OMAX®
Tilt-A-Jet®

Operator Guide

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Original Instructions in English
July 2017

Contents

Safety

The following safety instructions must be followed when installing, operating or servicing OMAX equipment. If ignored, physical injury or death may follow, or damage may occur to the equipment. Always observe applicable safety precautions when working with this equipment.

WARNING!

Indicates the presence of life-threatening voltages. Never access areas labeled as such without first taking appropriate safety precautions: locking out power, verifying no voltage present on circuits prior to maintenance activities, etc.

WARNING!

Indicates potential health, physical and environmentalhazards which, if not avoided, can result in serious damage to the product or injury or death. Always proceed using extreme caution.

MANDATORY ACTION!

Lock out power

Never do maintenance on your OMAX equipment with the main AC disconnect ON, unlocked, or with the pump in operation. Always follow standard lockout/tagout procedures.

MANDATORY ACTION!

Read the user's guide

Read your equipment's user's guide for specific operator instructions and additional safety requirements.

Wear Gloves

Bacteria in the tank water can build up. A minor break in the skin can introduce harmful bacteria into a wound. Always wear protective gloves if you have cuts or open wounds on your hands. When setting up material for cutting, wear gloves that provide protection against sharp metal edges.

Eye Protection

Always wear approved safety goggles whenever cutting. Regular glasses do not provide sufficient eye protection! Have an eyewash station located near the work area in the event abrasive spray splashes into your eyes. The garnet abrasive is not a chemical irritant, but if not quickly washed out, it can injure an eye just as any sand would. In addition, tank water could contain particles from the material or chemicals irritants.

Operating the Tilt-A-Jet

This section explains how to configure the Tilt-A-Jet to operate using the OMAX Intelli-MAX® software.

Tilt-A-Jet Overview

With the Tilt-A-Jet®, your OMAX abrasive waterjet can achieve virtually zero taper when cutting most materials. The Tilt-A-Jet positions the nozzle at an angle calculated by software to offset taper from the workpiece. Taper does not disappear—it moves to the scrap part of the material, leaving the machined part with square edges.

Figure 1

Enabling Tilt-A-Jet Operation

1. To enable Tilt-A-Jet operation, click **Change Path Setup** in **MAKE**

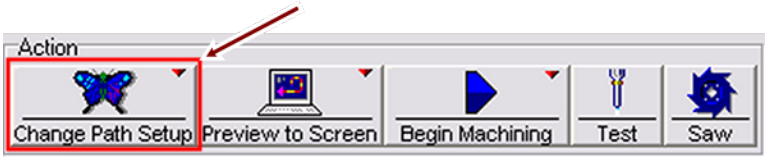


Figure 2

2. From **Enter your Material Setup here**, select the **Uses Tilting on Path** check box.

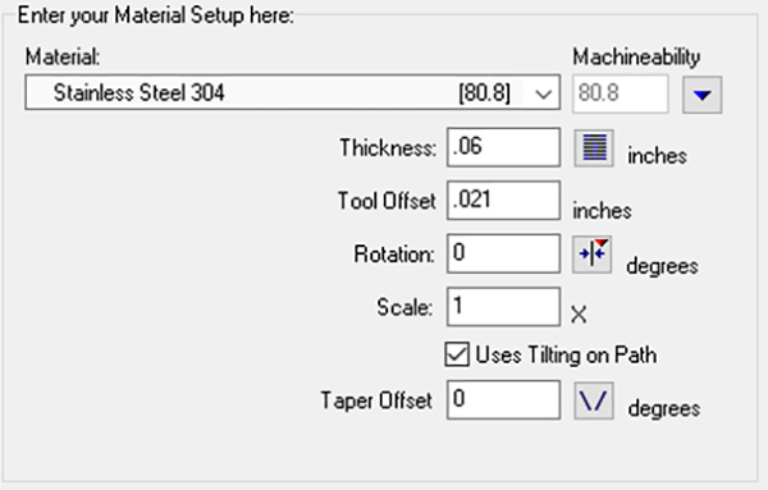


Figure 3

When Tilt-A-Jet features are enabled, the time required to compile a tool path does increase.

Using the Tilt-A-Jet

During operation, the Tilt-A-Jet continually makes tilting adjustments as it travels along the tool path. The tilting motion begins while on the lead in path to the part. At each lead out, the nozzle returns to its perpendicular position. In general, more tilting is expected when cutting thinner materials.

Machining Times

The Tilt-A-Jet increases the precision of the parts you make. For most parts, there is little difference in machining times when the Tilt-A-Jet is enabled or when it is disabled.

In some cases, especially with thin materials, enabling the Tilt-A-Jet can result in significantly longer machining times. Consider the part preview provided in the following figures. On the left is the preview with the Tilt-A-Jet disabled, while the right shows the same part with the Tilt-A-Jet enabled. Note in particular the slowing down around the upper-right curve of the part.

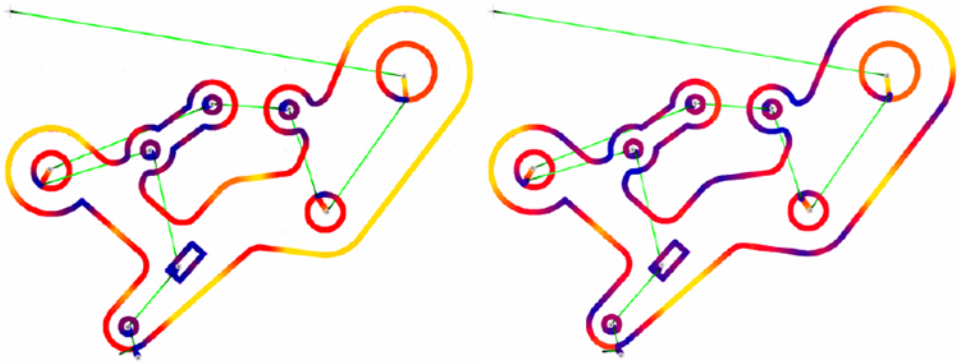


Figure 4

The nozzle slows down to tilt for the next position without causing a blemish or sudden jerk as the nozzle changes direction. This happens at the transitions between two arcs of different radii, line-to-arc intersections, or arc-to-arc intersections where the direction changes, as in an “S” shaped curve.

For thicker materials, the machining times can be significantly reduced, especiallly when tilt forward is being used.

In addition, lead ins and lead outs do not shrink as much when the Tilt-A-Jet is enabled. This gives the Tilt-A-Jet more room to tilt into position at the beginning and ending of cuts, but it also can increase the time slightly on some parts. The Tilt-A-Jet is slower when dealing with other kinds of geometry, such as tight and complex geometry where the Tilt-A-Jet would otherwise move back and forth so quickly that it would cause vibrations or mar the parts. In these cases, the nozzle speed may be slowed down with tilting minimized to ensure the best cut part.

NOTE: *For a few parts, a small blemish can occur at the transition between two arcs when the Tilt-A-Jet needs to change tilt directions. Decreasing the speed at this point requires less tilting and can eliminate or reduce any blemish.*

NOTE: *Using Minimum Taper quality, may dramatically increase the time needed to make your part. Set the value that should be used when a Quality of Minimum Taper is encountered in a tool path. The default setting uses the Minimum Taper quality, but this can be changed to any of the numbered Quality settings. If this Quality is set to Minimum Taper (the default setting), Make will slow the nozzle to eliminate as much taper as possible without tilting, and will then tilt a small amount to try to eliminate any remaining taper.*

Avoid Crashing the Tilt-A-Jet

Ensure the nozzle does not collide with anything (fixtures, parts, material on the table, etc.). Striking something when the nozzle is moving at full speed can damage Tilt-A-Jet link arms, requiring expensive repairs.

Follow these guidelines to avoid crashing your Tilt-A-Jet:

- **When creating traverse lines in LAYOUT, run them between already cut parts.**
  Once a piece is cut free from the material, it can easily tilt up and snag the nozzle as it moves by. If the nozzle catches the piece exactly right, it can crash and damage the Tilt-A-Jet head.

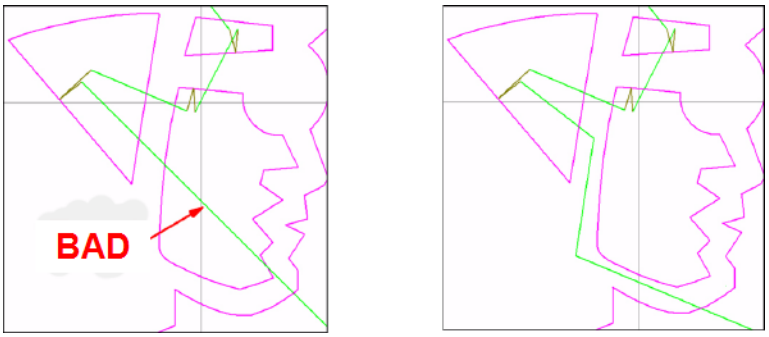


Figure 5

- **Use heads-up traverse if the head passes over already cut parts.**
  If you can't route a traverse around an already cut part, use a "heads-up traverse" to lift the nozzle before traveling across the slug.

Figure 6

- **Maintain enough room between mixing tube and material before doing rapid traversing.**
  If material to be cut is uneven or warped, use a heads-up traverse to move between sections. If using a regular traverse, the Tilt-A-Jet head could strike the uneven material.

- **Move the nozzle out of the way when loading material.**
  When loading material onto the machining table, always move the nozzle away and raise the Z-axis well out of harm's

way. It is very easy to strike the nozzle with the edge of material being loaded.

- **Ensure there is enough room around the Tilt-A-Jet during Auto-Homing .**
  During auto-homing, the Tilt-A-Jet moves through its entire range of motion. Ensure the head cannot strike any material or fixture during this process.

- **Carefully fixture the material.**
  Always be aware where your fixtures are relative to the machining path. Be very careful when moving the Tilt-A-Jet nozzle near a fixture to avoid a harmful collision.

NOTE: *Always use the **Check for Problem**s button in LAYOUT or MAKE to identify possible collision points in your tool path.*

Lead In and Lead Out Requirement

Every part cut with the Tilt-A-Jet should have a lead in and lead out path. Initial tilting of the Tilt-A-Jet is done on the lead in line and the tilt is restored to the vertical position on the lead out line. Therefore, lead in and lead out lines are required and the special **Lead i/o Quality** must be used for the Tilt-A-Jet to function properly. Using the Tilt-A-Jet without a lead in or lead out may cause inferior parts.

Tilt-A-Jet Auto-Home Tilt

The Auto-Home Tilt routine is done regularly. It automatically positions the Tilt-A-Jet nozzle perpendicular to the machining table, and references the Tilt-A-Jet to the hardstops and estabalishes a known position of the tilt motors.

The Auto-Home Tilt routine uses the data entered in the dial indicator squaring routine to automatically align the Tilt-A-Jet nozzle perpendicular to the table. The Auto-Home Tilt routine should be manually run whenever the following occurs:

- **Power has been turned OFF to the Tilt-A-Jet nozzle**
  When the Tilt-A-Jet nozzle is not powered, it can move out of alignmen, making the position of the tilting axes unknown. Always run the Auto Home Tilt routine after powering up the OMAX abrasive waterjet to enable calculation of its position and tilting motion.

- **Cutting a tool path has been interrupted**
  Running the Auto Home-Tilt routine typically lasts approximately 15 seconds. If there are doubts about the Tilt-A-Jet perpendicularity, run this routine.

- **Anytime it is felt the Tilt-A-Jet position is not correct**
  Whenever in doubt, always run the Auto Home Tilt routine. It is better to run it if not needed than to not run it when needed.

- **If the nozzle strikes something**
  If the nozzle strikes a fixture, material, or some other obstacle, it can be jarred out of alignment. In this case, running the Auto Home Tilt routine will make sure that the Tilt-A-Jet is aligned.

- **Whenever the machine/computer is rebooted**

- **When faulted or Override is used**
  When the tilting axes have faulted or the override button has been engaged for longer than three seconds, the

assumed position of the tilt motors may no longer be correct. The Auto-Home Tilt procedure will re-establish the known tilting position.

The Auto-Home Tilt routine moves the Tilt-A-Jet nozzle through its entire range of motion. Ensure nothing is in the way (such as a block of material, or a fixture) that the Tilt-A-Jet might strike during this movement. If the Tilt-A-Jet strikes something hard enough, damage can result, requiring factory repair.

To run Auto-Home Tilt, go to the **Homes** menu in **MAKE**, click **Auto-Home Tilt (OFF Hardstop)**.

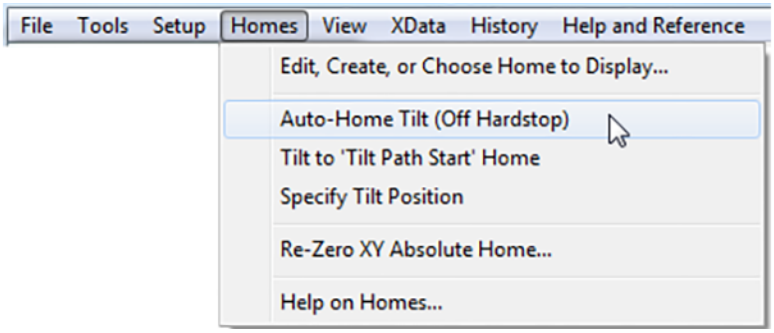


Figure 7

Tilt Display

The **Show Tilt Axes Control** option in the **MAKE View** menu shows the Tilt-A-Jet orientation angles.

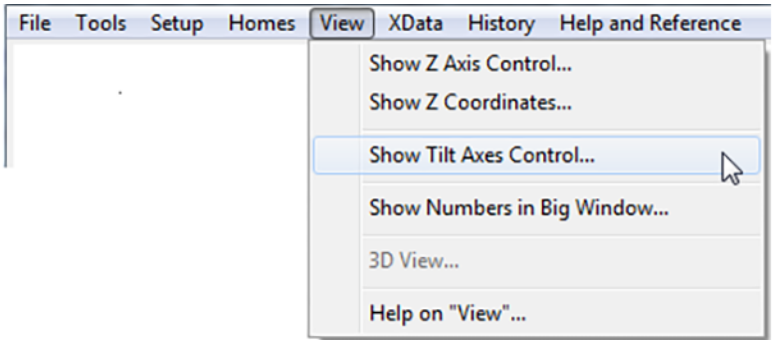


Figure 8

The **Jet Nozzle Orientation** values can be displayed either in **polar angles**:

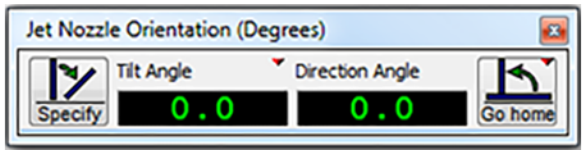


Figure 9

Or in **Cartesian angles** as **Tilt in X** and **Tilt in Y**:

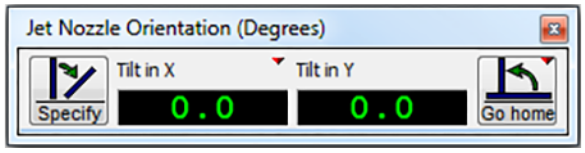
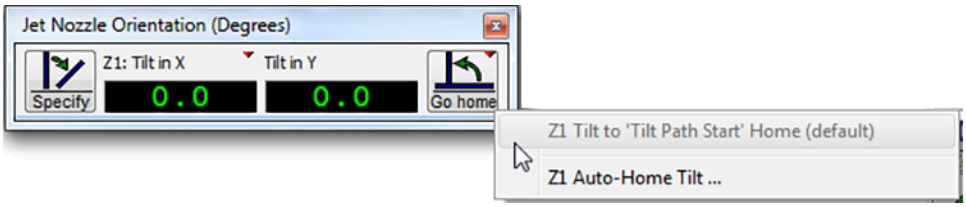


Figure 10

Right click the **Go Home** button to move the tilting axes into these specific positions:



Click the **Go Home** button to move the tilting axes to the Tilt Path Start Home position. This is the correct position to begin a cutting path.

Click the **Specify** button to open the Specify Absolute Angles of the Jet for the Tilt-A-Jet. See next section, **Specifying the Tilt Angles in the X and Y-axis**.

NOTE: *These displays are for information only. It is not necessary to view them during tilting axes operation.*

If the position of the tilting motors is unknown to the software, the display changes to dashes instead of numbers:

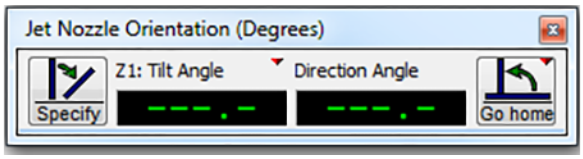


Figure 11

When dashes appear, the Auto-Home Tilt procedure needs to be executed from the Homes drop-down menu before the tilting axes will operate properly.

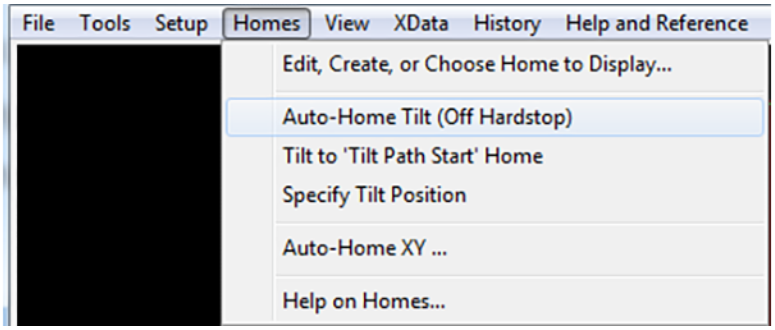


Figure 12

NOTE: *Any selection option that is already selected will be greyed out and non-functional.*

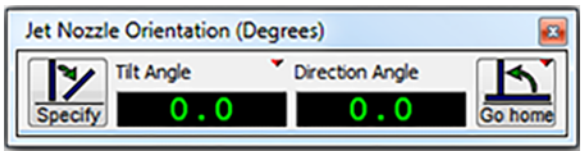
The right click menu always shows the assigned carriage name, ‘Z1’ or ‘Z2’. The bottom right click option forces execution of the ‘Auto-Home Tilt’ procedure.

Specify Tilt Dialog

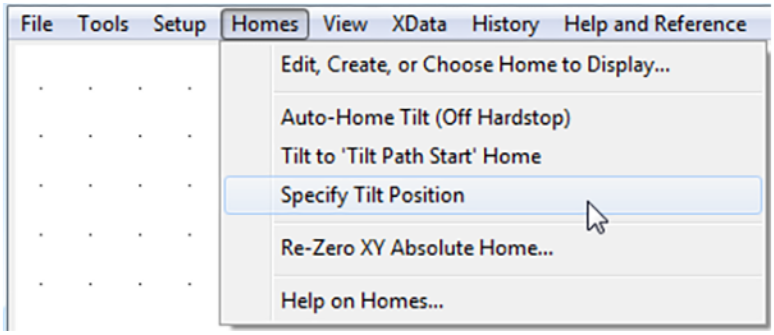
Using the Specify Button

Accessing the **Specify** button is done in either of two ways:

1. The **Specify** button in the **Jet Nozzle Orientation** window controls tilt directions of the Tilt-A-Jet.



2. Select **Specify Tilt Position** using the Home pull-down menu.



The Specify Tilt Dialog lets the user move the tilting kinematic to a desired jet orientation. This function is typically used for setup or diagnosis purposes. It is not necessary to use this function for normal operation. The tilting kinematic will move to the desired orientation after pressing 'OK'. There are three possible ways to enter a jet orientation

- Specify Jet Tilt and Direction Angle
- Specify Jet Tilt Angles in the X and Y axis
- Specify by Raw Motor Positions

Specifying Jet Tilt and Direction Angle

This method specifies the orientation of the jet as Tilt and Direction angles. The Direction angle describes the orientation in the XY plane. The Tilt angle specifies the angle between the Z-axis and the jet orientation.

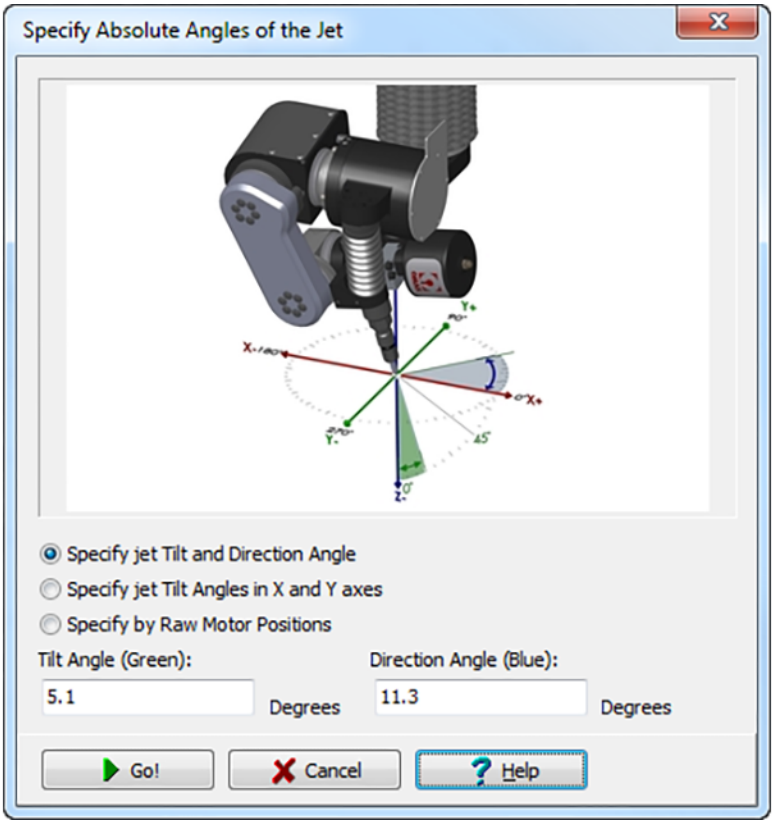


Figure 13

Remember that the Z-axis is actually oriented vertically, where as the X and Y-axis are oriented horizontally in relation.

Specifying the Tilt Angles in the X and Y-axis

This method specifies the orientation of the jet as ‘Tilt in X’ and ‘Tilt in Y’ separately. ‘Tilt in X’ describes the orientation in the XZ plane with positive values pointing the jet in +X direction. ‘Tilt in Y’ does the equivalent in the YZ plane.

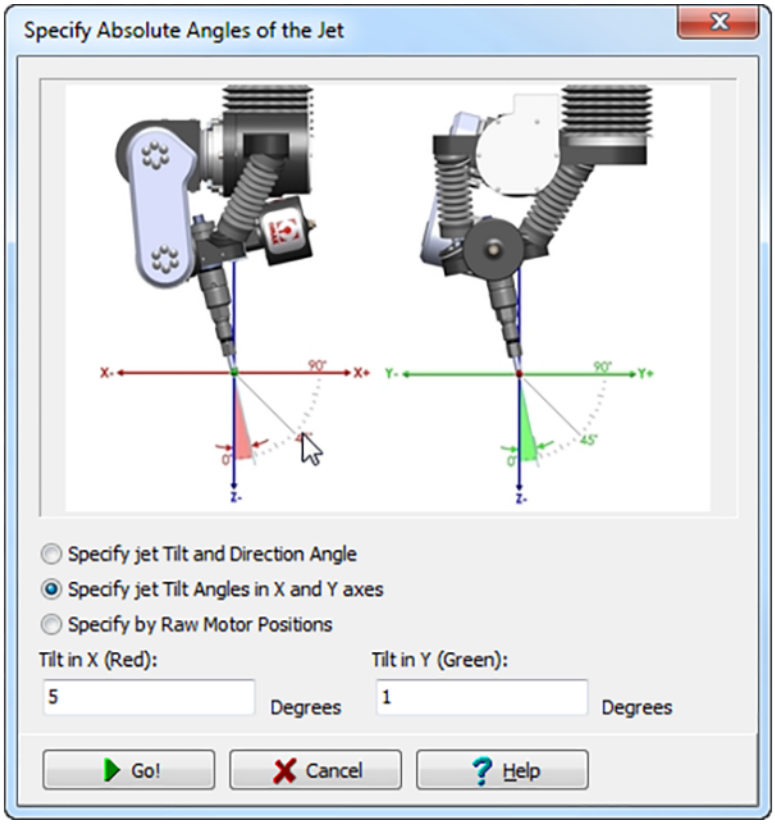


Figure 14

Specifying the Raw Motor Positions

The third method allows you to specify raw motor angle positions. The ranges of movement of the tilting motors depend on the type of tilting kinematic. This method is only useful for setup or diagnostic purposes. In case of an A-Jet, changing the Rotation Motor Angle might be useful to locate the kinematic in a certain way to avoid collisions. The better way to accomplish this would be to change the A-Jet Rotation Home in the Advanced Setup Dialog.

Specifying the Raw Motor Steps

The motor angles can also be represented in motor steps. This opt ion is accessible in debug mode only (shift ~) and is useful only for technicians and very advanced users.

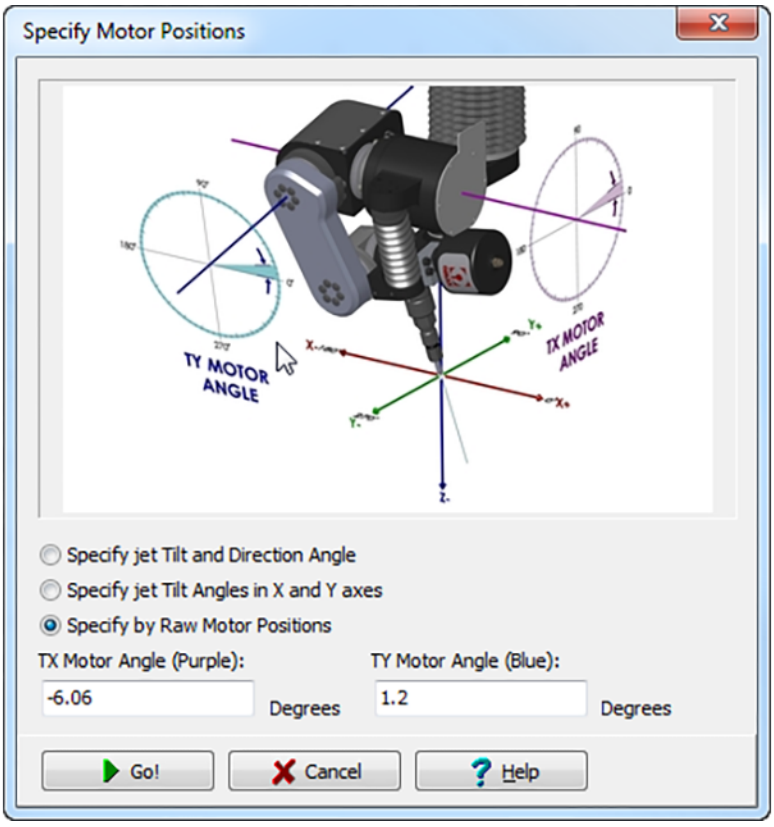


Figure 15

Compensating for Additional Taper

The Tilt-A-Jet is designed to remove taper from a part. In reality, it removes the majority of the taper. Depending on the material, the thickness, and the particular tool path, it may leave some taper (or take off a little too much). A worn mixing tube also may produce a slightly different taper than a new one.

Adjusting the taper offset is an essential prerequisite for obtaining taper-free parts.

Adjusting for Residual Taper

1. Cut a test block using Quality 4. Use the same material and thickness that matches the desired part. You may want to use the very part or a test block (for example, 3 in. long and 0.5 in. wide). The tes t cut needs to be exceuted in Quality 4. Make will then be able to adjust for all other cutting qualities.
2. Measure the taper of the part and determine the average taper per side while avoiding rolloff at the top and burr at the bottom of the edge. Always keep about 0.4 in. (10 mm) distance to the corner.
   a. Take the measurements at several points along the tool path so that everything is not optimized for one particular place on the tool path.
   b. The taper per side is half of the difference between the bottom of the cut and the top of the cut. This requires two measurements for each place on the tool path.
3. In MAKE, click **Change Path Setup** to display the setup options. In the lower right, under the **Enable Tilt** check box is **Taper Offset**.

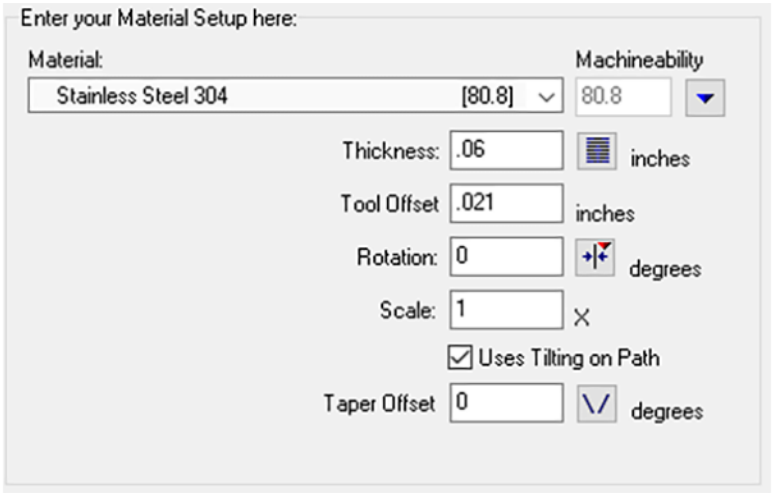


Figure 16

4. **Uses Tilting on Path** must be checked. Either type in your desired taper angle per side, or click the **\ /** **degrees** button to use the **Taper Offset Calculator**.

5. Use the **Taper Offset Calculator** to enter the amount of taper per side to be added to the part; it will automatically calculate the appropriate angle.
6. If the taper is currently positive or V-shaped, which is the most common, place a negative sign in front of the desired add-on taper to create a negative add-on taper.
7. If the taper is currently negative (inverted V), use a positive taper to counteract it.
8. When finished entering the taper value, click **OK** to enter the calculated angle into the **Taper Offset** field.
9. Cut the part and measure the taper again. Make any necessary adjustments.
10. The taper may vary slightly from run to run, depending on the uniformity of the material, the abrasive used, and the mixing tube wear. Additional adjustments will be small.

Stand-off Requirement

Because the tip of the nozzle tilts with the Tilt-A-Jet, an accurate stand-off is important for the final part accuracy. For maximum part accuracy, the stand-off should be 0.060 in., ±0.005 in. (1.5 mm ±0.1 mm).

When the nozzle is tilted, increases in the stand-off affect the position of the jet stream. When the nozzle is straight up and down, both the straight up and tilted jet streams follow the same path. When the nozzle tilts, a nozzle that is farther from the surface will enter the material at a different location. This problem becomes more pronounced at higher tilts. See example below.

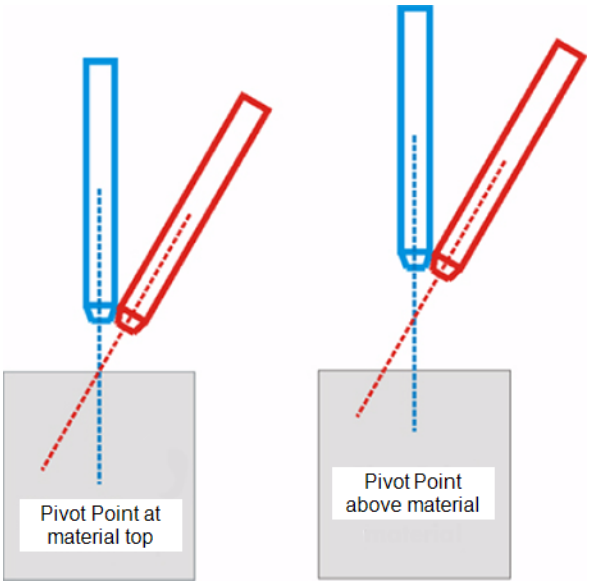


Figure 17

To obtain the greatest accuracy, set the stand-off by hand at the location where the part will be made. Always use a feeler gauge for verification.

Automatic Stand-off Function and the Tilt-A-Jet

Never use the automatic stand-off function when the Tilt-A-Jet is enabled. Because the stand-off distance is critical to taper reduction, always set the stand-off manually.

The Tilt-A-Jet uses servo motors, and exerts a considerable amount of downward force, typically in excess of 80 lb (36 Kg). This force can easily shatter brittle materials and bend thicker materials, producing an inaccurate stand-off.

Care and Maintenance

This section covers regular care and maintenance of the Tilt-A-Jet.

NOTE: *Do not disassemble components of the Tilt-A-Jet unless directed by OMAX Customer Service. The Tilt-A-Jet is a precision component and improper assembly will render it inoperative. Disassembling the Tilt-A-Jet also voids your warranty.*

Maintenance Activities

The following maintenance activities when done at the recommended intervals are important in maintaining reliable and accurate Tilt-A-Jet performance and minimizing potential problems.

Maintenance Tasks for Tilt-A-Jet	Frequency
Inspect the bellows for tears and holes	Daily
Ensure the Tilt-A-Jet seal is snug and flush with the surface	Daily
Inspect the nozzle for damage and loose connections	Daily
Inspect the pierce guard for damage	Daily
Wash garnet from the Tilt-A-Jet assembly	Daily
Ensure the Tilt-A-Jet hard stops are clean without abrasive buildup	Monthly
Inspect the table slats for wear and weakness	Monthly
Grease the Tilt-A-Jet Z-axis bearings	Yearly
Lubricate the Z-axis lead screw	Yearly

Daily

Inspect the Bellows for Tears and Holes

Any opening in the bellows should be immediately repaired. Once inside the bellows, garnet acts as an abrasive and quickly wears down expensive parts. For repair procedures call Customer Service.

Check to Ensure the Tilt-A-Jet Seal is Snug

Make sure the seal along the top side of the Tilt-A-Jet assembly has not been pushed out of position. If the seal is out of position, garnet may get into the Tilt-A-Jet mechanism. There are four seals to inspect. Each seal should be flush with the surface (see Figure 12). If the seal is out of place, press it back into place.

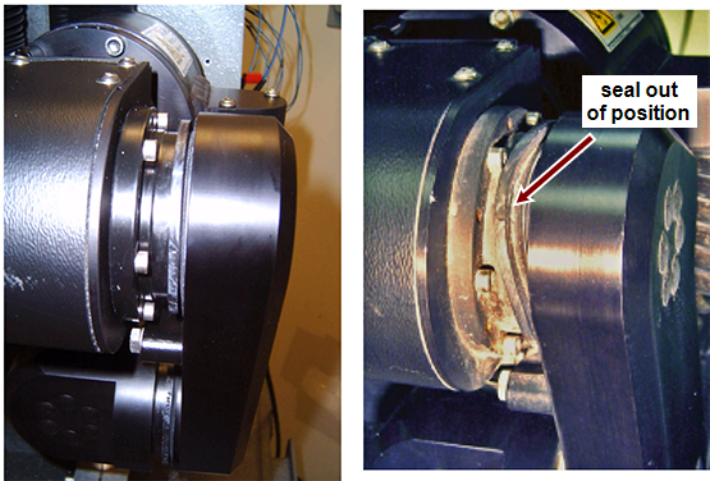


Figure 18

NOTE: *Do not cut parts when the Tilt-A-Jet seal is distorted. You can damage the Tilt-A-Jet assembly.*

Inspect the Nozzle
Verify the nozzle is not damaged and all connections are secure.

Inspect the Pierce Guard
Verify the pierce guard is not damaged and is installed properly. Operating the TAJ without the pierce guard in place will void your warranty.

Carefully Wash Down the Tilt-A-Jet Assembly
The Tilt-A-Jet should be kept reasonably clean. The bellows protect sensitive parts. When too much grit accumulates, proper functioning of the Tilt-A-Jet will be affected. Carefully wash down the Tilt-A-Jet assembly daily using water. Air may also be used to blow away grit. Maintain a distance of 18 inches when spraying air or water at the Tilt-A-Jet assembly.

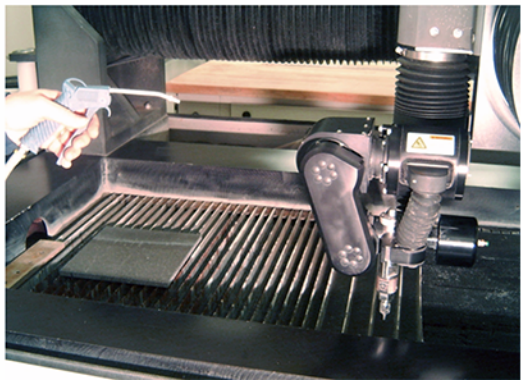


Figure 19

Monthly

Ensure the "Hard Stops" on the Tilt-A-Jet are Clean
If grit builds up on either hard stop, the auto squaring routine may incorrectly position the nozzle, causing the Tilt-A-Jet to increase the amount of taper left in parts.

There are two hard stops to check [1] [2]. Make sure that both kept are reasonably clean without a build-up of garnet or dirt.

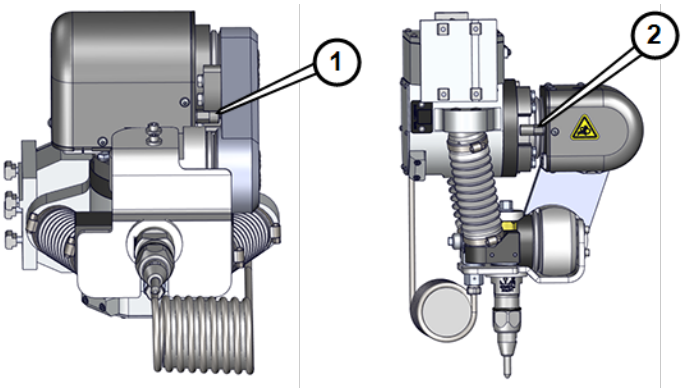


Figure 20

Inspect Table Slats for Wear and Weakness
Because the Tilt-A-Jet angles the jet stream, it is important to examine the slats along their sides for wear at least once a month. In extreme cases when cutting thin materials at sharp angles, the top of the slats may look fine, but the underneath has been worn away by the jet stream striking the side of the slat. Once a slat appears worn or weakened, replace it.

Yearly

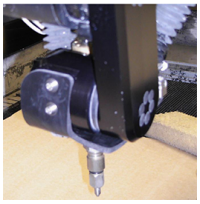
Grease the Tilt-A-Jet Z-axis Components
The Z-axis lead screw and bearings and must be lubricated to reduce wear and ensure accuracy. If you hear squeaking when the Z-axis moves, it most likely is lack of lead screw lubrication.

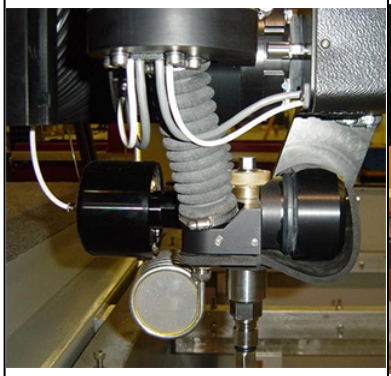
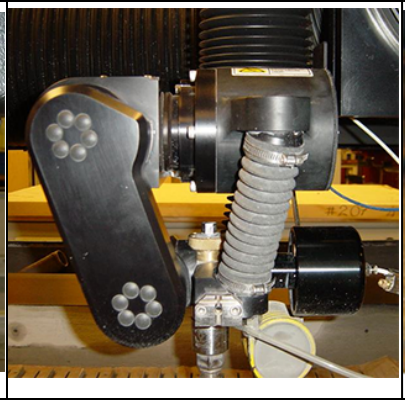
Lubrication of Z-axis components is covered in the *400433 OMAX JetMachining Center User's Guide*, and the *401085 OMAX MicroMAX Operator Guide*.

Tilt-A-Jet Operating Best Practices

The following steps should be taken to prevent damage to your Tilt-A-Jet:

Best Practice Hardware	Best Practice Software	Best Practice Operation	Best Practice Maintenance
Use splash and pierce guards	Set soft limits to prevent crashes	Cut underwater whenever possible	Keep the TAJ clean
Use a Terrain Follower	Use heads-up traverses to prevent hitting slugs	Clamp material securely	Lubricate the Z-axis bearings and lead screw
	Keep the Tilt-A-Jet homed	Use care when loading/unloading materials	NEVER use lubricants on the Tilt-A-Jet linkage arms
	Perform precision calibration as needed		Always use counter torque procedures

Splash Guards	Pierce Guard
  	 
One of the above types must be used	It is essential that the Tilt-A-Jet be operated with the pierce guard installed

New Tilt-A-Jet	2 year old Tilt-A-Jet after following best practices	Abused no-maintenance Tilt-A-Jet
		

Nozzle Alignment

Squaring the Nozzle

Although the Tilt-A-Jet nozzle is in line with the Z-axis, the Z-axis itself may be at a slight angle to the machining table. To ensure accuracy, follow procedures in document *401032*, *Operator's Guide Perpendicularity Alignment*, to square the Tilt-A-Jet to the table.

Tilt-A-Jet Precision Calibration

To ensure a precise calibration of the Tilt-A-Jet throughout its complete range of motion, the OMAX Tilt-A-Jet/A-Jet Precision Calibration Kit (P/N 306535) must be used.

Procedures for performing a Tilt-A-Jet precision calibration are detailed in the *400530*, *Tilt-A-Jet/A-Jet Precision Calibration Guide.*

Troubleshooting

This section provides solutions to some of the more common problems that may be encountered with Tilt-A-Jet use.

Equipment Problem and Solutions

The following table contains common problems encountered during Tilt-A-Jet operation. Possible causes for each problem are provided with the most likely causes listed first. If you continue having a problem after following these procedures, contact OMAX Customer Service.

Problems

Refer next to *Solutions* to match the Corrective Action number listed in the below table with the steps suggested to correct specific problems.

Condition and Possible Causes	Corrective Action
Problems with Cutting Accuracy	
Stand-off not set correctly	**1**
Nozzle not square to material	**2**
Taper offset set incorrectly for the particular nozzle	**3**
Bent, damaged or sticking Tilt-A-Jet link arms	**4**
Witness Marks on Parts	
Improperly fixtured parts	**5**
Wrong quality assigned to lead ins and lead outs	**6**
Nozzle strikes other object while machining	**7**
Working with too thin materials	**8**
Excess vibration	**9**
Motor Fault Message Appears	
Tilt-A-Jet servo motor failure	**10**
Z-axis Squeaks when Moved	
Lack of lubrication	**11**

Solutions

Refer back to *Issues* for a list of problems encountered.

Corrective Action	Description
1	**Stand-off not set correctly** Setting an accurate stand-off is especially important when using higher tilt angles. Use a feeler gaug to accurately determine the stand-off height. Also, make sure that the stand-off being used matches the stand-off value entered in MAKE. It is important to always set the stand-off **after** running the automatic squaring routine.
2	**Nozzle not square to material** Whenever the OMAX machine has been powered down, the Auto-Home routine should be run. Also run Auto-Home if the path has been interrupted. When in doubt, always run Auto-Home.
3	**Taper offset set incorrectly for the particular nozzle** As nozzles and mixing tubes wear, fine adjustments to the taper offset can compensate and maintain cutting accuracy.
4	**Bent, damaged or sticking Tilt-A-Jet link arms** If you are unsure if a link arm is damaged, etc., verify operation by doing a Tilt-A-Jet precision calibration test. See *400530 Tilt-A-Jet /A-Jet Precision Calibration Guide* for instructions. If Tilt-A-Jet link arm repairs are needed, see *400844 Replacing a Tilt-A-Jet Linkage Arm*.
5	**Improperly fixtured parts** Improperly fixtured parts that allow vibration are the leading cause of witness marks. Make sure that parts are not free to move side-to-side or up and down. Remember that an upward force on the material from below can push it up slightly. Weights on top of the material help reduce this. Do not fixture materials to the slats; these can move back and forth slightly, causing witness marks or imperfections. Attaching the fixtures to the table will provide a sturdy and steady brace for the material.
6	**Wrong quality assigned to lead ins and lead outs** Always use a Quality of **Lead i/o** for the lead ins and lead outs. Intelli-MAX **MAKE** software uses the lead ins to properly position the tilting head for the next section. If you do not have lead ins, the Tilt-A-Jet is forced to suddenly tilt into position, which can leave a witness mark.
7	**Nozzle strikes other object while machining** If the nozzle strikes a fixture or other object while machining, a witness mark can be created. The Tilt-A-Jet has more moving parts than other cutting heads and is more susceptible to bumps and motions. Ensure the nozzle clears all fixtures with nothing in the way when cutting. Use the Dry Run function to help check for potential problems. Click **Begin Machining**, **right-click Start**, and then click one of the Dry Run commands.

Corrective Action	Description
8	**Working with too thin materials** Working with thin materials (less than 1/8 in.), especially thin materials with lots of corners, may cause vibration problems because of the rapid speed of the nozzle and the relatively large tilting motions required. Stack materials to increase the thickness (making several parts at once). Sacrificial material may also be placed above and below to increase the thickness. Decreasing the maximum speed may also help reduce the vibrations. Also try cutting at a lower pressure and consider not using the Tilt-A-Jet for thin materials, unless taper is a primary concern. You can also try cutting using a higher Quality. For some parts, a small blemish can occur at the transition between two arcs when using the Tilt-A-Jet because the Tilt-A-Jet has to change tilt directions. Decreasing the speed at this point will require less tilting and can eliminate or reduce the blemish.
9	**Excess vibration** Vibration can be transmitted from the pump along the plumbing. This vibration can be dampened by securing the plumbing to the pump. Vibration dampers are missing or not installed properly. Loose hardware.
10	**Tilt-A-Jet servo motor failure** If one of the Tilt-A-Jet servo motors has faulted, check the green status LED on the Eclipse drives for Tilt-A-Jet. The green LED has three operating modes: Steady state green: the servo motor is disabled. Rapidly blinking: the servo motor is enabled. Blinking at two flashes per second: the servo motor has faulted. If the green light is OFF, the servos are not powered. This would also cause the fault message since the servo must provide a signal to turn off the fault relay on the controller back panel. When the fault message appears, open the back door of the electronic enclosure and check the status lights for the fault relays on the controller back panel. If the fault is the result of a servo failure, the light corresponding to the faulted servo will be lit. This fault condition can be cleared by briefly rotating the Reset/Override switch to the Reset position and releasing the switch.
11	**Lack of lubrication** If the Z-axis squeaks when raised or lowered, it is usually caused by a lack of lubrication on the lead screw. For lubrication procedures, refer to your machine's operator guide.

Customer Support

Refer to the **omax.com** web site for technical support contact information.

Original Instructions in English