

TECHNICAL DOCUMENT

OWNER'S GUIDE: TURRET FOR 15L SLANT-PRO LATHE

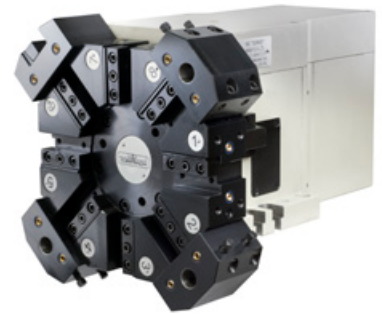
Product Identification: Turret Kit for 15L Slant-PRO (PN 37335)

Purpose: This document gives instructions to install the eight-position turret on a 15L Slant-PRO lathe.

Qty	Turret Installation Kit	PN
2	4 in. Cable Tie w/ Mounting Tab	—
4	11 in. Cable Tie	—
3	Boring Bar Holder (pre-installed)	37136
1	Capacitor	38460
1	Capacitor Bracket	38749
1	Cemented Carbide OD Turning Tool	34824
1	Coolant Fitting (may be pre-installed)	—
1	Eight-Position Turret	34947
1	Eye Bolt and Shackle (C- or U-Shaped)	—
1	IDC Ribbon Cable Assembly, 18 in. Long, 16 Pin	51540
1	OD Turning/Facing Tool Holder (pre-installed)	37137
4	Screw, Button Head Cap, M4 × 0.7 - 8, Stainless Steel	50838
4	Screw, Phillips, M4 × 20 mm	34627
6	Screw, Socket Head Cap, M10 × 30 mm	34621
1	Shim Kit	33324
1	Spare Motor Belt (under motor cover)	36047
2	Test Piece	34718
4	Standoff, 10 mm, M4 × 0.7 - 8mm Male, M4 × 0.7 - 5mm Female, Steel	50765
1	Turret Control Board	32785
1	Turret Installation Wiring Kit	35141
6	Washer, Flat, M10	32473

NOTE: If any of these items are missing, we can help. Create a support ticket with Tormach Technical Support at tormach.atlassian.net/service desk for guidance on how to proceed.

NOTE: The turret is pre-filled with oil and permanently sealed at the factory.



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Before You Begin

IMPORTANT! *You must install the turret before installing the lathe enclosure.*

Required Tools

Collect the following tools and items before you begin installation:

- Dial indicator (PN 31947 or similar)
- Electric drill
- Engine hoist
- Hacksaw (or similar metal cutting saw)
- Machinist stone (or similar)
- Metric hex wrench set
- Metric wrench set
- Micrometer / caliper
- Paint pen
- Phillips and flat-head screwdrivers
- Wood dowel or broom handle

Oil Line Relocation

Machines with serial numbers **10192 and below** must first relocate the oil line.

If your machine's serial number is **10192** or lower:

1. Go to the section *Relocate the Oil Line* later in this document.
2. After relocating the oil line, go to the section *Mechanical Installation*.

Machines with serial numbers **10193 and above** have a correctly positioned oil line.

If your machine's serial number is **10193** or higher:

- You don't need to perform the tasks in the section *Relocate the Oil Line*.
Proceed to the section *Mechanical Installation* to install your turret.

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Mechanical Installation

Clean the Mounting Surfaces

You must make sure the surface is free of burrs or debris:

1. Use a machinist stone (or similar) to clean the lathe's slant bed (see **Figure 1**).
2. Use a machinist stone (or similar) to clean the bottom of the turret.



WARNING! Transport and Lift Hazard: The transport, lifting, and moving of turret must be done by qualified professionals.

Install the Turret

1. Screw the Eye Bolt tightly into the turret and attach the Shackle as shown in **Figure 2**.
2. Use a lift system to raise the turret above the lathe.

IMPORTANT! Keep the turret attached to the lift system until instructed to remove.

3. Use an 8 mm hex wrench to screw two M10 x 30 mm Socket Head Cap Screws two-thirds of the way into the two slots as shown in **Figure 2**. Do not install the M10 Flat Washers.
4. Use a lift system to lower the turret onto the two screws installed in the slots (see **Figure 2**).
5. Install the remaining four M10 x 30 mm Socket Head Cap Screws and M10 Flat Washer into open positions on the front and back of the turret (see **Figure 2** and **Figure 3**).
6. One at a time, remove the two M10 x 30 mm Socket Head Cap Screws from the slots.
7. Add one M10 Flat Washer to each screw.
8. Reinstall the M10 x 30 mm Socket Head Cap Screws and M10 Flat Washers to the slots.

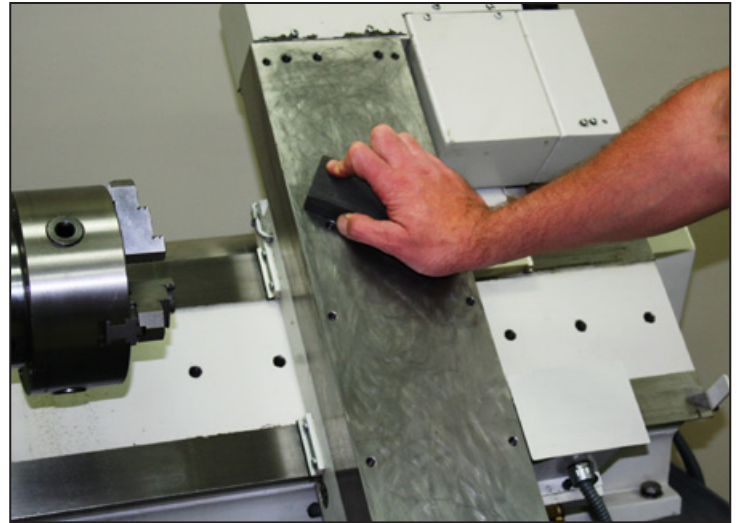


Figure 1

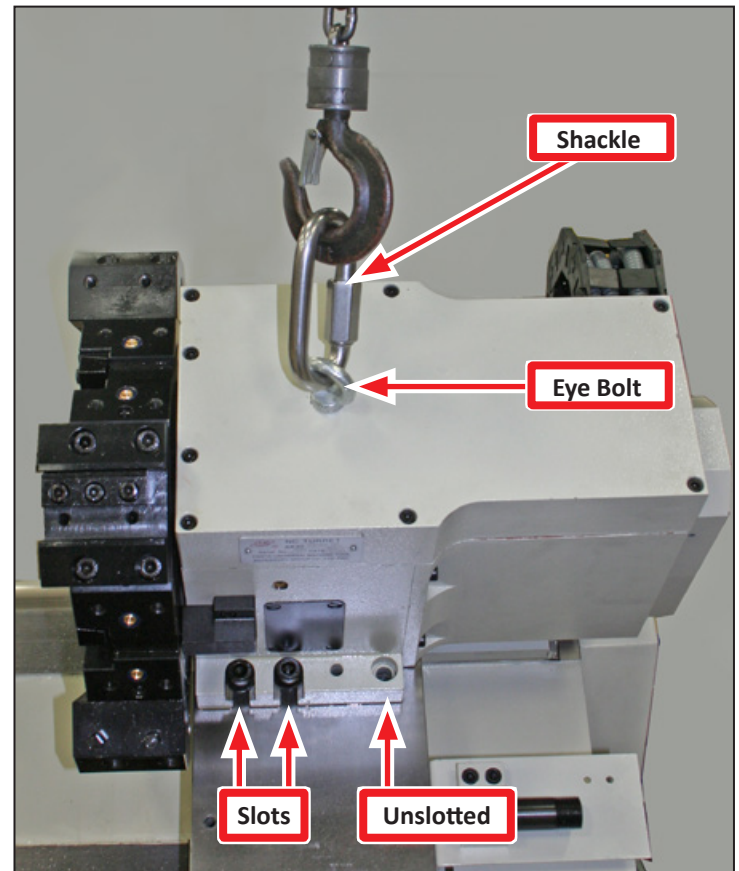


Figure 2

- 9. Snug down all six screws tightly.
- 10. When the turret is completely secure, disconnect the lift system from the turret’s eye bolt (see **Figure 3**).
- 11. Remove the eye bolt.

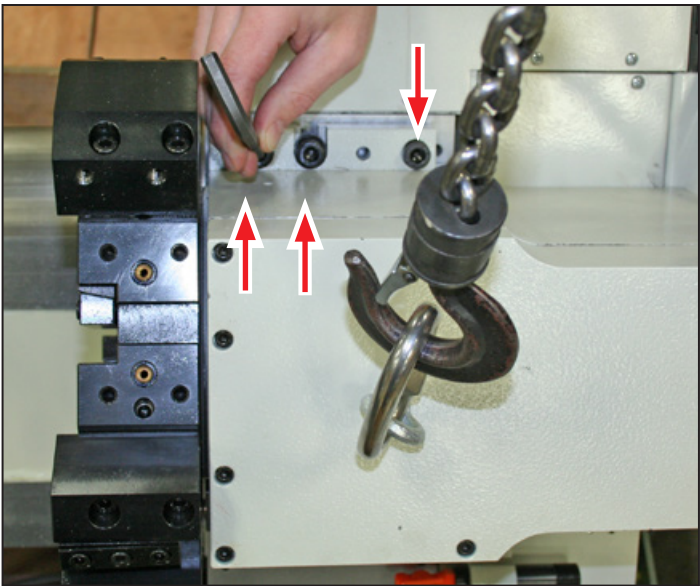



Figure 3

Route Wires to the Electrical Cabinet

- 1. Power off the machine according to *Power Off/On Procedure* detailed below.

 **WARNING! Electrical Shock Hazard:** You must power off the machine before you make any electrical modifications.

Power Off/On Procedure

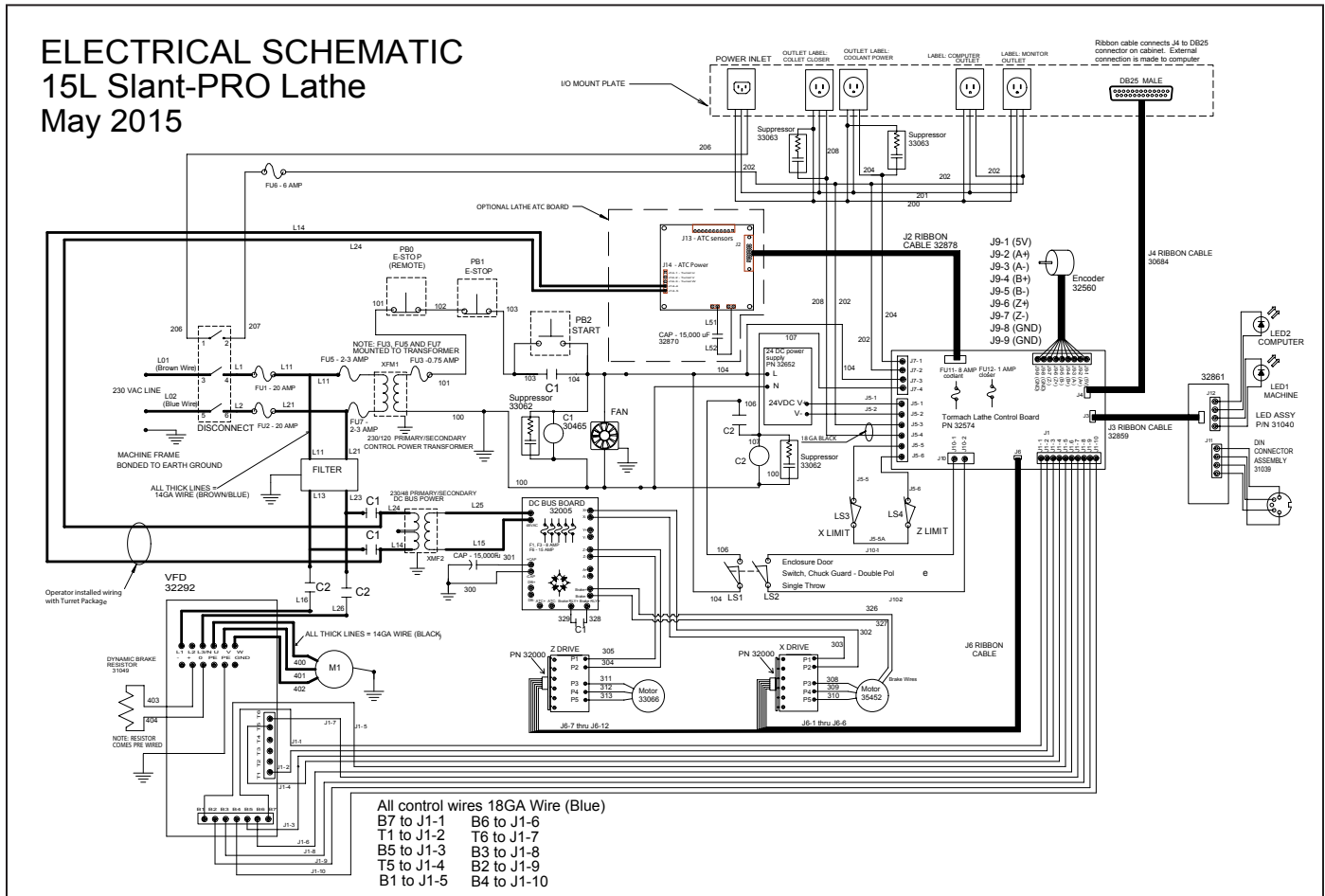
Power Off	1. Push red E-stop button in
	2. Click Exit on screen; when prompted click OK to power off
	3. Turn Main Disconnect Off (see image at right)
Power On	1. Turn Main Disconnect On (see image at right)
	2. After software loads, turn red E-stop clockwise to release
	3. Press green Start button
	4. Click Reset on screen



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For further details on turret electrical wiring, refer to **Figure 14** and/or the electrical schematic located inside the back cover of the lathe operator manual.

ELECTRICAL SCHEMATIC 15L Slant-PRO Lathe May 2015



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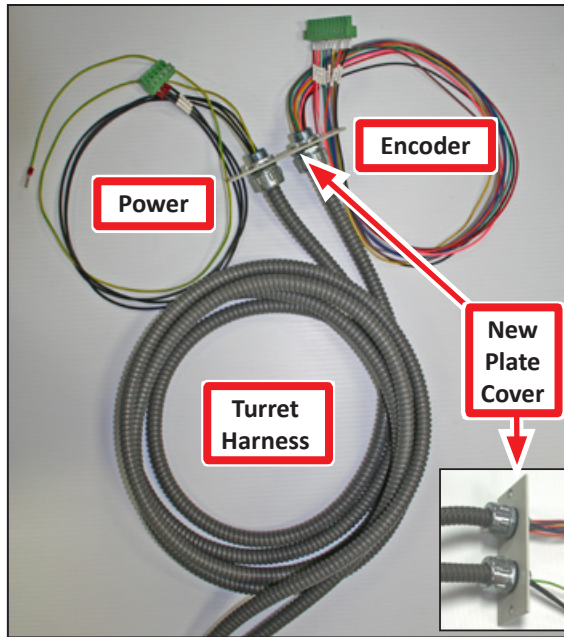


Figure 4

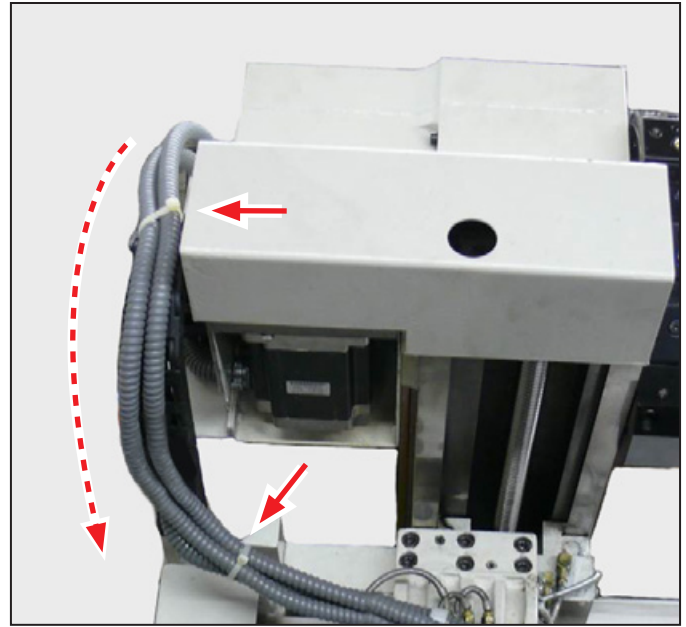


Figure 5

2. Route the Turret Harness (see **Figure 4**) over the back of the lathe; use two Cable Ties (included) to secure in locations shown in **Figure 5**.
3. Use one Cable Tie to attach the Turret Harness to the Oil Manifold (see **Figure 6**).
4. Route the Turret Harness into the Lathe Casting (see **Figure 6**) and out through casting hole on the opposite side of the lathe (see **Figure 7** and **Figure 8**).

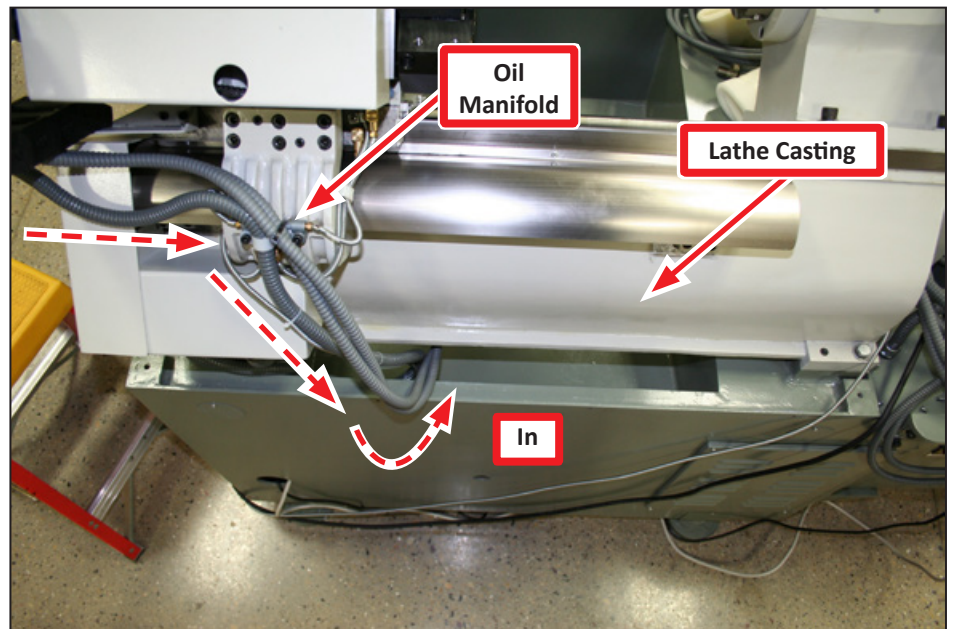


Figure 6

IMPORTANT! Verify that the Turret Harness is free from entanglement throughout its full motion.

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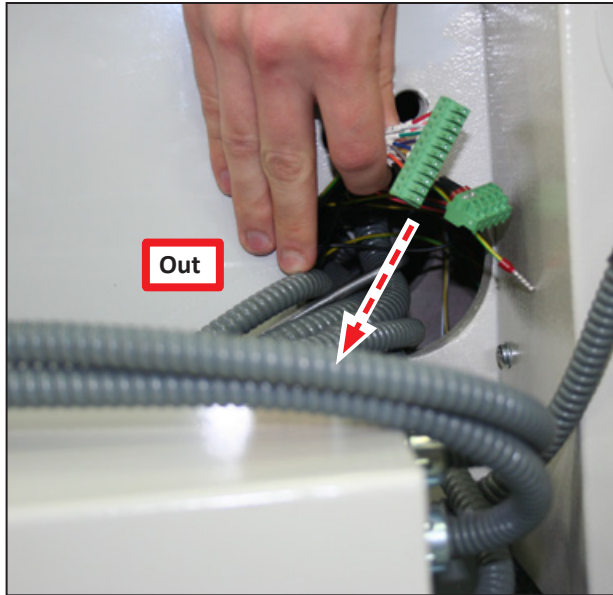


Figure 7

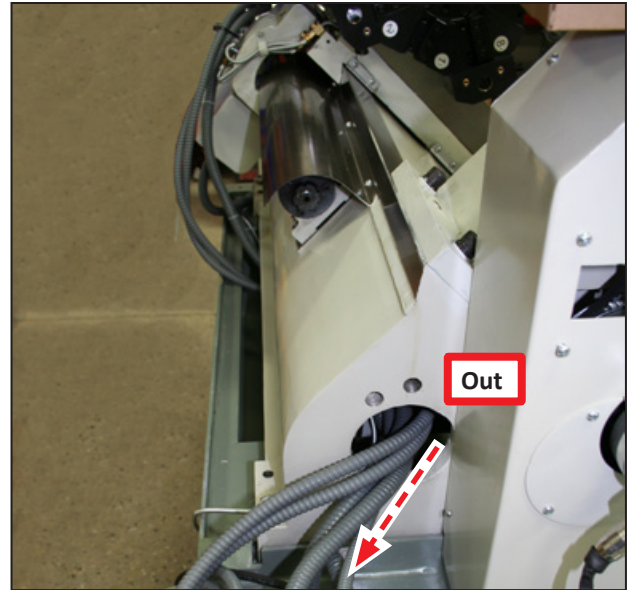


Figure 8

5. Pull the Turret Harness through the casting far enough so that the new cover plate can reach beyond the cabinet-top box (see **Figure 9**).
6. Open the electrical cabinet door on the side of the lathe.
7. To begin routing the Power and Encoder ends of the Turret Harness into the electrical cabinet, you must first unscrew the removable cover plate from the cabinet-top box (see **Figure 9**); set screws aside.

NOTE: Contact Tormach Technical Support if your lathe does not have a removable cover plate.

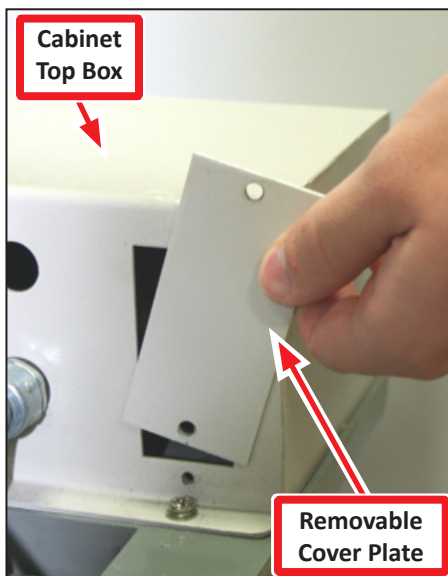


Figure 9

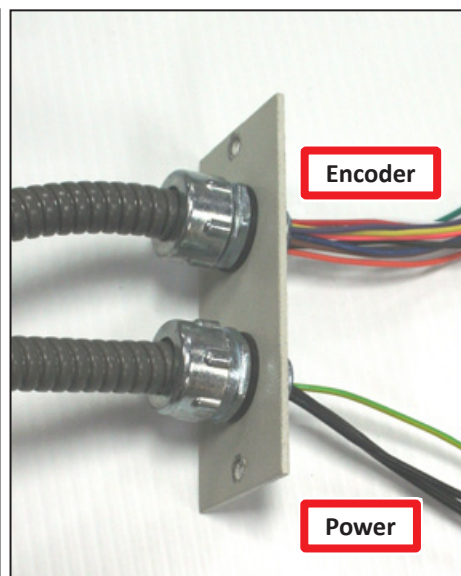


Figure 10

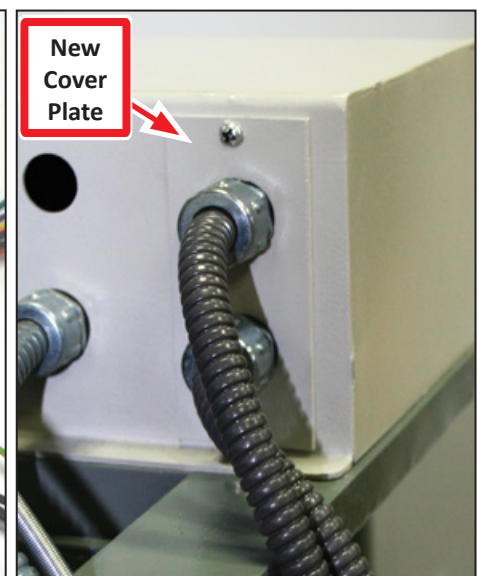


Figure 11

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8. Carefully feed the Power and Encoder wires down into the cabinet-top box (see **Figure 10** and **Figure 12**). Pull the wires into the electrical cabinet far enough so that they can reach all connections.
9. Use the two screws set aside earlier to install the new cover plate and Turret Harness assembly (see **Figure 11**).
10. Thread four M4 standoffs (PN 50765) into the four holes on the electrical cabinet back panel.
11. Use four M4 screws (PN 50838) to mount the turret control board to the standoffs that you installed in the Step 10.

NOTE: Holes for mounting the Turret Control Board are pre-drilled and tapped.



Figure 12

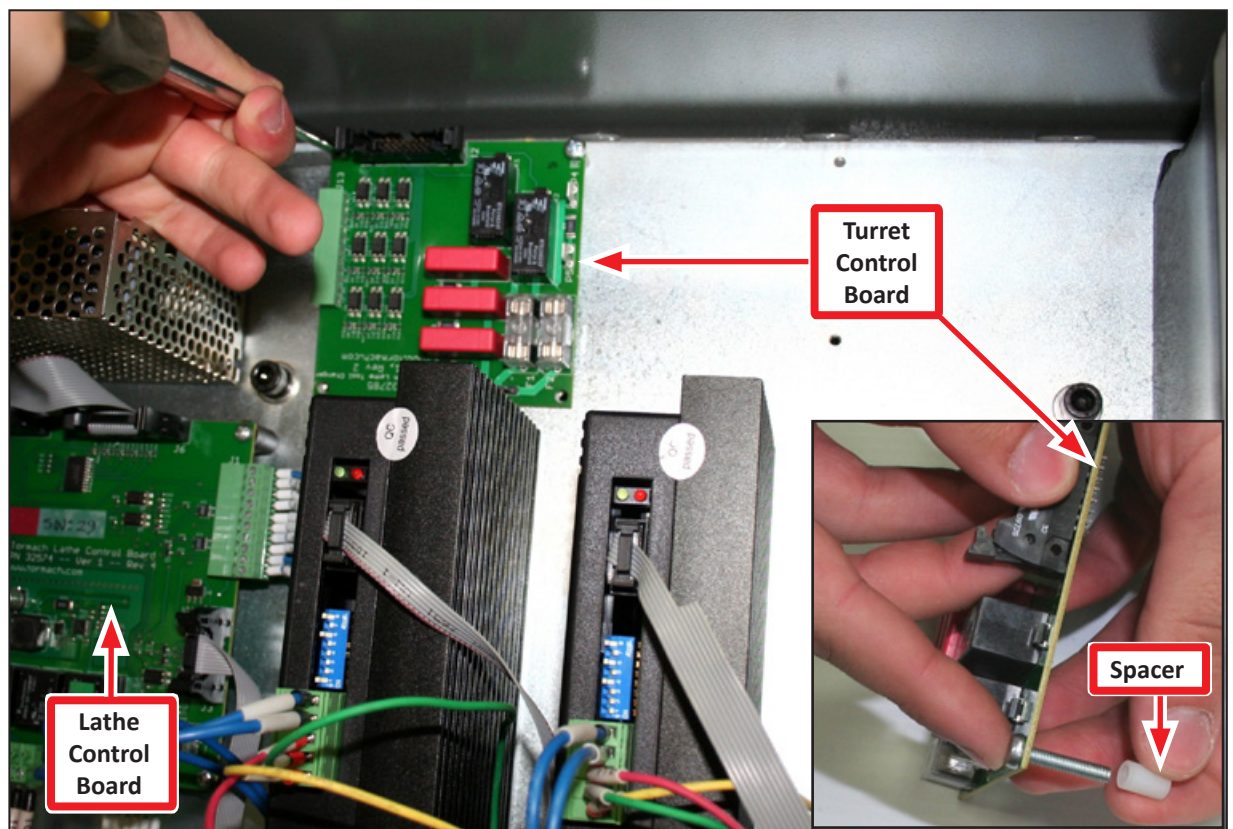
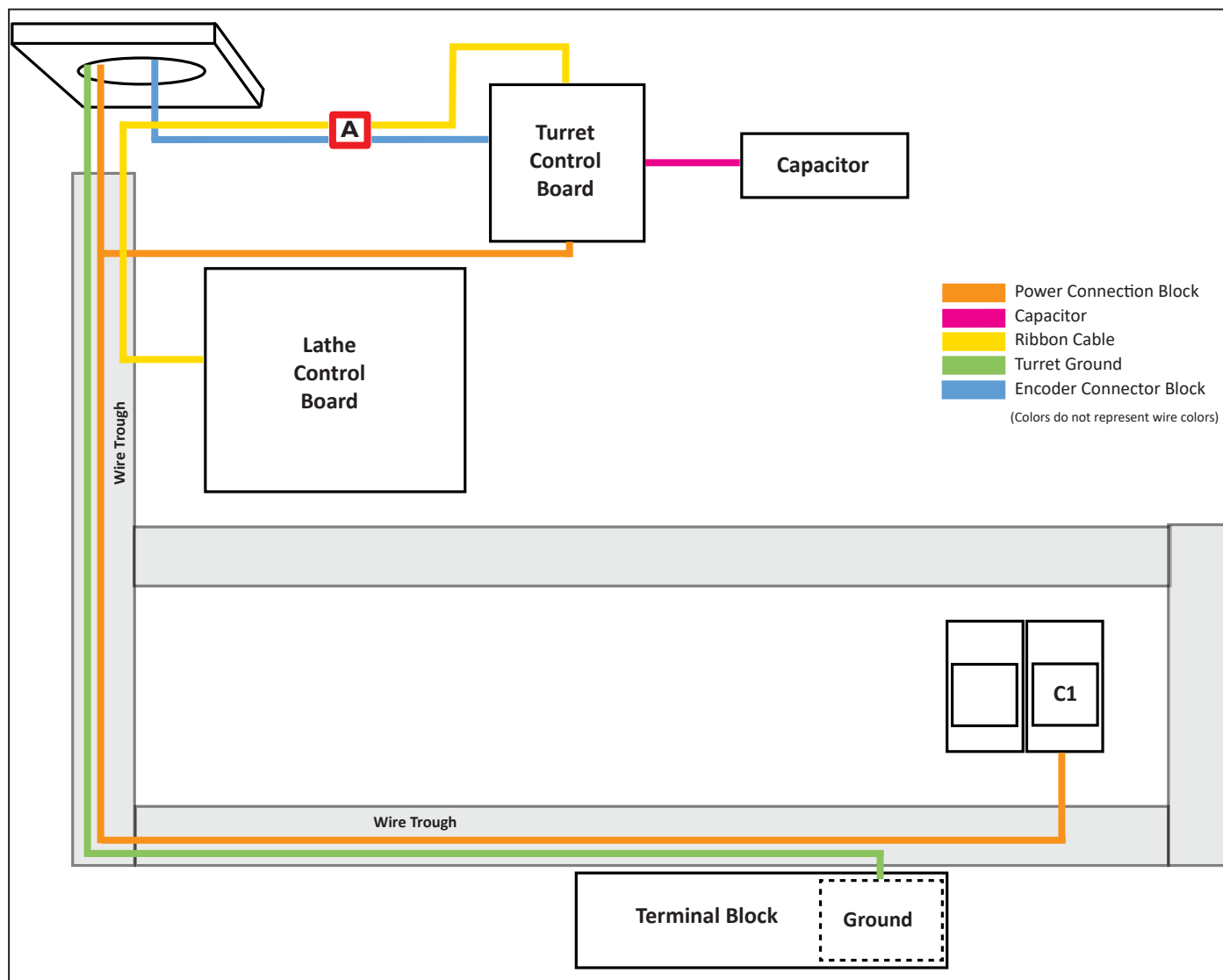


Figure 13

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Make Electrical Connections

An illustration of turret wire routing inside the electrical cabinet is shown in **Figure 14**. The steps to follow detail the connections shown below.



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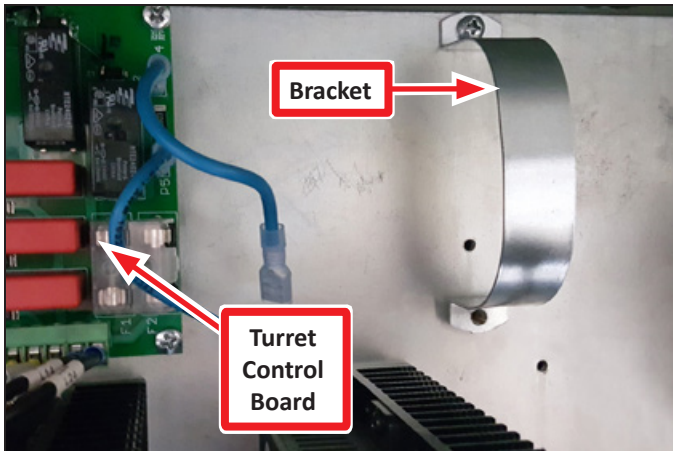


Figure 15

1. Use two M4 x 10 mm pan head screws to mount the capacitor and capacitor bracket on the back panel of the electrical cabinet (see **Figure 15**).

NOTE: If the back panel of your electrical cabinet doesn't have two holes to mount the capacitor bracket, use the bracket as a template to drill and tap the holes.

2. Locate two loose blue Capacitor Wires marked **L51** and **L52**.
3. Connect wires **L51** and **L52** between Capacitor terminals and terminals **P4/P5** on the Turret Control Board as shown in **Figure 16**.

NOTE: The Capacitor is non-polar. There is no wrong way to connect.

4. Locate and identify three harness end wire configurations (see **Figure 17**).
5. Make sure that the Encoder Connector Block wires are in sequential order (see **Figure 17**).

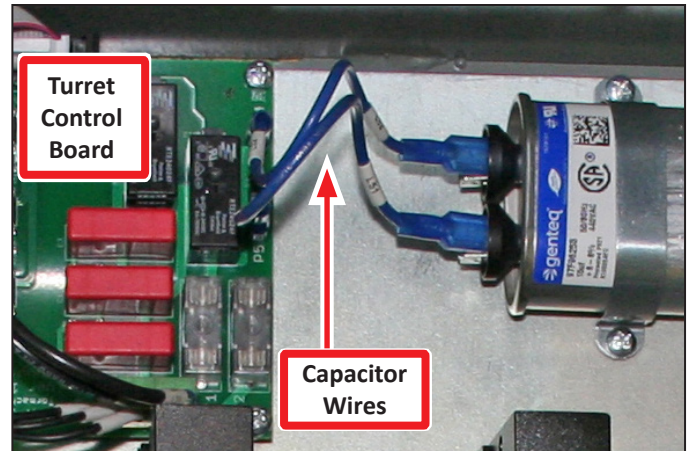


Figure 16

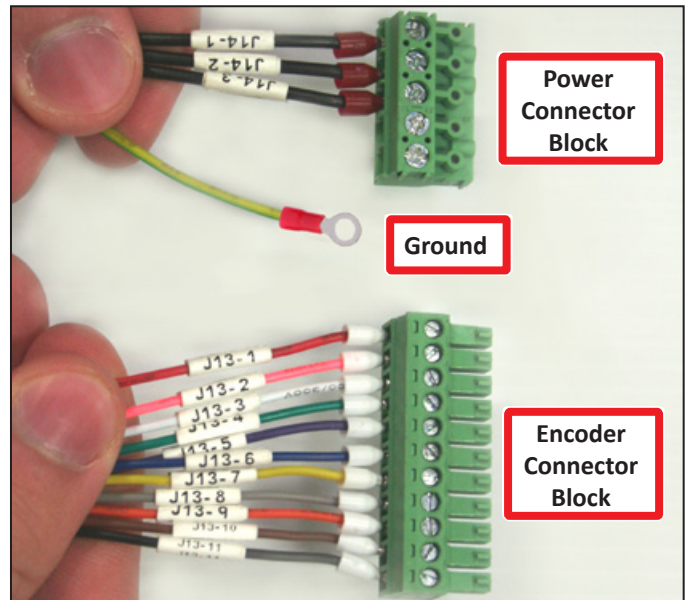


Figure 17

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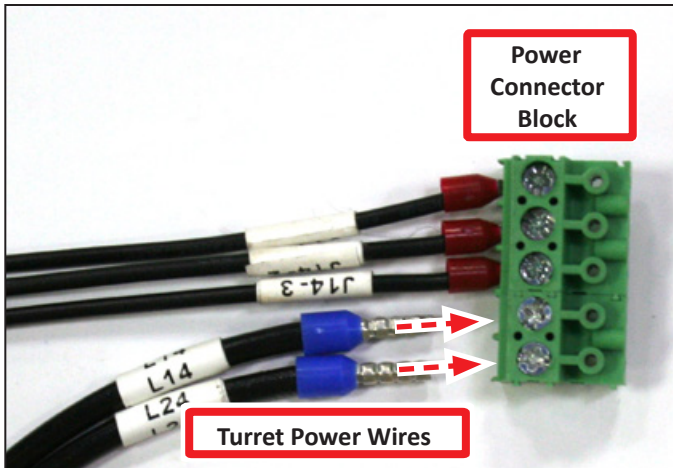


Figure 18

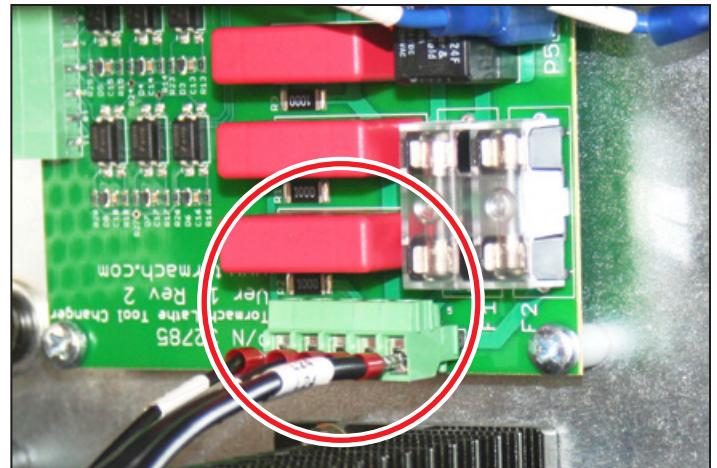


Figure 19

6. Locate two loose Turret Power Wires marked **L14** and **L24** shown in **Figure 18**.
7. Loosen lock screws in the Power Connector Block and connect wires **L14** and **L24**; re-tighten screws snugly.
8. Remove two Wire Trough covers as shown in **Figure 14**. Route the power and ground wires through the Wire Troughs.
9. Route the Power Connector Block to the Turret Control Board as shown in **Figure 14** and **Figure 19**.

IMPORTANT! To avoid damage to the Turret Control Board pins, carefully align the Power Connector Block.

10. Route the loose ends of the Power Connection Block (wires **L14** and **L24**) through the Wire Troughs and to C1 Contactor (see **Figure 14** and **Figure 20**).
11. Loosen the terminal lock screw above wire **L14**, and then piggyback **L14** spade terminal onto the existing **L14** connection on C1 Contactor (see **Figure 20**).
12. Re-tighten the terminal lock screw above wire **L14**, securing both terminal wires.
13. Loosen the terminal lock screw above wire **L24**, and then piggyback **L24** spade terminal onto the existing **L24** connection on C1 Contactor (see **Figure 20**).
14. Re-tighten the terminal lock screw above wire **L24**, securing both terminal wires.

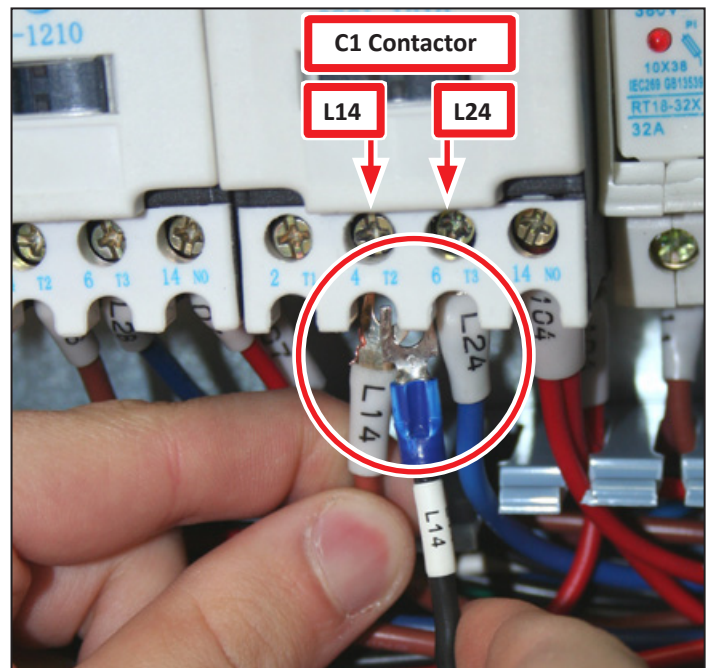


Figure 20

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15. Route the loose end of the Turret Ground wire through the Wire Troughs and to the green-colored section of Terminal Block (see **Figure 14** and **Figure 21**).
16. Cut the eyelet off of the Turret Ground wire, and then twist the wire ends together.
17. Slowly insert the end of a small, flat-head screwdriver straight into the slot above or below the wire (see **Figure 22**).
18. Pry the terminal clip open carefully.
19. Insert the wire into the terminal block, and then slowly remove the screwdriver (see **Figure 23**).

NOTE: If the Turret Ground wire does not reach the Terminal Block, attach the Turret Ground extension (provided).

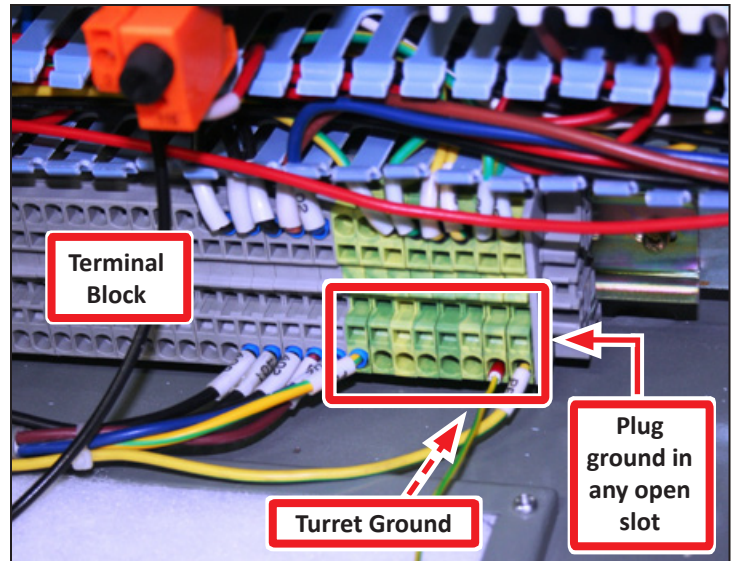


Figure 21

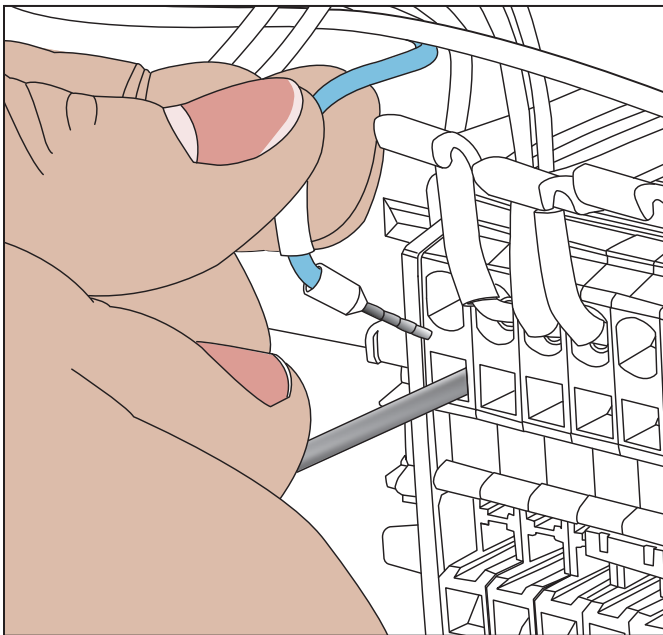


Figure 22

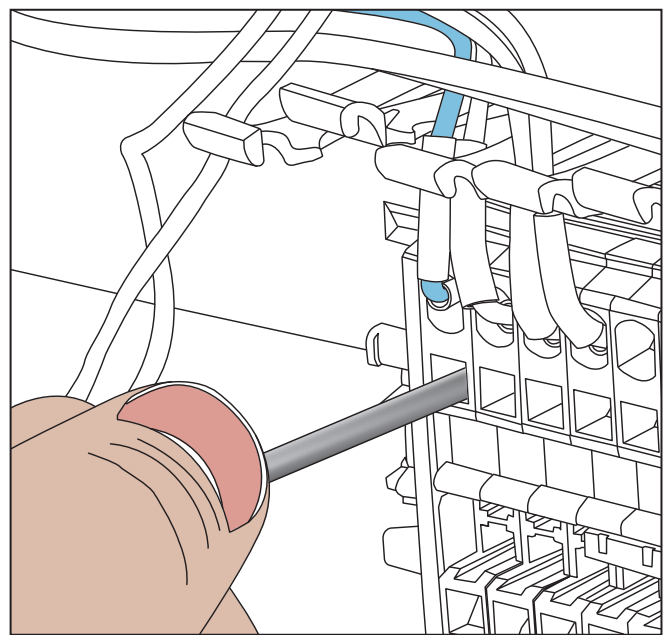


Figure 23

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20. Route the Encoder Connector Block to the Turret Control Board, and then plug in (see **Figure 24**).
21. Connect one end of the Ribbon Cable to the Turret Control Board as shown in **Figure 24**.
22. Route the opposite end of the Ribbon Cable through the wire trough and connect to the Lathe Control Board as shown in **Figure 24**.
23. Use two Mounting Tabs, M4 x 10 mm Pan Head Screws, and 4" Cable Ties to secure excess Encoder Connector Block and Ribbon Cable connections to the back of the electrical cabinet in location marked "A" on **Figure 14**.

NOTE: Holes are pre-drilled and tapped.

24. Reinstall the Wire Trough covers.

IMPORTANT! You have completed installing the turret on the lathe. You must follow the instructions to align the turret. Make sure the lathe enclosure is installed before attempting any alignment procedures. For information on enclosure installation, refer to documentation that ships with the product.

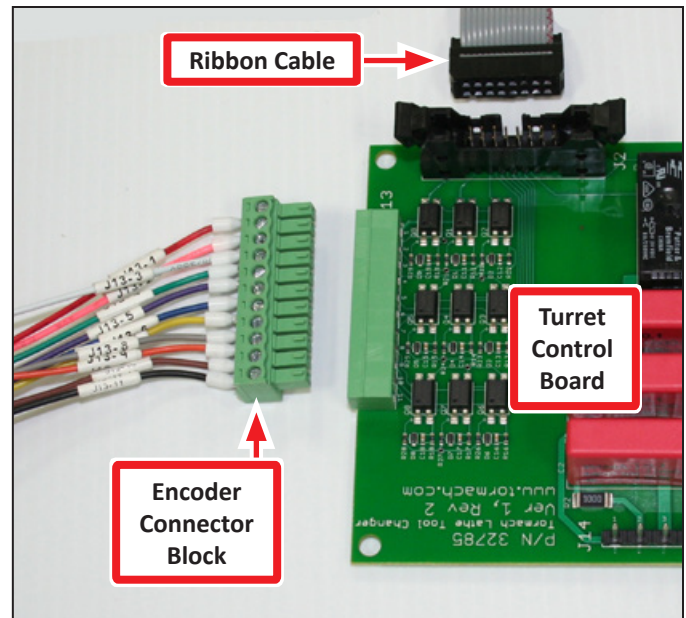


Figure 24

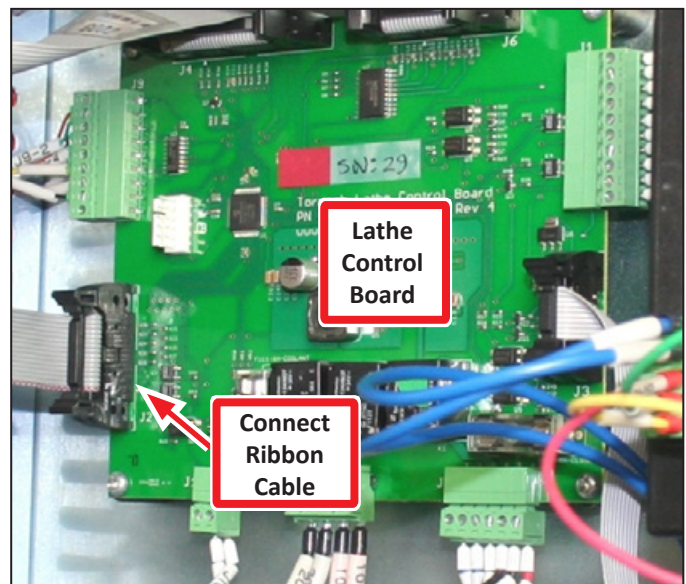


Figure 25

Alignment

IMPORTANT! Before attempting the following procedures, become familiar with the lathe control system (per the operator manual). This will make alignment go quicker and minimize the possibility of machine damage.

- 1. Power on the machine according to the *Power Off/On Procedure* detailed earlier in this document.
- 2. Use a dial indicator, mounted on the Z-axis way, to make sure that the cutting position tool pocket (i.e., pocket slated for tool insertion) is level to the X-axis (see **Figure 26**):
 - a. Zero the dial indicator at back of the pocket, and then jog to the front of the pocket.
 - b. Use this measurement to calculate the amount of level adjustment required (by adding or removing shims).

For example, if the dial indicator reads $-.004''$, divide that figure by two, which equals $.002''$ – the amount of shim correction required for the front of the turret.

If the dial indicator reads zero from back to front, no extra shimming is required (for this step); proceed to the next step. Jot down this number for use later in this procedure. Also refer to Calculating Shim Adjustments table (see right).

- 3. To make sure that the tool pocket is perpendicular to spindle, jog the X-axis moving dial indicator front to back in the tool pocket (see **Figure 27**).

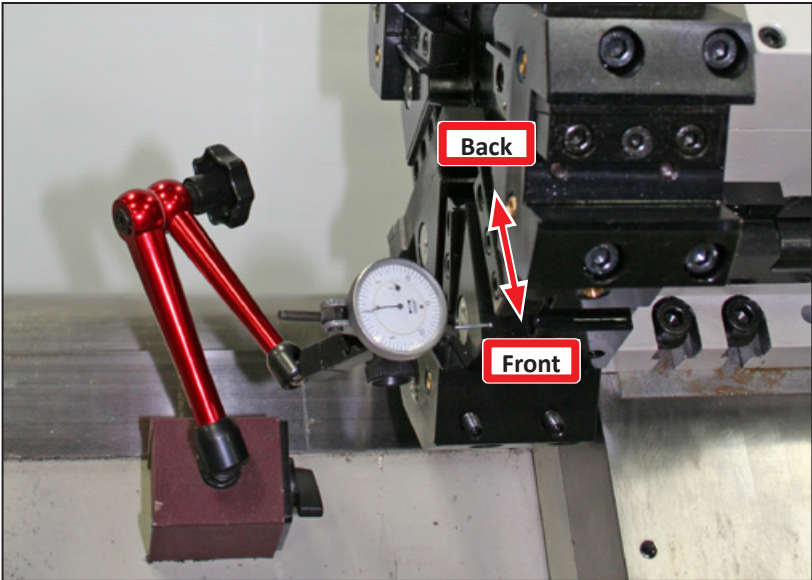


Figure 26

Calculating Shim Adjustments	
- reading	If dial indicator jog results in minus reading, then add shims to the front of the turret
+ reading	If dial indicator jog results in plus reading, then remove shims to the front of the turret

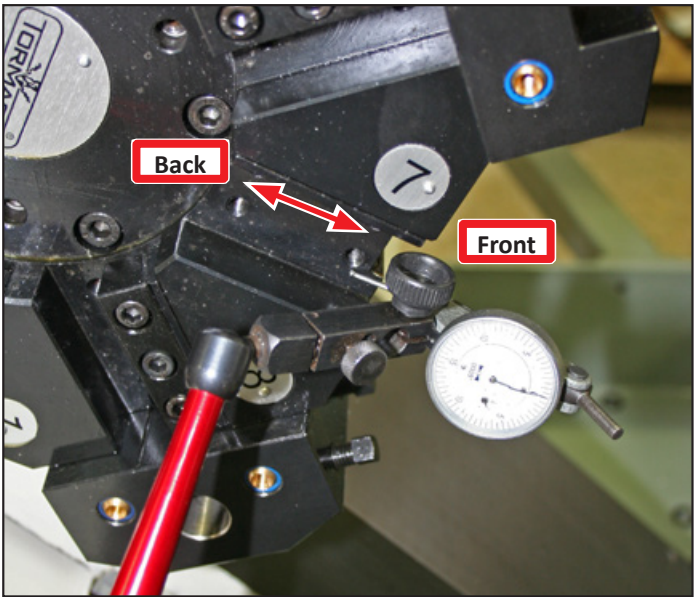


Figure 27

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If, for example, the dial indicator reads $-.001"$, slightly loosen all six Socket Head Cap Screws.

4. Use a piece of wood to tap the turret with a dead-blow hammer (see **Figure 28**); repeat until the tool pocket is perpendicular to the spindle.
5. Once the adjustment is complete, securely tighten all six Socket Head Cap Screws.
6. Insert an aluminium Test Piece (included) into the lathe spindle, leaving 1 inch protruding; tighten the spindle (see **Figure 29**).

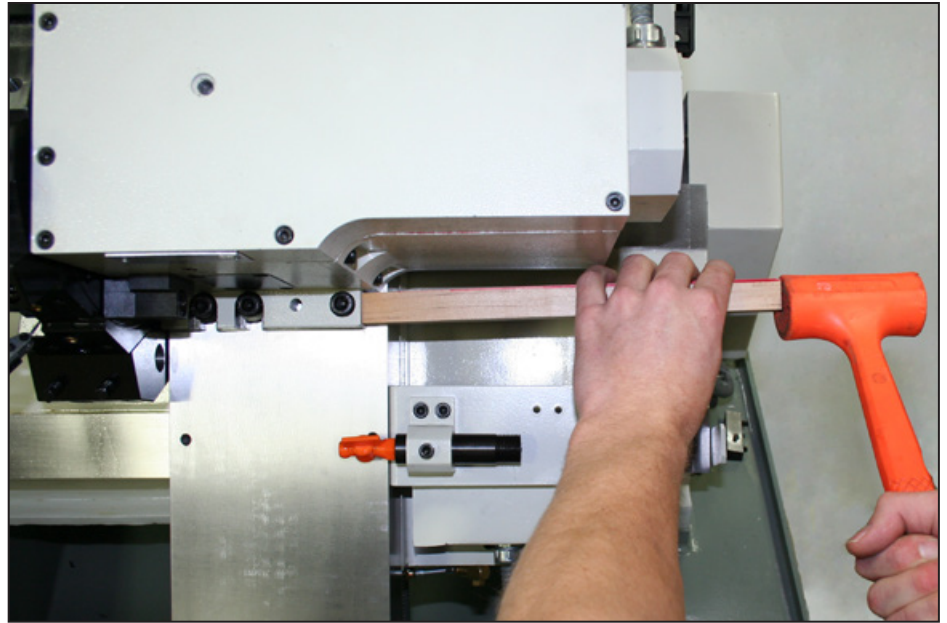


Figure 28

7. Position the tool in an upward facing orientation (see **Figure 29 inset**).
8. Face the Test Piece at 500 RPM with the spindle in reverse (rotating clockwise) until a pip forms at the center of the piece (see **Figure 29**).
9. Use a micrometer to measure the pip; divide the measurement by two to determine the amount of shim correction required.

For example, if pip measures $.022"$, divide number by two which equals $.011"$.

10. To adjust alignment, combine the pip measurement with the level measurement (from earlier in the alignment procedure).

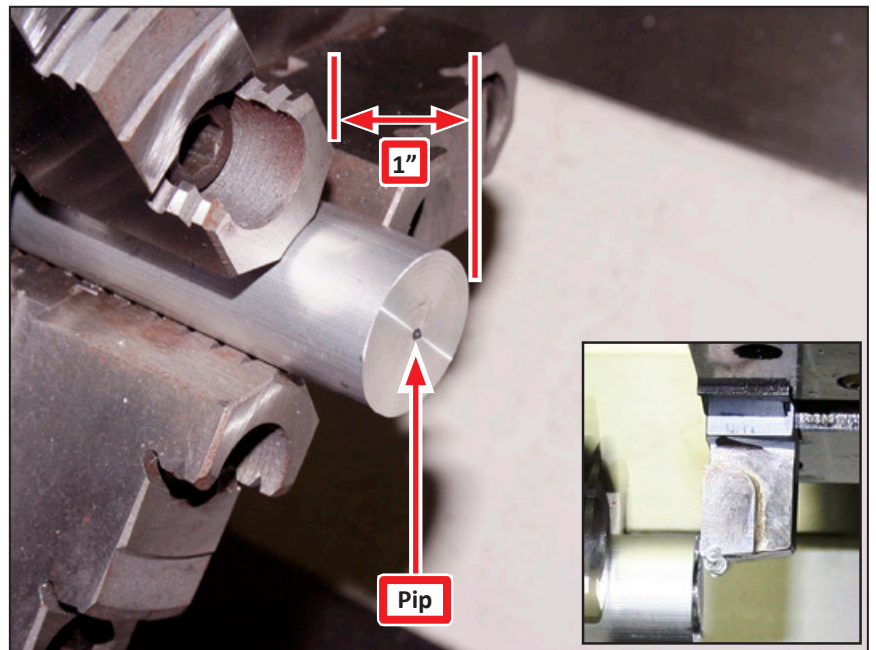


Figure 29

For example, $.002" + .011" = .013"$. This is the shim thickness required to be inserted under the *front* of turret. The $.011"$ number represents shim thickness required to be placed under the *back* of turret.

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11. Add shims (from the included Shim Kit) to the front and the back of the turret after loosening all six M10 x 30 mm Socket Head Cap Screws (see **Figure 30** and **Figure 31**). To create a gap necessary to add shims to front of turret, push forward on it (see **Figure 30**); insert required shim(s).

IMPORTANT! Do not use pry bar or similar device to create a gap between turret and lathe bed as mounting surfaces may be damaged.

NOTE: For easy insertion of shims use lift mechanism as outlined in Mechanical Install section.

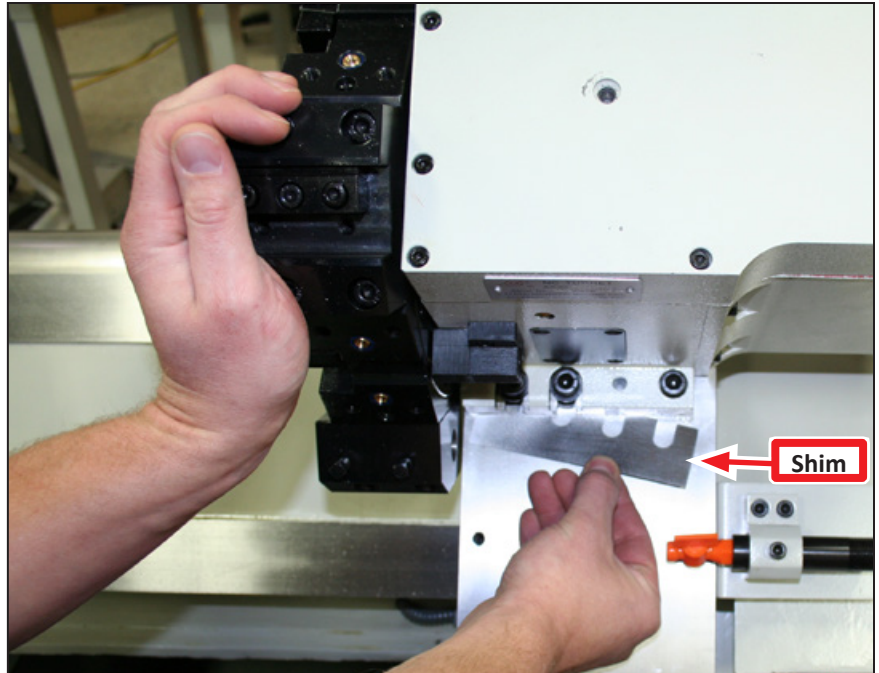


Figure 30

12. To add shims to the back of the turret, pull backward on it to create a gap; insert required shim(s) as shown in **Figure 31**.
13. Repeat Step 1 through Step 10 until the cutting position tool pocket (the pocket that you are going to insert tool in) is level to the X-axis.
14. Once the adjustment is complete, securely tighten all six Socket Head Cap Screws.

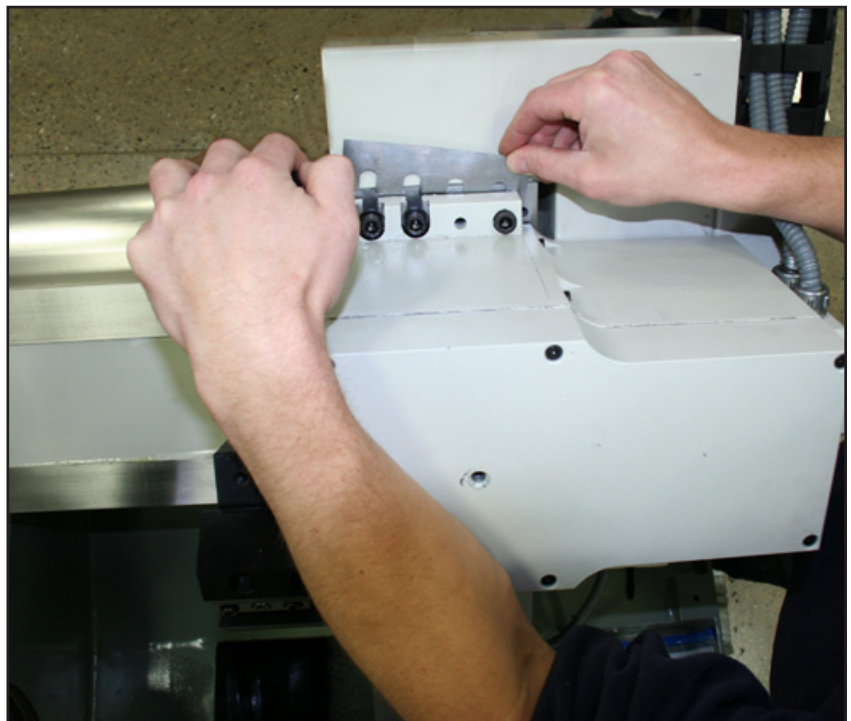


Figure 31

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Coolant Fitting

1. Locate the pre-installed Coolant Fitting on the turret.
2. Screw on the lathe's coolant hose (see **Figure 32**).

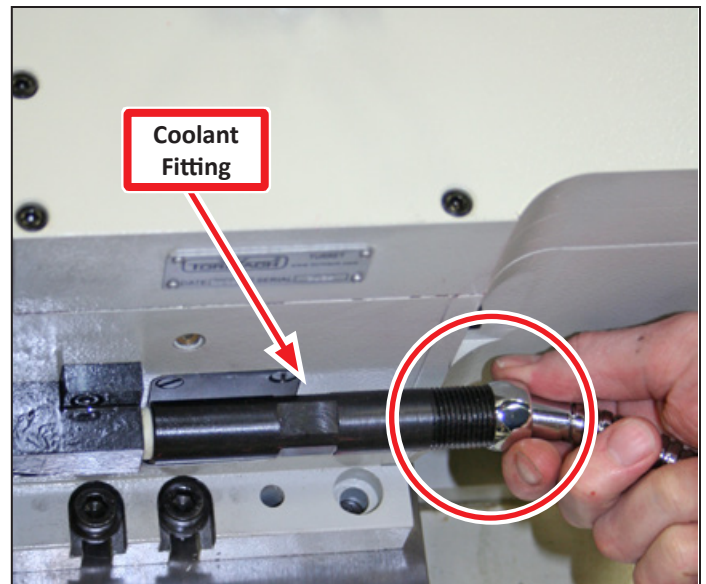


Figure 32

Boring Bar Holder Use

IMPORTANT! Mark the factory-installed location of each boring bar holder on the turret with a paint pen for future re-install (if removed).

Two types of tool holders are pre-installed on the turret as shown in **Figure 33**. If removal or relocation is necessary, unscrew four bolts on each.

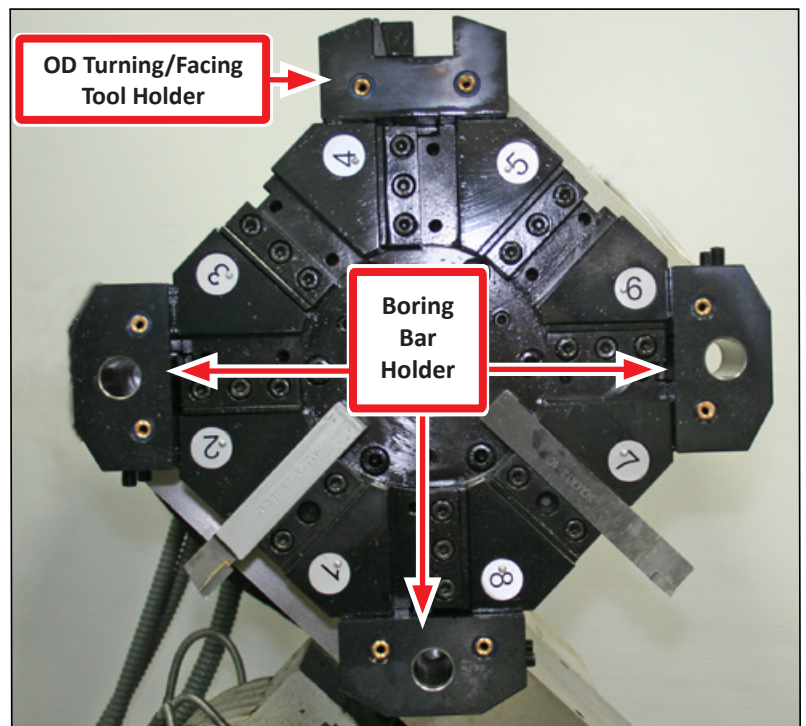


Figure 33

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To insert tool in any Boring Bar Holder:

1. Identify the tool pocket to be used and insert a 3/4" tool (see **Figure 34**). Make sure that the tool is flat as shown in **Figure 34 inset**. Tighten snugly; reverse process to remove.

NOTE: If using smaller-sized tool, use appropriate-sized bushing.



Figure 34

Wedge Block/Tool Extraction

1. Loosen two outside screws in the Wedge Block (see **Figure 35**); remove the Extraction Bolt in the center hole and keep for later use.
2. When the tool is inserted, push the Wedge back to seat in the rear of the pocket as shown in **Figure 36**.
3. Tighten the Wedge Block snugly.
4. To extract the tool, loosen two Wedge Block screws, insert the Extraction Bolt into the center hole and — while holding the tool with hand — screw in the Extraction Bolt until the tool comes free.

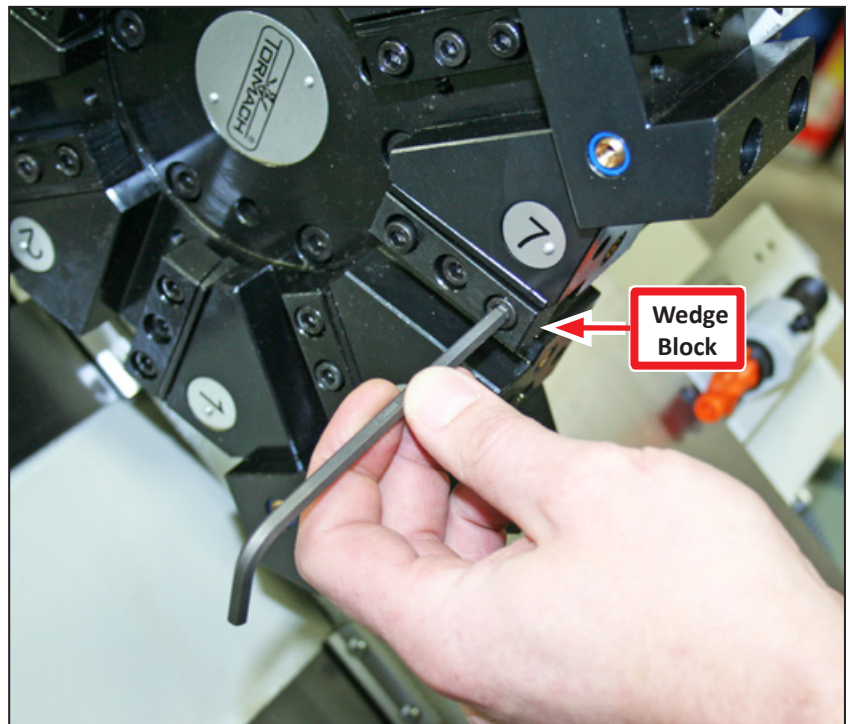


Figure 35

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Coolant Nozzle

Use M5 x 8 mm socket head cap screw (or hex wrench) to aim Coolant Nozzle as needed (see **Figure 36**).

NOTE: Aim Coolant Nozzle to allow coolant flow to cutting edge of tool.

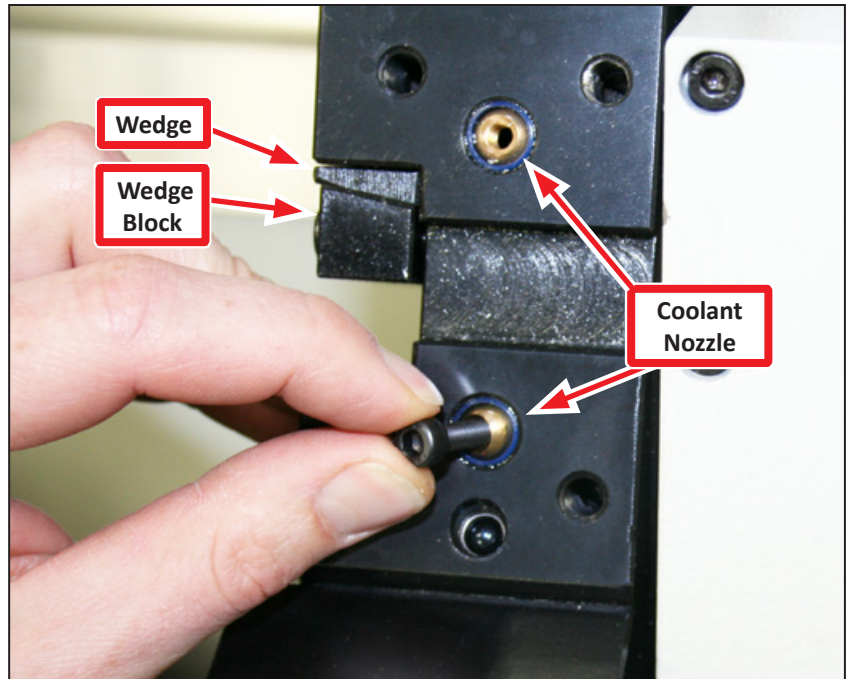


Figure 36

Setup

Tool Alignment and Crash Avoidance

Tool alignment pertains to how the cutting edge of the cutting insert is oriented/positioned along the X, Y (tool height), and Z axes. While turret alignment with the axes was addressed earlier in this document, some cutting tools may require additional alignment. A lathe turret allows the mounting of multiple tools for fast, accurate, mid-program tool changes. That said, it's important to note that when using a CNC lathe there is always the risk of tool crashes – into the work, the spindle head stock, or the chuck. This applies to CNC lathes equipped with turrets as well as gang-mounted tools. Therefore, careful tool and program planning are necessary. Do test runs (cutting air) at decreased feed rates. Take every precaution necessary to avoid a tool crash. Choosing which tool is mounted in which turret position is extremely important. Since operator machining setups vary widely, Tormach is unable to instruct where to mount your tools. This following section is intended to give some general pointers on tool mounting.



WARNING! Ejection Hazard: Do not allow turret tools to come in contact with rotating spindle as objects may be ejected from machine with deadly force.

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Shimming

Shimming of tools to set tool height and orientation is common in any lathe set up. Shims come in a wide variety of shapes, sizes, materials, and thicknesses. Shims typically range in size from .0005" to .01" or larger. Stacking of shims to get the right thickness is not ideal, but not uncommon either.

Nominal Tooling Size

Tormach advises $\frac{3}{4}$ " tooling for the turret, but it is possible to use smaller tool holders (see **Figure 37**). Keep in mind that these must be shimmed so tool tip is in line with the spindle axis.

Tooling Length

To reduce vibration and deflection, mount tools with the cutting tip as close to the turret clamp or block as possible (see **Figure 38**).

Tool Turret Position Repeatability

While turret operation is fairly accurate and repeatable, it's impossible to be perfect. During turret installation, height and alignment were adjusted for one pocket. This resulted in all other pockets being close to but not exactly the same pocket height and alignment at the first one. Since most lathe tools aren't sensitive to this alignment, being off by, for example, .003", may not have any measurable impact on a part. Some tools, such as parting tools for example, need to be as close to perfect as possible. We recommend mounting tools sensitive to alignment in the first pocket (used for aligning the turret), or shimming (up/down, side to side) appropriately (see **Figure 39**). There is sometimes a trial and error process that occurs to learn where this may or may not be relevant.

IMPORTANT! Be aware that it is possible for a tool to be mounted out far enough that it could crash into the lathe bed.

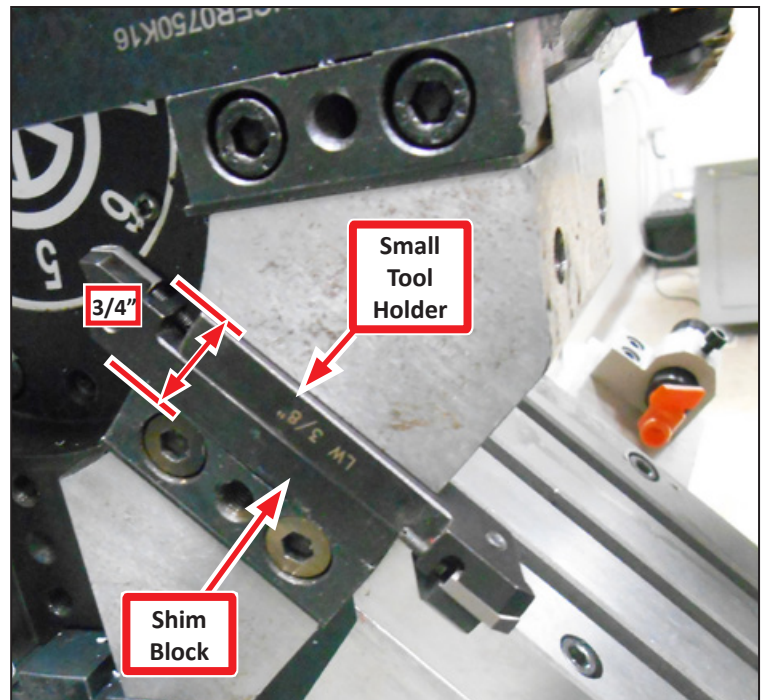


Figure 37

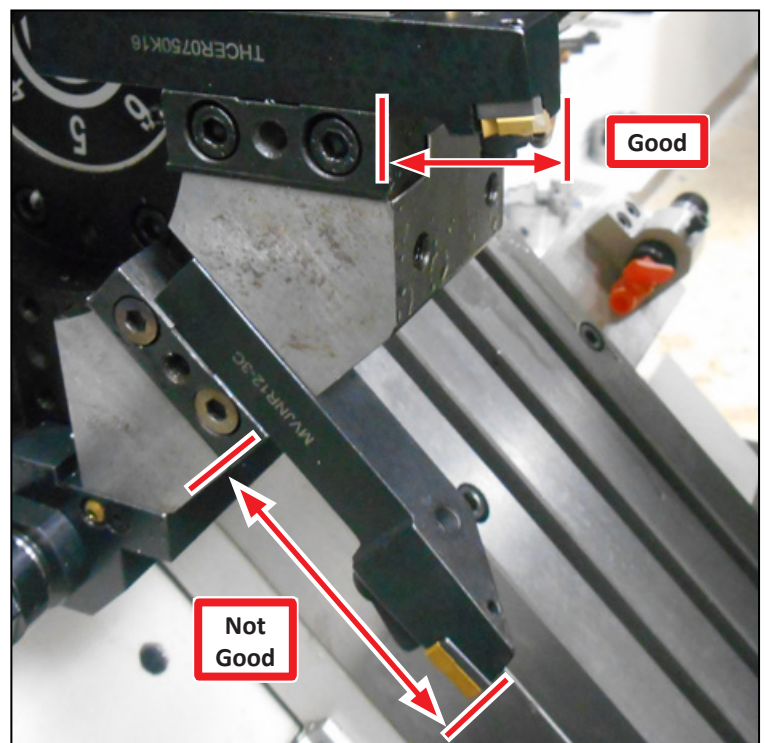


Figure 38

IMPORTANT! Some 3/4" boring bars can protrude out too far towards the turret base, resulting in a crash during a tool change. To eliminate this issue, cut the boring bar shorter.

Turret Tool Positions

Be aware of the crash potential of all tool positions during use of each tool (see **Figure 40**). For example when using turret position #1 for a short tool like a tap (that requires turret be very close to the workpiece), be aware of tools in the remaining positions (2-8), as the tap is cutting into the stock.

Issues to consider:

Is the boring bar or a long drill bit (in position #2) going to hit the chuck or head stock? This is a complicated crash scenario to predict. Simply creating a CAM program, inserting the code in the lathe, loading tools, and pushing *Cycle Start* – without considering where all tools are at all times – can trigger such a crash scenario.

Typically the greatest concern is related to tools oriented parallel to the spindle. For example, if there are large variations in length of tools mounted in boring bar holders, mount the tools as far away from each other as possible.

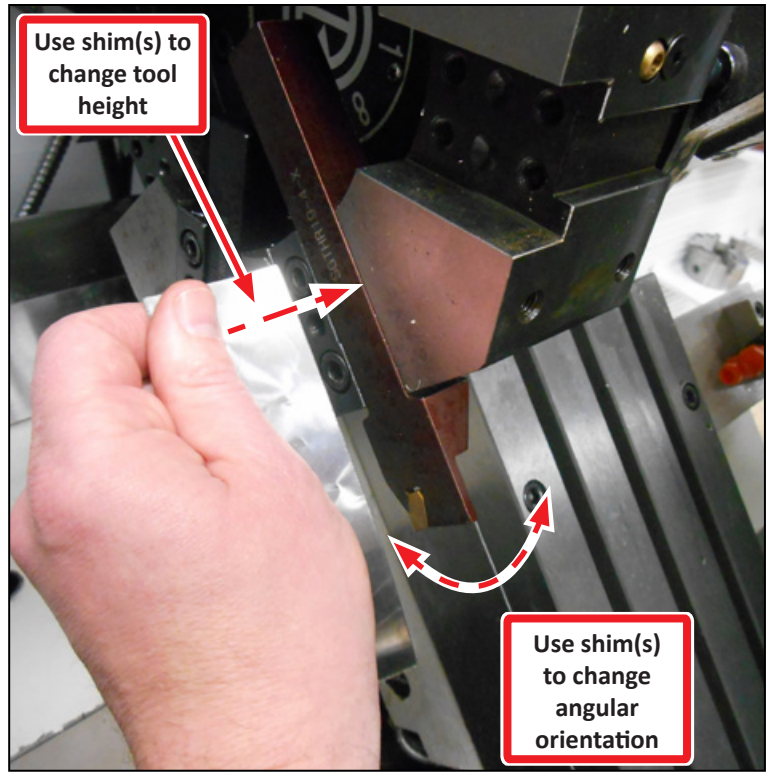


Figure 39

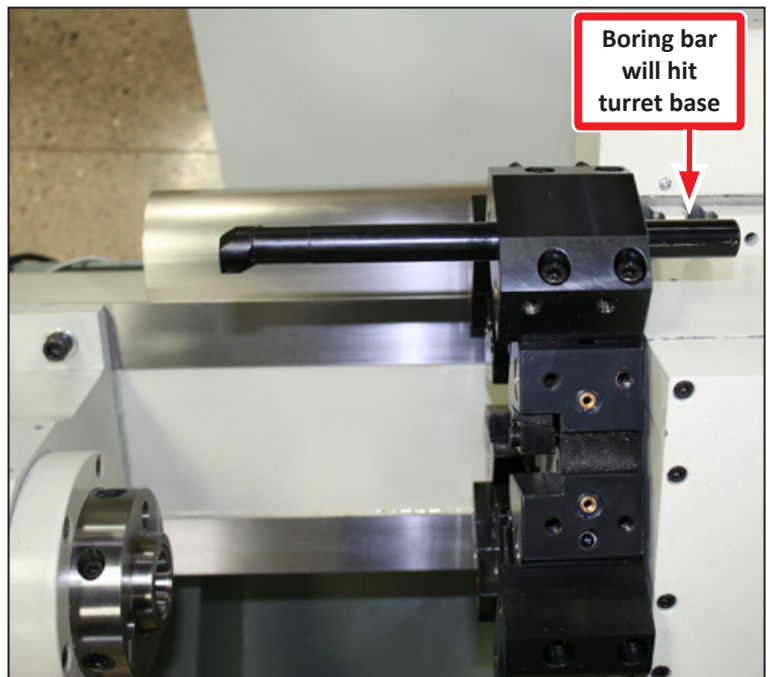


Figure 40

Troubleshooting

Lock Switch Adjustment

The Turret has a *tool lock switch* that may require adjustment to achieve a complete locking of the turret face after a tool change. To adjust:

1. Push the **Emergency Stop** button.
2. Remove eight socket head cap screws to remove the motor cover from turret (see **Figure 41** and **Figure 42**); remove cover.
3. Pull on the Motor Belt in a clockwise direction to rotate turret motor until turret is in a fully-locked position (see **Figure 42**).

NOTE: Spare Motor Belt located under Motor Cover (see **Figure 42**).

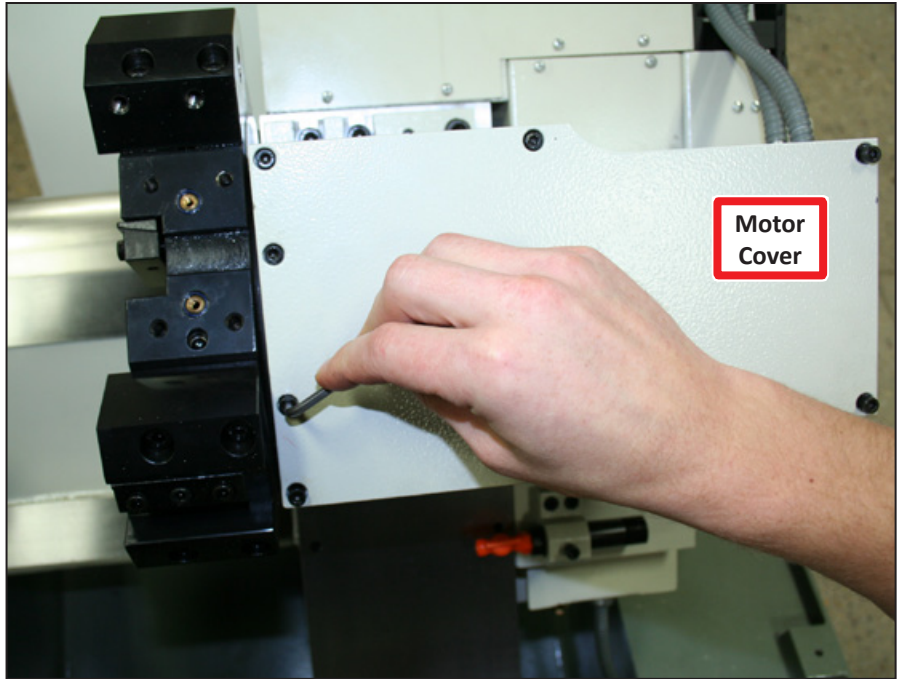


Figure 41

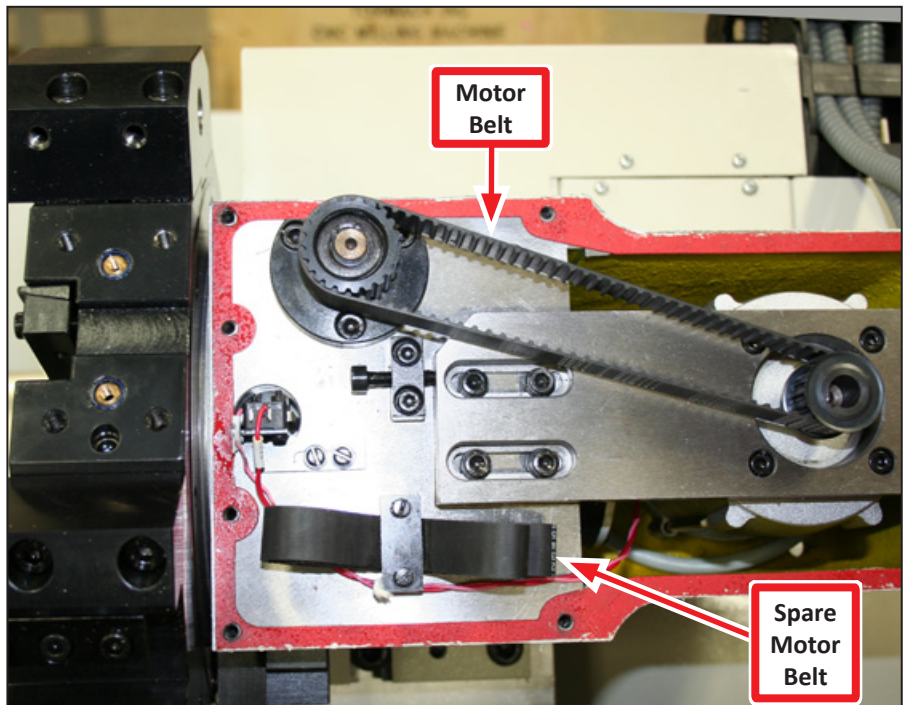


Figure 42

TECHNICAL DOCUMENT

4. Check to make sure that the turret is locked by inserting a 3/4" broom handle (or similar wooden dowel) into the pocket and then rotating the turret back and forth as shown in **Figure 43**. The turret is mechanically locked when no further rotation is possible.

IMPORTANT! Only use a wooden material for this test. Other materials may damage the turret.

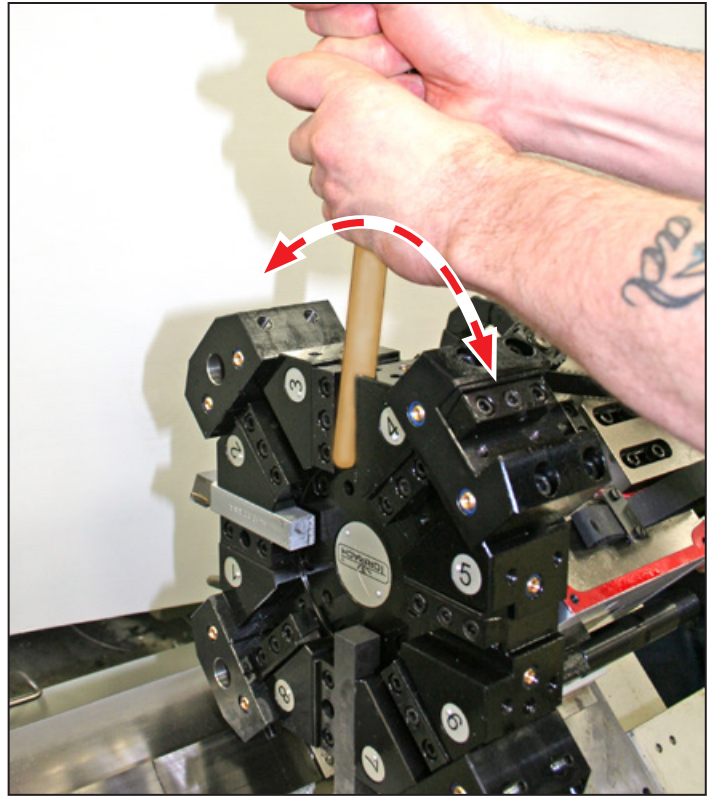


Figure 43

5. On Operator Panel, twist out the **Emergency Stop** button, and then push the **Start** button.
6. Use a flat-head screwdriver to loosen two screws on the lock switch bracket (see **Figure 44**).

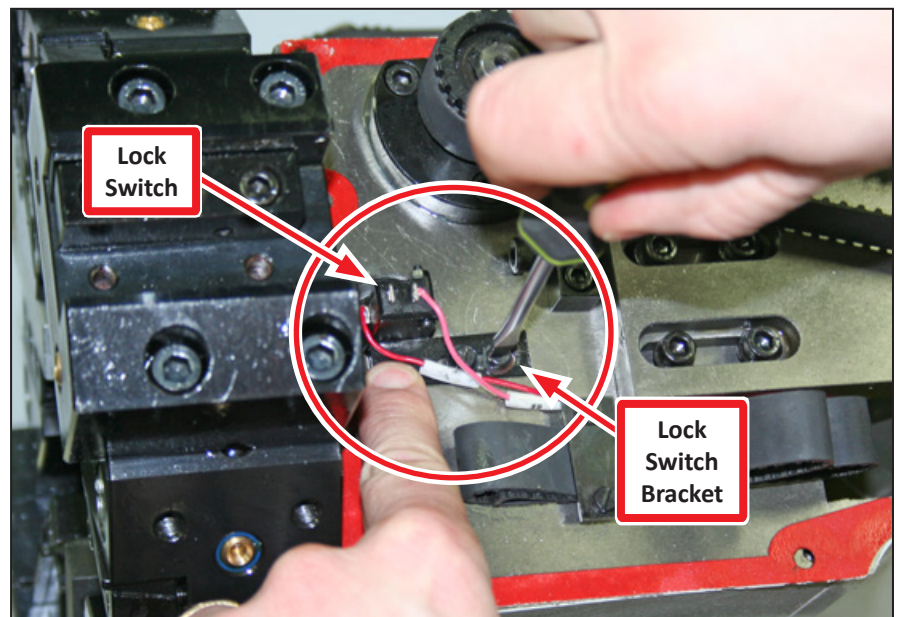


Figure 44

TECHNICAL DOCUMENT

7. Move the bracket left and, using a multimeter, touch contact shown in **Figure 45** and a ground; adjust switch location until the multimeter reads 0 volts.

NOTE! Ensure that your multimeter lead is placed on the pink wire as shown. The position of the wire on the switch may differ from the pictured position.

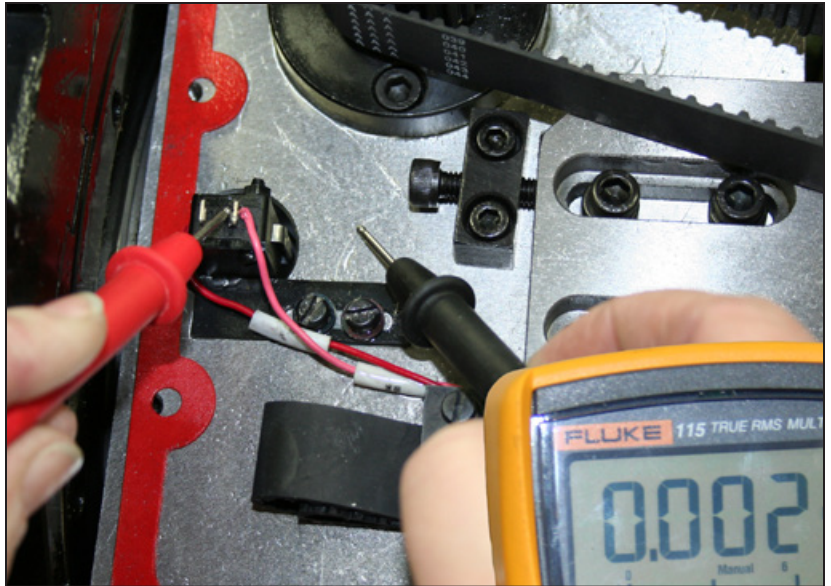


Figure 45

8. Move the bracket right until multimeter reads 24 volts (see **Figure 46**).
9. Re-tighten the bracket and re-install the motor cover.



Figure 46

TECHNICAL DOCUMENT

Relocate the Oil Line

IMPORTANT! The procedure to relocate the oil line is only required for machines serial number **10192 and below**.

You must relocate the lathe's carriage oil line to allow for turret clearance.

1. At back of the lathe, disconnect the oil line from the oil manifold (see **Figure 47** and **inset**).
2. Use a Phillips screwdriver to remove the oil line bracket (see **Figure 48**); set it aside.
3. Put the disconnected oil line back through the carriage (see **Figure 49**).
4. Reconnect the oil line to the manifold (see **Figure 47** and **inset**).

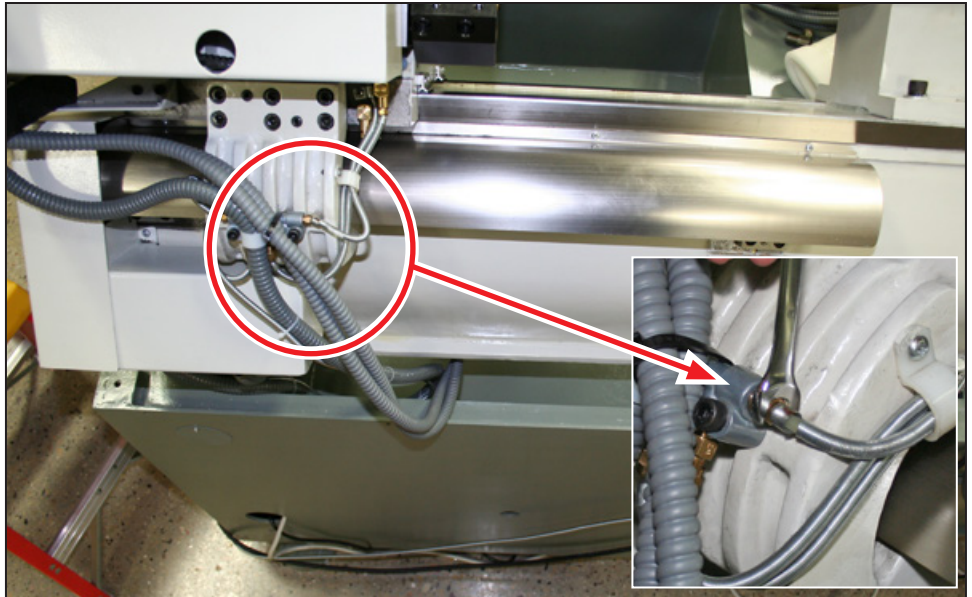


Figure 47



Figure 48

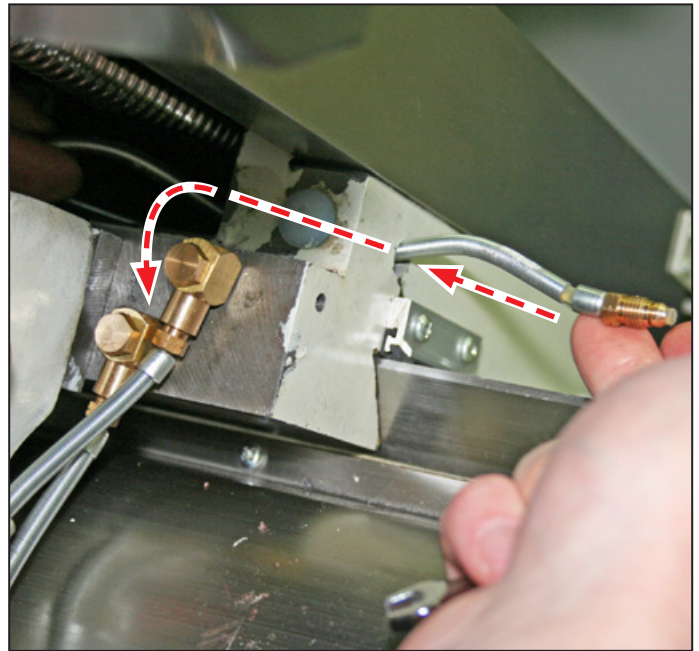


Figure 49

TECHNICAL DOCUMENT

5. Locate the notch below the X-axis motor cover as shown in **Figure 50**.
6. Mark the cutout location.
7. Use a Phillips screwdriver to remove four screws on the X-axis motor cover, and then remove the motor cover. Set all aside.

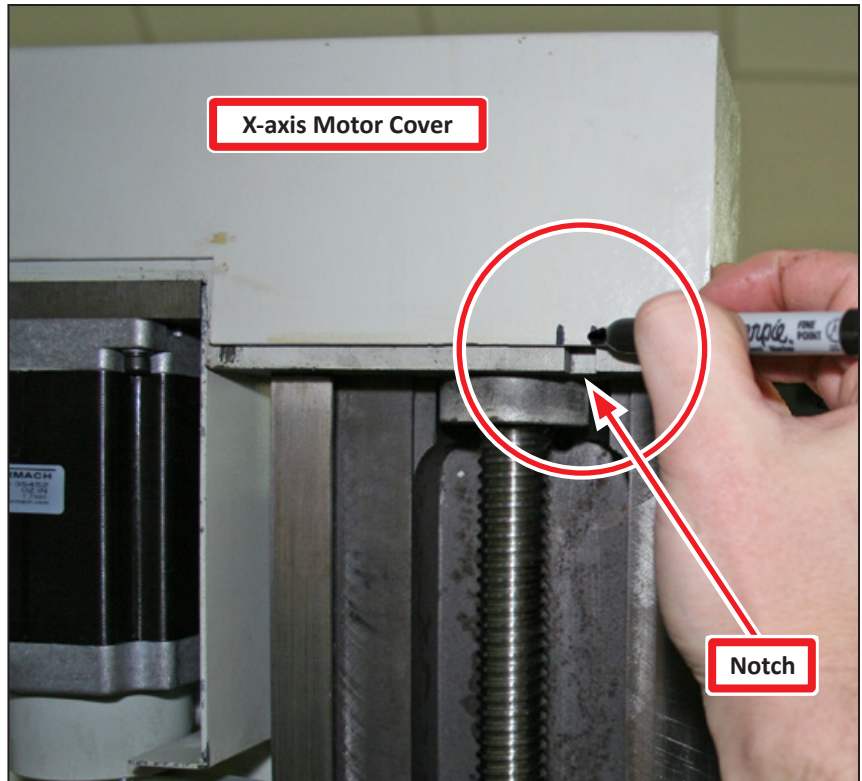


Figure 50

8. Slowly move the X-axis down, making sure to not pinch the oil line (see **Figure 51**).
9. Attach the oil line bracket (set aside earlier) to the oil line and position as shown in **Figure 51**.
10. Make sure that the tension in the oil line is correct.
11. Mark a drill hole for the bracket as shown in **Figure 51**.
12. Use a #19 drill, M5 × 0.8 tap, and a tapping handle to drill and tap the marked location.

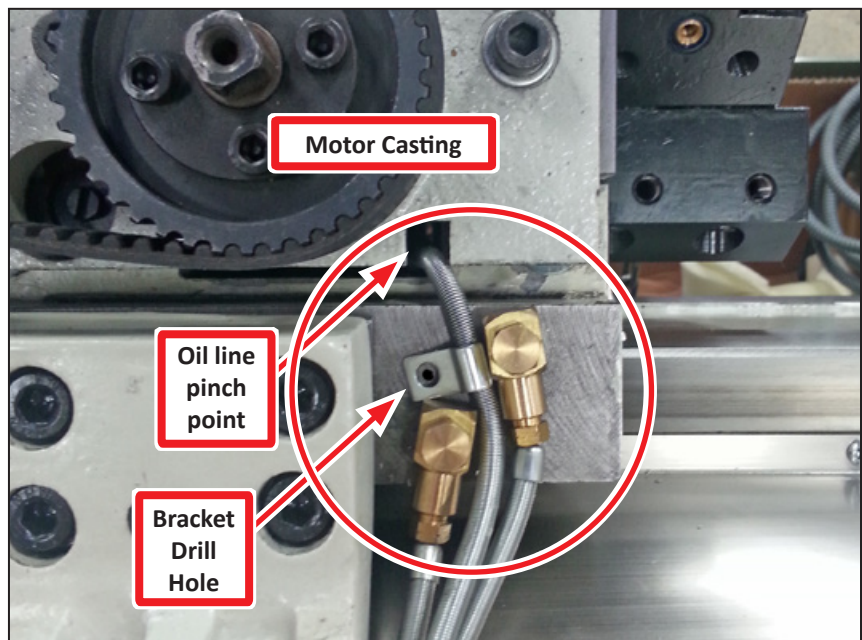


Figure 51

TECHNICAL DOCUMENT

13. Mark a cutout slot — $5/8"$ x $1/2"$ — on the X-axis motor cover as shown in **Figure 52**.
14. Use a $1/2"$ Drill bit to drill a hole at location shown in **Figure 52**.
15. Use a hacksaw to cutout the remainder of the slot.
16. Reinstall the X-axis motor cover. Make sure that the oil line has clearance around the slot (see **Figure 53** and **Figure 54**).

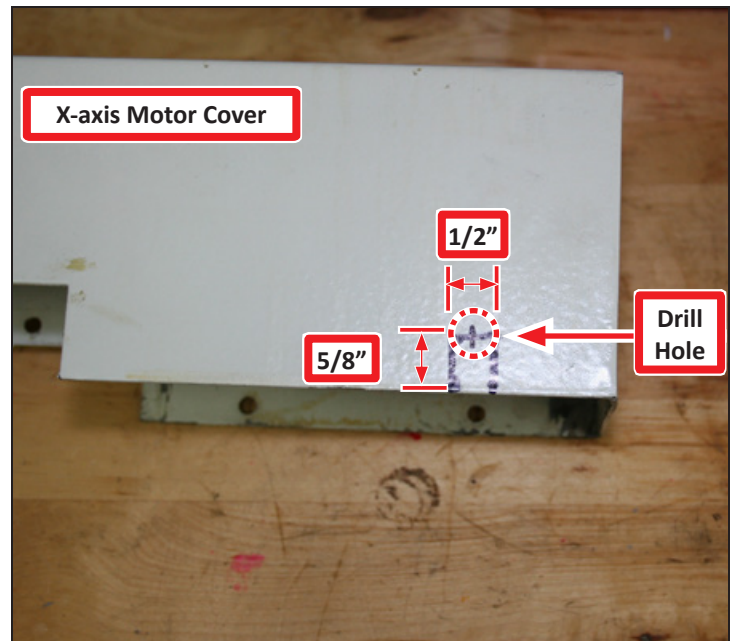


Figure 52

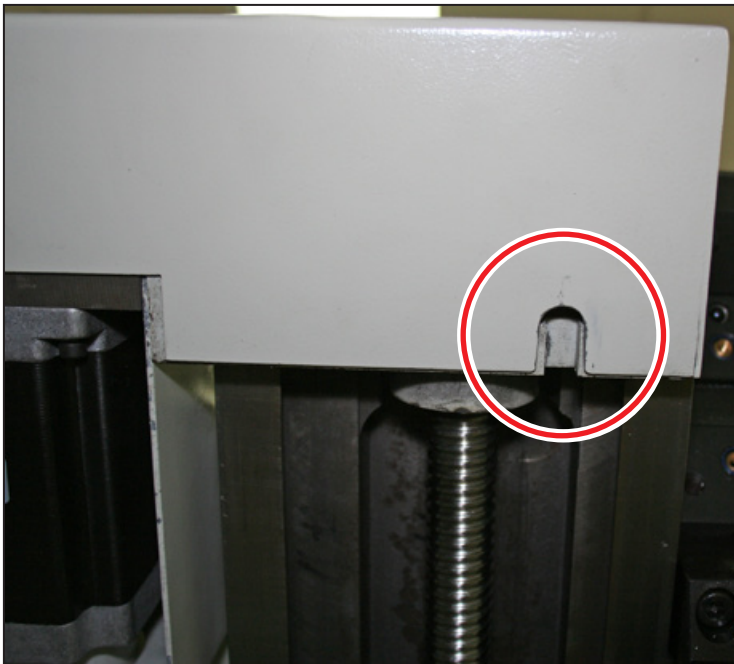


Figure 53

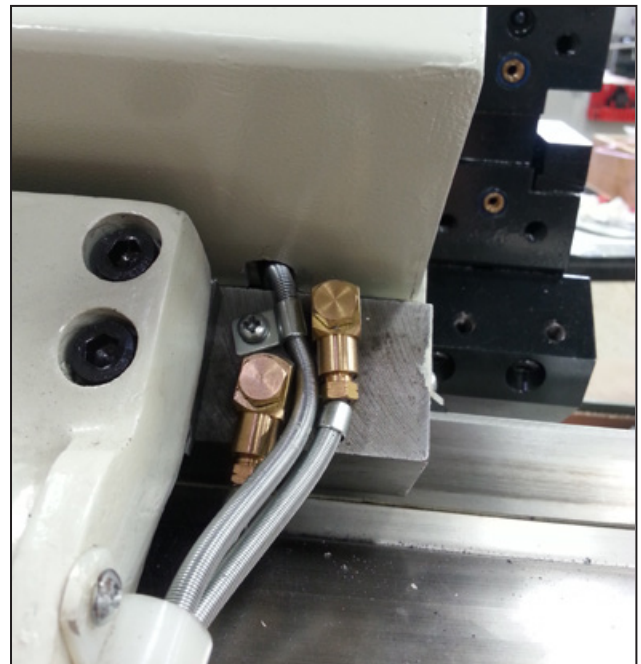


Figure 54