

SBME Jim McEwen Zone for Innovators,
Creators and Entrepreneurs Training

Waterjet Cutter Quick Walkthrough Booklet

Vers: Feb 2025



THE UNIVERSITY OF BRITISH COLUMBIA

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Faculties of Applied Science and Medicine



Some photos used in this manual are attributed to the above official protomax operation guide.

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Safety Requirements and Instructions:



1. ALWAYS wear the proper PPE when operating this machine. This includes safety glasses / goggles, hearing protection and gloves.
2. Hearing protection must be worn by all individuals in the shop room while the waterjet is running.
3. Nitrile gloves should be worn when handling waterjet components or recently cut parts. The stagnant water in the basin can be a breeding ground for bacteria and precaution should be taken to avoid infections / exposure.
4. Never lean or stand on the waterjet cutter at any time.
5. Never place your hands or other body part directly below the cutting nozzle, even when not in operation.
6. Ensure all components of the waterjet (nozzle, abrasive feed tube, etc.) are properly seated and secured before starting an operation.
7. When cutting larger parts or using a material prone to throwing up particulates (such as aluminum), a face or dust mask should be worn in the room.
8. In the case of flammable materials such as aluminum dust, no ignition source or spark-generating activity such as metal cutting or welding may be done in the room at the same time as these materials are being waterjet cut due to explosive risk.
9. Never handle material in the tank or otherwise place body parts within the operative area while the machine is in operation or otherwise in motion.
10. Take care with recently cut parts to prevent injury on sharp edges and ensure to debur all cut parts.
11. When finished the waterjet, the LOCKOUT padlock on the power switch must be immediately replaced to prevent unauthorized operation.

ALL INJURIES MUST BE IMMEDIATELY REPORTED. PRESSURIZED INJURIES FROM WATERJET CUTTERS CAN BE SEVERE DUE TO INTERNAL INJURIES NOT IMMEDIATELY APPARENT AND MAY BE EASILY INFECTED.

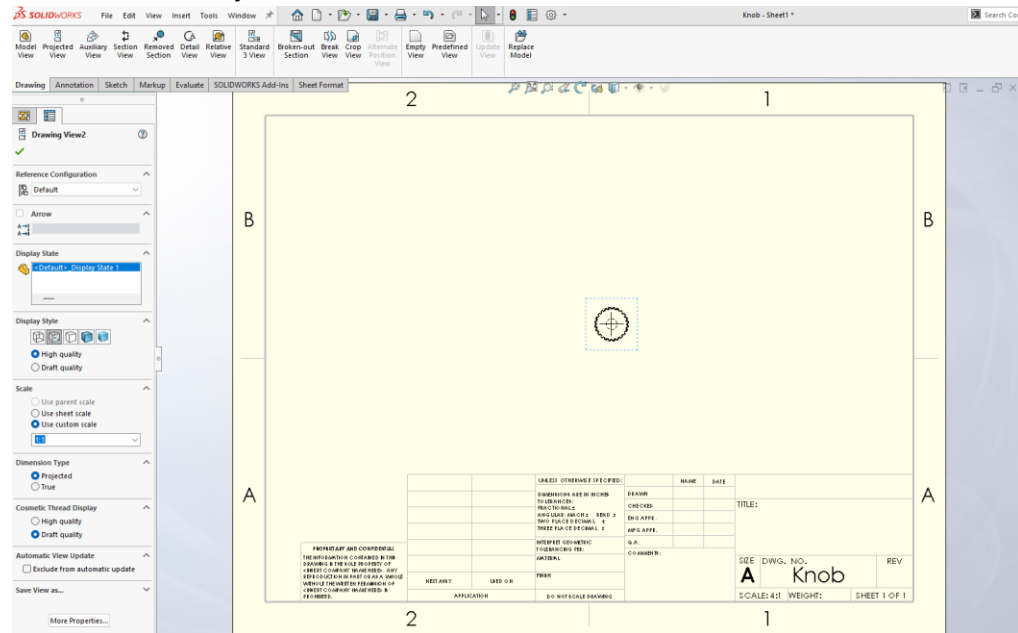
Notes on the WaterJet Cutter

1. The waterjet cutter is designed to cut materials from wood to Stainless Steel with up to 1in thickness.
2. When using the waterjet cutter for precise dimensions such as hole tolerancing, it is best to make the hole too small and then drill it out afterwards.
3. This waterjet cutter has a reported +/- 0.005in accuracy, but this is the highest end of accuracy possible, most cuts will not reach this level. This accuracy reports linear positional accuracy of the nozzle and does not account for sources of error such as washout (slanting in cut faces on thicker materials).
4. The cut area is 1ft by 1ft maximum.
5. While the waterjet is great for rapid machining of parts, not all projects will be fit for this method. Consult a lab instructor or TA prior to machining.
 - a. It may also sometimes be best to only waterjet certain features of a part and leave others to different machining methods (ex. Cutting holes in the side of a square stock with the waterjet, then brining it to a CNC or Lathe to turn it into a cylinder).
6. Never hesitate to ask questions when using this machine, it can be potentially very dangerous if misused.

Creating a Drawing File to Cut

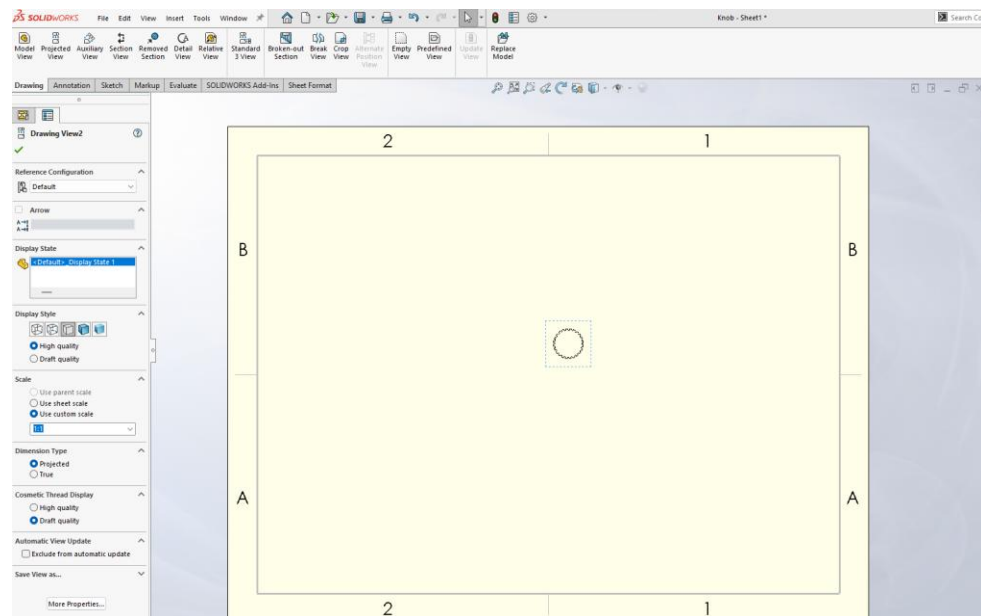
1. Any software can be used to create a drawing file for use with the waterjet cutter if they can export to a .DXF or similar file format. This example will use Solidworks.
2. Import your part into a drawing file, ensuring the scale is set to 1:1. Only the face that corresponds to the 'top' of the part needs to be shown.

- a. The 'top' here is the face of the part that would be seen if you were to look down the barrel of the waterjet nozzle.



3. Remove any centre marks or extra lines that do not correspond directly to an edge to be cut (you may not be able to remove everything, additional editing will be done later). This can be done normally to the part and by right clicking and choosing "Edit Sheet" for any sheet markings.

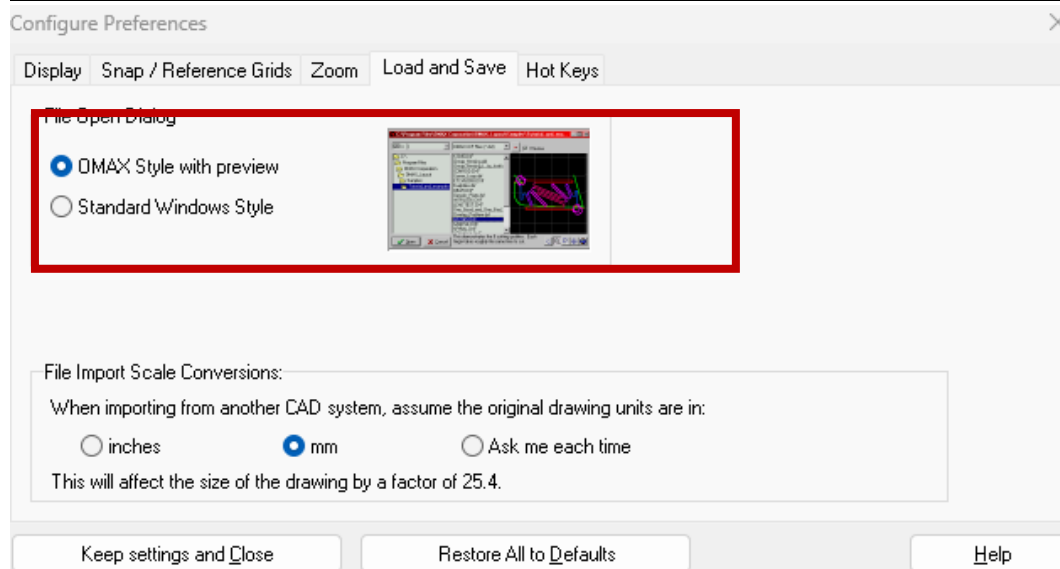
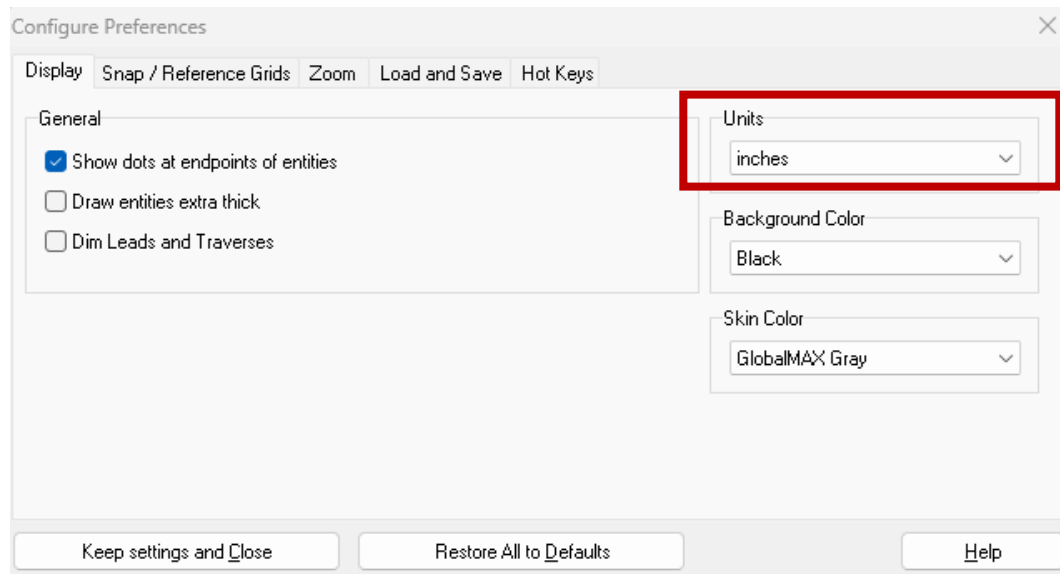
- a. Note: Hidden lines should be turned off



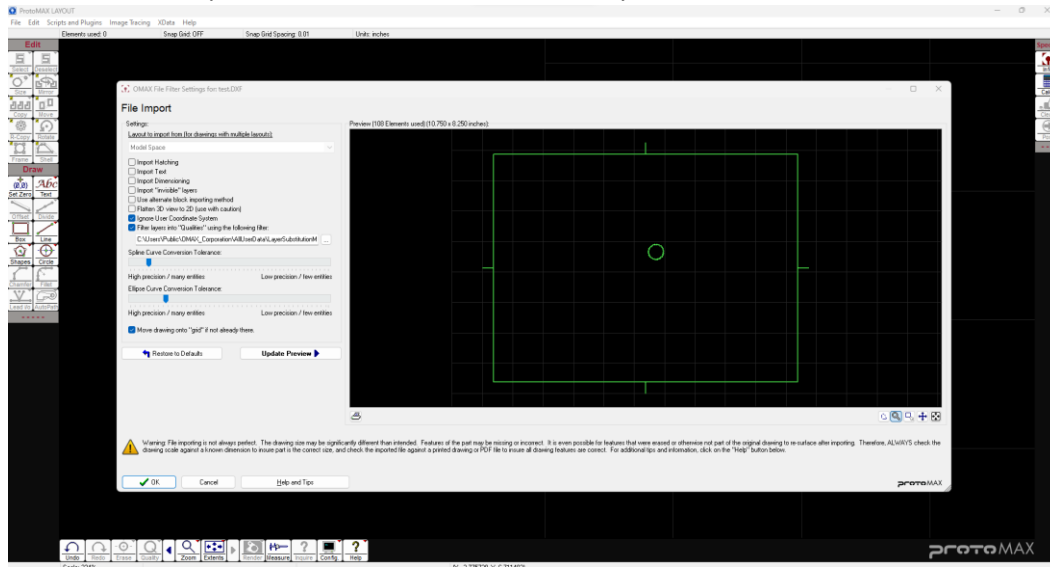
4. Select "File -> Save As" and save as a .DXF.

Importing and Editing Drawing Filing in PROTOMAX LAYOUT

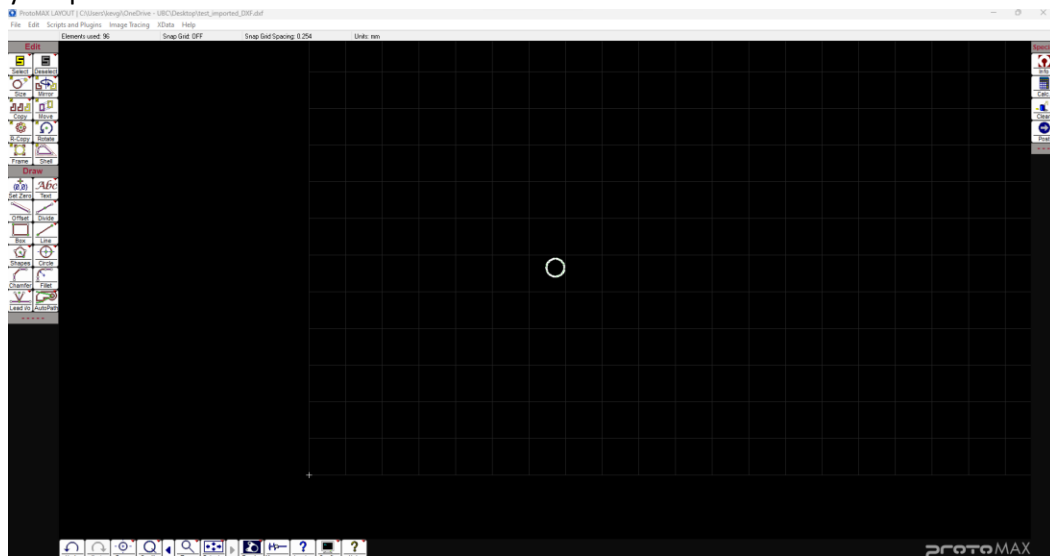
1. Open PROTOMAX Layout, select “File -> Configure Preferences -> Display” and change the units to the native units of your part. Under the “Load and Save” tab in the same window, change “File Import Scale Conversions” to the same units or to “Ask me each time. Select “Keep Settings and Close”.



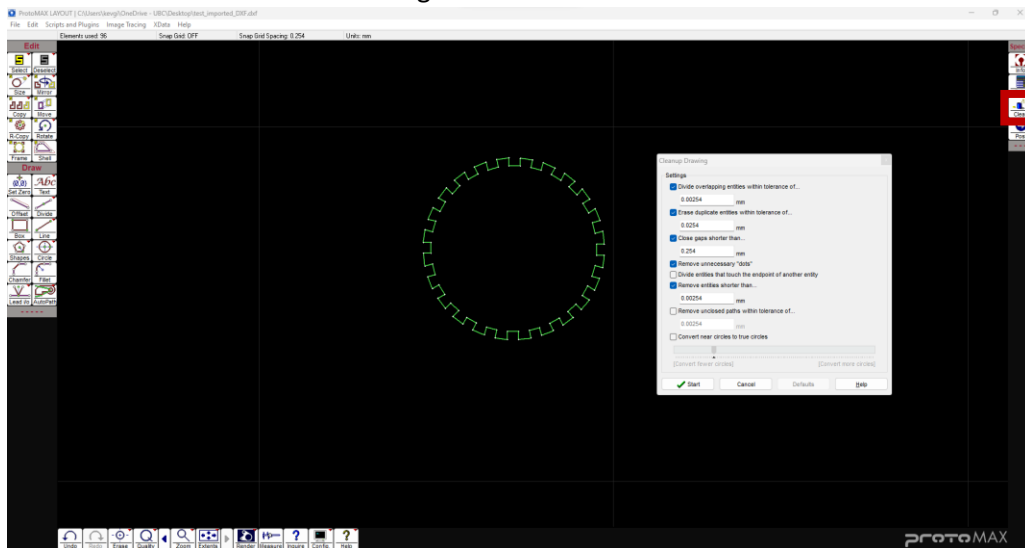
2. Select “File -> Import from Other CAD” and choose your .DXF file.



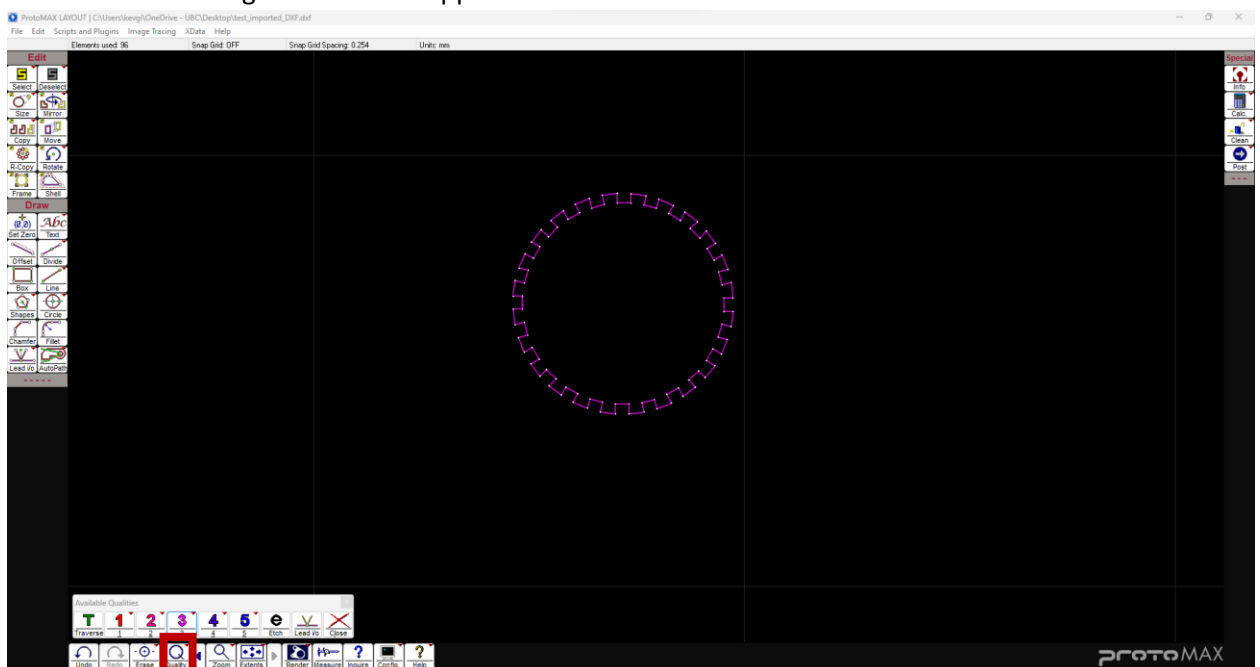
3. Using the “Select” function under the “Edit” side ribbon, select all lines not defining cut edges in your part and delete them.



4. Select the “Clean” button on the right side ribbon and choose “Start”.

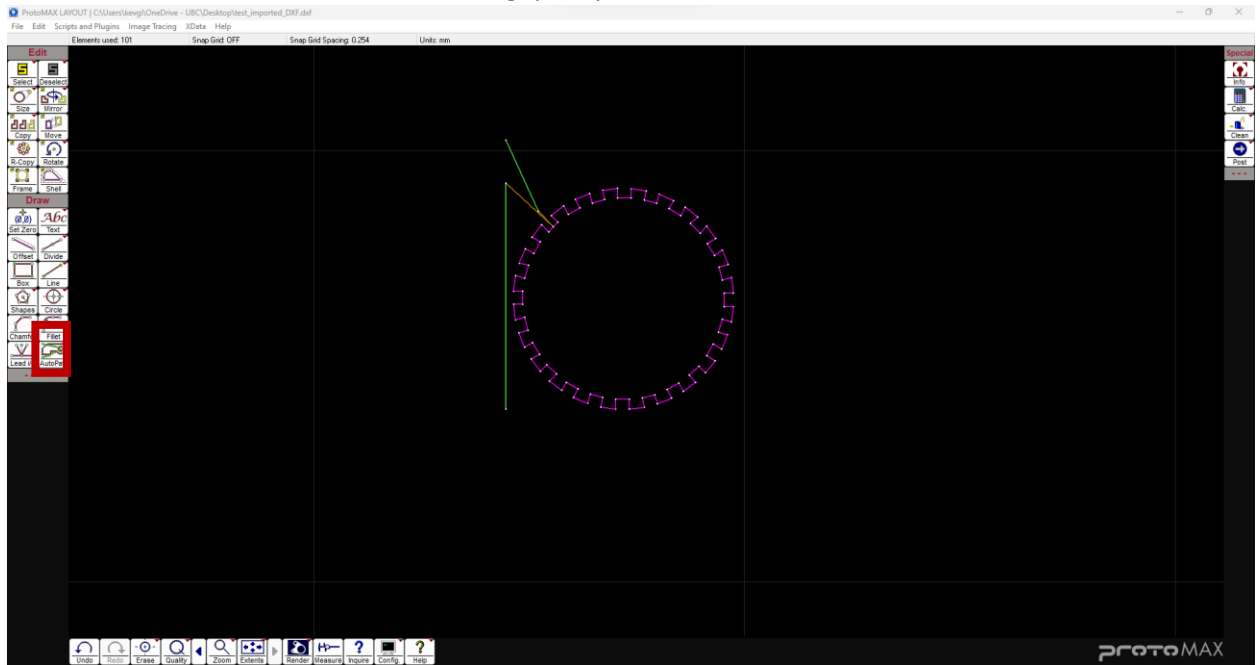


5. At the bottom of the screen, choose “Quality” and use your mouse to define all lines with cut qualities. You should see a color change when defining quality of cuts. For edges where dimensions do not matter, use quality 1; for most dimensions, use 3. If all qualities are the same, the button can be right clicked and applied to all.

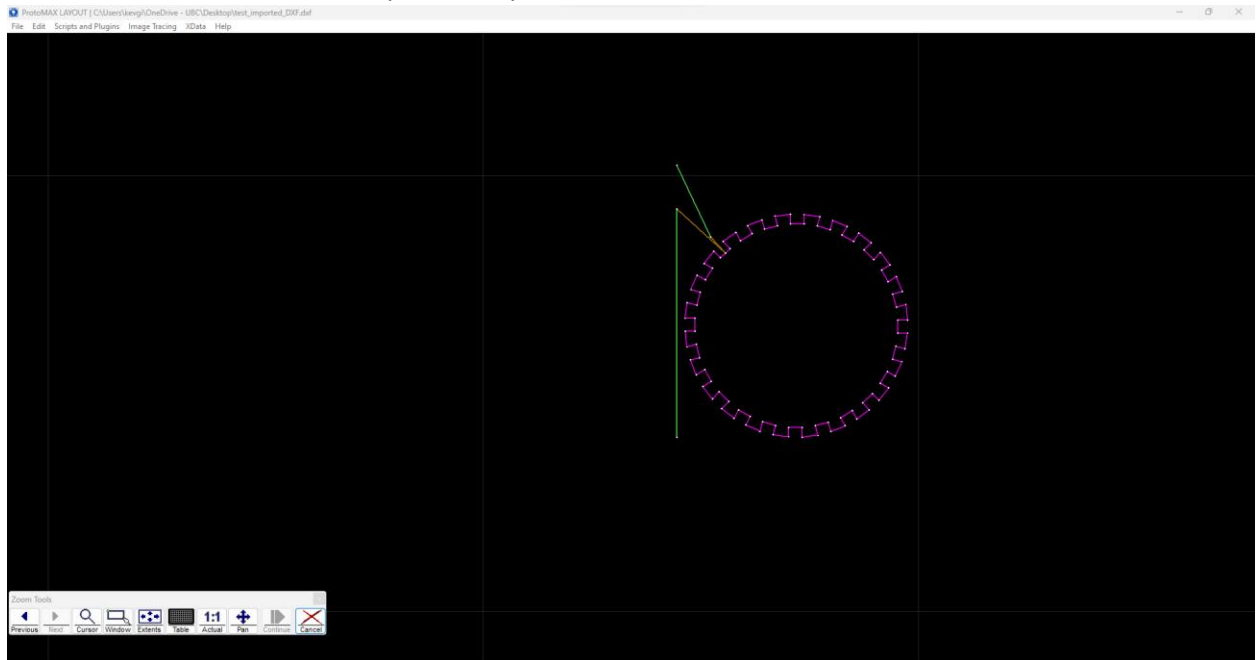


6. On the left side “Draw” tab, select “AutoPath”. Several green traversal lines should appear. These are paths where the nozzle will travel but not cut. Examine the path to ensure it is continuous and reasonable. The path can be manually edited or created by deleting and creating traversal

lines with the “Draw” functions and setting quality to “T”.

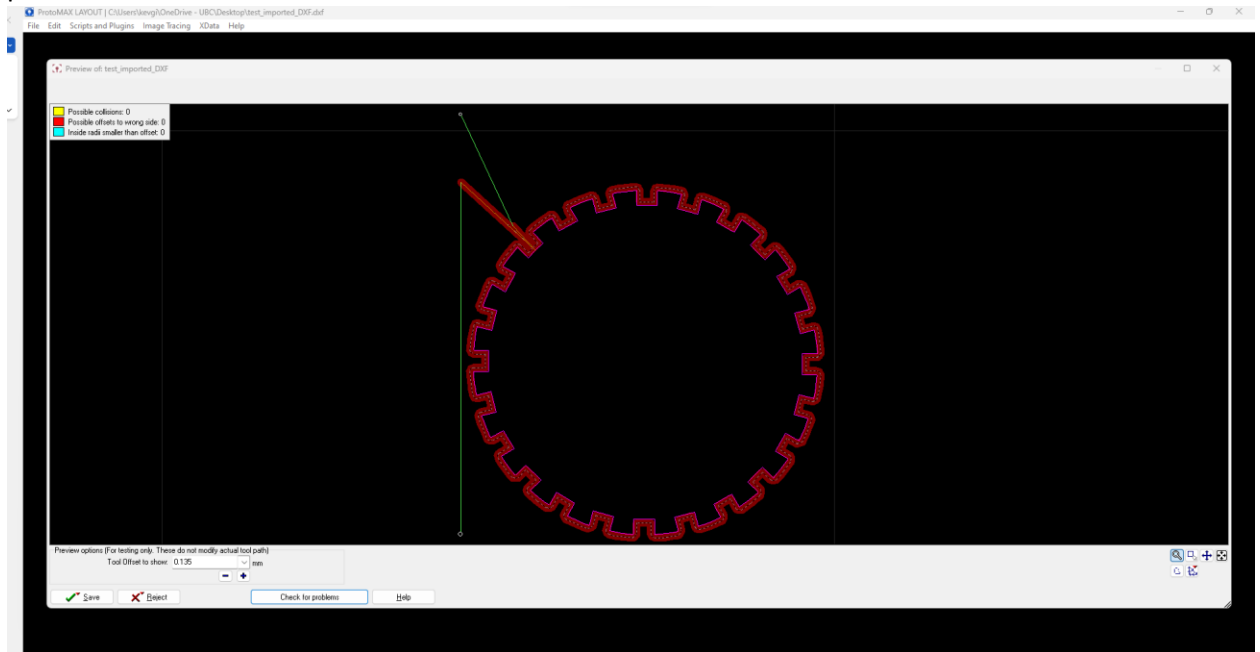


7. Once checked, “select the “Post” option on the right side ribbon and choose one of the floating ends of the green traversal lines as the start point. This end can be moved to change how far the cut area will be from the nozzle path start point.

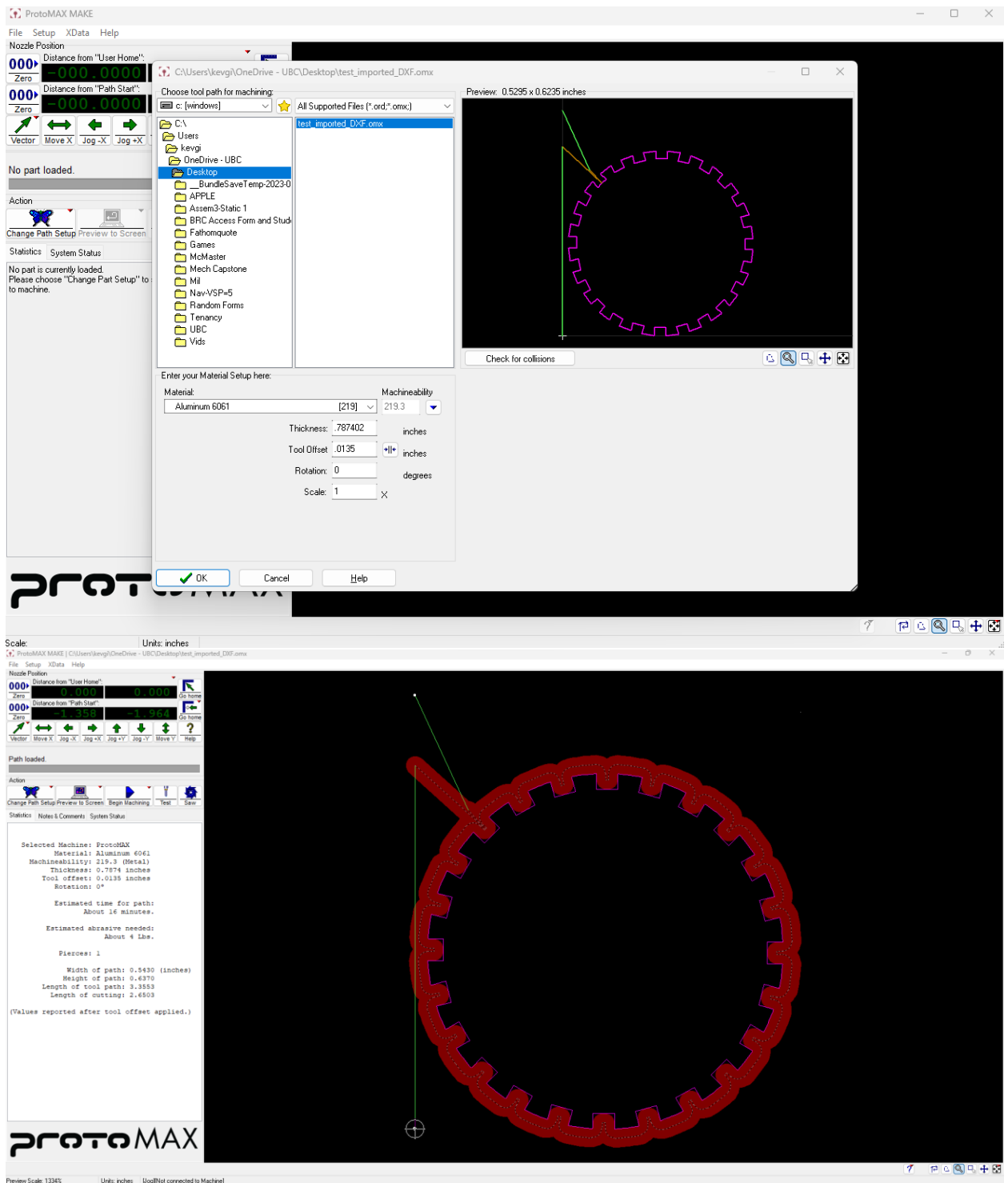


- 8.

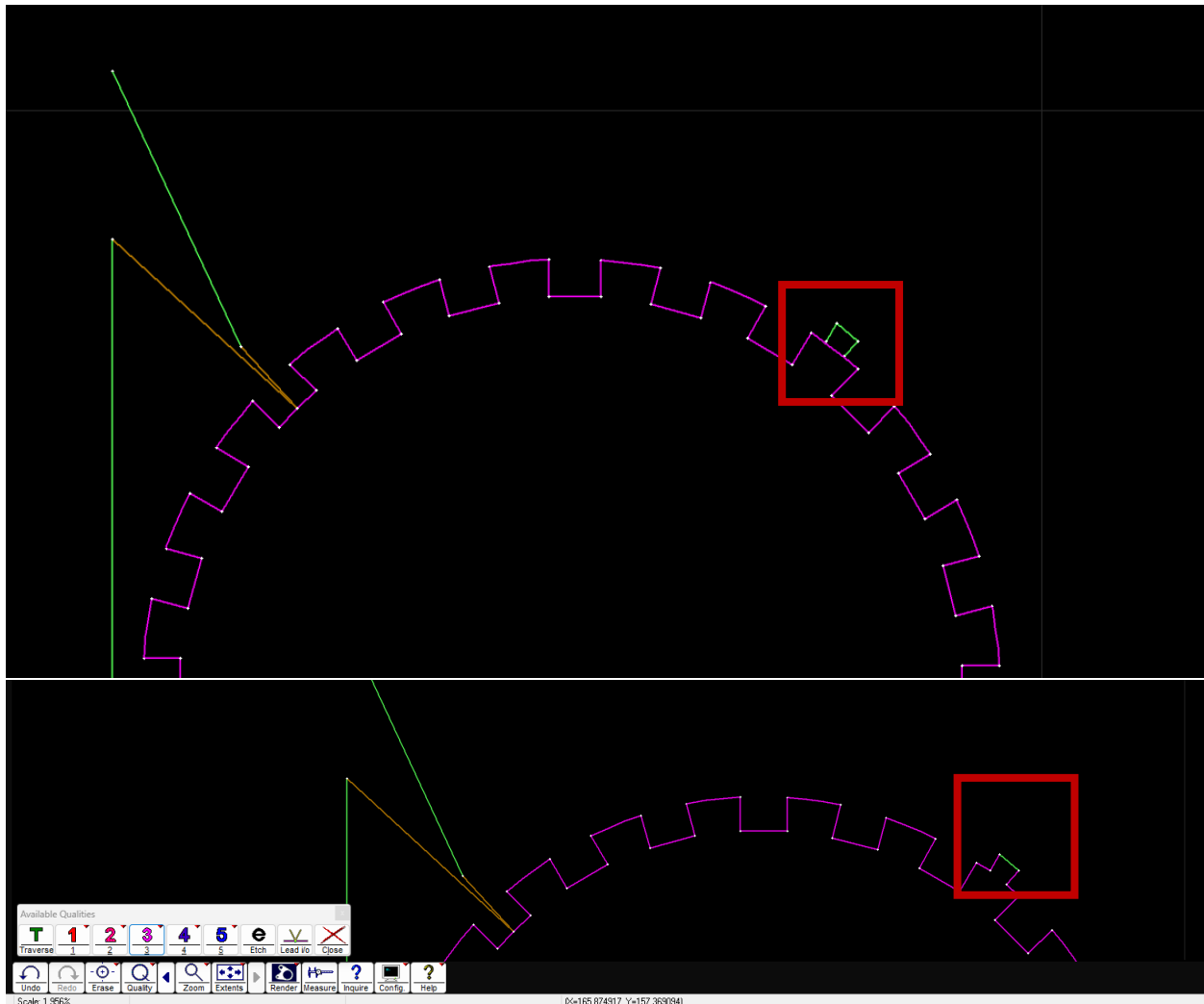
9. A window should appear showing cut and traversal areas. Select “Check for problems”. If clear, press “Save”.



10. Right click the same “Post” button and choose “Open OMX Path in MAKE”.
11. Choose all settings to reflect your material and stock thickness. Set Tool Offset to 0.0135in. Choose “Ok”.



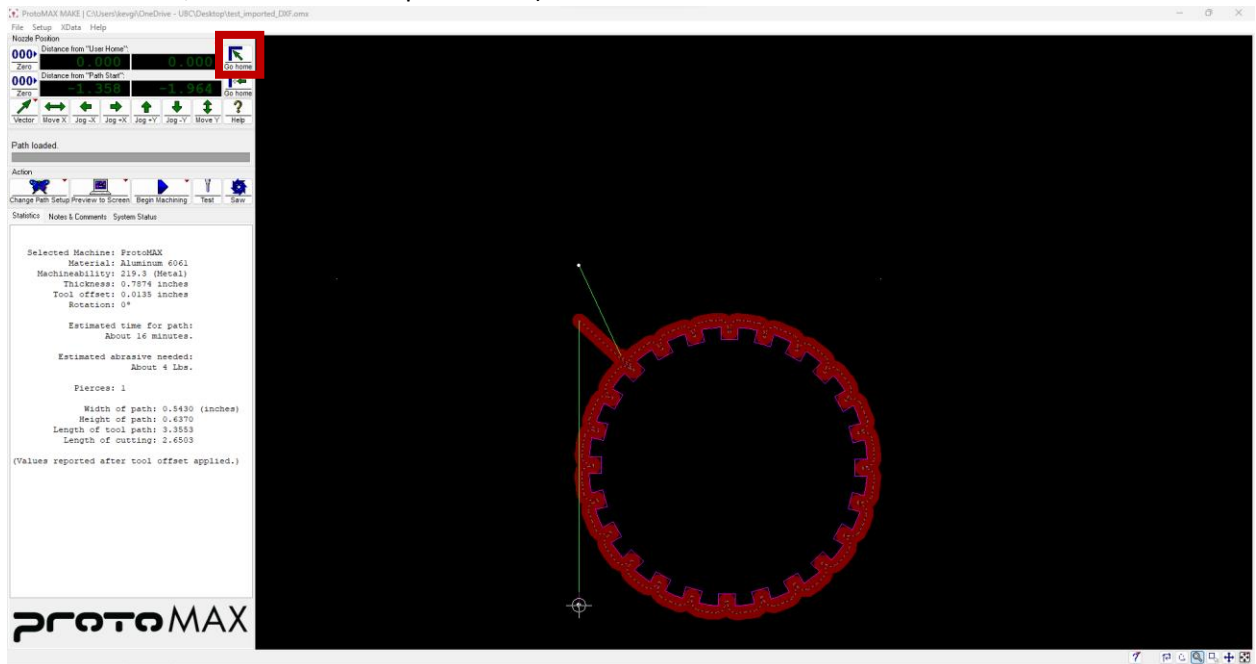
Note: For thinner parts in height or width or simple shapes, it may be best to add a tab to the part that will keep it attached to the stock material after cutting. This helps to prevent parts from falling into the tank basin. This can be done by using the “Draw” functions to add a small square onto the side of the part. Once aligned with the existing edge, the original flat line can be deleted and redrawn to match the box corners. The most outside edge of the box must be changes to a traversal quality line.



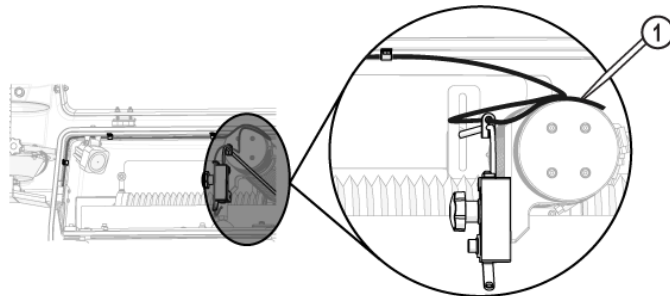
Startup and Safety Checks

1. Before using the waterjet cutter, read the full operation manual and ensure familiarity with all components and safety procedures.
2. Turn on and connect the laptop to the USB cable leading to the waterjet cutter.
3. Turn on the main power by turning the red power switch on the front of the machine. Verify the light in the tank turns on.
4. Turn on the water supply (piping on the back wall behind the waterjet). Check that the water has been turned on by spraying the hose into the tank. Verify the pressure is between 45-85 psi on the gauge beside the power switch.

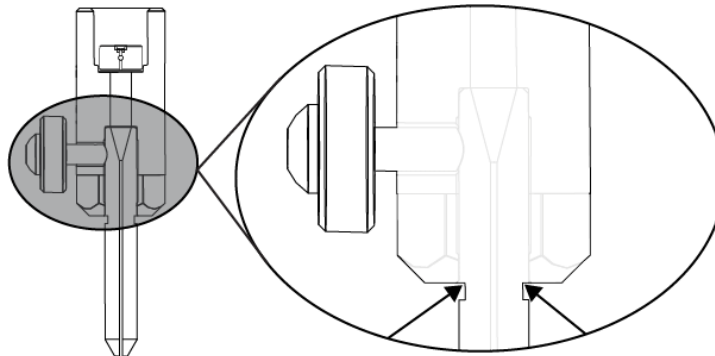
5. Ensure the nozzle is raised above any obstructions and select “Go Home” (the top one is for the machine home, the bottom one is for path home).



6. Perform a nozzle test without abrasive:
 - a. Secure lid in the open position.
 - b. Remove (if present) the clear abrasive feed tube from the nozzle and place it over the Y Axis.

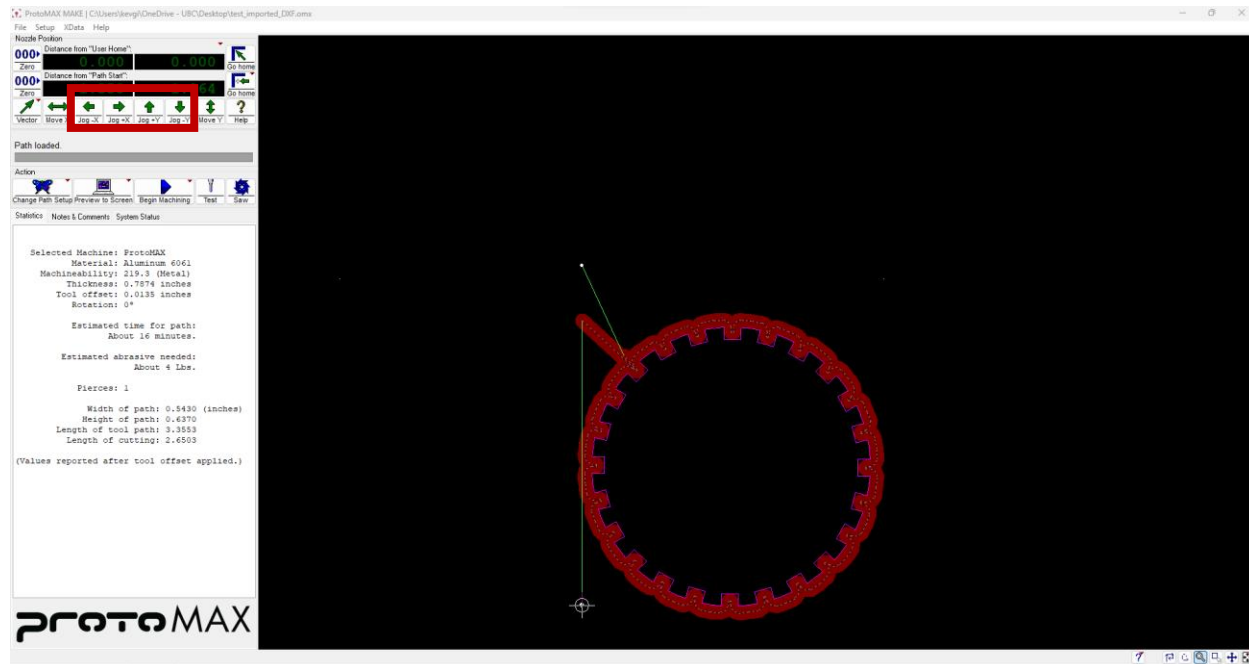


- c. Verify the mixing tube is properly seated by loosening the thumb screw, pushing the nozzle upwards, and re-tightening the screw.

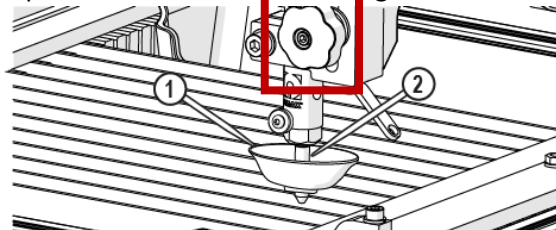


- d. Fold the yellow nozzle splash upwards.

- e. Position the nozzle in the centre of the tank between 2 slats using the jog function buttons.

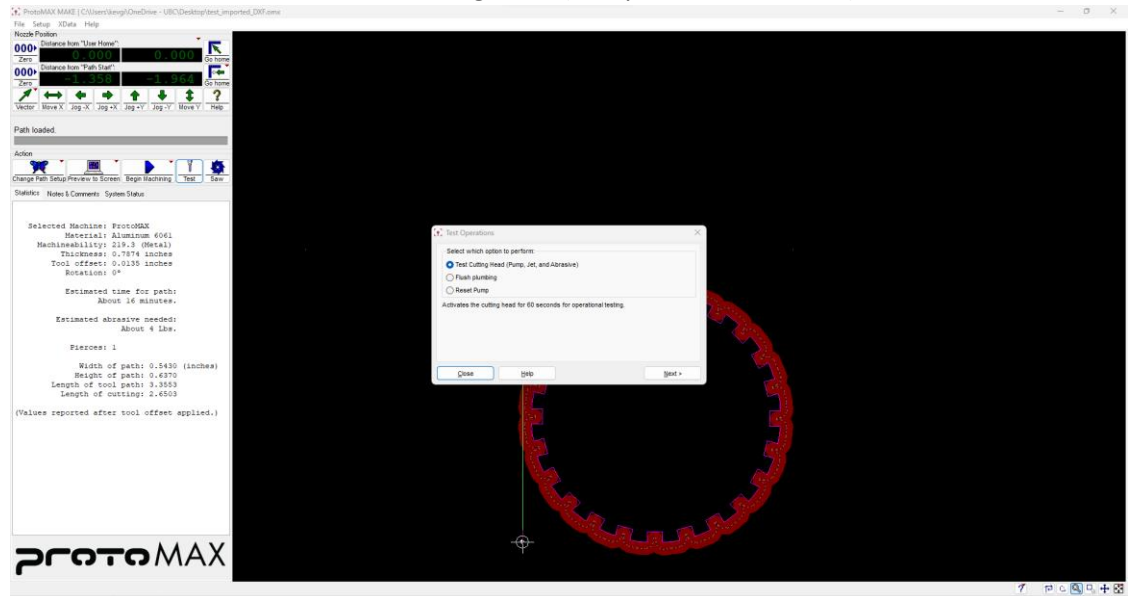


- f. Lower the nozzle to within 1in of the water's surface using the large black knob on the side of the nozzle carriage. Note: Be careful to hold the nozzle when loosening or tightening the Z Axis bolt to prevent the nozzle from falling into the tank or into material.

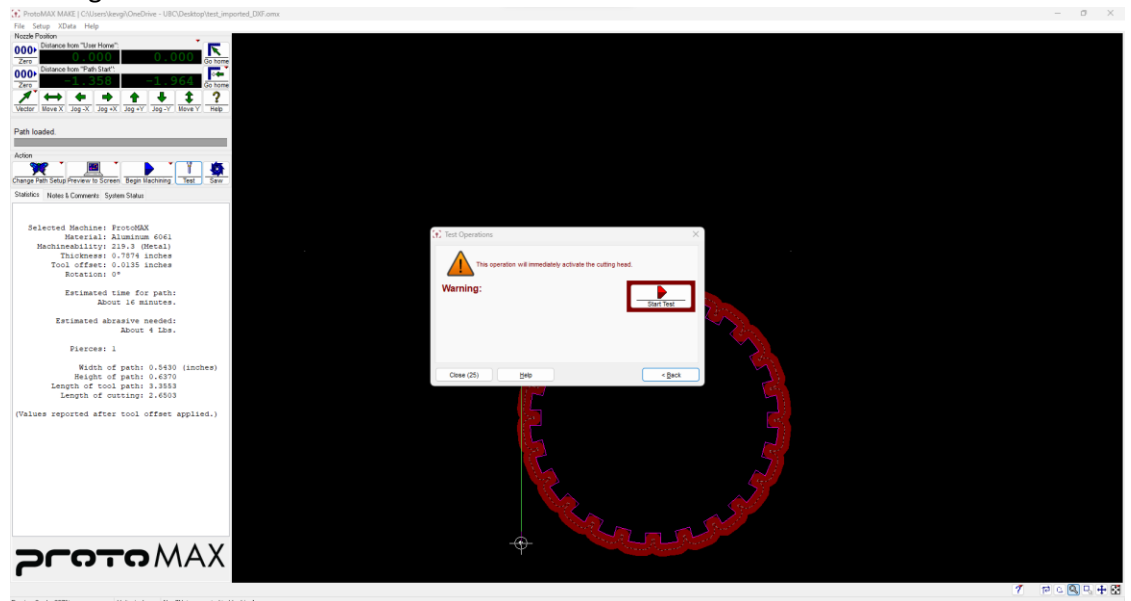


- g. Close Lid.

- h. In MAKE, select “Test” and “Test Cutting Head (Pump, Jet and Abrasive)”



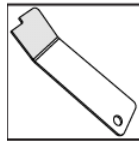
- i. Select “Next” and “Start Test” when ready. Ensure no one will open the tank lid and nothing is below the nozzle.



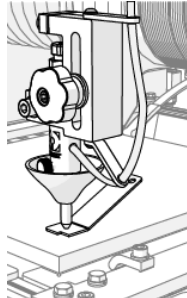
- j. The nozzle should immediately begin shooting water. Allow the test to run its course and select “Close” when it finishes.
7. Conduct nozzle test with abrasive.
 - a. Replace abrasive feed tube into nozzle (it will just be pushed in, there is no securement).
 - b. Repeat steps 6 e-j.
 - c. You should faintly see garnet flowing through the clear tube. The sound should also be different from the previous cut test.

Setting Up for Cut

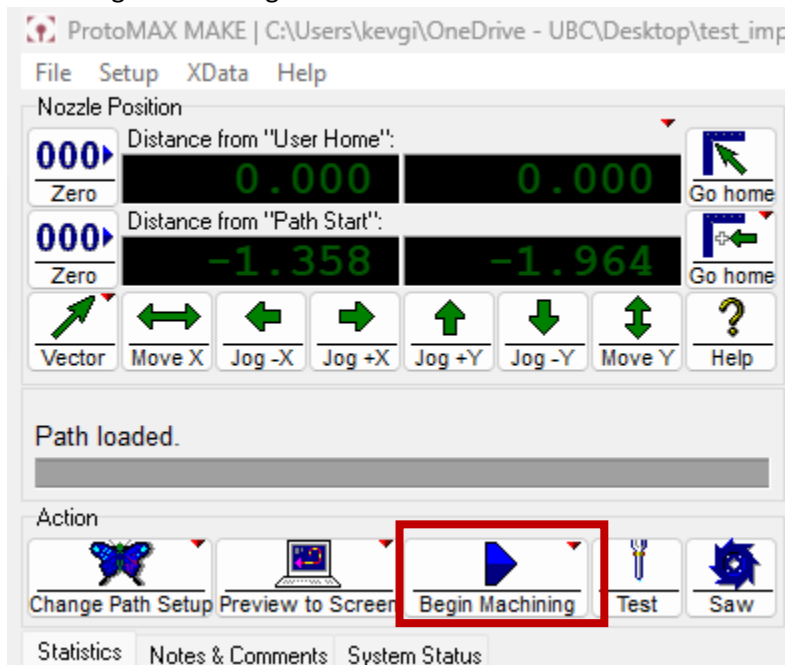
1. Place the stock material to be cut into the tank on the slats, trying to use the centre of the tank or other areas with less visible cut damage on the slats.
2. Secure the stock with the metal support arms found on rails on the sides of the tank.
3. Set the nozzle height by adjusting the Z.
 - a. Place the height offset gauge on the stock material.



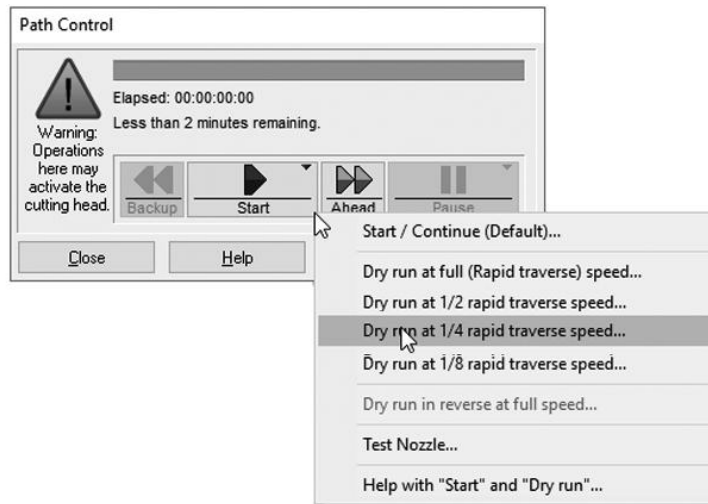
- b. Set the nozzle height to just touch the gauge while it rests on the material and lock the nozzle height. It may take a few attempts as the nozzle moves during locking.



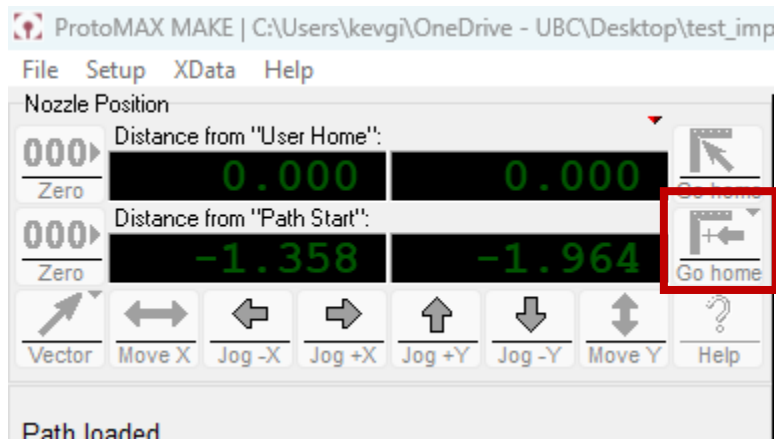
4. Using the XY Jog buttons, move the nozzle head to where you want the cut path to begin.
5. Perform a dry run cut cycle.
 - a. Click "Begin Machining."



- b. Right click the “Start” button and select “Dry Run at ¼ Rapid Traverse Speed” The nozzle will start to move but should be shooting water or abrasive.

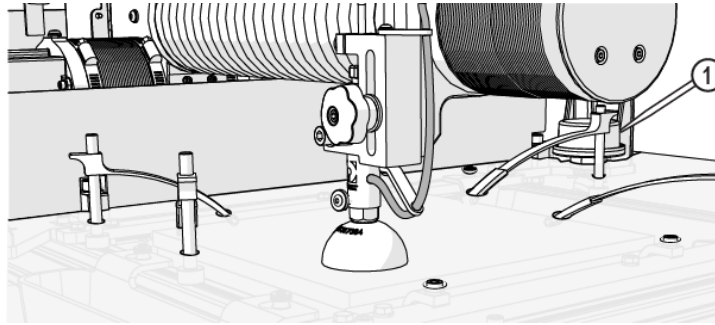


- c. Allow the dry run to occur, watching for areas where the cut would miss material or is otherwise obstructed. If this occurs, adjust the path start position using the jog and redo the dry run cutting process.
- d. Once complete, the forward and reverse buttons can be used to move the nozzle through the path to check specific areas. Check the most extreme corners of the X and Y axis present in your cut to ensure all cutting procedures fall within material boundaries.
- e. Click “Go to Path Home”.



Performing Cutting Operation

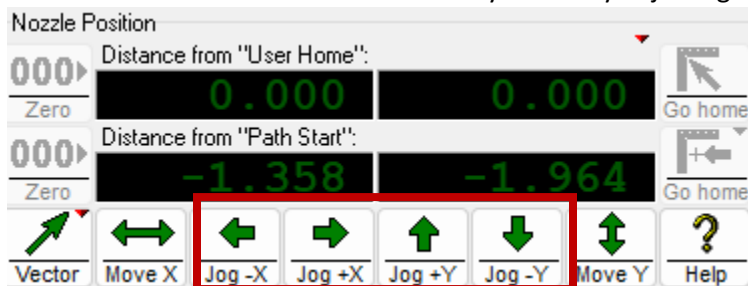
1. When ready to perform the cutting operation, fold down the yellow splash guard.



2. Raise the water in the tank, using the external hose, to above the surface of the material being cut, when possible. The tank drain (hose with a black sponge filter on it) must be adjusted to allow for a higher water level.
3. Click "Begin Machining" and choose "Start".
4. Pay attention to abrasive levels in the hopper. If adding abrasive to the hopper mid-cut, pause the cutting process and resume once hopper is refilled.
5. If during cutting, you see a stream of water shooting off sideways along the surface of the stock material, the abrasive is likely not being fed properly. Pause the cut. If the abrasive hopper is full, reseal the abrasive feed tube.
6. Resume cut once resolved.
7. Be sure to keep an eye on all cut processes for errors or nozzle obstructions.
8. NEVER REACH INTO THE TANK WHILE THE NOZZLE IS ON AND DO NOT PLACE ANY PART OF YOUR BODY UNDER THE NOZZLE, EVEN DURING A PAUSED CUT PHASE. ALWAYS WEAR PROPER PPE.
9. Once cut operation is complete, move the nozzle clear of the material using the Jog functions and remove the material and parts from the tank.

Shut Down and Clean Up

1. Using the "Jog" controls in Protomax Make, move the nozzle to the middle of the tank and about an inch above the surface of the water by manually adjusting the z axis.



2. Remove the abrasive feed tube from the nozzle and place it over the Y axis.
3. In MAKE, select "Test" and "Test Cutting Head (Pump, Jet, and Abrasive)". Click Next.
4. Click "Start Test" to flush the nozzle. Select "Close" when complete.
5. Lift the nozzle back above the slats in the z axis and home the nozzle.
6. Power off the waterjet cutter and turn off the water line.
7. Replace the lock on the power switch.
8. Lower the water level to below the slats by moving the tank drain downwards.

9. Close MAKE and disconnect and put away the waterjet laptop.
10. Clean any surfaces with a cloth or brush (e.g. inside of clear tank lid) and remove as much abrasive as possible from metal surfaces in tank (while wearing the proper PPE).

IF YOU ARE EVER UNSURE OF A TASK OR PROCESS WITH THE WATERJET CUTTER, DO NOT HESITATE TO ASK A LAB INSTRUCTOR OR TEACHING ASSISTANT. THEY ARE THERE TO GUIDE YOU AND ENSURE YOUR SAFETY.