, metal-plated</li> <li>• Clear coat anodized aluminum</li> <li>• Cobalt chrome steel</li> <li>• Colored Delrin (black/brown)</li> <li>• Compacted powder iron with iron phosphate coating</li> <li>• Copper</li> <li>• DAP- Diallyl Phthalate</li> <li>• Delrin, colored (black/brown)</li> <li>• GE Plastics polycarbonate resin 121-R</li> <li>• Glass filled PEEK</li> <li>• Glass filled Teflon</li> <li>• Hard coat anodized aluminum</li> <li>• Inconel metals (various)</li> <li>• Machine tool steel</li> </ul>	<ul style="list-style-type: none"> <li>• Magnesium</li> <li>• Metal-plated ceramics</li> <li>• Molybdenum</li> <li>• Nickel plated 1215 mild steel</li> <li>• Nickel plated brass</li> <li>• Nickel plated gold</li> <li>• Nickel plated Kovar</li> <li>• Nickel plated steel</li> <li>• Nylon</li> <li>• PEEK, white</li> <li>• Polybutylene Terephthalate</li> <li>• Polycarbonate, (black/white)</li> <li>• Polycarbonate resin 121-R, GE Plastics</li> <li>• Polycarbonate, Bayer 2807 Makrolon</li> <li>• Polysulphone</li> <li>• Rynite PET</li> <li>• Santoprene</li> <li>• Silicon carbide</li> <li>• Silicon steel</li> <li>• Silicon wafers</li> <li>• Stainless steel 303</li> <li>• Stainless steel 17-4 PH</li> <li>• Steel 4043</li> <li>• Steel, machine tool</li> <li>• Various inconel metals (nickel-chromium super alloys)</li> <li>• White PEEK</li> <li>• Yellow chromate aluminum</li> <li>• Zinc plated mild steel</li> </ul>
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**Figure 4: List of Compatible Materials with the FiberMark Epilog Laser Engraver**

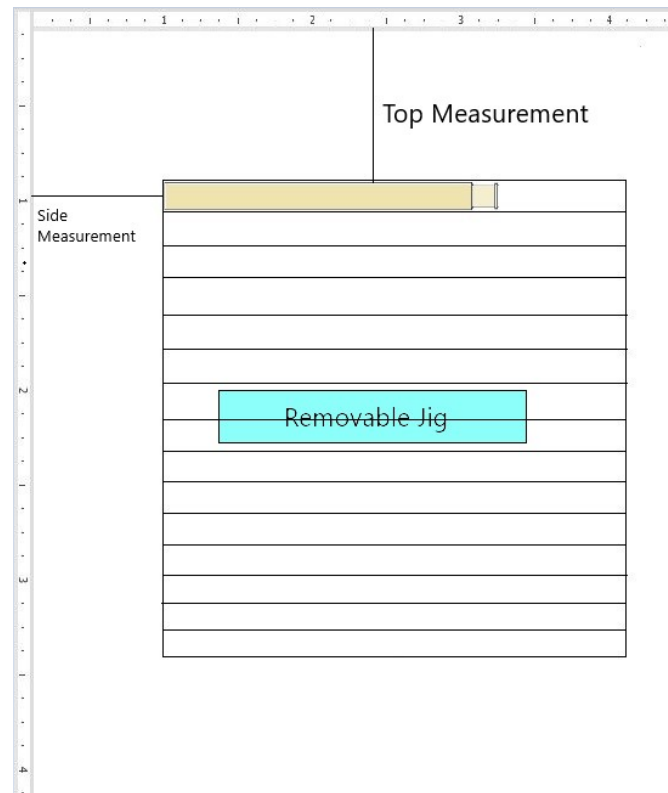
Finally identify the type of markings that are to be made on the material (annealing, etching, or polishing). The settings will also change based on the type of markings to be made.

A good way to practice the engraving without marking the item and thus ruining the item is to cover the item in an acceptable medium such as aluminum foil and then engrave with settings which only penetrate the foil. This technique works best for setting up the first engraving made on this type of object, so that proper placement of the engraving marks is identified. Another acceptable technique for practicing the engraving is to use a test part with the same dimensions and material make-up as the item to be engraved. It is important to remember to adjust the settings from the aluminum foil practice markings to the material used in the actual engraving.

### 3. CREATING A TEMPLATE TO USE IN MICROSOFT EXCEL®

Virtually any computer software that has the capability of printing can be used to create a template. Microsoft Excel® was chosen for this project's application because column widths, row heights, and margins can easily be adjusted to achieve accurate placement of the engravings.

1. Open a blank workbook in Excel from Microsoft office to create a template for the item to be engraved.
2. Place the item to be engraved on the removable jig (which has been mounted in the laser engraving cabinet with double-sided tape).
  - Aligning the item to be engraved along the straight edges of the jig on the left side and top will make it easier to identify the placement in Excel.
  - Remove the jig if it proves to be unhelpful or an impediment with the laser engraving process.
3. Using a micrometer or a similar tool measure the distance from the edge of the ruler in the engraving cabinet to the starting point of the engraving from the left side.

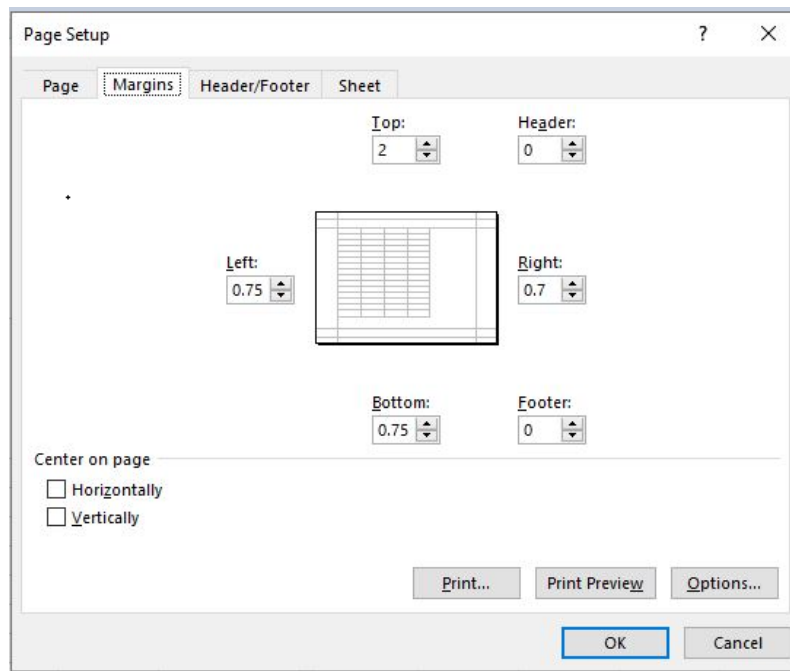


*Figure 5: Top and Side Measurement of the Jig Placement*



4. Go to the opened workbook in Excel and adjust the left side margin to be the value measured in step 3.

- Open the page layout tab.
- Select Margins.
- Open Custom Margins.
  - For example, if the measurement in step 3 was 0.75 inches, then enter 0.75 inches for the Left Margin.



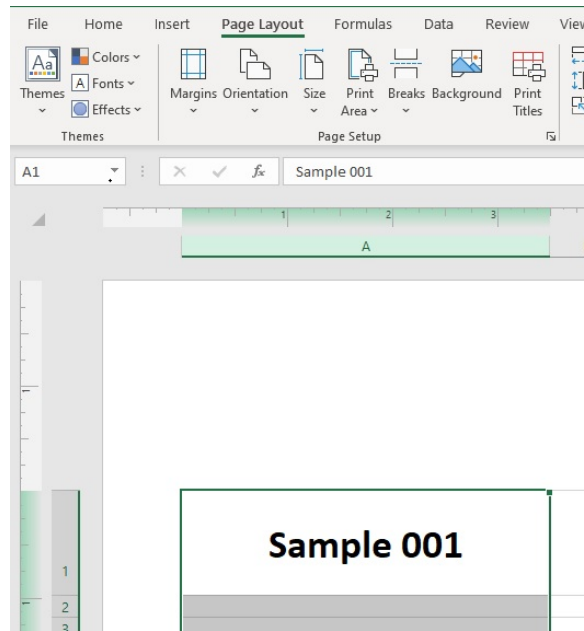
*Figure 6: Margin Set-up in Excel*

5. Using a micrometer or a similar tool measure the distance from the edge of the ruler in the engraving cabinet to the starting point of the engraving from the top.

6. Go to the opened workbook in Excel and adjust the top margin to be the value measured in step 5.

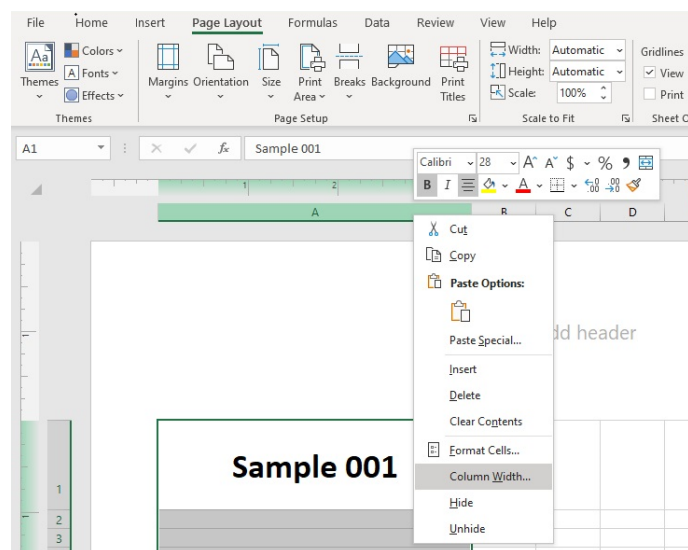
- Open the page layout tab.
- Select Margins.
- Open Custom Margins.
  - For example, if the measurement in step 5 was 2.0 inches, then enter 2.0 inches for the Top Margin.

7. Using a micrometer or similar tool measure the area that will contain the engraving starting with the width or length.
8. Go to the opened workbook in Excel and adjust the column width for the engraved area.
  - Highlight column A.



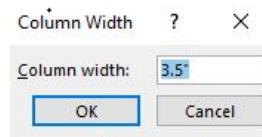
*Figure 7: Column Width Adjustment Under Page Set-up in Excel*

- Right click on column A.



*Figure 8: Column Width Selection*

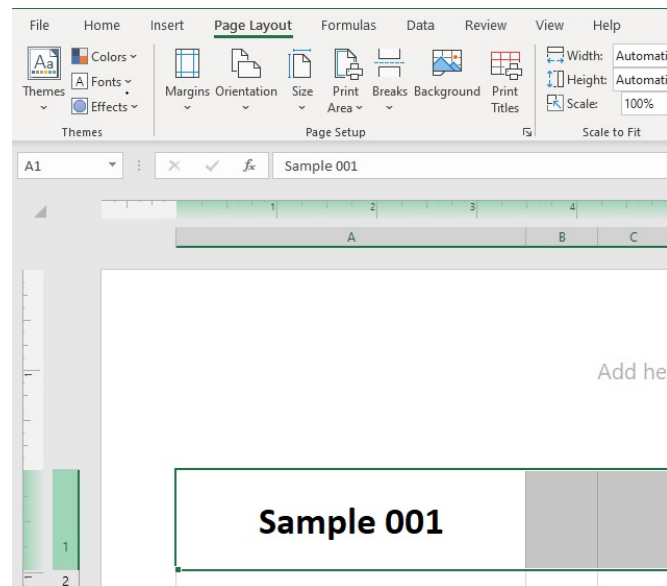
- Select Column Width.
  - For example, if the measurement in step 7 was 3.5 inches, then enter 3.5 inches for the Column width which is also the engraved length.



**Figure 9: Column Width Adjustment**

9. Using a micrometer or similar tool measure the height of where the engraved area will be.
10. Go to the opened workbook in Excel and adjust the Row Height for the engraved area.

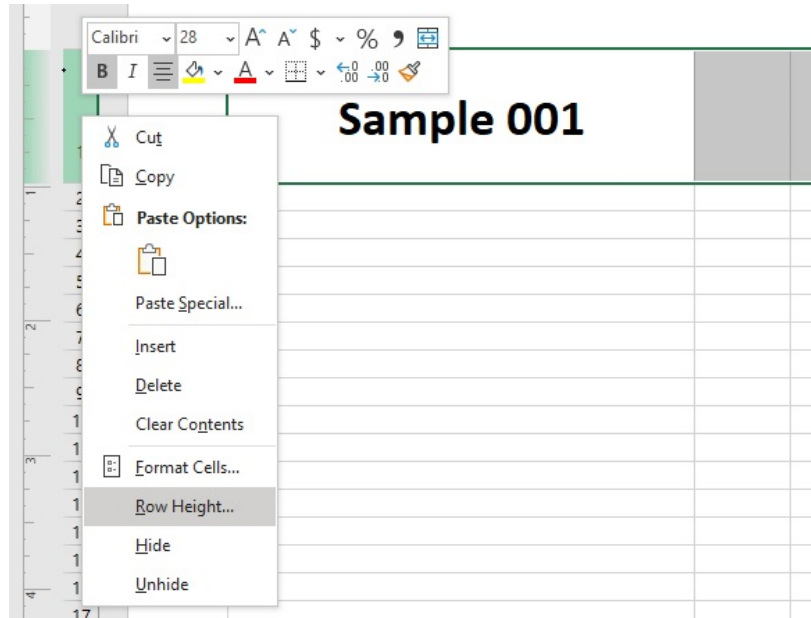
- Highlight row 1.



**Figure 10: Row Height Adjustment Under Page Set-up in Excel**

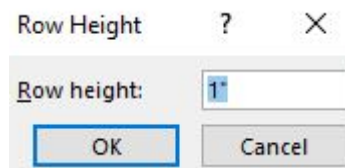
- Right click on row 1.





*Figure 11: Row Height Selection*

- Select row 1.
  - For example, if the measurement in step 9 was 1 inch, then enter 1 inch for the row height which is the height of the engraving.



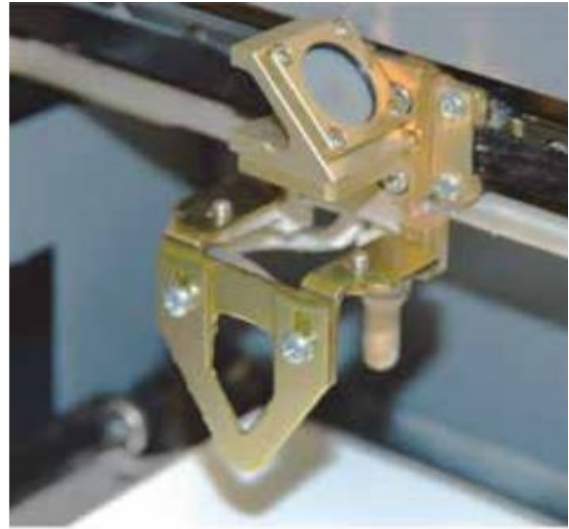
*Figure 12: Row Height Adjustment*

11. Enter the letters and or numbers to be engraved in A1 in the workbook from Excel be sure to use the largest font that will fit in the space and Bold it.
12. Save the template created for this engraving.
13. Minor adjustments may need to be made to later to either the row height or column width after the first practice markings have been made.

#### **4. SETTING-UP THE PRACTICE ENGRAVING MARKS**

1. Carefully wrap the object's engraved area in Aluminum foil to protect it from being marked in any way.

2. Return the object to the laser engraving cabinet making sure to align it as before when creating the template in Excel.
3. Place the “V” shaped manual focus gauge on the carriage to start the process of focusing (setting the distance from the bottom of the focus lens to the top of the item to be engraved).





*Figure 13: V shaped Manual Focus Gauge*

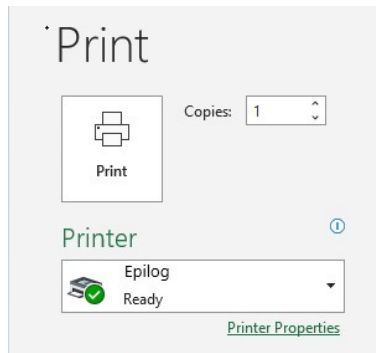
4. Press the “X/Y Off” key on the keypad and then press “Go”.



*Figure 14: Keypad*

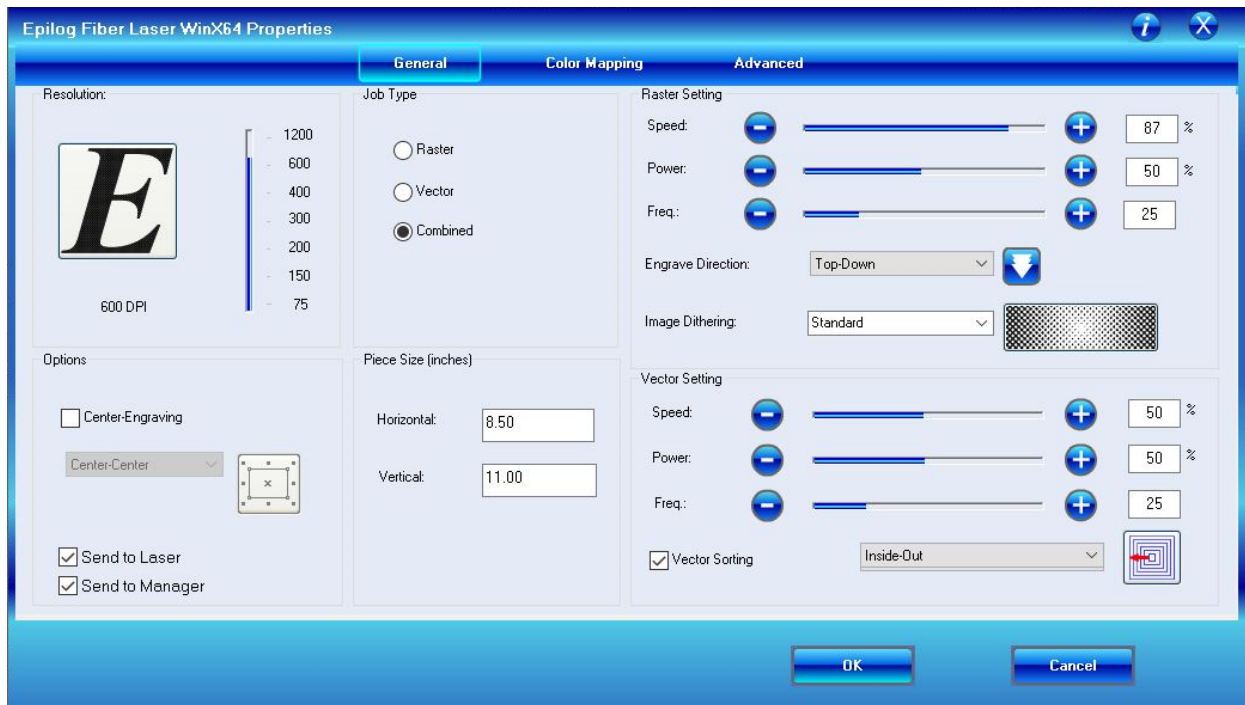
5. Move the carriage by hand to just above the object to be engraved.

6. Use the up or down arrows on the keypad to move the table to the proper focus height, where the tip of the “V” shaped manual focus gauge is just touching the surface of the object being engraved.
  - For rapid, rough, movement of the table use the double arrow buttons: 
  - For slower, more precise, movement of the table use the double arrow buttons: 
7. Once the proper focus height has been determined press the “Reset” key on the keypad to return the carriage to the original parked position.
8. Open the template created in Excel for this item.
9. Select Print from the File tab.
10. Ensure the Epilog Printer is selected and Ready to print.
11. Select Printer Properties in green text.



***Figure 15: Select Print***

12. The FiberMark Printer Properties under the General tab will appear.



*Figure 16: FiberMark Printer Properties*

13. Under Raster Settings the speed, power, and frequency need to be adjusted for only marking the Aluminum Foil.

- Change the raster settings for Speed to 60%, Power to 50%, and frequency to 2%.
- Select OK.

14. Select Print from the Excel Print Screen.

15. Verify the keypad on the Epilog FiberMark Laser Engraver states “Job 1” with the title of the Excel document.

16. Start the engraving by pressing the “Go” key on the keypad.

- As needed press the “Stop” key to stop the engraving.

17. Once the engraving is complete on the aluminum foil, check to see if the placement is accurate and font size is appropriate.

- As needed adjust the engraving area and font using the steps from Creating a Template to Use in Excel.

## 5. COMPLETING LASER ENGRAVING

1. Unwrap the object from the Aluminum foil.
2. Return the object to the laser engraving cabinet making sure to align it as before when creating the template in Excel.
3. Place the “V” shaped manual focus gauge on the carriage to start the process of focusing (setting the distance from the bottom of the focus lens to the top of the item to be engraved).
4. Press the “X/Y Off” key on the keypad and then press “Go”.
5. Move the carriage by hand to just above the object to be engraved.
6. Use the up or down arrows on the keypad to move the table to the proper focus height.
7. Once the proper focus height has been determined press the “Reset” key on the keypad to return the carriage to the original parked position.
8. Open the template created in Excel for this item.
9. Select Print from the File tab.
10. Ensure the Epilog Printer is selected and Ready to print.
11. Select Printer Properties in green text.
12. The FiberMark Printer Properties under the General tab will appear.
13. Under Raster Settings the speed, power, and frequency need to be adjusted for the type of markings desired such as annealing and for the type of material such as stainless steel.
  - The settings for engraving on Aluminum are speed 25%, power 100%, frequency 70%, and Focus adjustment 0.
  - The settings for annealing Stainless Steel are speed 2%, power 100%, frequency 1%, and focus adjustment +0.08
  - The settings for marking ULTEM 9085 are speed 50%, power 60%, frequency 50%, and focus adjustment 0.
  - As needed refer to the Epilog FiberMark Laser System Manual for guidance on settings and/or practice on sample items made from the same material to get the best setting combinations.

14. If the focus needs an adjustment such as when annealing Stainless Steel then, after completing the manual focus adjustment in steps 3-7 go to the keypad and change the focus by +0.08 using the up and down arrows on the keypad.
15. Select "Reset" on the keypad after completing any focus adjustment's that are needed.
16. Select Print from the Excel Print Screen.
17. Verify the keypad on the Epilog FiberMark Laser Engraver states the most recent Job number and has the correct title of the Excel document.
18. Start the engraving by pressing the "Go" key on the keypad.
  - As needed press the "Stop" key to stop the engraving.
19. Once the engraving is complete, check to see if another pass is needed. If another pass is needed to make the engraving deeper/darker, press "Go" on the keypad to complete the same engraving as many times as needed.
20. When engraving a series of identical items with different labels, make sure to return to the Excel workbook and change the text as needed, and to print the document to send the current job to the laser engraver.
  - Each time a document is printed to the Epilog laser engraver the job number on the keypad will increase by 1.
21. When the engraving session is complete, ensure that **ALL** the engraving equipment (air pump, filtration unit, and the laser engraver itself) are fully powered off and nothing is left running. When left running for long periods of time, equipment can get very hot, resulting in an unnecessary hazard if it is not being used.