

# OMAX and MAXIEM Tilt-A-Jet® and A-Jet®

## Precision Calibration Guide



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# SAFETY

This section contains important safety information for the equipment. Careful observance of the safety information will help prevent physical injury, damage to the equipment, and extend the equipment life.

## Equipment Labels

The following safety labels may appear on the equipment. If ignored, physical injury, death, or equipment damage may occur. Read the safety information in the equipment operation guides before installing, operating, or maintaining the equipment.



### **WARNING Electrical Shock Hazard**

This symbol 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 is present on circuits prior to maintenance activities, etc.



### **Lock Out Power**

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



### **Wear Eye Protection**

Always wear approved safety glasses whenever cutting. Regular glasses do not provide sufficient eye protection! 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 chemical irritants. Have an eyewash station located near the work area in the event abrasive spray splashes into your eyes.

Read the product labels and refer to product Safety Data Sheets (SDS) to identify properties and hazards of chemical products and materials referenced in this document. Handle in accordance with good industrial hygiene and safety practice. Use personal protective equipment as specified in the SDS.



### **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.

Read the product labels and refer to product Safety Data Sheets (SDS) to identify properties and hazards of chemical products and materials referenced in this document. Handle in accordance with good industrial hygiene and safety practice. Use personal protective equipment as specified in the SDS.



### **Read Manual**

Read the equipment operator's guide for specific operator instructions and additional safety requirements. Do not attempt to operate this machine until you have read and understand all safety precautions and operating instructions.



#### **Electrostatic Discharge**

Attention! Observe precautions for handling electrostatic sensitive devices.

## **Safety Legend**

The following safety signal word panels and paragraph notifications may appear throughout this and other documentation. Each provides safety issue identification and recommended actions to avoid the hazard. Be alert! Follow the recommended safety actions and precautions to prevent injury or damage to the equipment.

### **⚠ WARNING**

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

### **⚠ CAUTION**

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

### **NOTICE**

Used to address practices not related to physical injury—property damage only.

### **NOTE**

Used to provide supplementary information, emphasize a point or give a tip for easier operation.

# REQUIRED TOOLS

The following table contains a list of tools with the appropriate sizes needed to operate and maintain equipment.

## Customer Tools

These tools are not provided by OMAX or included with the equipment.

Icon	Tool	Size(s)
	Clamp	
	Precision Phillips screwdriver	

## OMAX Tools

The following table contains a list of tools provided by OMAX. These tools are included with the equipment.

Icon	Tool	Size(s)
	Kit, TAJ/A-JET, Precision Calibration P/N 306535	

# REFERENCES

## Documents

The following table contains document and diagrams associated with these instructions.

Part Number	Description
400568	Tilt-A-Jet User's Guide
401032	Operators Guide Perpendicularity Alignment
400555	Kerf Check Part Cutting Guidelines
400572	Measuring X- and Y-axis Repeatability
400610	A-Jet Users Guide

## Video

Title	URL Link
A-Jet Precision Calibration video	<a href="https://elearning.omax.com">https://elearning.omax.com</a>

# **DOCUMENT SCOPE**

This document contains instructions to perform a precision calibration of the OMAX and MAXIEM Tilt-A-Jet (TAJ) and A-Jet.

# OVERVIEW

The TAJ/A-Jet Precision Calibration Kit is a combination of hardware and software that allows precise calibration of the TAJ and A-Jet throughout their complete range of motion. After the initial hardware setup, the calibration process takes approximately 20 minutes and can be left to run unattended. These instructions explain how to install the hardware provided with the precision calibration kit and how to perform the precision calibration.

# TILT-A-JET PRECISION CALIBRATION

## NOTE

*These instructions are for calibration of the TAJ cutting head. Do NOT use them for A-Jet calibration. For A-Jet calibration procedures, see [A-Jet Precision Calibration Instructions](#).*

## When to Conduct a Precision Calibration

- The precision calibration is needed prior to starting any precision cutting application.
- Calibration is necessary following any maintenance on the cutting head mechanism.
- After any damage or mechanical crashes with the mechanism, regardless if no visible damage occurred.
- Any time the nozzle was adjusted, removed or tightened.

## NOTE

*Without precision calibration, large part errors (>0.01 in. or >0.254 mm) may occur.*

## Required Software and Documents

- 400568 *Tilt-A-Jet User's Guide*
- 401032 *Operators Guide Perpendicularity Alignment*
- 400555 *Kerf Check Part Cutting Guidelines*
- 400572 *Measuring X- and Y-axis Repeatability*
- Intelli-MAX Software most current
- A-Jet Precision Calibration video at <https://elearning.omax.com>

# Kit Contents

The figure below illustrates components of the precision calibration kit.

## NOTICE

Following calibration each item should be reinstalled identically to prevent damage. Handle the connectors on the RS-232 cables carefully. They are easily broken.



Figure 1

- |                               |                      |
|-------------------------------|----------------------|
| [1] Ball stem assemblies      | [2] X-axis indicator |
| [3] Indicator holder assembly | [4] Y-axis indicator |
| [5] USB/COM port adapter      | [6] Software         |
| [7] USB cable                 | [8] Ball-tool gauges |
| [9] RS-232 COM port cables    |                      |

## NOTE

Always store the ball stem assemblies in the plastic tubes.

## NOTE

The most current version of Intelli-MAX Software on the machine is recommended to assure proper working function when performing a precision calibration.

# TAJ Calibration Prerequisites Checklist

	Verify machine setup is correct in MAKE (left- or right-hand TAJ - see Setup/Advanced/ Administrator Setup/Motor Setup menu).
	Verify the mechanical integrity of the TAJ.
	If there has been any maintenance to the TAJ mechanism, any physical damage, or machine crashes since the last squareness calibration, a perpendicularity calibration must be conducted prior to the precision calibration per the instructions in the <i>401032 Operators Guide Perpendicularity Alignment</i> .
	Verify the ball stem assembly ball is free of any damage (scratches, gouges, burrs) or debris prior to performing the calibration. <b>NOTE</b> <i>A damaged or dirty ball will negatively impact calibration results.</i>
	Inspect the precision calibration kit components to verify dial indicators and other items attached to the mounting plate are seated level and tight, and the dial indicator contacts are tight. If loose, erroneous calibration will result.
	Ensure the machine slats are in good condition to provide a level surface for the indicator holder assembly to set on.
	Find a quiet time to perform the calibration. Vibrations or machine movement can affect the readings.

# Install and Use the Indicator Holder Assembly

## NOTE

*Ensure that Version 32 or later Intelli-MAX software is installed before proceeding.*

- Back up the machine's current settings. Click **Setup/Transfer/Backup Settings/Export Machine Setup Files to Disk...**.

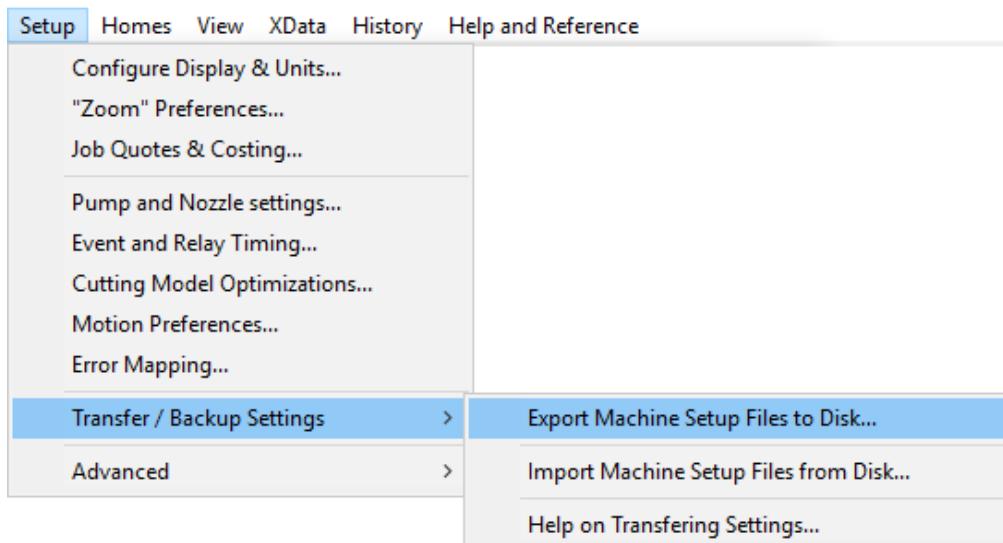


Figure 2

## NOTE

*Ensure that the items on the Calibration Prerequisite Checklist are completed before proceeding any further. Failure to perform the checklist tasks may severely affect machine accuracy.*

## NOTE

*The proper placement of the ball stem and the mixing tube are critical for an accurate calibration. Improper placement results in a poor calibration.*

## Auto-Home the Tilt-A-Jet/A-Jet

1. Open **MAKE**.
2. Select **Homes, Auto-Home (Off Hardstop)**.

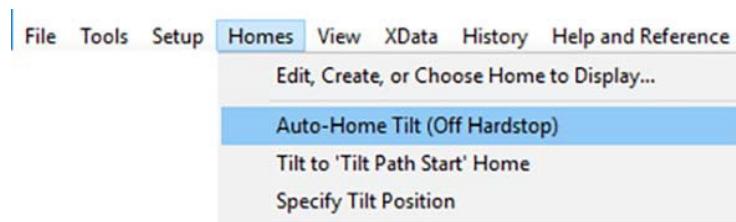


Figure 3

## NOTICE

Do not auto home the nozzle when the ball is positioned in the measuring tool (Figure 19). Doing so will damage the dial indicators and ball.

## NOTE

Auto-Home is required, otherwise the Calibration Wizard will not execute the Create and Test Map function.

## Launch the Precision Calibration Wizard

1. In **MAKE**, select **Setup**, **Advanced/Tilt Axes Calibrations**, **Precision Calibration Wizard** to open the Calibration Wizard.
2. Enter the **administrator password**.

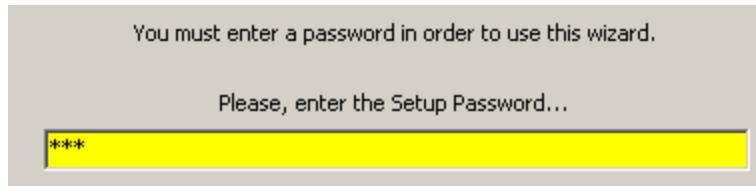


Figure 4

## Install the Ball Stem Assembly into the Nozzle

1. In the **Precision Calibration Wizard**, select 2) **Ball Setup**.

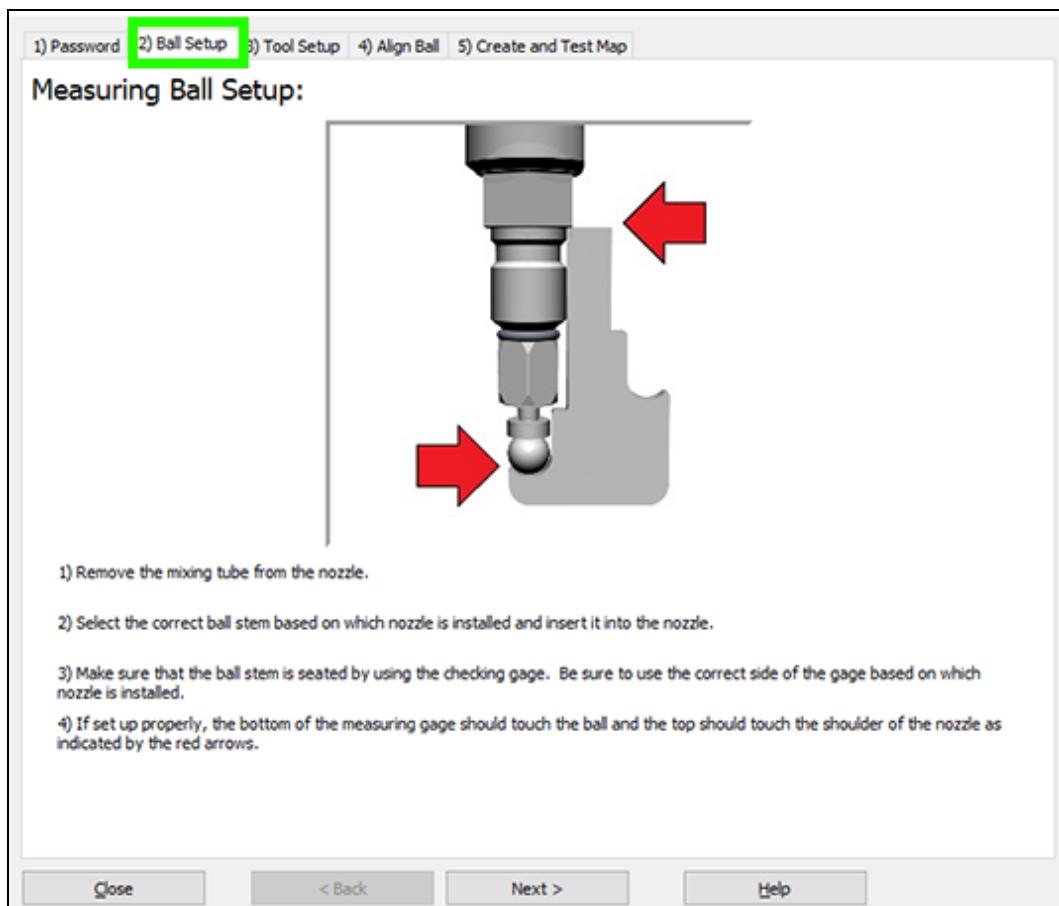


Figure 5

2. Place a sheet of cardboard or similar material directly beneath the **nozzle** to prevent dropped tools or components from falling into the **catcher tank**.
3. Remove the **mixing tube**.
4. Install the **ball stem assembly** for the **nozzle type** being used into the **nozzle body**(Figure 6).

## **NOTE**

*Ensure the surface of the ball is free from scratches and clean prior to installing it into the nozzle body. Any damage (scratches, nicks, gouges), or debris, dirt, paint, rust, etc. will adversely affect the calibration process.*

5. Ensure that the **stem** of the **ball stem assembly** inserts all the way into the shaft of the **nozzle body**.

## **NOTE**

*Verify full insertion with the ball-tool gauge. This gauge comes in a variety of sizes that support the various nozzle types. Select the correct size for your nozzle and align the gauge so that the ball fits into the curved recess of the gauge. The top of the gauge should just be making contact with the nozzle guard shoulder.*

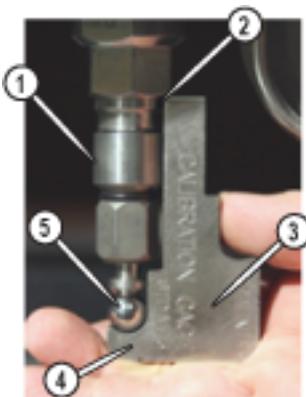


Figure 6

[1] Nozzle assembly (MAXJET 5) [2] Nozzle guard shoulder [3] Ball-tool gauge  
 [4] Curved recess of gauge [5] Ball stem assembly

6. Select **Next** to proceed to the **3) Tool Setup** tab (Figure 7).

# Setup the Precision Calibration Measuring Tool

## NOTE

See Kit Contents for dial indicator software requirements.

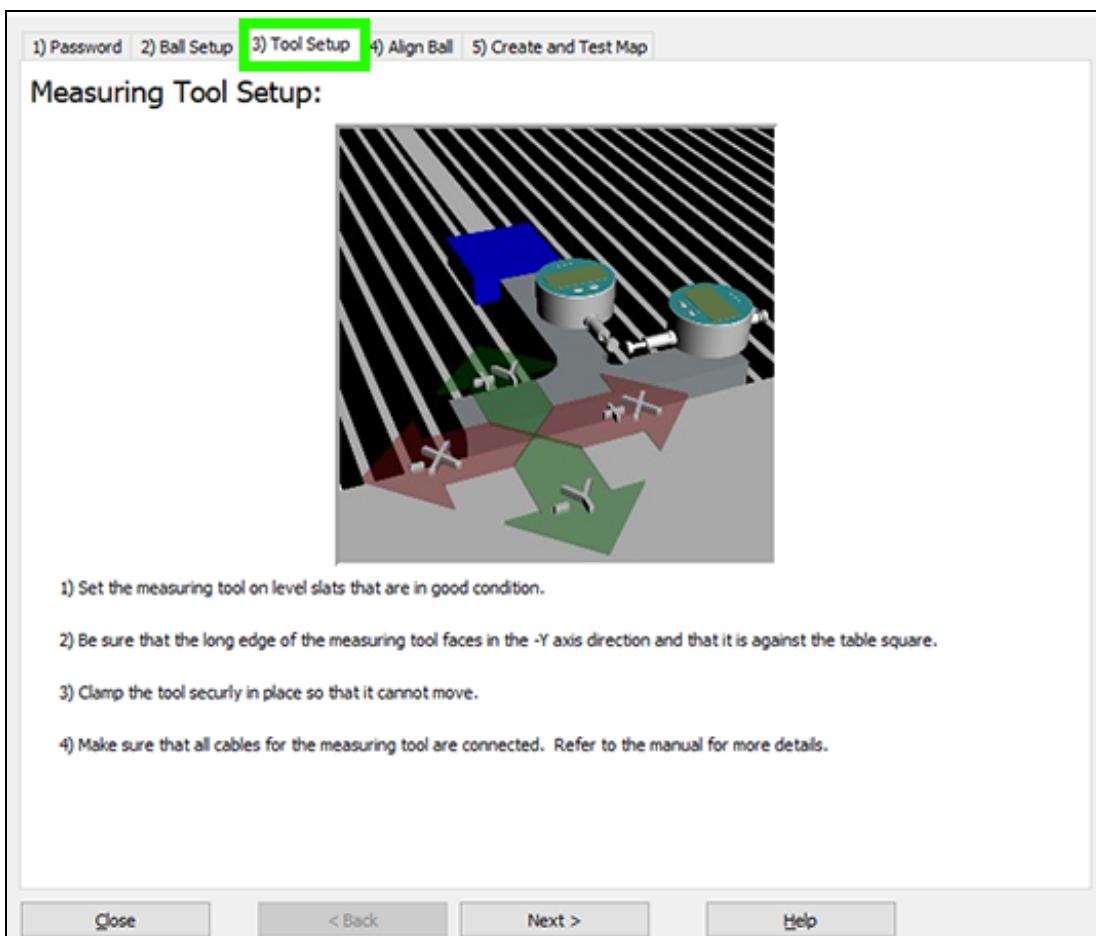


Figure 7

1. Remove the **protective plug** from the **interface** on each of the **dial indicators**.



Figure 8

2. Inspect the **dial indicator contacts** to make sure they are not loose. If loose, finger-tighten them.

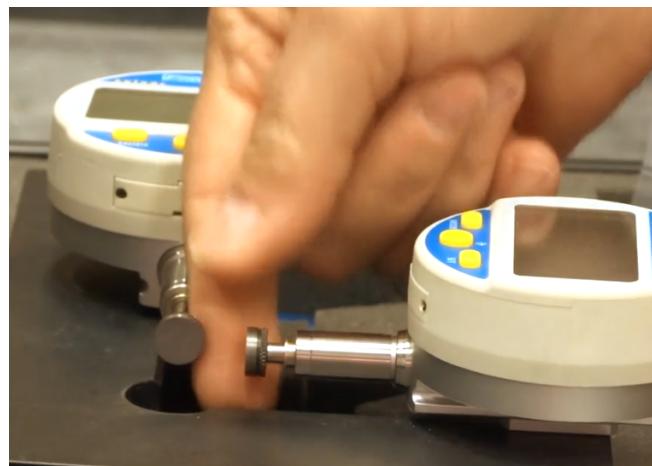


Figure 9

3. Plug the end of one of the **COM port/cables** into the **X-axis dial indicator** as shown below. Plug the other **COM port/cable** into the **y-axis dial indicator**.

### NOTICE

Connectors can be easily broken. Handle the connectors on these cables carefully. Do not force connectors into the ports. Broken connectors will result in inaccurate readings.

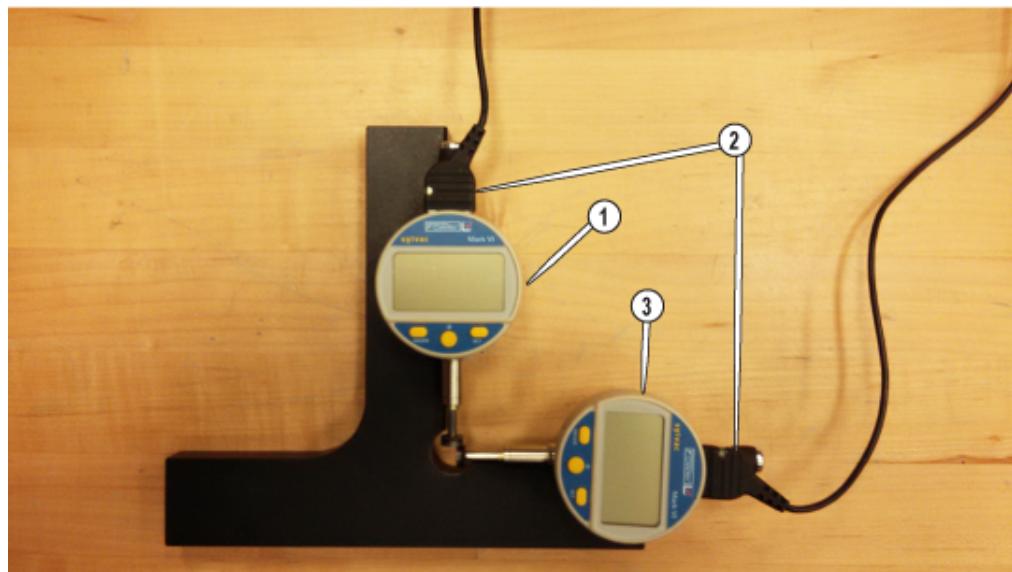


Figure 10

[1] Y-axis indicator [2] COM port cables [3] X-axis indicator

4. Plug the **COM port end** of the **cable** from the **X-axis indicator** into the **port** (Figure 11) [2] on the **USB/COM port adapter**. The **COM port adapter** will auto detect which **axis indicator** is plugged in.

5. Insert the **COM port end** of the **Y-axis cable** into the other **port** of the **USB/COM port adapter**.

6. Plug the enclosed **USB cable** into the **USB port [1]** of the **USB/COM port adapter**.

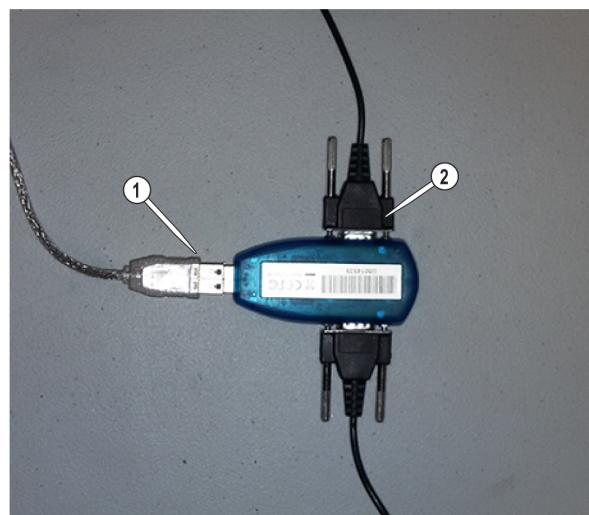


Figure 11

7. Plug the other end of the **USB/COM port adapter** into an open **USB port** on the **computer**.



Figure 12



Figure 13

8. Place the **indicator holder assembly** onto the **tank slats**. See (Figure 14) for an example of OMAX/ MAXIEM fixturing. See (Figure 15) for an example of MicroMAX fixturing.

## NOTICE

**Damage to the cutting head may occur when the cutting head collides with the tank. Ensure the indicator base is placed away from the internal edge of the tank (8 in. (200 mm) for the TAJ or 12 in. (305 mm) for the A-jet) to prevent tilting movement from colliding with the tank.**

## NOTE

*The tank slats should be relatively "new" (structurally sound and not cut through too many times). If the slats are weak or uneven so that the instrument is not level during the testing process, the readings of the measurements may be inaccurate.*

## NOTE

*The bottom edge of the indicator holder assembly must run parallel with the X-axis. Securely fixture the tool to the tank's X-axis square using clamps to prevent movement. Ensure that the clamping fixtures do not interfere with the indicators.*



Figure 14

- [1] Fixturing
- [2] Y-axis indicator
- [3] X-axis indicator
- [4] Indicator holder assembly

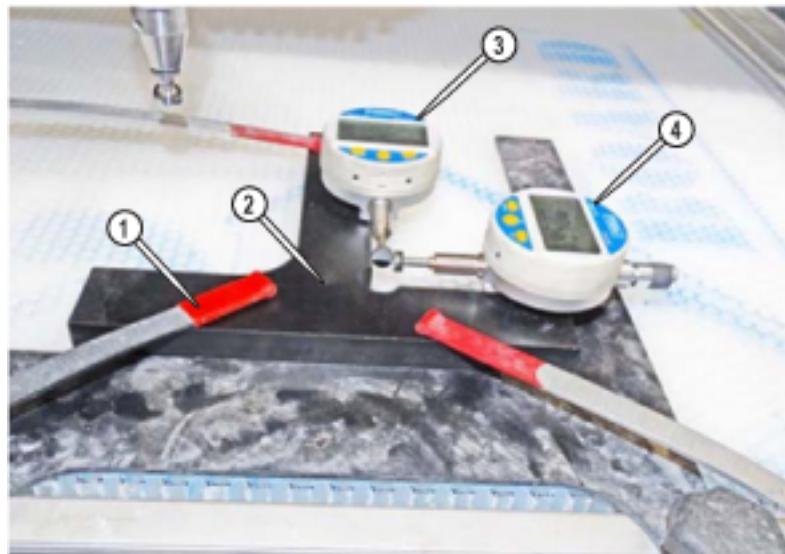


Figure 15

- [1] Clamp
- [2] Indicator holder assembly
- [3] Y-axis indicator
- [4] X-axis indicator

# Align the Ball Stem Assembly

## NOTE

If the nozzle and ball are far away from the dial indicator contacts, exit the wizard and manually jog the nozzle near to the assembly and restart the Precision Calibration Wizard.

1. In the Precision Calibration Wizard, select 4) Align Ball.

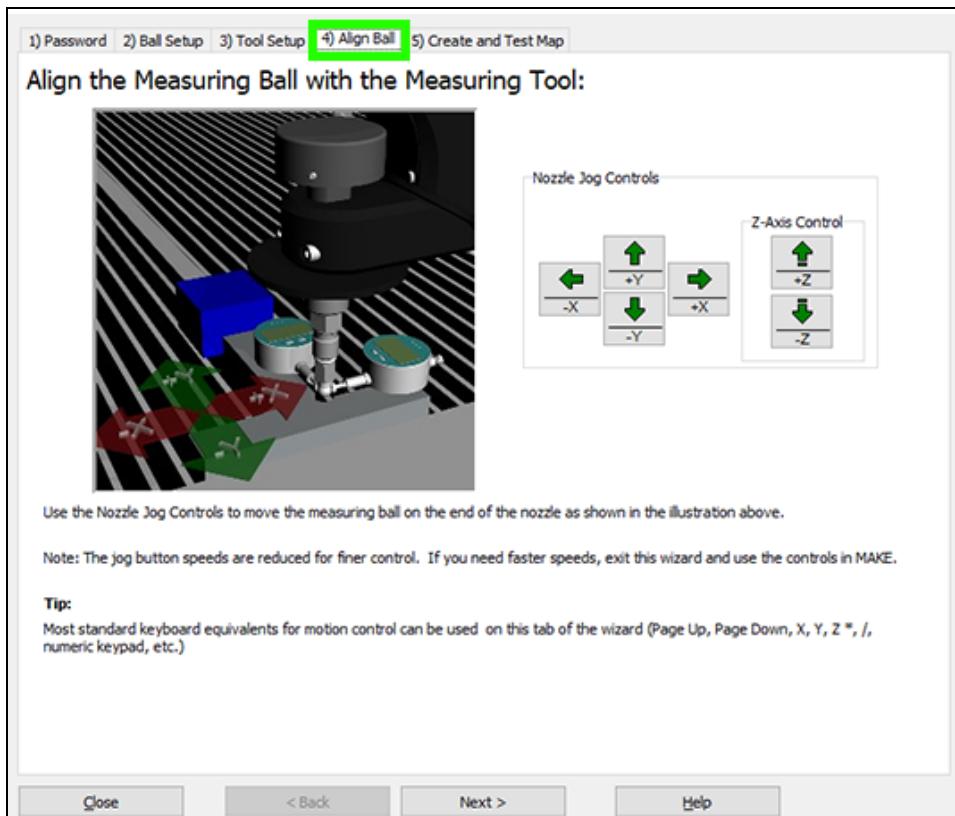


Figure 16

When the Align Ball tab on the Calibration Wizard is active, the keypad on the keyboard can be used to move the nozzle. Using the mouse to click the Nozzle Jog Controls (Figure 16) will also move the nozzle. Click and hold for continuous movement.

Use the keypad to precisely move the nozzle when aligning the ball to the indicator shafts: press 7 for nozzle up movement or press 1 to move it down for coarse movement. The PgUp PgDn keys are also active for fine up/down movement.

## NOTE

The velocity of the nozzle motion will be slower than normal when the Calibration Wizard is active.

## NOTICE

When moving the Z-axis down, ensure the ball stem assembly does not collide with the edges or sides of the dial indicator contacts. This can cause serious damage to the ball and calibration equipment.

Never allow the ball's surface to contact or slide across the ends of the indicator shafts. The hard, sharp edges of the contact can scratch the ball causing an inaccurate calibration, or could bend the indicator shaft.

2. Lift the **dial indicator contacts** and use the plastic clips holding the cables to hold the **dial indicator contacts** out of the way while centering the ball into position.



Figure 17

- The proper method for centering the ball to the center of the dial indicator contacts is to lower the ball away from both contacts.
  - Adjust the center height of the ball near the center line of the dial indicator contacts.
  - Use the keypad/mouse to jog in both X and Y-axis with zig-zag movements until the ball is centered with both X and Y-dial indicator contacts (Figure 18).
3. Lower the **Z-axis** in 0.010 in. (0.25 mm) increments (page up/page down) so that the center of the **ball** is only 'slightly' above the center line of the **dial indicator contacts**.

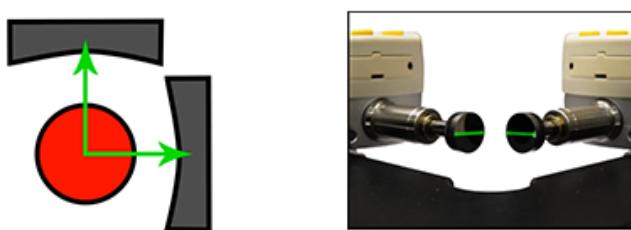


Figure 18

## NOTICE

The center of the ball must not be positioned below the center line of the dial indicator contacts, otherwise, contact between the shaft/stem of the ball and the dial indicator contacts may occur during calibration, resulting in a poor calibration map, or damage to the dial indicators and/or contacts.

4. Remove the plastic clips securing the **dial indicator contacts** and ease the contacts so they are touching the **ball**.



Figure 19

# Create and Test the Error Map

## NOTE

*Ensure that the area around the machine is free from vibrations and movement. Do not lean against the waterjet while performing the calibration. Movement may cause inaccurate readings.*

- When the **ball** is positioned as shown in (Figure 19) above, select **5) Create and Test Map** and **Begin Calibration**.

## NOTE

*Ensure that the cables going from the dial indicators to the PC are routed out of the way, avoiding contact with the cutting head and not interfering with indicator movement during the calibration procedure.*

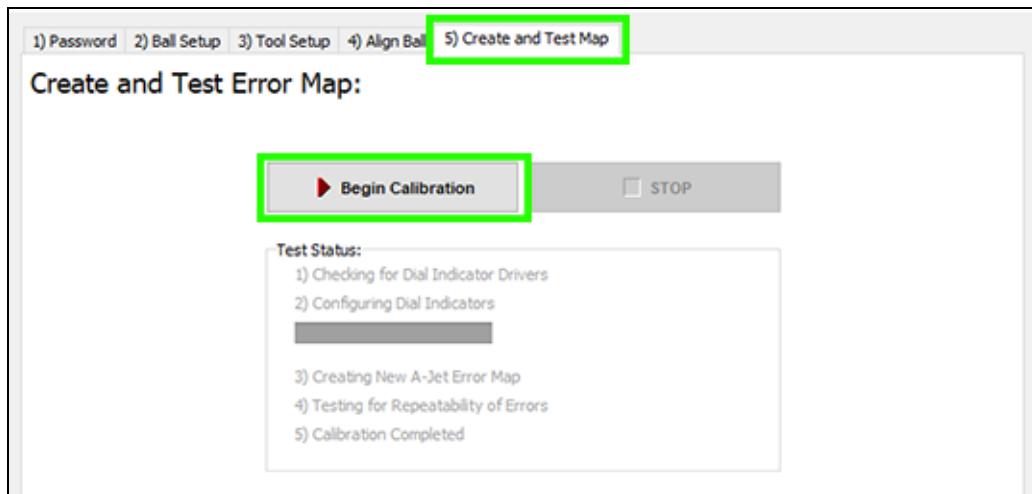


Figure 20

## NOTE

*Improper use of this calibration software can disrupt the machine's calibration and produce results that can severely affect machine accuracy. Always follow instructions accurately.*

- Read the warning and select **OK**.

The wizard configures the dial indicators. In this step, the wizard automatically locates each of the dials if they are plugged in; then, if both dials are found, the wizard moves the machine in the X and Y directions to determine which dial indicator is measuring which axis and to also determine if the ball is in the correct position with respect to the X- and Y-axis.

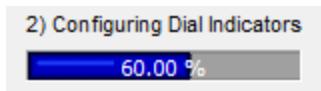


Figure 21

If, at any of these checking points, something wrong is detected, a prompt appears to check the physical setup and fix the problem.

When the configuration of the dial indicators is complete, the wizard automatically moves on to 5) Create and Test Map. During this step, an error map for the cutting head is created. Observe the cutting head tilting during this time while the dial indicators read the amount of error in the X- and Y-axis at each tilting point.

## NOTE

To stop the calibration process while the map is being created or tested, select STOP. Exit the wizard, remove the dial indicator contacts, use MAKE to reposition the nozzle away from the indicators, and auto home the cutting head again before proceeding to use the wizard.



Figure 22

## NOTE

When STOP is selected, any map in progress will be lost, and the previous map (if any) will be automatically restored. In addition, the calibration process must be restarted from the beginning. The cutting head must be moved away from the digital indicators and moved vertically up. Auto home will again be required.

## NOTICE

**NEVER** auto-home the cutting head with the ball touching the dial indicator contacts. This will damage the dial indicators and ball!

Once map creation is complete, the wizard automatically moves onto the next step; 6) View Residual Error and Map. The wizard tilts the TAJ nozzle using the map that was just created as a reference. This test records the amount of error that is remaining after the correction at each point has been applied.

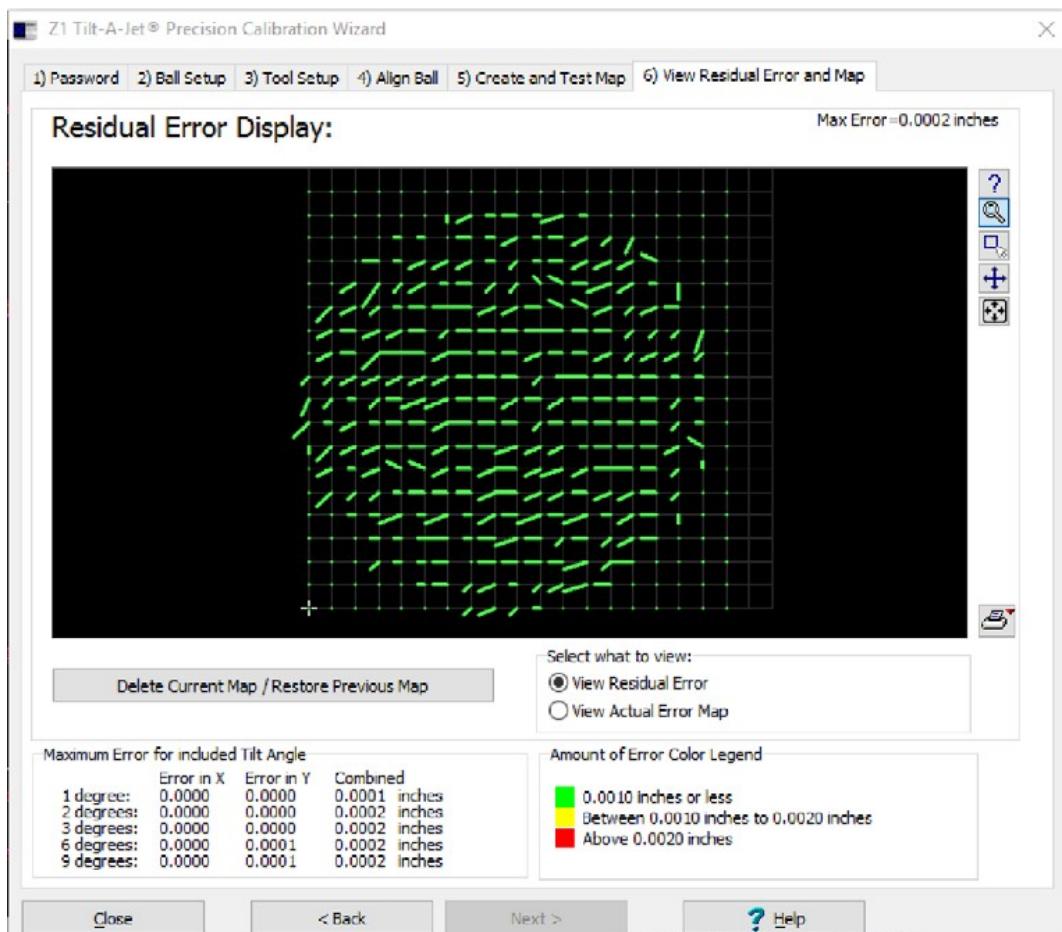


Figure 23

The maximum error recorded in either the X or Y direction at any point in the graph is displayed in the upper right-hand corner above the graph.

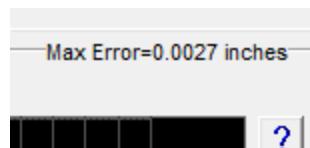


Figure 24

## NOTE

*The residual errors reflect the machine's repeatability error in the X, Y, Tx, and Ty-axis. They should fall within the machine's specifications and are typically less than 0.002 in. (0.0508 mm). If values are 0.003 in. (0.0762 mm) or larger, the machine should be checked for repeatability issues. (If the test ball does not make full contact with the dial indicator's foot during the entire error mapping process, large "fake" residual errors may occur.) Contact OMAX technical support if necessary. To validate the TAJ accuracy following the creation of a new error map, always cut test parts by following the instructions provided in the document, The 400555 OMAX Kerf Check Part Cutting Guidelines.*

To inquire about the error values at any particular point in the graph, click the "?" button and then click the point of interest on the graph. The X and Y error values for that point, as well as the combined error value, displays at the bottom of the graph.

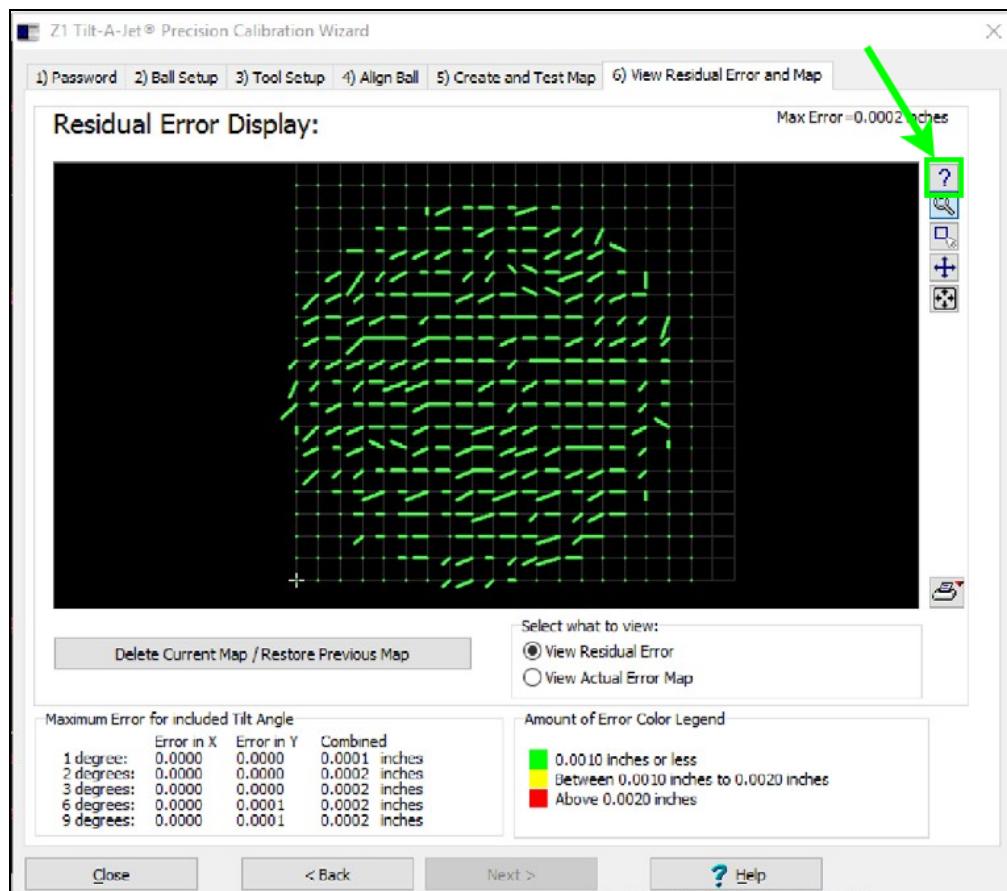


Figure 25

The actual error map can also be viewed by selecting View Actual Error Map. The error map shows the actual amount of error that was measured in the creation of the map while the residual error view shows how much error still remains after the corrections have been applied in relation to the error map.

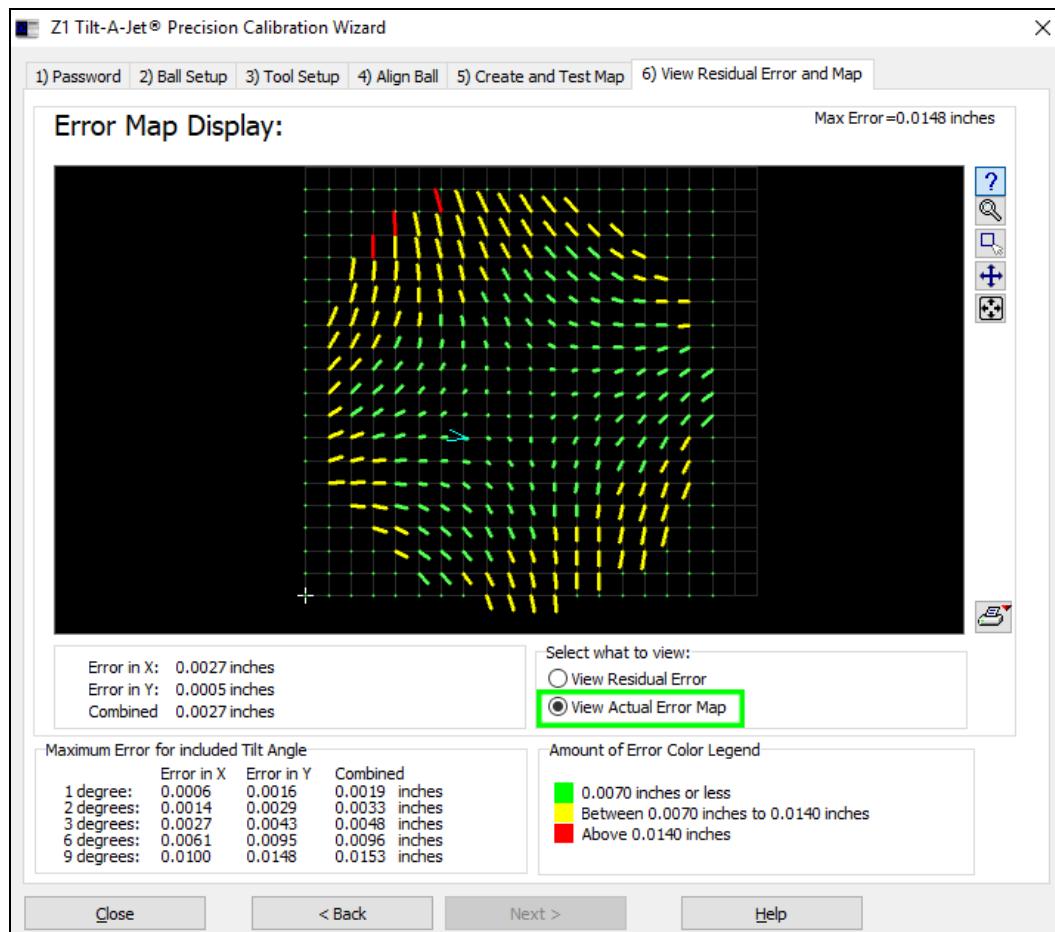


Figure 26

3. If the map is acceptable, select **Close** to save the new error map.

## Deleting the Current Map

1. If the map is unacceptable, click **Delete Current Map / Restore Previous Map**.

The last map used will be restored. If there were no previous maps, the wizard displays that it couldn't restore the previous map. Deleted maps end up in the Windows Recycle Bin. The button is available only if creating/testing a map is completed

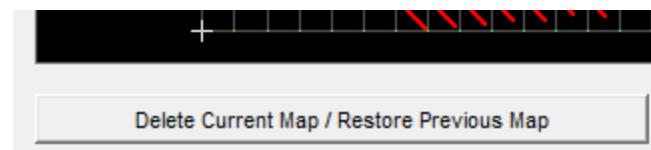


Figure 27

2. Select **Close** to save the new error map.

# Remove the Precision Calibration Tool

1. To prevent damage to the **ball**, manually pull the **dial indicator contacts** away from the **ball** and insert the clips to hold the **contacts** away from the **ball**.



Figure 28

2. Move the **cutting head** away from the **dial indicator contacts**.

## NOTICE

**Do not damage the ball.** To prevent damage to the ball, do not let the edges of a dial indicator contact slide across the surface of the ball. A damaged ball will produce inaccurate readings.

3. Remove the **indicator holder assembly**.
4. Press and hold **Set** for three seconds until OFF is displayed to turn OFF each **dial indicator** as shown below.



Figure 29

## NOTE

*Prevent battery drain. If OFF is not displayed, the dial indicator will remain on and battery will drain.*

5. Replace the **protective plugs** (Figure 8) into the **dial indicator ports**.
6. Remove the **ball stem assembly**.

7. Clean, dry, and return the **ball stem assembly** to its protective tubing.

## NOTICE

Avoid scratching the ball and stem while disassembling the calibration tool. The ball stem assembly is not hardened tool steel and is easily scratched and damaged causing rust. A scratch can cause inaccurate measurement readings. Always handle with care. Clean and thoroughly dry the ball stem assembly before storing in the protective tubing.

8. To protect from damage, pack each component of the **calibration kit** in the carrying case properly (Figure 1).

9. Install the **mixing tube** in the **nozzle**.

## NOTE

*Make sure the nozzle body is clean and free from abrasive contamination. Use the correct nozzle gauge to properly align the mixing tube.*

## Troubleshooting

### Dial Indicator(s) Not Working Correctly

1. **Communication cables** not inserted correctly or not being recognized by software.
  - a. Verify the **connectors** plugged into the **dial indicators** are correctly seated.
  - b. Verify the **connectors** plugged into the **PC USB ports** are correctly seated.
  - c. Verify that the nonworking **dial indicator** is turned **ON**. Do this manually if necessary.
  - d. Switch the **USB cable** from the **USB adapter** to another **USB port** on the **PC**.
  - e. Verify that a **cable** is not defective by swapping **dial cables** to determine if the problem is specific to the same cable.
2. Reset the **dial indicator** by removing and then reinserting its battery (this also applies if the indicators do not turn OFF by themselves).
  - a. Locate the battery compartment directly below the **MODE** and **ON/OFF** switches and unscrew the cover.



Figure 30

b. Remove the **battery** from the **indicator** for at least 30 seconds.



Figure 31

c. Reinsert the **battery** into the **indicator**, ensuring that it snaps into the original position and replace the screws.

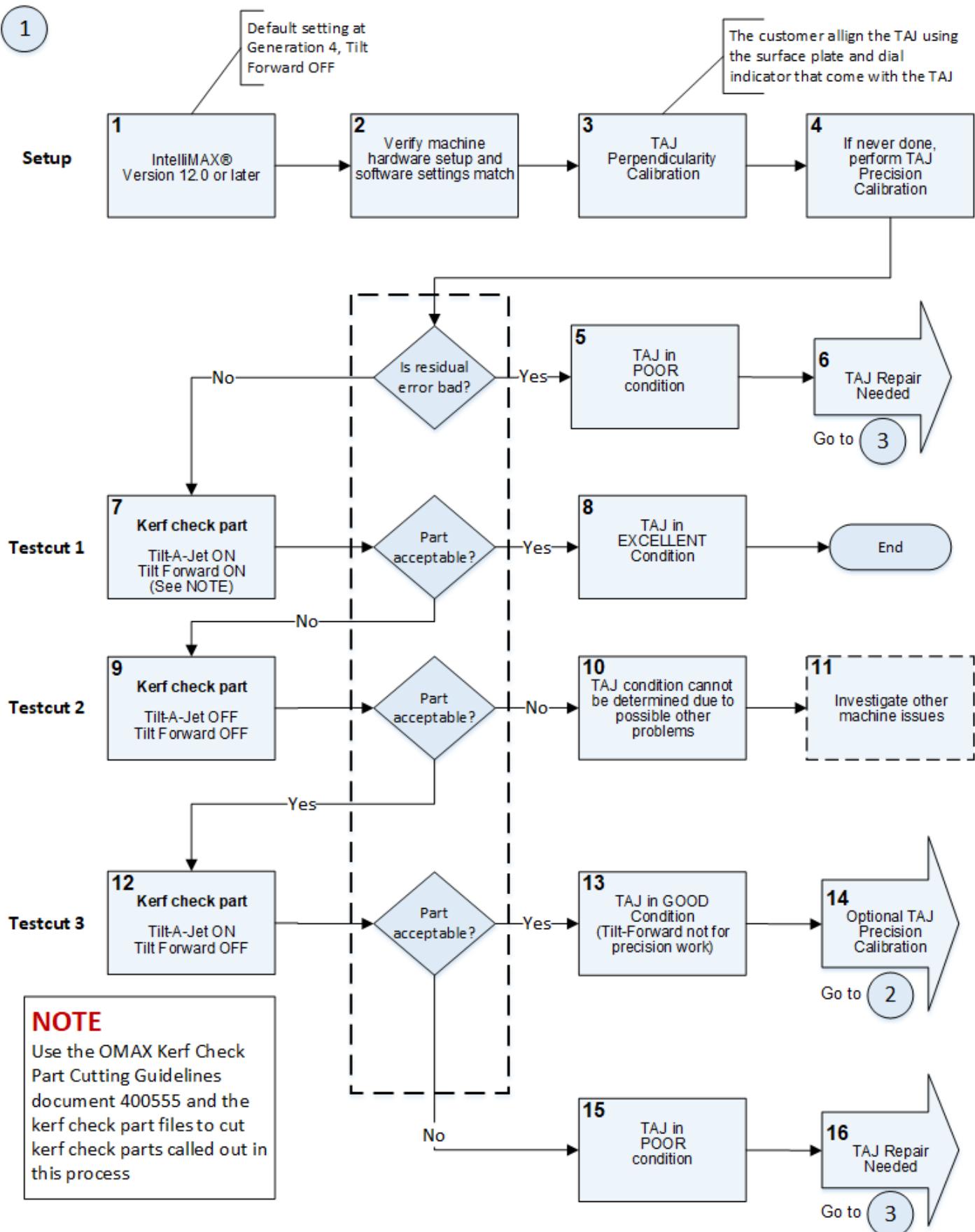


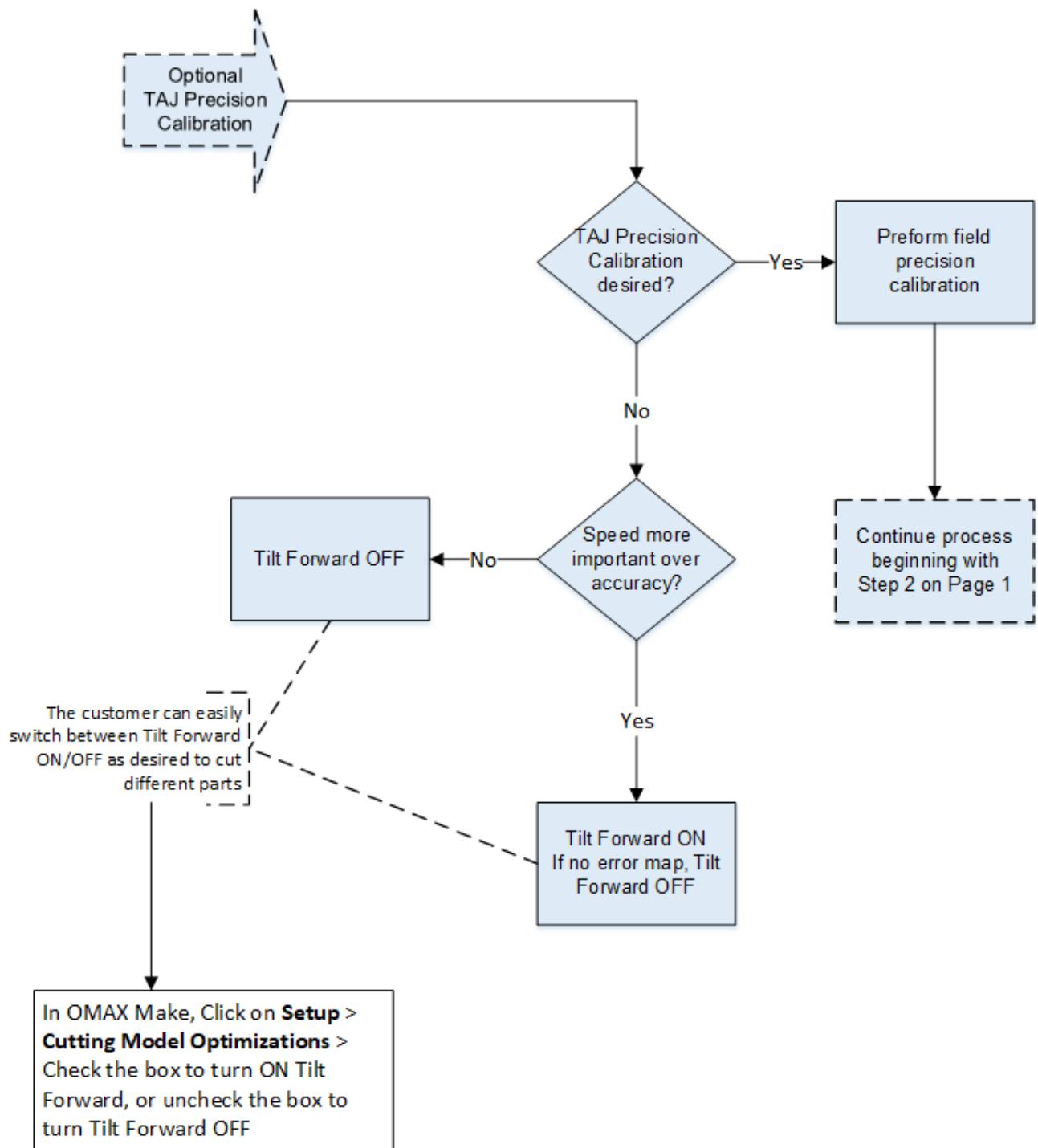
## Residual Errors are Larger than 0.002 in.

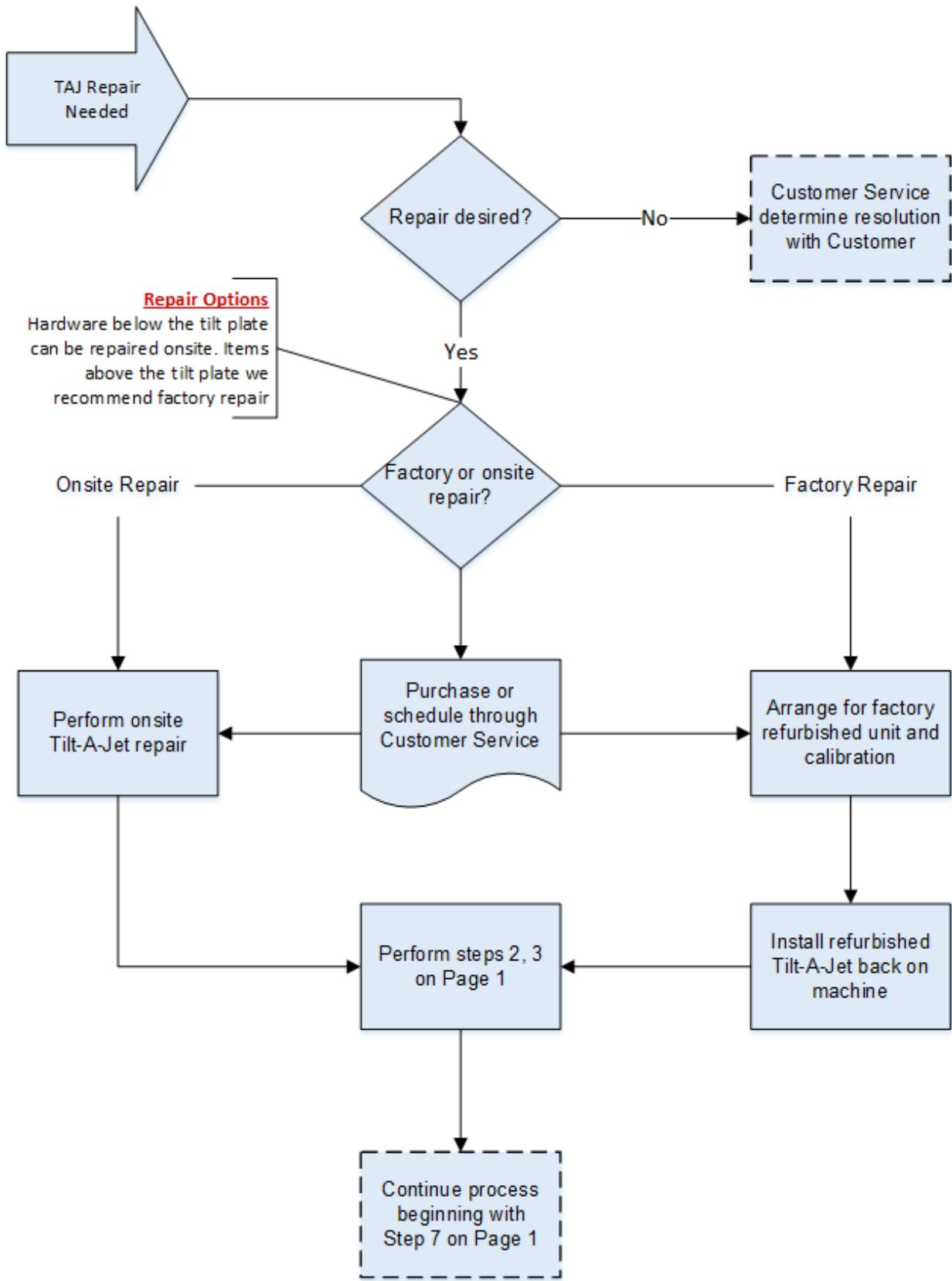
Cause of Error	Solution
If the ball does not make full contact with both dial indicator contacts during the calibration process, large, "fake" residual errors can occur.	Re-adjust the ball stem assembly with the ball properly aligned to the dial indicator contacts. Run the Create a New Error Map process again.
If the machine X, Y, TX, or TY-axis has something causing repeatability issues, large residual errors can occur.	If the problem is exactly repeatable, it could be an electrical or mechanical issue. To verify repeatability for each axis, follow the instructions for verifying machine repeatability. See 400572 <i>Measuring X- and Y-axis Repeatability</i> .
If the wrong setup recorded for the TAJ (specified as left-hand when it should be right-hand or vice versa), resulting in maximum residual error greater than the maximum map error.	Change the TAJ setup in the Advanced Administrator Setup and run the Create a New Error Map process again.
If the X and Y cables were switched during calibration, resulting in maximum residual error greater than the maximum map error.	Verify the X and Y cable connections are correct and run the Create a New Error Map process again.
If the ball on the ball stem assembly is damaged, resulting in maximum residual error greater than the maximum map error.	Check the condition of the ball to make sure there are no scratches or other damage, and that the ball is completely clean. Clean the ball and/or replace the damaged ball stem assembly and run the Create a New Error Map process again.

Cause of Error	Solution
If the ball is aligned below the center of the dial indicator contacts, there is the potential for the ball stem assembly shoulder (sits above the ball) to make contact with the dial indicator contacts during testing. This can result in higher residual errors and possibly damage the dial indicators.	Realign the ball stem assembly so the center of the ball is slightly above the center line of the dial indicator contacts and repeat the error mapping process.
If the ball stem assembly is not inserted into the nozzle body correctly, larger residual errors can occur.	Re-insert the ball stem assembly in the nozzle body and repeat the precision calibration procedure.
Scratches on the ball surface.	Replace the ball stem assembly.
Erroneous calibration results.	Verify the dial indicators and other items attached to the mounting plate are seated level and tight, and the dial indicator contacts are tight.
Ball moves vertically during precision calibration.	During the precision calibration, the Z-axis moves up and down to compensate for the tilting motion of the TAJ. Because of this Z-axis compensation motion, the ball should stay at about the same vertical position during the entire calibration process. The Z-axis movement should not be a concern unless the ball is moving vertically due to a mechanical issue with the Z-axis (lead screw needs lubricated) or similar issue.
After troubleshooting, if you continue to experience large residual errors, contact <a href="#">OMAX technical support</a> for assistance.	

# Tilt-A-Jet Precision Calibration Decision Tree





**Note:**

If an OMAX Technician performs the onsite repair, or reinstalls the factory repaired Tilt-A-Jet, they will also have the Precision Calibration Kit with them to perform the service if needed.

# A-JET PRECISION CALIBRATION INSTRUCTIONS

## NOTE

*These instructions are for calibration of the A-Jet cutting head. Do NOT use them for calibrating the TAJ. For TAJ calibration procedures, see the [Tilt-A-Jet Precision Calibration Instructions](#).*

## When to Conduct a Precision Calibration

- The precision calibration is needed prior to starting any precision cutting application.
- Calibration is necessary following any maintenance on the cutting head mechanism.
- After any damage or mechanical crashes with the mechanism, regardless if no visible damage occurred.
- Any time the nozzle was adjusted, removed or tightened.

## NOTE

*Without precision calibration, large part errors (>0.01 in. or >0.254 mm) may occur.*

## Required Software and Documents

- 400610 A-Jet Users Guide
- 400555 Kerf Check Part Cutting Guidelines
- Intelli-MAX Software most current
- A-Jet Precision Calibration video at <https://elearning.omax.com>

# Kit Contents

The figure below illustrates components of the precision calibration kit.

## NOTICE

Following calibration each item should be reinstalled identically to prevent damage. Handle the connectors on the RS-232 cables carefully. They are easily broken.



Figure 32

- |                               |                      |
|-------------------------------|----------------------|
| [1] Ball stem assemblies      | [2] X-axis indicator |
| [3] Indicator holder assembly | [4] Y-axis indicator |
| [5] USB/COM port adapter      | [6] Software         |
| [7] USB cable                 | [8] Ball-tool gauges |
| [9] RS-232 COM port cables    |                      |

## NOTE

Always store the ball stem assemblies in the plastic tubes.

## NOTE

The most current version of Intelli-MAX Software on the machine is recommended to assure proper working function when performing a precision calibration.

# Calibration Prerequisites Checklist

	Verify the machine setup is correct in MAKE; see Setup/Advanced/Administrator Setup. Select the Motor Setup tab and ensure A-Jet is selected.
	Verify the mechanical integrity of the A-Jet.
	If there has been any maintenance to the A-Jet mechanism, any physical damage, or machine crashes since the last A-Jet squareness calibration, an A-Jet squareness calibration must be conducted prior to the precision calibration per the instructions in the <i>400610 A-Jet Operator's Guide</i> .
	Verify the ball on the ball stem assembly is free of any damage (scratches, gouges, burrs) or debris prior to performing the calibration.  <b>NOTE</b> <i>A damaged or dirty ball will negatively impact calibration results.</i>
	Inspect the precision calibration kit components to verify dial indicators and other items attached to the mounting plate are seated level and tight, and the dial indicator contacts are tight. If loose, erroneous calibration will result.
	Ensure the machine slats are in good condition to provide a level surface for the indicator holder assembly to set on.
	Find a quiet time to perform the calibration. Vibrations or machine movement can affect the readings.

# Install and Use the Indicator Holder Assembly

## NOTE

*Ensure that Version 32 or later Intelli-MAX software is installed before proceeding.*

- Back up the machine's current settings. Click **Setup/Transfer/Backup Settings/Export Machine Setup Files to Disk...**.

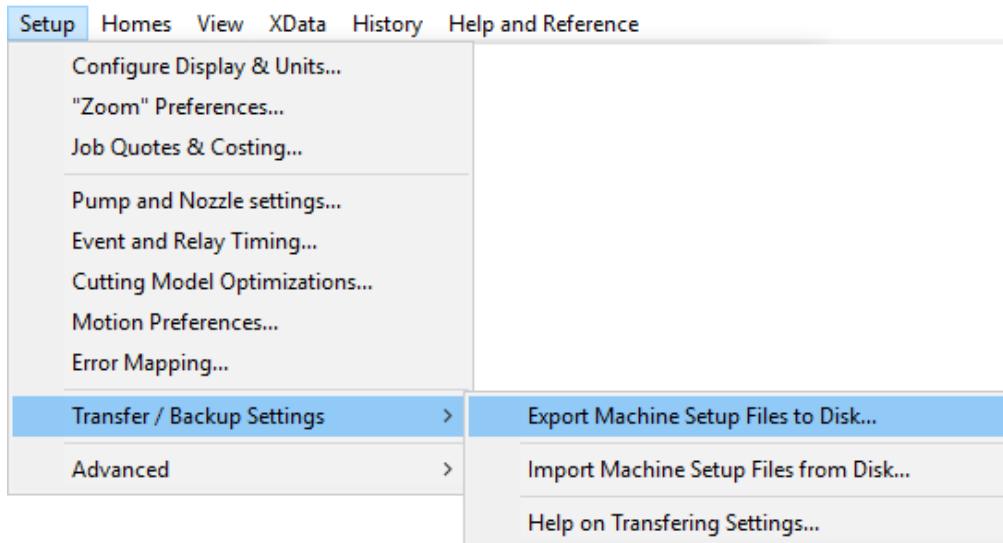


Figure 33

## NOTE

*Ensure that the items on the Calibration Prerequisite Checklist are completed before proceeding any further. Failure to perform the checklist tasks may severely affect machine accuracy.*

## NOTE

*The proper placement of the ball stem and the mixing tube are critical for an accurate calibration. Improper placement results in a poor calibration.*

## Auto-Home the Tilt-A-Jet/A-Jet

1. Open **MAKE**.
2. Select **Homes, Auto-Home (Off Hardstop)**.

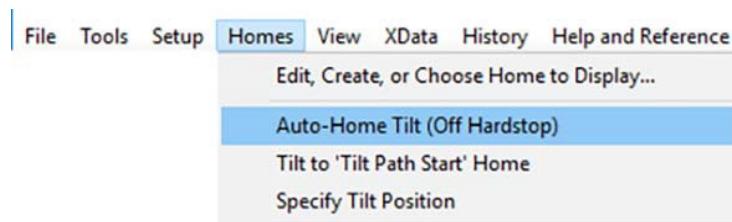


Figure 34

## NOTICE

Do not auto home the nozzle when the ball is positioned in the measuring tool (Figure 50). Doing so will damage the dial indicators and ball.

## NOTE

Auto-Home is required, otherwise the Calibration Wizard will not execute the Create and Test Map function.

## Launch the Precision Calibration Wizard

1. In **MAKE**, select **Setup**, **Advanced/Tilt Axes Calibrations**, **Precision Calibration Wizard** to open the Calibration Wizard.
2. Enter the **administrator password**.

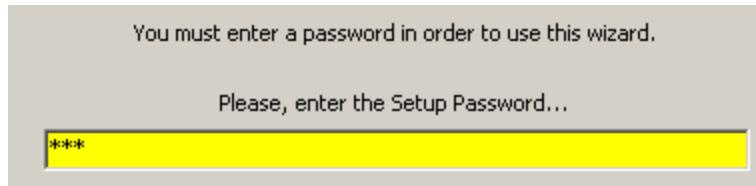


Figure 35

## Install the Ball Stem Assembly into the Nozzle

1. In the **Precision Calibration Wizard**, select 2) **Ball Setup**.

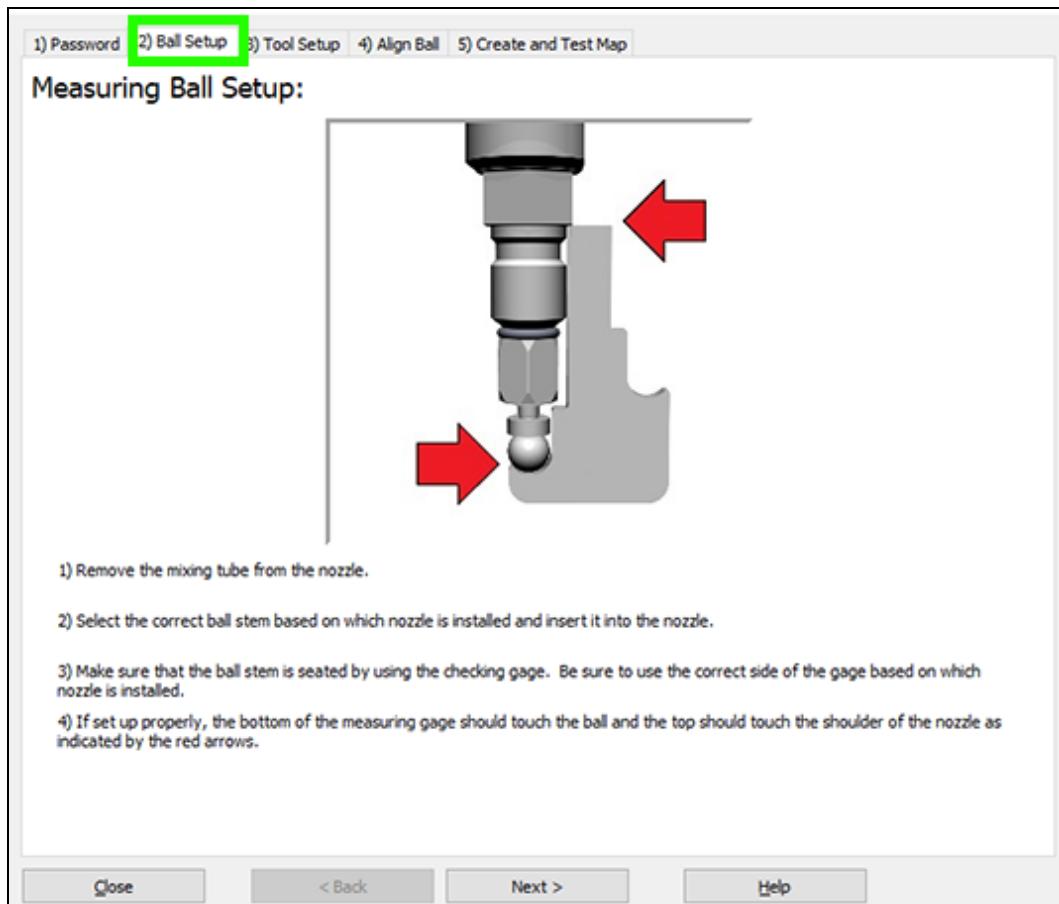


Figure 36

2. Place a sheet of cardboard or similar material directly beneath the **nozzle** to prevent dropped tools or components from falling into the **catcher tank**.
3. Remove the **mixing tube**.
4. Install the **ball stem assembly** for the **nozzle** type being used into the **nozzle body**(Figure 37).

## **NOTE**

*Ensure the surface of the ball is free from scratches and clean prior to installing it into the nozzle body. Any damage (scratches, nicks, gouges), or debris, dirt, paint, rust, etc. will adversely affect the calibration process.*

5. Ensure that the **stem** of the **ball stem assembly** inserts all the way into the shaft of the **nozzle body**.

## **NOTE**

*Verify full insertion with the ball-tool gauge. This gauge comes in a variety of sizes that support the various nozzle types. Select the correct size for your nozzle and align the gauge so that the ball fits into the curved recess of the gauge. The top of the gauge should just be making contact with the nozzle guard shoulder.*

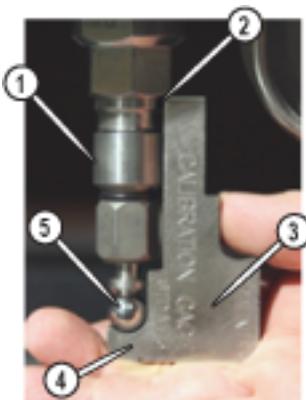


Figure 37

[1] Nozzle assembly (MAXJET 5) [2] Nozzle guard shoulder [3] Ball-tool gauge  
 [4] Curved recess of gauge [5] Ball stem assembly

6. Select **Next** to proceed to the **3) Tool Setup** tab (Figure 38).

# Setup the Precision Calibration Measuring Tool

## NOTE

See Kit Contents for dial indicator software requirements.

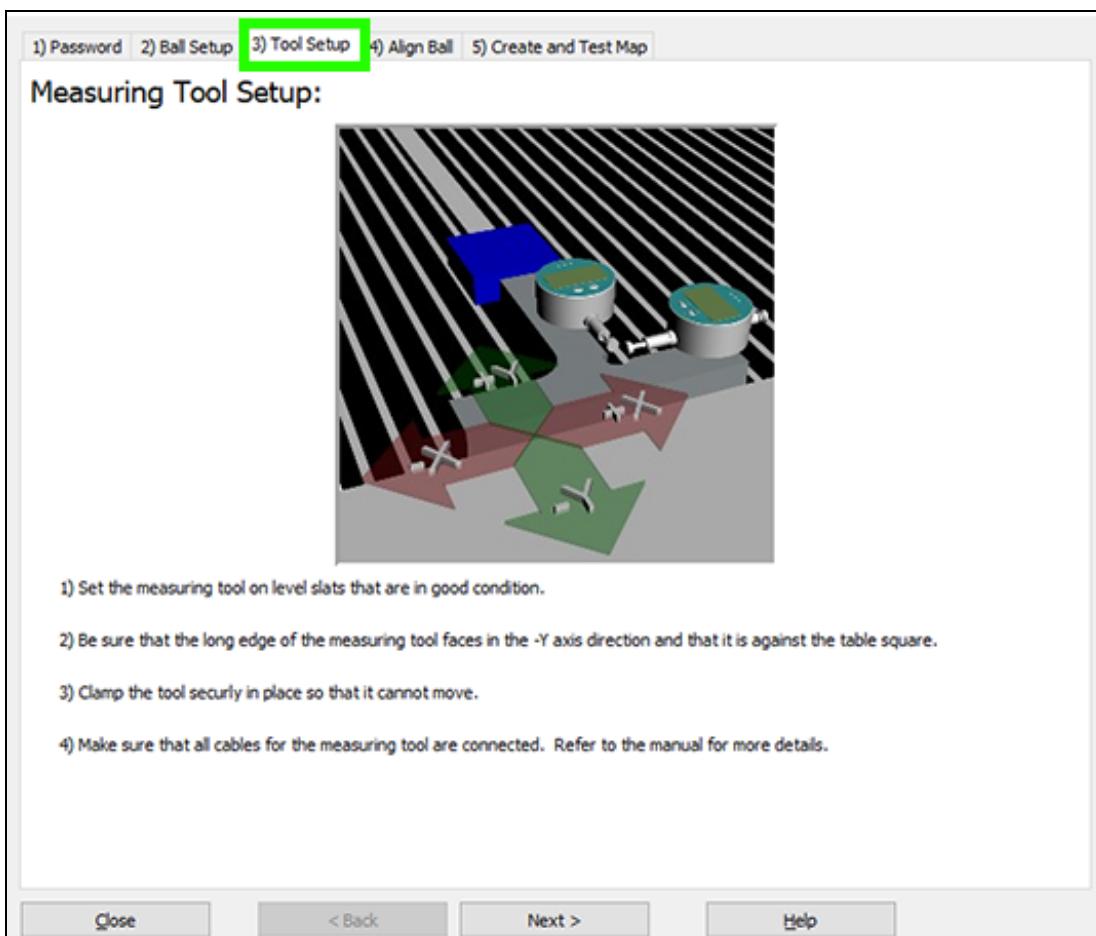


Figure 38

1. Remove the **protective plug** from the **interface** on each of the **dial indicators**.



Figure 39

2. Inspect the **dial indicator contacts** to make sure they are not loose. If loose, finger-tighten them.

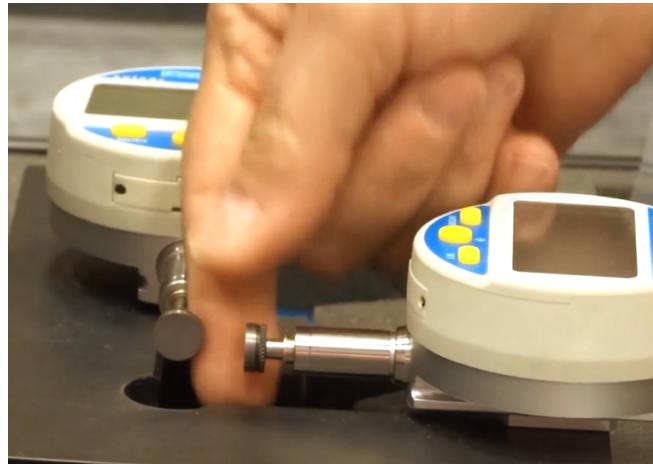


Figure 40

3. Plug the end of one of the **COM port/cables** into the **X-axis dial indicator** as shown below. Plug the other **COM port/cable** into the **y-axis dial indicator**.

### NOTICE

Connectors can be easily broken. Handle the connectors on these cables carefully. Do not force connectors into the ports. Broken connectors will result in inaccurate readings.

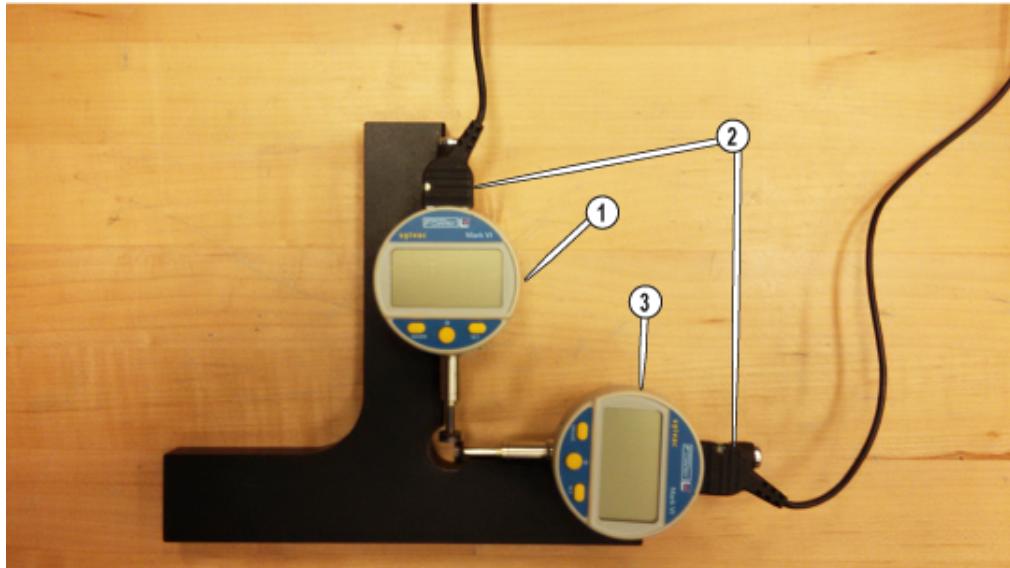


Figure 41

[1] Y-axis indicator [2] COM port cables [3] X-axis indicator

4. Plug the **COM port end** of the **cable** from the **X-axis indicator** into the **port** (Figure 42) [2] on the **USB/COM port adapter**. The **COM port adapter** will auto detect which **axis indicator** is plugged in.

5. Insert the **COM port end** of the **Y-axis cable** into the other **port** of the **USB/COM port adapter**.

6. Plug the enclosed **USB cable** into the **USB port [1]** of the **USB/COM port adapter**.

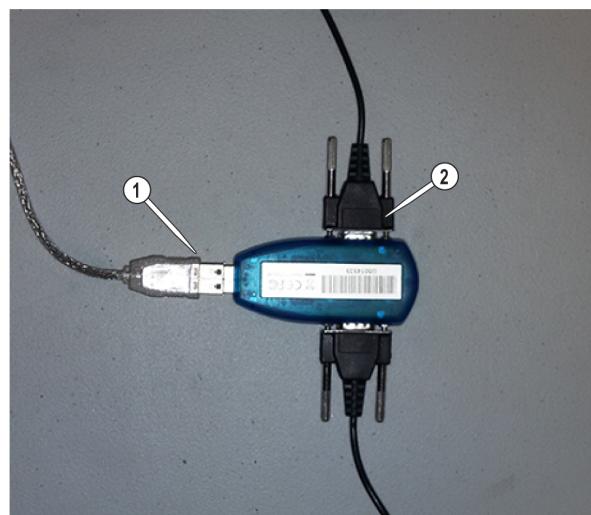


Figure 42

7. Plug the other end of the **USB/COM port adapter** into an open **USB port** on the **computer**.



Figure 43



Figure 44

8. Place the **indicator holder assembly** onto the **tank slats**. See (Figure 45) for an example of OMAX/ MAXIEM fixturing. See (Figure 46) for an example of MicroMAX fixturing.

## NOTICE

**Damage to the cutting head may occur when the cutting head collides with the tank. Ensure the indicator base is placed away from the internal edge of the tank (8 in. (200 mm) for the TAJ or 12 in. (305 mm) for the A-jet) to prevent tilting movement from colliding with the tank.**

## NOTE

*The tank slats should be relatively "new" (structurally sound and not cut through too many times). If the slats are weak or uneven so that the instrument is not level during the testing process, the readings of the measurements may be inaccurate.*

## NOTE

*The bottom edge of the indicator holder assembly must run parallel with the X-axis. Securely fixture the tool to the tank's X-axis square using clamps to prevent movement. Ensure that the clamping fixtures do not interfere with the indicators.*



Figure 45

- [1] Fixturing                  [2] Y-axis indicator
- [3] X-axis indicator    [4] Indicator holder assembly

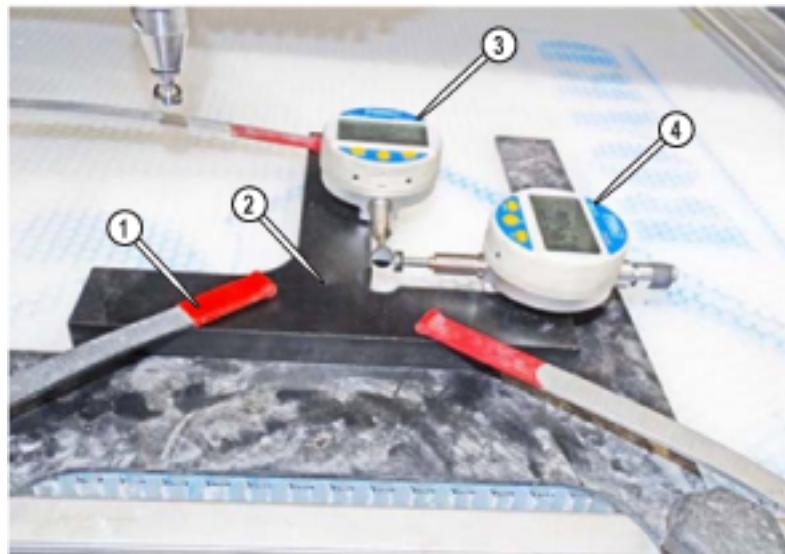


Figure 46

- [1] Clamp
- [2] Indicator holder assembly
- [3] Y-axis indicator
- [4] X-axis indicator

# Align the Ball Stem Assembly

## NOTE

If the nozzle and ball are far away from the dial indicator contacts, exit the wizard and manually jog the nozzle near to the assembly and restart the Precision Calibration Wizard.

1. In the Precision Calibration Wizard, select 4) Align Ball.

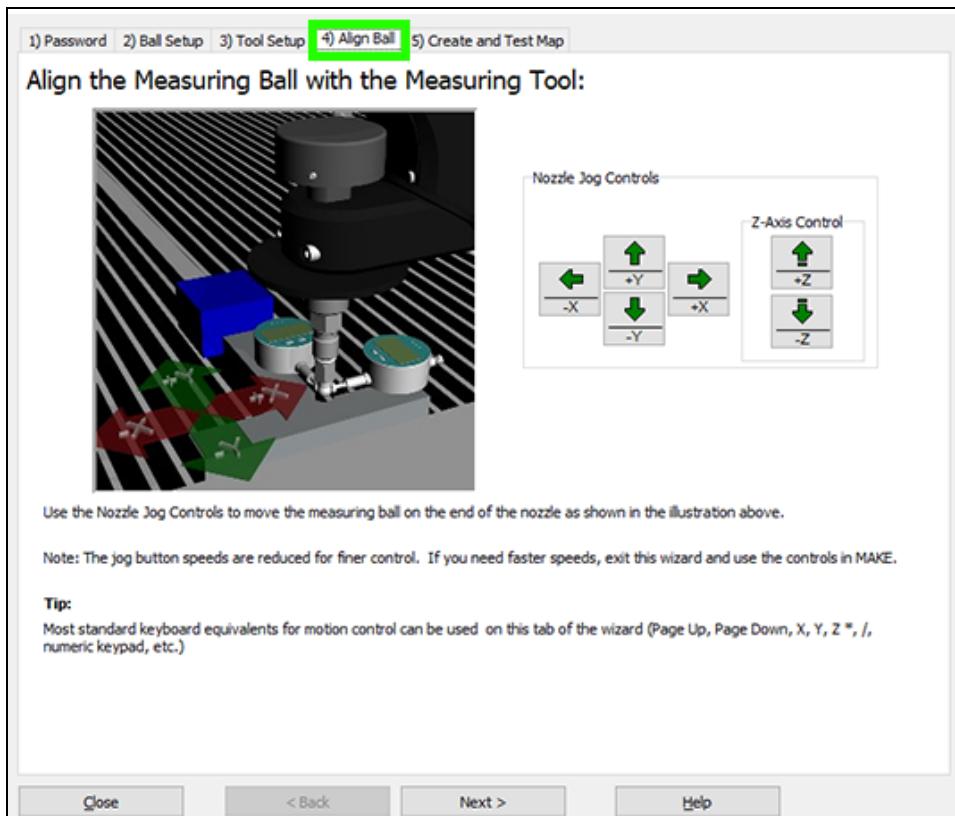


Figure 47

When the Align Ball tab on the Calibration Wizard is active, the keypad on the keyboard can be used to move the nozzle. Using the mouse to click the Nozzle Jog Controls (Figure 47) will also move the nozzle. Click and hold for continuous movement.

Use the keypad to precisely move the nozzle when aligning the ball to the indicator shafts: press 7 for nozzle up movement or press 1 to move it down for coarse movement. The PgUp PgDn keys are also active for fine up/down movement.

## NOTE

The velocity of the nozzle motion will be slower than normal when the Calibration Wizard is active.

## NOTICE

When moving the Z-axis down, ensure the ball stem assembly does not collide with the edges or sides of the dial indicator contacts. This can cause serious damage to the ball and calibration equipment.

Never allow the ball's surface to contact or slide across the ends of the indicator shafts. The hard, sharp edges of the contact can scratch the ball causing an inaccurate calibration, or could bend the indicator shaft.

2. Lift the **dial indicator contacts** and use the plastic clips holding the cables to hold the **dial indicator contacts** out of the way while centering the ball into position.



Figure 48

- The proper method for centering the ball to the center of the dial indicator contacts is to lower the ball away from both contacts.
  - Adjust the center height of the ball near the center line of the dial indicator contacts.
  - Use the keypad/mouse to jog in both X and Y-axis with zig-zag movements until the ball is centered with both X and Y-dial indicator contacts (Figure 49).
3. Lower the **Z-axis** in 0.010 in. (0.25 mm) increments (page up/page down) so that the center of the **ball** is only 'slightly' above the center line of the **dial indicator contacts**.

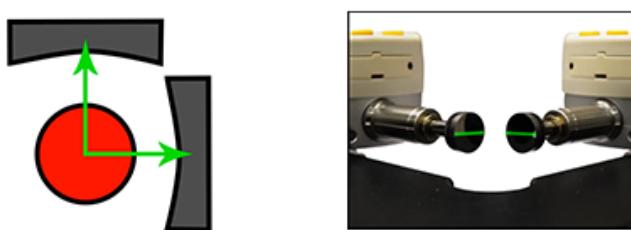


Figure 49

## NOTICE

The center of the ball must not be positioned below the center line of the dial indicator contacts, otherwise, contact between the shaft/stem of the ball and the dial indicator contacts may occur during calibration, resulting in a poor calibration map, or damage to the dial indicators and/or contacts.

4. Remove the plastic clips securing the **dial indicator contacts** and ease the contacts so they are touching the **ball**.



Figure 50

# Create and Test the Error Map

## NOTE

*Ensure that the area around the machine is free from vibrations and movement. Do not lean against the waterjet while performing the calibration. Movement may cause inaccurate readings.*

- When the **ball** is positioned as shown in (Figure 50) above, select **5) Create and Test Map** and **Begin Calibration**.

## NOTE

*Ensure that the cables going from the dial indicators to the PC are routed out of the way, avoiding contact with the cutting head and not interfering with indicator movement during the calibration procedure.*

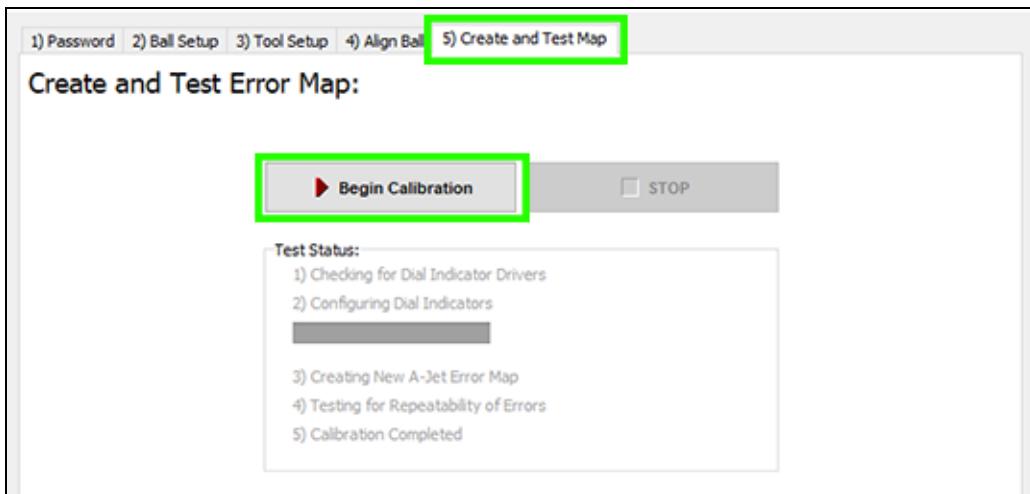


Figure 51

## NOTE

*Improper use of this calibration software can disrupt the machine's calibration and produce results that can severely affect machine accuracy. Always follow instructions accurately.*

- Read the warning and select **OK**.

The wizard configures the dial indicators. In this step, the wizard automatically locates each of the dials if they are plugged in; then, if both dials are found, the wizard moves the machine in the X and Y directions to determine which dial indicator is measuring which axis and to also determine if the ball is in the correct position with respect to the X- and Y-axis.



Figure 52

If, at any of these checking points, something wrong is detected, a prompt appears to check the physical setup and fix the problem.

When the configuration of the dial indicators is complete, the wizard automatically moves on to 5) Create and Test Map. During this step, an error map for the cutting head is created. Observe the cutting head tilting during this time while the dial indicators read the amount of error in the X- and Y-axis at each tilting point.

## NOTE

To stop the calibration process while the map is being created or tested, select STOP. Exit the wizard, remove the dial indicator contacts, use MAKE to reposition the nozzle away from the indicators, and auto home the cutting head again before proceeding to use the wizard.



Figure 53

## NOTE

When STOP is selected, any map in progress will be lost, and the previous map (if any) will be automatically restored. In addition, the calibration process must be restarted from the beginning. The cutting head must be moved away from the digital indicators and moved vertically up. Auto home will again be required.

## NOTICE

**NEVER** auto-home the cutting head with the ball touching the dial indicator contacts. This will damage the dial indicators and ball!

Once map creation is complete, the wizard automatically moves onto the next step; 6) A-Jet Calibration Status and displays the status of the calibration.

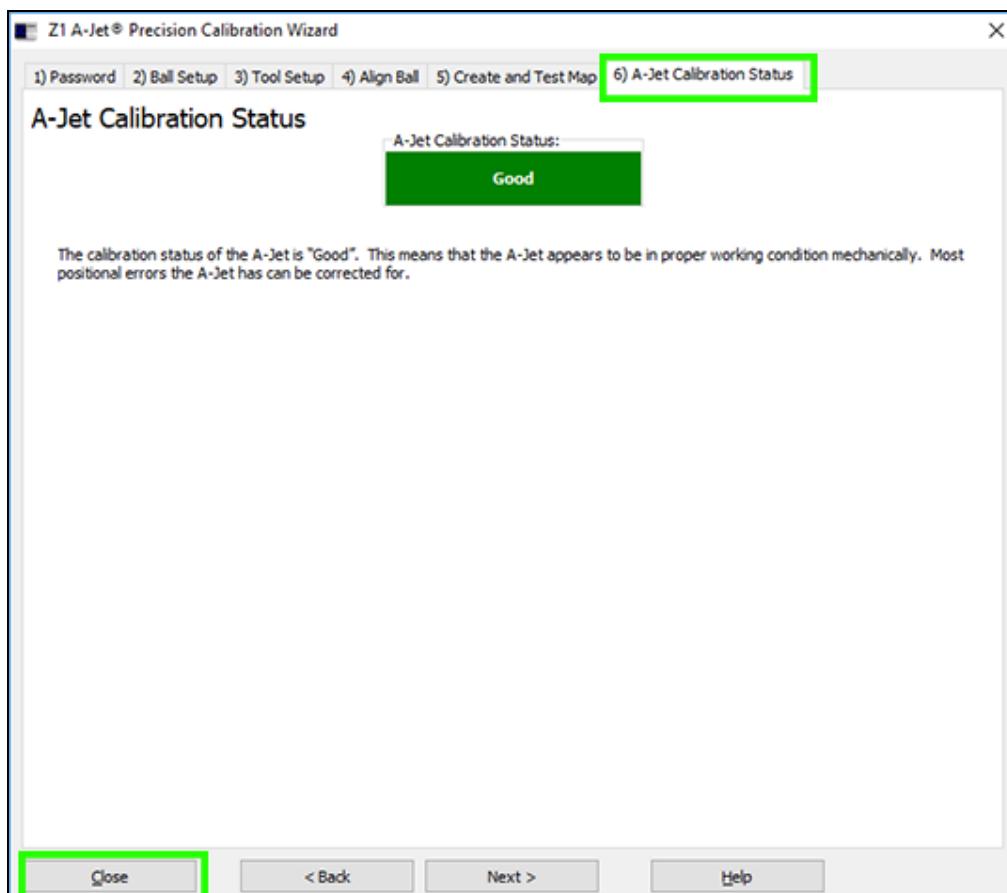


Figure 54

3. Select **Close** to save the new error map.

## Revert to the Initial Error Map

To revert back to the previous error map after the precision calibration:

1. Navigate to the error map file folder using Windows Explorer:

- Right click **Start/Explorer/C: (local drive)/Program Files/OMAX Corporation/OMAX- Layout\_and\_Make.**
- In Vista, the error map files are stored with the configuration files at: C: (local drive)/Users/ Public/OMAX\_Corporation/AllUserData.

2. Locate the original error map file named **ajetcalibration.bak** and rename it **ajetcalibration.ini**.

The original error map has now been reinstated as the current error map.

3. To create a new map, run the **precision calibration** procedure once again.

# Remove the Precision Calibration Tool

1. To prevent damage to the **ball**, manually pull the **dial indicator contacts** away from the **ball** and insert the clips to hold the **contacts** away from the **ball**.



Figure 55

2. Move the **cutting head** away from the **dial indicator contacts**.

## NOTICE

**Do not damage the ball.** To prevent damage to the ball, do not let the edges of a dial indicator contact slide across the surface of the ball. A damaged ball will produce inaccurate readings.

3. Remove the **indicator holder assembly**.
4. Press and hold **Set** for three seconds until OFF is displayed to turn OFF each **dial indicator** as shown below.



Figure 56

## NOTE

*Prevent battery drain. If OFF is not displayed, the dial indicator will remain on and battery will drain.*

5. Replace the **protective plugs** (Figure 39) into the **dial indicator ports**.
6. Remove the **ball stem assembly**.

7. Clean, dry, and return the **ball stem assembly** to its protective tubing.

## NOTICE

Avoid scratching the ball and stem while disassembling the calibration tool. The ball stem assembly is not hardened tool steel and is easily scratched and damaged causing rust. A scratch can cause inaccurate measurement readings. Always handle with care. Clean and thoroughly dry the ball stem assembly before storing in the protective tubing.

8. To protect from damage, pack each component of the **calibration kit** in the carrying case properly (Figure 32).
9. Install the **mixing tube** in the **nozzle**.

## NOTE

*Make sure the nozzle body is clean and free from abrasive contamination. Use the correct nozzle gauge to properly align the mixing tube.*

# Troubleshooting

## Dial Indicator(s) Not Working Correctly

1. **Communication cables** not inserted correctly or not being recognized by software.
  - a. Verify the **connectors** plugged into the **dial indicators** are correctly seated.
  - b. Verify the **connectors** plugged into the **PC USB ports** are correctly seated.
  - c. Verify that the nonworking **dial indicator** is turned **ON**. Do this manually if necessary.
  - d. Switch the **USB cable** from the **USB adapter** to another **USB port** on the **PC**.
  - e. Verify that a **cable** is not defective by swapping **dial cables** to determine if the problem is specific to the same cable.
2. Reset the **dial indicator** by removing and then reinserting its battery (this also applies if the indicators do not turn OFF by themselves).
  - a. Locate the battery compartment directly below the **MODE** and **ON/OFF** switches and unscrew the cover.



Figure 57

b. Remove the **battery** from the **indicator** for at least 30 seconds.



Figure 58

c. Reinsert the **battery** into the **indicator**, ensuring that it snaps into the original position and replace the screws.



## Excessive Residual Errors

Cause of Error	Solution
If the ball does not make full contact with both dial indicator contacts during the calibration process, large, "fake" residual errors can occur.	Re-adjust the ball stem assembly with the ball properly aligned to the dial indicator contacts. Run the Create a New Error Map process again.
If the machine TX-, or TY-axis (tilt or rotational) have something causing repeatability issues, large residual errors can occur.	Check A-Jet mechanism for loose, damaged, or under torqued components. The shear screws may be stretched. Check to see if the high-pressure swivels are binding or wobbling. If the problem is exactly repeatable, it could be an electrical or mechanical issue.
If the ball is aligned below the center of the dial indicator contacts, there is the potential for the ball stem assembly shoulder (sits above the ball) to make contact with the dial indicator contacts during testing. This can result in higher residual errors and possibly damage the dial indicators.	Realign the ball stem assembly so the center of the ball is slightly above the center line of the dial indicator contacts and repeat the error mapping process.
If the ball stem assembly is not inserted into the nozzle body correctly, larger residual errors can occur.	Re-insert the ball stem assembly in the nozzle body and repeat the precision calibration procedure.
Scratches on the ball surface.	Replace the ball stem assembly.

Cause of Error	Solution
Jog speed does not return back to “normal” speed prior to opening the wizard.	Navigate back to Motion Control and set it back to normal (20x).
Erroneous calibration results.	Verify the dial indicators and other items attached to the mounting plate are seated level and tight, and the dial indicator contacts are tight.
Ball moves vertically during precision calibration.	During the precision calibration, the Z-axis should not move. If up/down movement is detected, suspect problems with the Z-axis motor assembly.
After troubleshooting, if large residual errors continue, contact <a href="#">OMAX technical support</a> for assistance.	

# **CUSTOMER SUPPORT**

Refer to the <https://support.omax> website for technical support contact information.

