

TECHNICAL DOCUMENT

4TH AXIS INSTALLATION KIT

Product Identification

Model	With 4th Axis Kit	Without 4th Axis Kit (motorized table only)
6" Rotary Table	PN 30290	PN 30267
6" Super Spacer Rotary Table	PN 34123	PN 33089
6" Tilting Rotary Table	PN 31996	PN 31847
8" Rotary Table	PN 30289	PN 30194
8" Super Spacer Rotary Table	PN 34122	PN 33264
8" Tilting Rotary Table	PN 31997	PN 31848



Purpose: This document details installation, setup, use, and maintenance of six models of 4th Axis rotary tables.

IMPORTANT! Fill rotary table with oil before initial use; operating without lubrication voids warranty. Refer to Maintenance section for detailed instructions for Standard, Tilting, and Super Spacer tables.

IMPORTANT! Adjust backlash before initial use. Refer to Maintenance section for detailed instructions.

NOTE: For more information on axis drives, refer to Tormach technical document TD10173.

Overview

Mill Identification

This document periodically references the series configuration of PCNC 770 and PCNC 1100 mills. Use the following table to help identify the specific mill series:

PCNC Mill	Serial Number
1100 Series I	1-1325
1100 Series II	1326-1999
1100 Series 3	2000 and up
770 (early models)	70000-70199
770 Series 3	70200 and up

Performance Expectations

Rotary tables offer quick and accurate indexing or consistent rotary feed, and can be a cost effective way to turn a 3-axis mill into a 4-axis mill. They can be used for a wide variety of machining operations including drilling bolt patterns, milling angled slots, or making simple gears. Operating speed is 4 RPM, and the recommended backlash setting is 60-arc seconds. Avoid direct exposure to coolant.



TECHNICAL DOCUMENT

Specifications

Description	8" Standard or Tilting	6" Standard or Tilting	8" Super Spacer	6" Super Spacer
Diameter of table	200 mm (7.9")	160 mm (6.3")	200 mm (7.9")	160 mm (6.3")
Pilot Diameter	1.18"	.985"	—	—
Through Bore	MT-3 .850" (morse taper)	MT-2 .650" (morse taper)	2.470"	1.550"
Width of T-slot	12 mm (0.47")	10 mm (0.39")	.425"	.465"
Adjacent angle of T-slot	90°	90°	60°	60°
Width of locating key	15.875 mm (5/8")	15.875 mm (5/8")	15.875 mm (5/8")	15.875 mm (5/8")
Worm ratio	1:90	1:90	1:90	1:90
Graduation of table	360° (1° per graduation)	360° (1° per graduation)	360° (1° per graduation)	360° (1° per graduation)
Rotating angle per full axis motor step	0.02° (1.2') subdivide with microstepping	0.02° (1.2') subdivide with microstepping	0.02° (1.2') subdivide with microstepping	0.02° (1.2') subdivide with microstepping
Motor steps	200 steps/rev	200 steps/rev	200 steps/rev	200 steps/rev
Motor winding	2 phase, 4 wire	2 phase, 4 wire	2 phase, 4 wire	2 phase, 4 wire
Motor induction	3.5 mH	5.73 mH	3.5 mH	3.5 mH
Motor resistance	0.42 Ω	1.34 Ω	0.42 Ω	0.42 Ω
Motor phase current	5.5 A	2.8 A	5.5 A	5.5 A
Motor holding torque	4.6 Nm (640 oz-inch)	1.9 Nm (264 oz-inch)	4.6 Nm (640 oz-inch)	4.6 Nm (640 oz-inch)
Motor mount	NEMA 34	NEMA 23	NEMA 34	NEMA 34
Motor shaft	1/2"	1/4"	1/2"	1/2"
Cable	10 ft - 18 AWG shielded, twisted pair (Belden 1063a)	10 ft - 18 AWG shielded, twisted pair (Belden 1063a)	10 ft - 18 AWG shielded, twisted pair (Belden 1063a)	10 ft - 18 AWG shielded, twisted pair (Belden 1063a)
Product weight	Standard Table: 94 lbs (43 kg) ¹ Tilting Table: 148 lbs (67 kg) ²	Standard Table: 76 lbs (31 kg) ¹ Tilting Table: 97 lbs (44 kg) ²	141 lbs (64 kg) ²	110 lbs (50 kg) ²

¹Can be shipped UPS

²Requires truck freight

TECHNICAL DOCUMENT

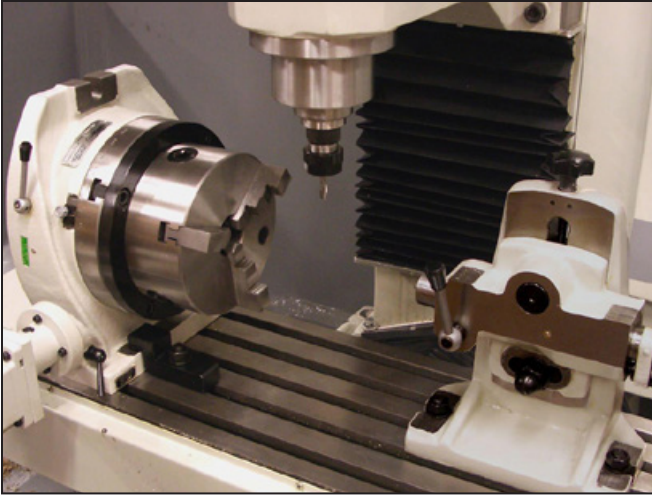


Figure 1

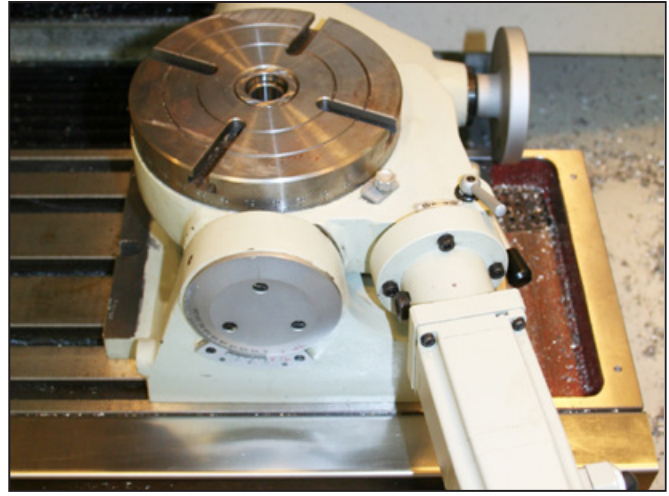


Figure 2

Uncrating and Inspection

Upon receipt, inspect all parts for damage and, if necessary, report issues to Tormach immediately.

IMPORTANT! Check to ensure all loose parts are removed from shipping container before discarding.

First Lubrication and Backlash Adjustment

Rotary tables are shipped without oil and must be filled before initial use. Refer to *Lubrication and Adjusting Backlash* sections later in this document.

IMPORTANT! Operating without lubrication voids warranty.

Installation

NOTE: Most photos shown in this document are of the PCNC 1100, but are applicable to the PCNC 770 as well.

Mounting Vertically (typical A-axis)

1. Position the 4th Axis on the left side of table (see **Figure 1**).
2. Use Toe Clamps to secure.


NOTE: The Tilting and Super Spacer tables are typically positioned on the right-hand side of table.

Mounting Horizontally (typical C-axis)

1. Position the 4th Axis on the right side of the table (see **Figure 2**).
2. Use Toe Clamps (included) to secure.

Fitting Drive Module

- 1. Power off mill according to *Power Off/On Procedure*.

 **WARNING! Electrical Shock Hazard:** Be sure to power off machine before making any electrical modifications. Failure to do so could result in death and/or serious injury.

Power Off/On Procedure

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



- 2. Identify location *D* in electrical cabinet as shown in **Figure 3** to install 4th axis drive.
- 3. Loosely attach one M4 screw in the bottom of the two tapped holes; rest drive on screw.
- 4. Attach one M4 screw in the remaining tapped hole; tighten both M4 screws securely.

Mounting Interface Connector

- 1. Locate the blanking plate (if equipped) below the main disconnect switch, to the right of the electrical cabinet. Remove and set aside four screws.

NOTE: Use larger of two blanking plates for 4th Axis.

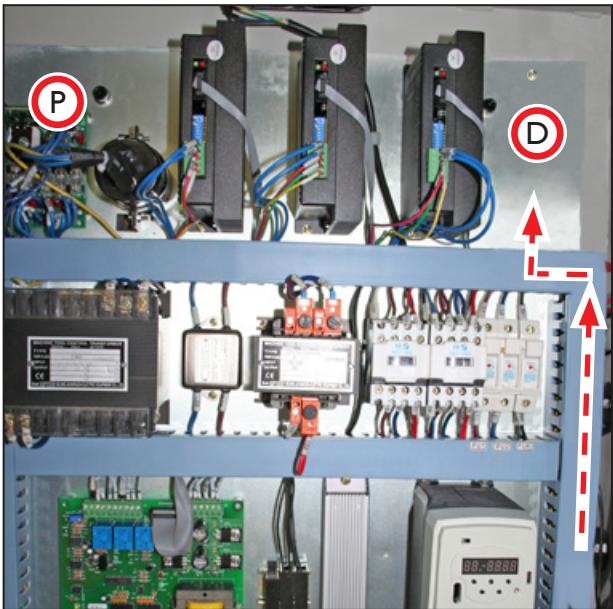


Figure 3

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2. Thread the Interface Connector wires through the side of the electrical cabinet (see **Figure** and **inset**); secure using four screws set aside in Step

NOTE: Interface Connector's Dust Cap is attached on bottom right screw (see **Figure 4** and **inset**).

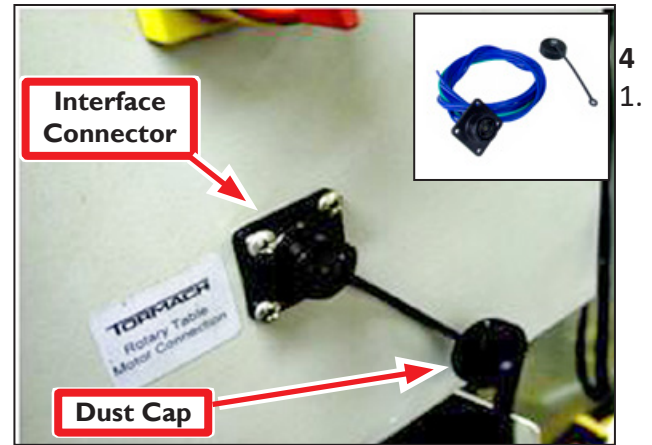


Figure 4

Ground Wire Connections

1. Remove wire trough covers in electrical cabinet; set aside.
2. Route wires 320-323 from Interface Connector through wire troughs and to location *D* as shown in **Figure 3**.
3. Older mills are equipped with a Ground Bar (see **Figure 5**), while newer mills have a green Ground Terminal Block (see **Figure 6**). Identify the ground connection specific to your mill and route green ground wire.
4. Based on ground connection identified in Step 3, either use pre-mounted ferrule for Ground Terminal Block connection (see **Figure 6**) or clip off Ferrule, strip wire back 1/4" and crimp on ring connector for Ground Bar connection (see **Figure 5**).

Ground Bar

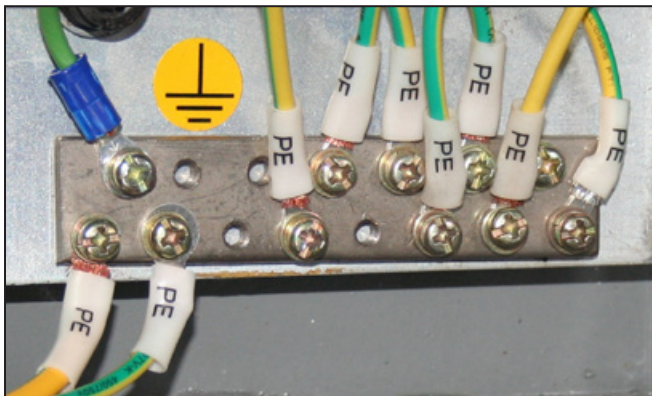


Figure 5

Ground Terminal Block

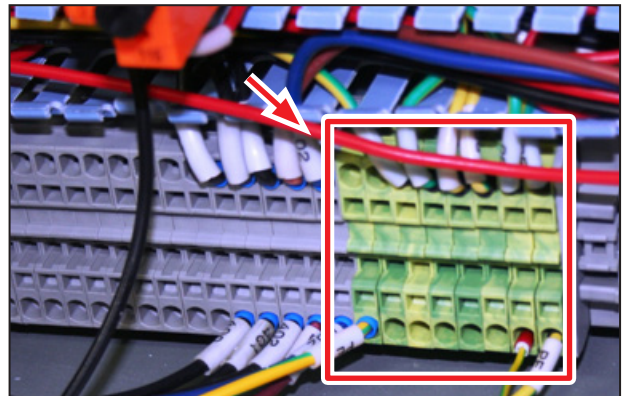


Figure 6

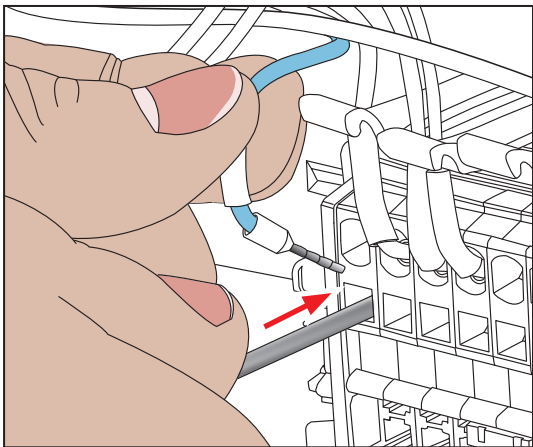


Figure 7

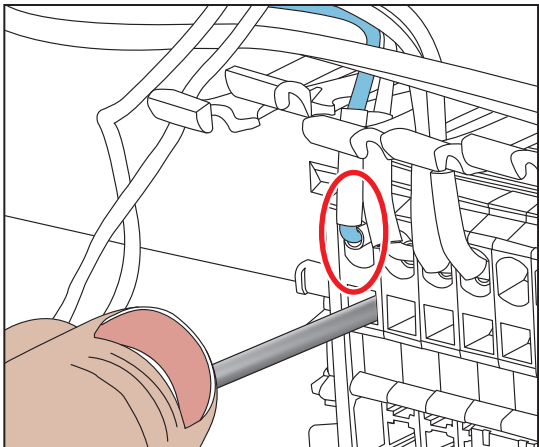


Figure 8

5. Make ground wire connection as detailed in the table below:

Ground Bar	1) Route ground wire via lower wire trough and connect to any Ground Bar terminal screw (see Figure 5).
Terminal Block	1) Route ground wire via lower wire trough.
	2) Slowly insert end of a small, flat-head screwdriver straight into any slot in green section of Ground Terminal Block (see Figure 7). IMPORTANT! Do not move screwdriver up or down inside terminal block. Failure to do so could result in terminal block damage.
	3) Once resistance is felt, insert wire into terminal block (see Figure 8); slowly remove screwdriver.

Power Wire Connections

1. Identify the blue power wire (included) with two 1/4” crimp connector ends; cut it in half to make two power wires that are required for installation.
2. Using a wire stripper, strip off 1/4” of insulation on cut end of blue power wire to expose bare metal.
3. Add wire labels (included) to stripped ends of blue power wire. For more information, refer to PCNC 1100 Wiring Overview and PCNC 770 Wiring Overview sections later in this document.

NOTE: Wire connections for PCNC 1100 and PCNC 770 varies. See related section for information.

TECHNICAL DOCUMENT

PCNC 1100

1. Plug crimp connector end of wire 325 to connector marked –A on the DC Bus Board (at location *P* in **Figure 3**); plug crimp connector end of wire 324 to the connector marked +A (see **Figure 9** and **Figure 10**). Refer to *PCNC 1100 Wiring Overview* section later in this document for wire labeling details.

IMPORTANT! Wire identification is critical; for more information, refer to *PCNC 1100 Power Wiring Overview* section later in this document.

2. Route loose end of power wire to drive (at location *D* in **Figure 3**).

PCNC 1100 Series 1 & Series II

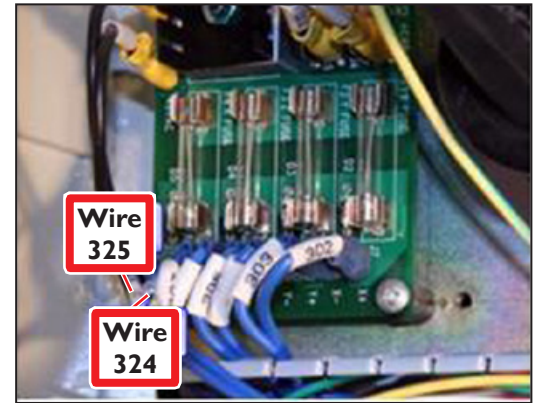


Figure 9

PCNC 1100 Series 3

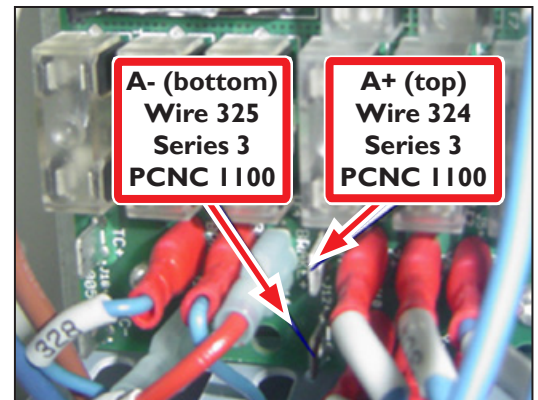


Figure 10

PCNC 770

1. Plug crimp connector end of wire 170 to connector marked –A on the DC Bus Board (at location *P* in **Figure 3**); plug crimp connector end of wire 169 to the connector marked +A (see **Figure 11** and **Figure 12**). Refer to *PCNC 1100 Wiring Overview* section later in this document for wire labeling details.

IMPORTANT! Wire identification is critical; for more information, refer to *PCNC 770 Power Wiring Overview* section later in this document.

2. Route loose end of power wire to drive (at location *D* in **Figure 3**).

PCNC 770 Series 1 (early models)

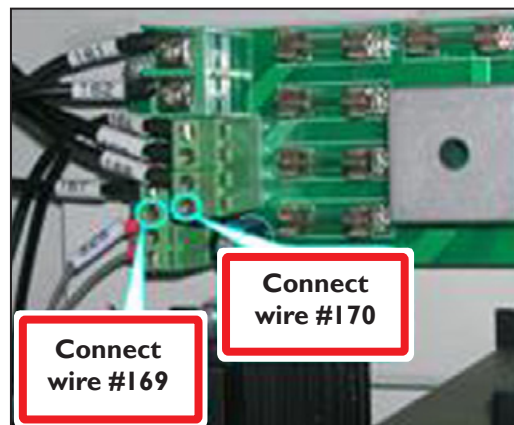


Figure 11

PCNC 770 Series 3

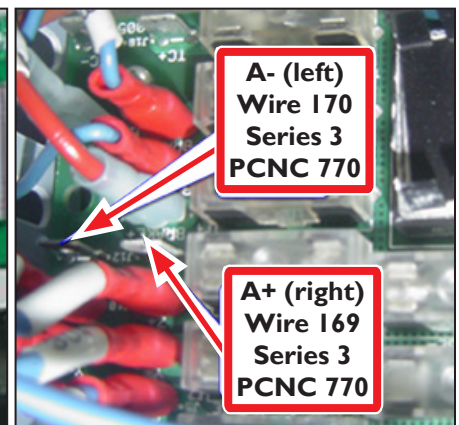
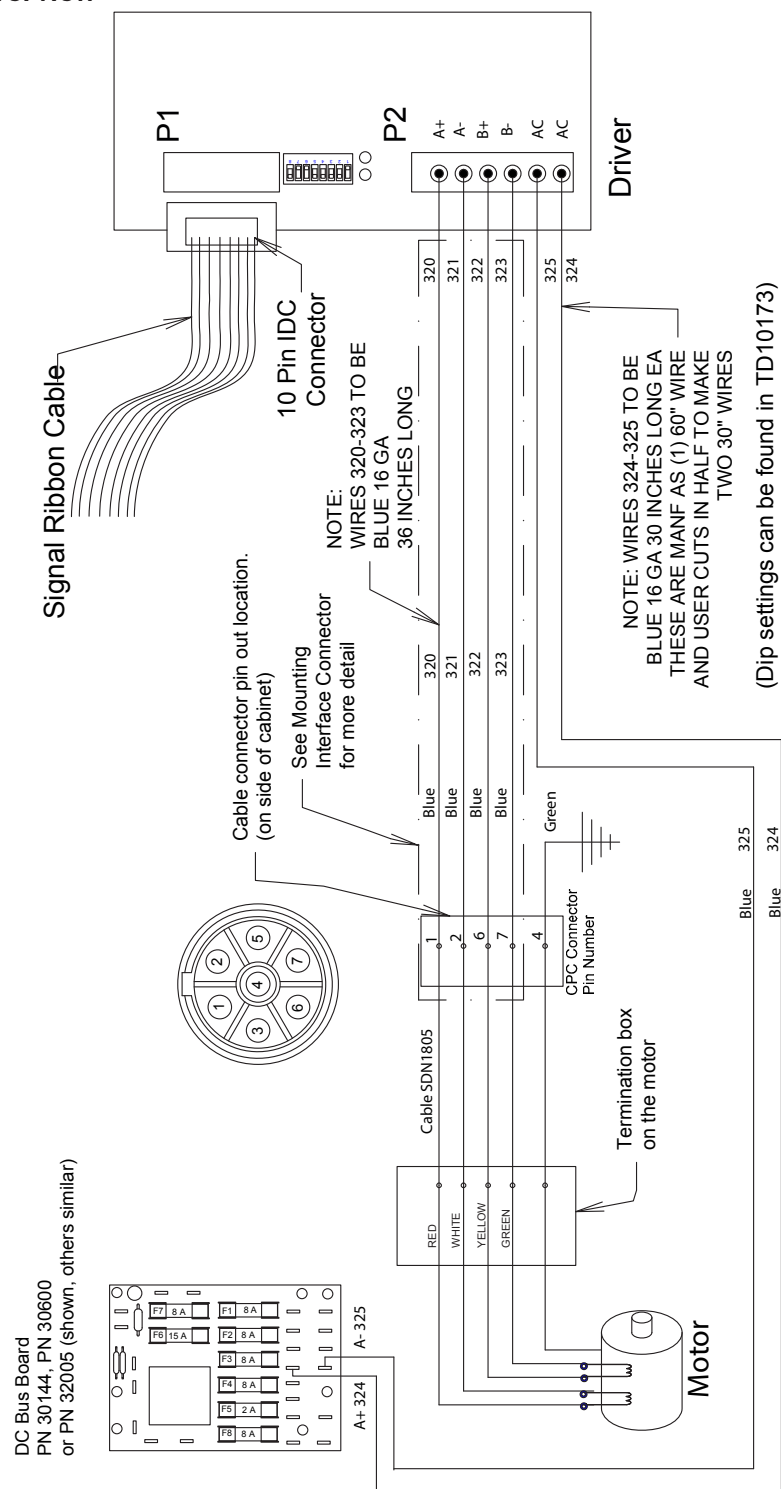


Figure 12

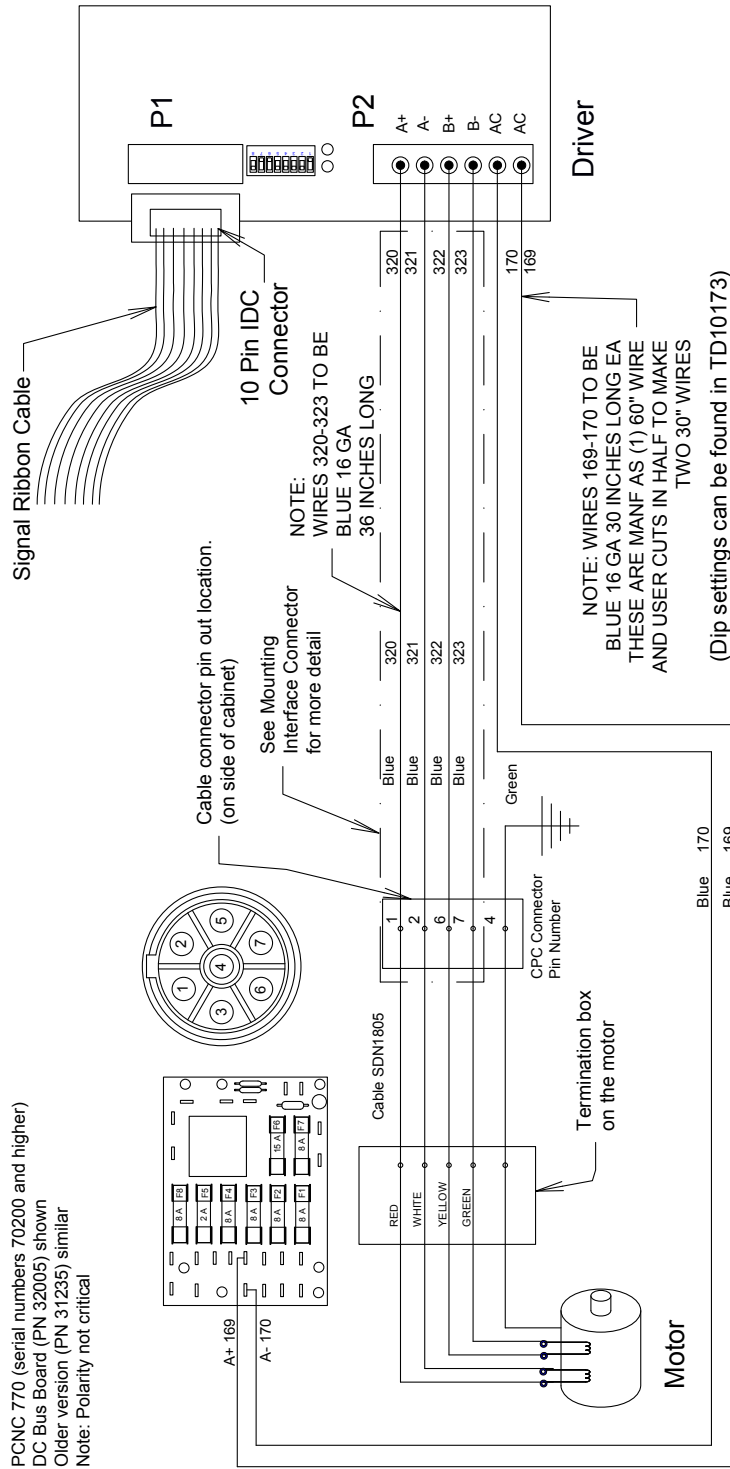
TECHNICAL DOCUMENT

PCNC 1100 Wiring Overview



TECHNICAL DOCUMENT

PCNC 770 Wiring Overview



TECHNICAL DOCUMENT

Drive Connections

1. In the electrical cabinet, locate the loose Ribbon Cable under the wire trough cover (in line with ribbon cables to existing drives).
2. Plug Ribbon Cable into IDC Connector on drive (see **Figure 13**).
3. Locate Connector Plug on drive; this is for power (see **Figure 13**).
4. Install power and motor wires in Connector Plug with wire numbers visible; refer to Tormach technical document *TD10173* (included) for wire connection details.

IMPORTANT! Wire identification is critical; for more information, refer to *PCNC 1100 Power Wiring Overview* and *PCNC 770 Power Wiring Overview* sections earlier in this document.

5. Match DIP switch (see **Figure 13**) settings on drive as detailed in technical document *TD10173* (included).

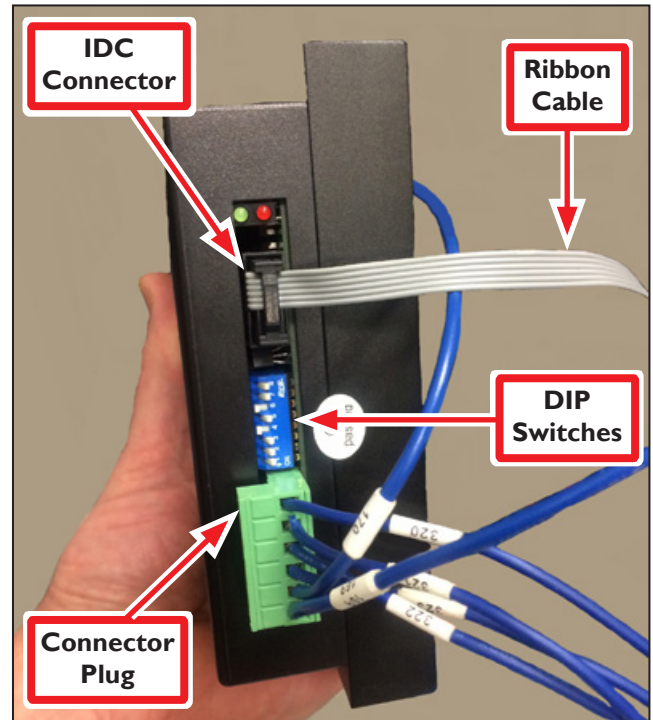


Figure 13

Final Check Before Powering On

After assembly is complete, review wiring in detail:

1. Check closely to see that there are no individual strands of loose copper wire.

NOTE: A magnifying glass may help locate loose wires.

2. Refer to *Electrical Connections PCNC 1100* and *Electrical Connections PCNC 770* sections earlier in this document to confirm each of the wire numbers for the power wires.
3. Confirm the wire clamps in the Connector Plug (see **Figure 13**) are clamping on the copper wire and not on the plastic insulation around the copper wire.
4. Replace wire trough covers.
5. Plug in rotary table.
6. Power on mill according to *Power Off/On Procedure* detailed earlier in this document; the power LED on the newly installed driver module should light.
7. Run the control program. You should be able to jog the rotary table using the left and right arrow keys.

TECHNICAL DOCUMENT

Basic Operation

Components of the Standard, Super Spacer, and Tilting tables are shown in **Figure 14**, **Figure 15**, and **Figure 16**.

IMPORTANT! Backlash should be adjusted prior to first use as detailed later in this document.

IMPORTANT! This product ships without oil and must be filled before being put into service. Operating this product without lubrication voids warranty. Refer to the Maintenance section for detailed instructions on how to lubricate Standard, Tilting, and Super Spacer rotary tables.

IMPORTANT! To avoid damage to the driver, power off the mill according to the Power Off/On Procedure detailed earlier in this document before connecting or disconnecting the rotary table.

Rotary Clamps: To keep the table from rotating during heavy milling operations, tighten the clamps with the clamp handles. The clamps should be loosened during motorized rotation to allow free rotation. If the clamps are locked during a move, correct position will likely be lost.

StandardTable

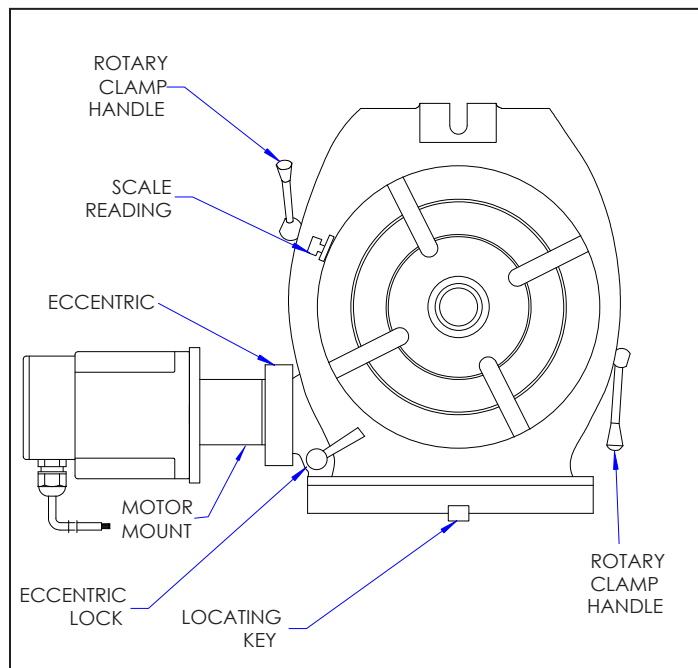


Figure 14

Super Spacer Table

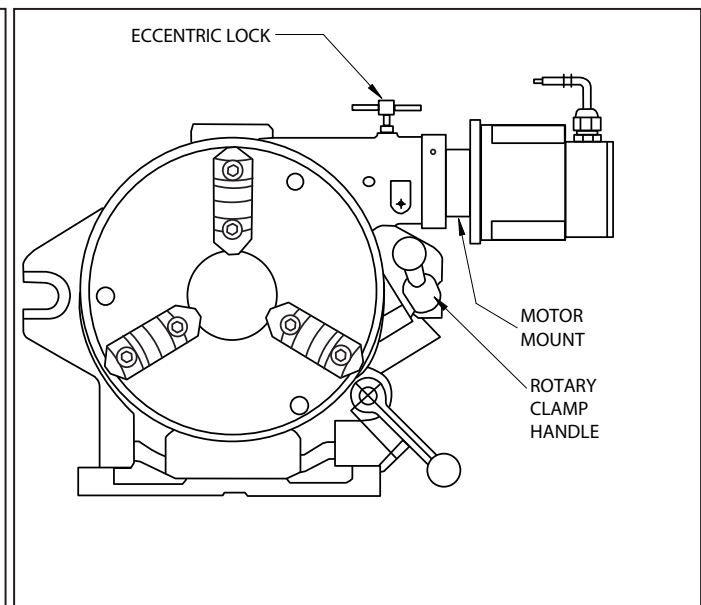


Figure 15

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Tilt Clamps: The Tilting Table has two Tilt Clamps that are tightened to lock the tilt position; tighten prior to machining (see **Figure 16**).

Engaging and Disengaging Worm Drive: On Standard and Tilting tables, to disengage the worm gear so the table can be turned by hand, loosen the Eccentric Lock (see **Figure 14**), rotate the eccentric by turning the Motor Mount as far as it will rotate clockwise, and re-tighten the Eccentric Lock. To re-engage the worm, loosen the Eccentric Lock, rotate the motor mount as far as it will rotate counterclockwise, and tighten the Eccentric Lock.

Rotate the table slightly, if necessary, by hand so the worm gear can engage the ring gear. If the worm is not completely engaged, the table will exhibit excessive backlash.

On a Super Spacer Table, rotate the motor mount counterclockwise to disengage the ring gear and clockwise to engage it; tighten the Eccentric Lock.

Adjustable Reference Mark: (see **Figure 17**) Used to read angles directly off the table, the clamp holding it in place can be loosened to allow the pointer to be moved to an exact degree mark.

Tilting Table

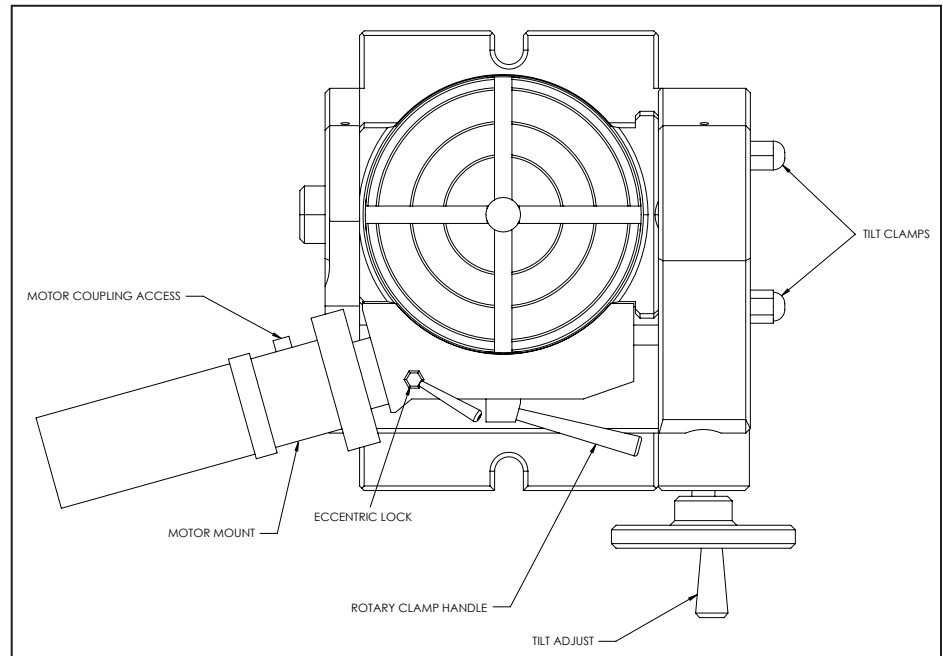


Figure 16



Figure 17

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Vernier Scale

Used to align the angle of the Tilting Table from horizontal to vertical (see **Figure 18**).

Use Vertical Setup: Chucks or fixtures to be used with the table in the vertical position are often easier to setup if the table is first horizontal and then moved to the vertical position.

Center Hole: The center hole (see **Figure 19**) is ground to an MT taper or a through bore to fit workholders. On tables with an MT taper, there also exists a shallow, concentric pilot hole which is used to locate a chuck or other tooling. See *Workholding* later in this document and refer to the *Specifications* table earlier in this document. Should coolant enter moving rotary table components, drain and flush with new oil.

Wear: Try to distribute wear over the whole of the worm gear. When doing long runs of constant back and forth movement, occasionally reposition the table top and workholding fixture. Or if moves are close to 180°, continue rotating in the same direction to the start point rather than returning in the opposite direction. Or if the part permits, program the start point to change a few degrees each time.

Locking the Eccentric

Power is transmitted from the axis motor to the rotary table by worm gear at the end of the drive shaft. Use the Eccentric Lock (shown in **Figure 14**, **Figure 15**, and **Figure 16**) to stop the eccentric sleeve from rotating. This must be done before the worm drive is engaged to prevent the drive from disengaging during use.



Figure 18

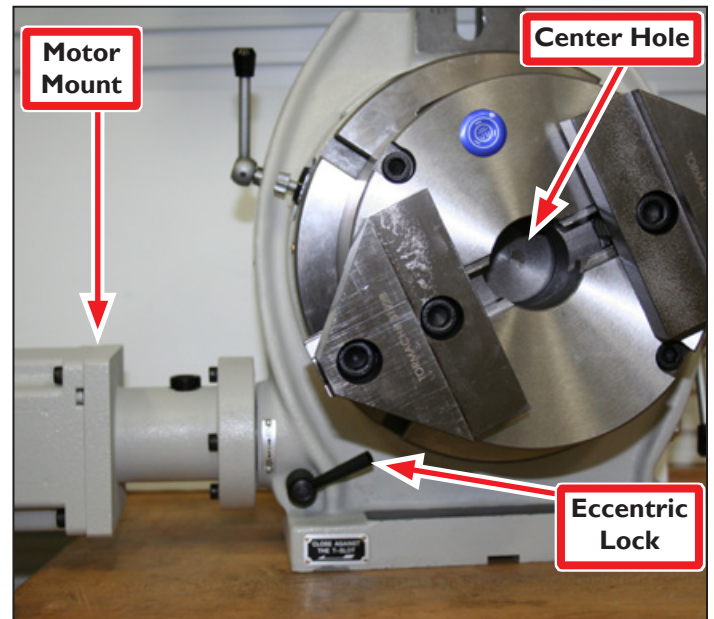


Figure 19

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Workholding

Direct Mount to Table

The 6" tables have 10 mm T-slots and the 8" tables have 12 mm T-slots. These can be used in combination with T-nuts and a clamp set to hold work directly to the table. Another option is to attach a vice or custom fixture plate to the table with bolts and T-nuts.

2-Jaw, 3-Jaw, and 4-Jaw Chuck

The 2-Jaw Chuck for a 6" Table (PN 32627) provides rapid prototype workholding. The set includes a self-centering 2-Jaw Chuck with an adapter plate and mounting hardware, including jaw plates. The 2-Jaw Chuck for an 8" Table (PN 32622) includes a MT3 adapter ring. The 3-Jaw Chuck is available in a 6" Table (PN 30292) and an 8" Table (PN 30291). The 4-Jaw Chuck is available in a 6" Table (PN 31721) and an 8" Table (PN 30293). Each chuck includes an adaptor plate and pin for mounting the chuck to the table and centering it to the rotational axis. Each chuck comes with both inside and outside interchangeable jaw sets.

5C Collet Adapter

A 5C Collet Adapter for 8" Table (PN 30294) includes an adaptor plate for mounting and centering the holder.

5C Collet Fixture

A 5C Collet Fixture for both 6" Table (PN 31414) and 8" Table (PN 31415). These mount directly to table T-slots.

MT2 Alignment Kit for ER32 Collet Fixture

This Morse Taper #2 Alignment kit for ER32 Collet Fixture (PN 34382) is available for use with 6" tables.

MT3 Alignment Kit for ER32 Collet Fixture

This Morse Taper #3 Alignment kit for ER32 Collet Fixture (PN 34383) is available for use with 8" tables.

MT3 Collet and Drawbolt

The 8" Table can accept an MT3 Collet, held in with a drawbolt. This can be used in combination with a Tormach Tooling System (TTS) tool holder as a low-cost method for holding slender bar stock. The 6" Table accepts an MT2 collet.

Maintenance

Lubrication

IMPORTANT! Rotary tables ship without oil and must be filled before initial use. Operating this product without lubrication voids warranty.

Lubrication-related locations for the Standard Rotary Table, Tilting Rotary Table, and Super Spacer Table are shown in **Figure 20**, **Figure 21**, and **Figure 22**. The standard rotary tables have an oil reservoir and Oil Points, better known as Ball Zerks (spring-loaded oil fittings), that must be filled with AGMA 2 gear oil or SAE 30 weight motor oil before first operation.

NOTE: Do not use way oil on 4th Axis or any rotary products.

Standard Table

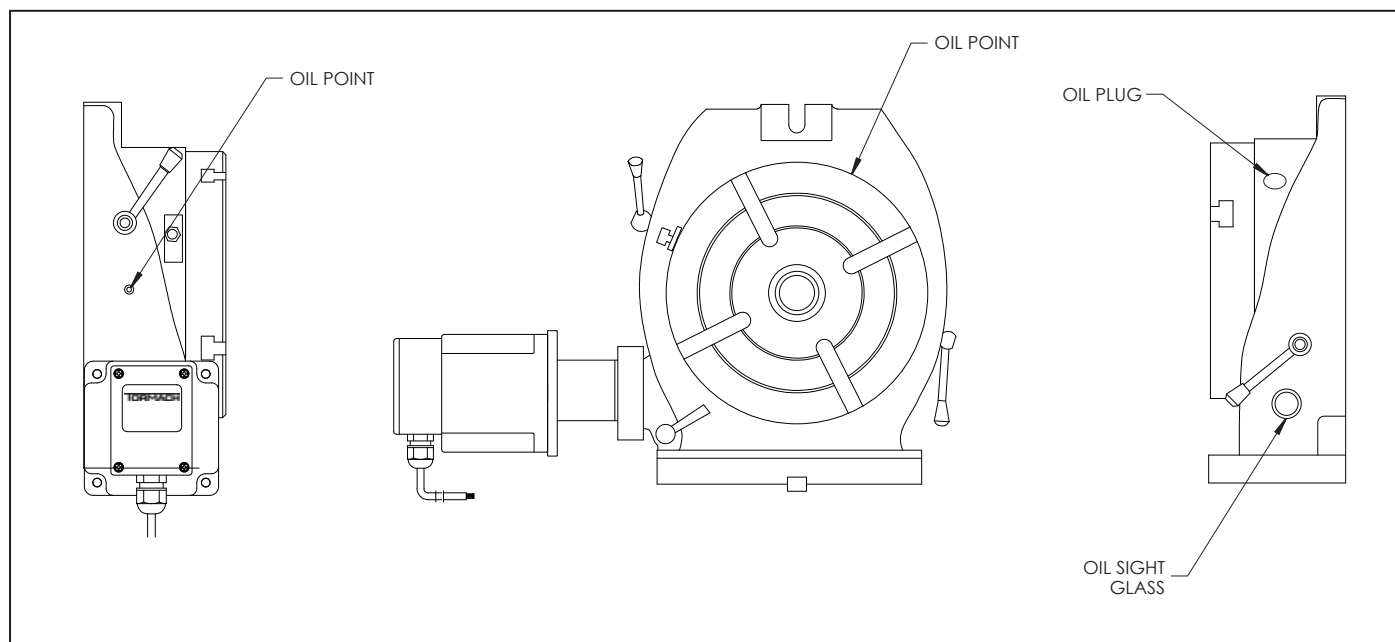


Figure 20

Tilting Table

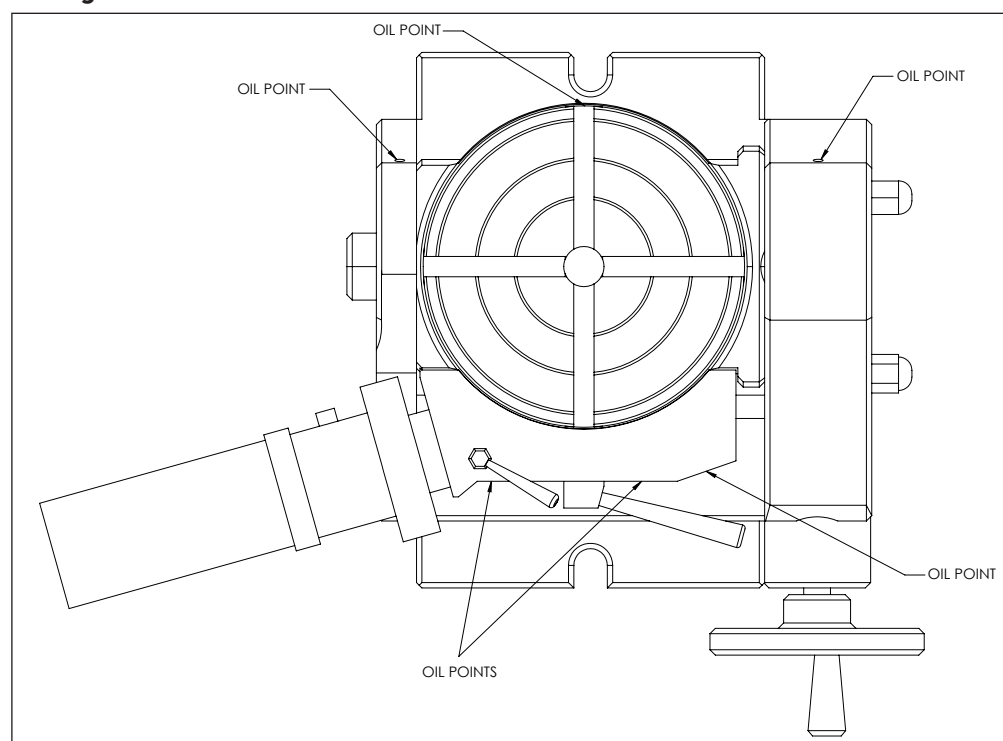


Figure 21

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Ball Zerks (all tables)

Using a trigger-style oil can (included), fill the Ball Zerk oil fittings (see **Figure 23** and **inset**). Depress the zerk's spring-loaded ball with the tip of oil can and pump until there is back pressure.

The oil reservoir (Standard table) is filled via the Oil Plug (see **Figure 20** and **Figure 24**). The oil reservoir should be filled with the table oriented (horizontal/vertical) as it will be used. With the table in the horizontal position, fill the reservoir halfway up the Oil Sight Glass (see **Figure 25**). With the table in the vertical position fill the reservoir until oil just begins to leak out at the bottom of the table. If overfilled, the reservoir will slowly leak oil until it reaches the proper level.

Super Spacer Table

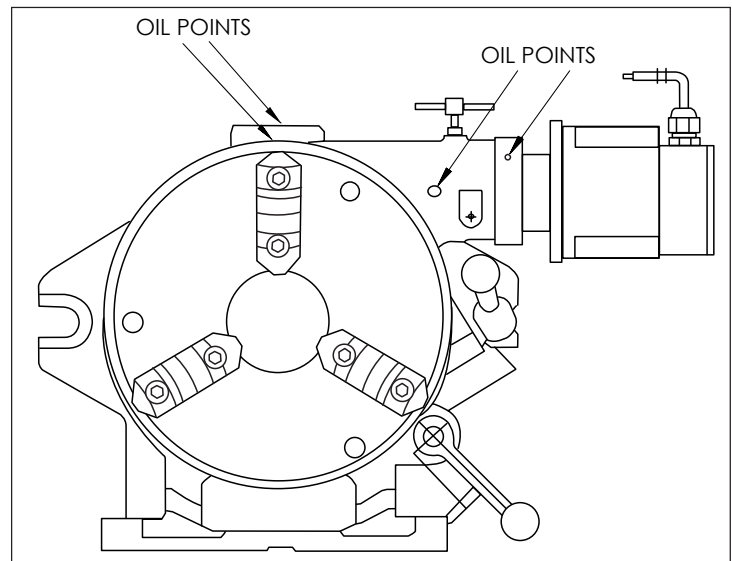


Figure 22

NOTE: When the oil reservoir is filled with the rotary table in the horizontal position, and then the rotary table is shifted to a vertical position, oil will leak out.

Place the rotary table in a pan or on a stack of newspaper until the excess oil has drained out (this may take a day or two). The rotary table can be used while oil is leaking out. Tilting Tables have six Oil Points, while Super Spacer tables have four. Neither table has an oil reservoir like the Standard Table.

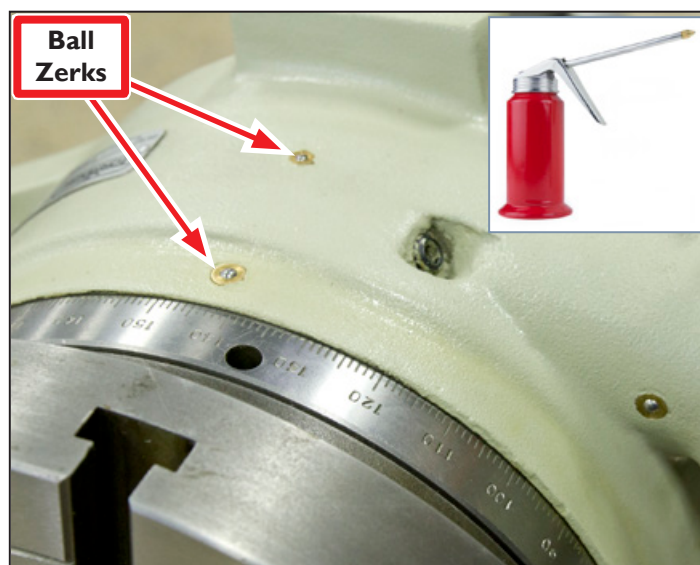


Figure 23

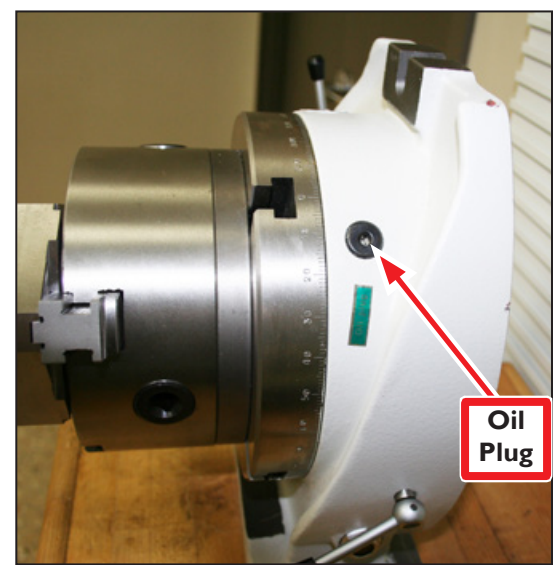


Figure 24

TECHNICAL DOCUMENT

IMPORTANT: Because Tilting and Super Spacer tables do not have an oil reservoir; frequent oiling is required.

Adjusting Backlash

⚠ CAUTION! Pre-mature Rotary Table Wear: Be sure to adhere to backlash adjustment procedures. Failure to do so could result in machine damage (pre-mature wear on rotary table's ring and worm gear).

Backlash is an important element in managing overall accuracy. The rotary table has a number of internal sliding surfaces that depend on a hydrodynamic oil film for low friction and long life. Similar to the adjustments of the lead screw nut and gibs (on mill or lathe), adjustment of clearances between internal moving parts seeks common ground between extreme precision and long life.

If backlash is adjusted to zero, the worm screw and other parts are subject to excessive wear, friction, and consequently, table stalling. As the screw turns, the oil shears off at the gear interface – with no film to protect against metal-to-metal wear. Correctly adjusted backlash provides both long life and a minimum of backlash.

1. Backlash is adjusted by positioning of the Backlash Adjustment Screw. For the Standard Table, see **Figure 26**; for the Tilting Table, see **Figure 27**; and for the Super Spacer Table, see **Figure 28**.
2. The Backlash Adjustment Screw is accessed by removing the protective cover screw on top of it, or loosen a jam nut.
3. Loosen Backlash Adjustment Screw six turns counterclockwise.
4. Disengage Eccentric Lock and clamp handles.
5. Engage motor/worm gear by grasping it and rotating it fully (counterclockwise on Standard and Tilting tables; clockwise on Super Spacer Table). Verify the table does not turn; the table will not turn if the motor is engaged.
6. With counterclockwise pressure on the motor using one hand (clockwise on Super Spacer table), slowly tighten the set screw until resistance is felt to the pressure.

NOTE: Pay attention as this resistance is subtle.



Figure 25

Standard Table

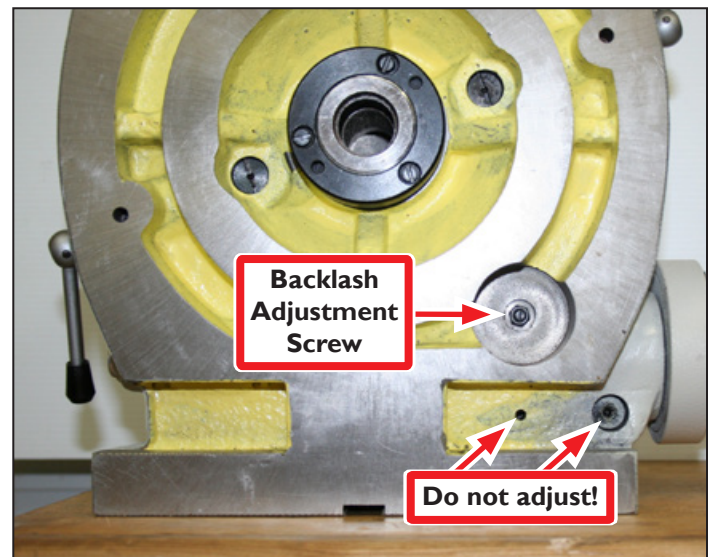


Figure 26

TECHNICAL DOCUMENT

7. At this point, the set screw is just against the worm drive. Tighten the set screw approximately 1/4 turn, which will rotate motor slightly. This step creates a gap between table and worm gear for an oil film.

Alternatively, to set backlash by the numbers, adjust for a minimum backlash of 30 arc-seconds. Measured at the outer circumference of an 8" diameter circle with a dial indicator, 30 arc-seconds will be 0.0006" of lost motion.

- Setting backlash to 60 arc-seconds will sustain a thicker oil film, yielding lower friction and longer life. This would be 0.0012" on the outside of an 8" circle.
- Setting backlash greater than 90 arc-seconds (1.5 arc-minutes) is not recommended; it will do nothing to improve the life of the mechanism and can result in chatter during machining operations.

8. Replace cover screws.

Tilting Table

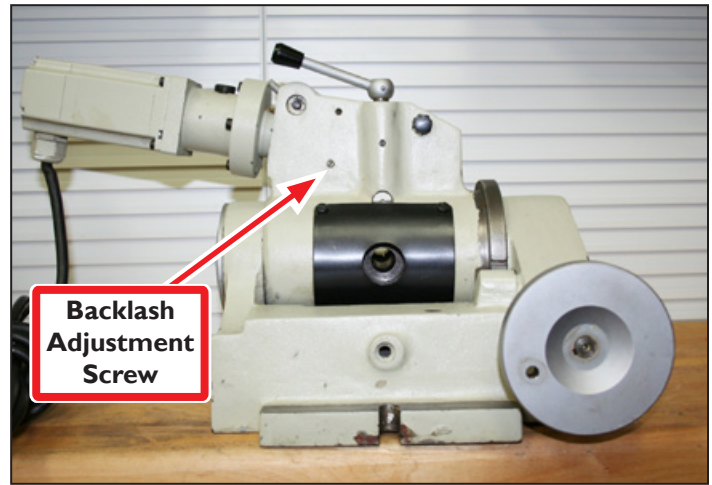


Figure 27

Super Spacer Table

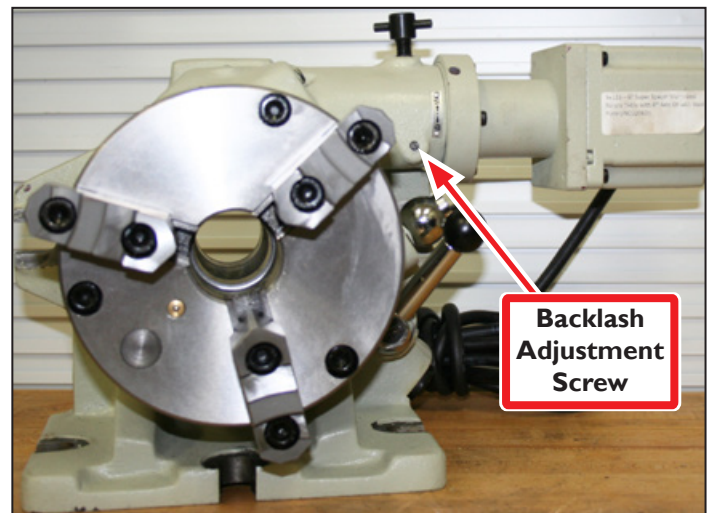


Figure 28

Inspect or Tighten Motor Coupling

In the rare instance where a motor coupling is loose or cracked, this will cause the table to slip relative to motor rotation and subsequently lose position.

1. Remove the set screw on the motor mount (see **Figure 29**).
2. Jog the motor until the first of two coupling screws inside motor mount can be accessed.
3. Tighten screws on coupling.



Figure 29

Motor Coupling Removal

1. If removal is required, loosen the socket head cap screw and the set screw on the motor coupling; do not remove (see **Figure 30**).



Figure 30

2. Detach the motor from the motor mount by removing four mounting screws (see **Figure 31**). Remove the motor with the coupling still attached (see **Figure 32**).
3. With motor out, inspect the coupling and tighten the remaining coupling screws on motor shaft.
4. If coupling is broken, remove motor coupling and replace with 6" rotary table coupling (PN 31840) or 8" rotary table coupling (PN 30715).

Ensuring Water/Coolant Resistance

The electric motor is sealed against cutting fluids. However, the motor, motor cable, and the seam between the rotating table and the base casting should not be subject to constant coolant flow, or exposed to high-pressure coolant jets. Keep the motor body painted, particularly the magnetic laminations in the center. To prevent rust from trapped, water-based coolants on the table base, apply a thin film of oil (WD-40® or similar) to surfaces before set up.

There are several steps that ensure the rotary table remains resistant to water/coolant. Use thread seal tape (PTFE) to seal the set screw on the motor mount (see **Figure 29**). Position the motor so its cord points downward when the motor is engaged. Depending on the operational position (horizontal or vertical), this may require repositioning of the motor with respect to the motor mount. The rotary table is designed to operate in the presence of coolant, but not when submersed in coolant. If coolant is dripping over the edge, this is rarely a problem. If there is a serious external coolant flow, and the joint between the rotating table and the stationary body is submersed, this is a problem.

There is an oil distribution system internal to the rotary table. As the table turns it carries oil over the worm gear. This distribution system does not cover the sliding joint between the rotating table and the body. That joint is similar to the slideways of a mill and has a large, flat surface supported by an oil film. The oil port on the edge of the rotary table (and on the body itself) provides oil to these sliding surfaces. Oiling at those ports on occasion is analogous to pulling the pump handle for oil distribution on the mill. It is important because this film of oil is essential to keep water/coolant away from the sliding joint. If running coolant, then it becomes even more important to occasionally pump some oil in at the oil ports. A combination of heavy flood coolant and never oiling the sliding joints, will result in coolant entering the table. If this happens, simply drain it out and refill it with one of the following: AGMA 2 gear oil, or SAE 30 weight motor oil.



Figure 31



Figure 32

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Coolant contains anti-corrosion agents which protect the table surfaces. A small amount of coolant and oil generally forms an emulsion, with the oil view port showing a milky fluid inside. If the oil gets milky, or if you can see raw coolant inside, drain it and refill with new oil.

Worm Axial Adjustment

To adjust for wear in the worm gear, the lock nut must be adjusted. Location of the lock nut is shown in the exploded views later in this document.

1. Follow the steps in the *Inspecting/Removing Motor Mount and Coupling* section earlier in this document to remove motor and coupling.
2. Apply a dab of grease to the back side of the spacer. Location of the spacer is shown in the exploded views later in this document.
3. Using two spanner wrenches (PN 30485), tighten (or loosen) the lock nuts (see **Figure 33**). Adjust the spacer nut (PN 35557) so there is no axial play when turned by hand (see **Figure 34**) in the worm shaft and the shaft moves freely; Do not overtighten the locknut.

Table Adjustment

On the Standard, Tilting, and Super Spacer tables, test for correct axial adjustment by disengaging the worm and rotating the table by hand; slight drag should be felt. If not, loosen the three screws in the Retaining Plate (see **Figure 35**) two turns with a flathead screwdriver. Next, tighten or loosen Retaining Plate with an Adjustable Pin Spanner Wrench (PN 31118). Rotate the plate clockwise to increase drag and counterclockwise to decrease drag. Location of the aforementioned parts are shown in exploded views later in this document.



Figure 33



Figure 34

TECHNICAL DOCUMENT

Engaging Locking Lugs on Tilting Table

The Tilting Table has two locking lugs. When intentionally or inadvertently moved out of position, the table will not tilt within the full range of motion.

In particular, the more interior locking lug is difficult to realign/fit with the recessed groove. To manually align this lug, manually crank the handle and move the table to a position that allows access to the displaced part.

Using fingers or a small tool, move the locking lug back into place. In its correct orientation, only the cap of the lug will be visible (see **Figure 36** and **Figure 37**).

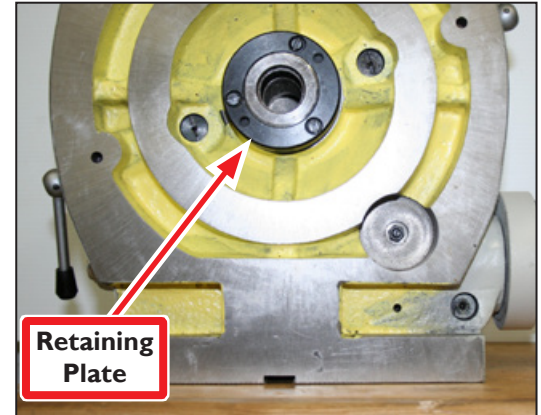


Figure 35

Lug In



Figure 36

Lug Out

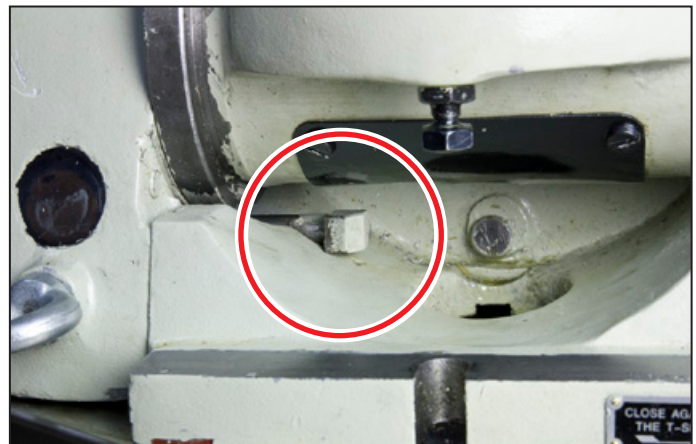


Figure 37

TECHNICAL DOCUMENT

Troubleshooting

Problem: 4th Axis will not move, but other axes operate properly

Possible Cause	Probability	Action to Identify Cause of Problem	Discussion
No power to the table	High	Inspect cord	Ensure motor cord is plugged in to 4th Axis socket.
Loose wires or ribbon cables	Medium	Remove and inspect power and ribbon cable connectors and wires entering and exiting the A-axis drive at both ends.	Tighten loose wires
Table lock(s) engaged	High	Release lock(s)	Standard Table has two locks, Tilting Table has one.
Motor coupling loose or cracked	Low	Inspect and tighten coupling bolts or replace coupling if necessary.	Refer to <i>Inspecting/Removing Motor Coupling</i> section
Worm gear not engaged	High	Engage gear	The gear operates on an eccentric pivot. To engage gear manually, twist motor and motor coupling housing counterclockwise and lock into place with lever (Standard and Tilting tables), and or locking bolt (Super Spacer Table).
Worm gear out of adjustment	Medium	Inspect worm gear adjustment screw and worm gear shaft locknut	Refer to <i>Adjusting Backlash</i> and <i>Worm Axial Adjustment</i>
A blown fuse on the DC bus board	Low	Inspect fuse	A blown fuse is usually the result of a bad drive. If a fuse is replaced and it immediately blows, suspect a bad drive or bad wiring to the drive.

TECHNICAL DOCUMENT

Problem: 4th Axis will not move, but other axes operate properly

Possible Cause	Probability	Action to Identify Cause of Problem	Discussion																					
Defective motor or motor connection	Low	Inspect motor and leads	<p>Remove the motor leads from the connector plug on the drive. Measure the resistance of motor windings and compare to values in the table below. If the resistance is out of range, check wiring carefully. If the wiring is good and the resistance readings are out of range, the motor is defective.</p> <table><tr><th colspan="3">A-axis</th></tr><tr><th>From (Black Probe)</th><th>To (Red Probe)</th><th>Resistance Ω</th></tr><tr><td rowspan="3">320</td><td>321</td><td>0.5-2.0 Ω</td></tr><tr><td>322</td><td>>1 M Ω</td></tr><tr><td>323</td><td>>1 M Ω</td></tr><tr><td rowspan="2">322</td><td>323</td><td>0.5-2.0 Ω</td></tr><tr><td>321</td><td>>1 M Ω</td></tr><tr><td>All Wires Above</td><td>Ground Bar</td><td>>1 M Ω</td></tr></table>	A-axis			From (Black Probe)	To (Red Probe)	Resistance Ω	320	321	0.5-2.0 Ω	322	>1 M Ω	323	>1 M Ω	322	323	0.5-2.0 Ω	321	>1 M Ω	All Wires Above	Ground Bar	>1 M Ω
A-axis																								
From (Black Probe)	To (Red Probe)	Resistance Ω																						
320	321	0.5-2.0 Ω																						
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322	323	0.5-2.0 Ω																						
	321	>1 M Ω																						
All Wires Above	Ground Bar	>1 M Ω																						
Exact stop mode used in program, G-code G61	Low	Examine G-code	<p>Use of Exact Stop Mode has been shown to cause a loss of steps on older mill versions. Avoid using this mode if at all possible. Try slowing down the rates of acceleration and deceleration by a factor of 10 to start and stop more smoothly.</p>																					

TECHNICAL DOCUMENT

Problem: Table Losing Position

Possible Cause	Probability	Action to Identify Cause of Problem	Discussion
Backlash out of adjustment	Medium	Inspect backlash	Refer to <i>Adjusting Backlash</i> section
Coupling screws not tight	Medium	Inspect motor coupling	Follow steps 1-6 in <i>Inspecting/Removing Motor Coupling</i> section. Completely remove motor coupling from motor. The coupling must be removed from motor in order to inspect all four set screws.
Coupling access plug in too far.	Low	Inspect plug	There is an access port used to tighten the worm-motor coupling. If the plug in the access hole is in too far, it binds on the coupling.

Problem: Table Rotation Direction Incorrect

Possible Cause	Probability	Action to Identify Cause of Problem	Discussion
Motor Wiring	Medium	Check motor wiring	Set motor wiring per <i>Electrical Installation</i> section. Reversing the leads on either coil will change motor direction.

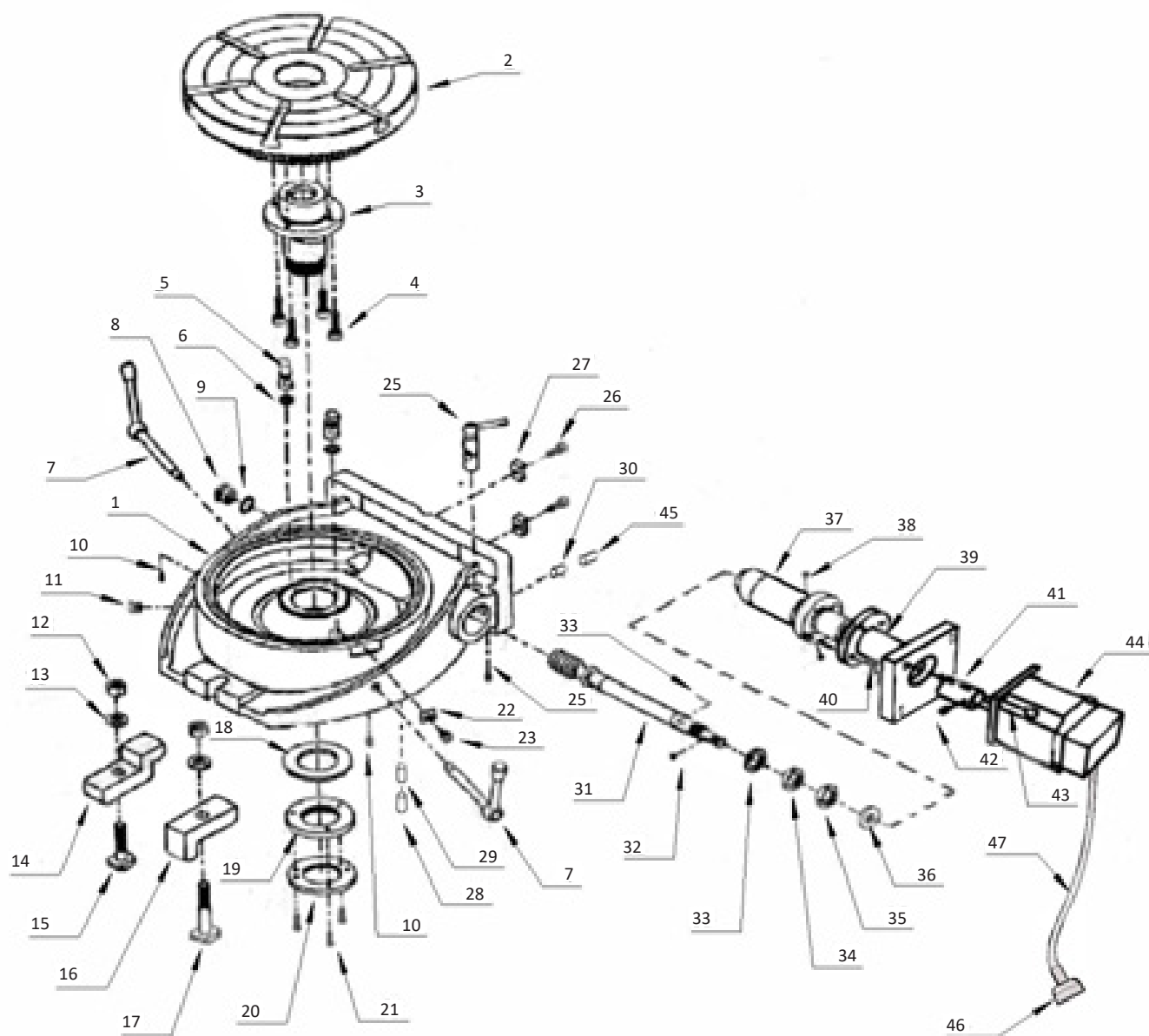
Problem: Table Rotates Correctly in One Direction and Shutters in the Other Direction

Possible Cause	Probability	Action to Identify Cause of Problem	Discussion
Incorrect DIP switch settings	High	Check the DIP switch settings	Check to make sure that the DIP switch settings are set correctly for your motor. Refer to TD10173 for information (provided).

TECHNICAL DOCUMENT

Parts Lists

Standard Rotary Table (exploded view)



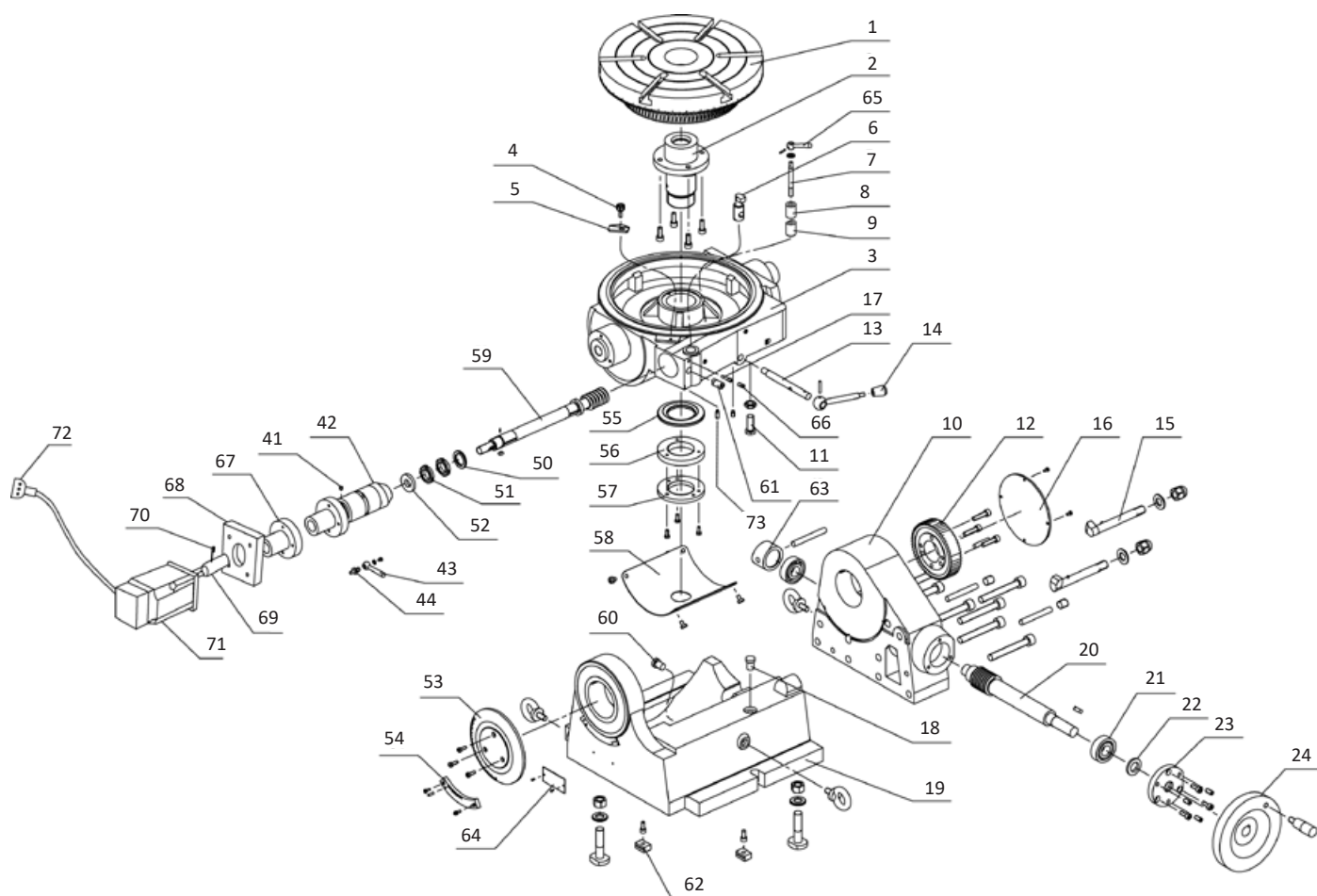
TECHNICAL DOCUMENT

Standard Rotary Table Parts List

Item #	Description	Qty.	Item #	Description	Qty.	Item #	Description	Qty.
1	Base	1	17	T-bolt	1	33	Dowel pin	1
2	Table	1	18	Ring	1	34	Spacer	1
3	Taper sleeve	1	19	Table nut	1	35	Lock nut	2
4	Socket head bolt*	4	20	Retaining plate	1	36	Spacer with keyway	1
5	Table clamp	2	21	Fillister head screw	3	37	Eccentric sleeve	1
6	O-ring dash 110*	2	22	Indicator	1	38	Fillister head screw	2
7	Handle assembly	2	23	Knob	1	39	Motor mount	1
8	Sight glass	1	24	Set screw dog point	1	40	Socket head screw*	4
9	O-ring	1	25	Eccentric lock	1	41	Coupling 6" (PN 31840) 8" (PN 30715)	1
10	Dog point set screw	2	26	Socket head bolt*	2	42	Set Screw*	1
11	Plug	1	27	Locating key	2	43	Socket head screw*	4
12	Hex nut*	4	28	Set Screw*	1	44	Motor complete 6" (PN 32677) 8" (PN 32379)	1
13	Washer	2	29	Backlash Adjustment Screw (PN 34380)	1	45	Oil plug	1
14	Clamp	1	30	Block	1	46	Power plug	1
15	T-bolt	1	31	Worm gear	1	47	Cable	1
16	L-clamp	2	32	Key	1	(not shown)	Oil fitting (PN 35220)	

*Standard hardware items

Tilting Rotary Table (exploded view)



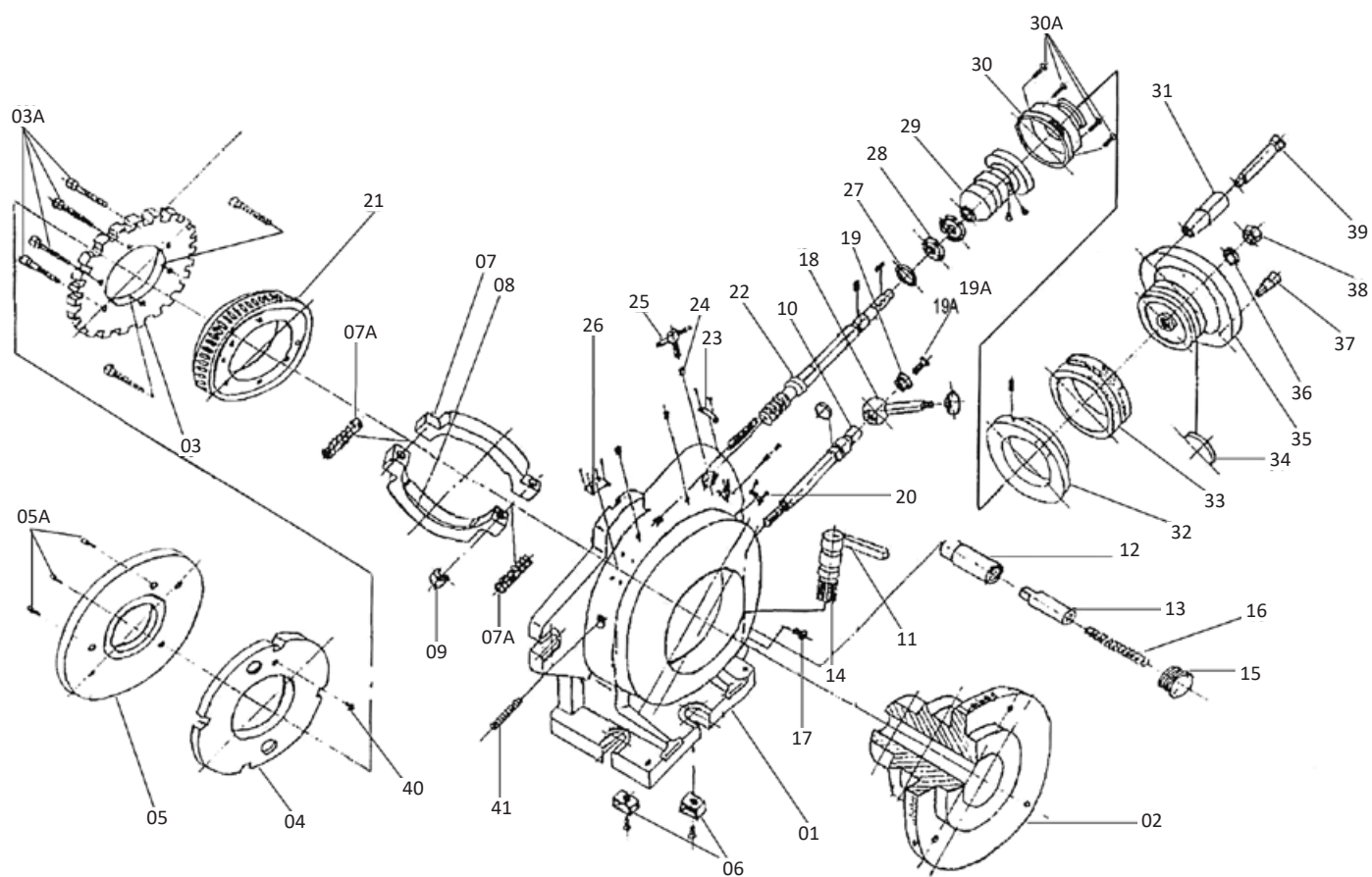
TECHNICAL DOCUMENT

Tilting Rotary Table Parts List

Item #	Description	Qty.	Item #	Description	Qty.	Item #	Description	Qty.
1	Table	1	20	Screw bar	1	60	Positioning block	1
2	Taper sleeve	1	21	Bearing	1	61	Pin	1
3	Base	1	22	Sealing	1	62	Locating key	2
4	Knob	1	23	Cover	1	63	Block	1
5	Indicator	1	24	Handle wheel	1	64	Name plate	1
6	Table clamp	1	41	Pin	1	65	Eccentric lock	1
7	Bolt	1	42	Eccentric sleeve	1	66	Bolt	1
8	Locking pad	1	43	Handle	1	68	Socket head screw	1
9	Locking pillar	1	44	Bolt	1	69	Motor coupling 6" (PN 31840) 8" (PN 30715)	1
10	Supporter	1	50	Spacer	1	70	Set screw	2
11	Positioning screw	1	51	Spanner nut	2	71	Motor complete 6" (PN 32677) 8" (PN 32379)	1
12	Helical gear	1	52	Spacer	1	72	Power plug	1
13	Eccentric axle	1	53	Indicate plate	1	(not shown)	Oil Fitting (PN 35220)	
14	Table clamp handle	1	54	Vernier	1			
15	Locking lug	2	55	Spacer	1			
16	Cover	1	56	Locating nut	1			
17	Backlash adjustment screw (PN 34380)	1	57	Locating nut				
18	Positioning block	1	58	Cover				
19	Base	1	59	Worm gear				

TECHNICAL DOCUMENT

Super Spacer Rotary Table (exploded view)



TECHNICAL DOCUMENT

Super Spacer Rotary Table Parts List

Item #	Description	Item #	Description	Item #	Description
1	Body	14	Gear shaft	29	Eccentric sleeve
2	Spindle	15	Cover	30	Shaft sleeve
3	Index plate	16	Spring	31	Set screw
3A	Screw	17	Screw	32	Backlash adjustment screw (PN 34380)
4	Masking plate	18	Clamp handle	40	Locating pin for masking plate
5	Bumper plate	19	Bushing	41	Screw
5A	Screw	19A	Screw	(not shown)	Oil fitting (PN 35220)
6	Centering key w/ screw	20	Vernier scale		
7	Brake shoe	21	Ring gear		
7A	Spring	22	Worm gear		
8	Brake shoe	23	Indicating plate		
9	Screw	24	Pin w/ inclined surface		
10	Screw arbor	25	Handle		
11	Index handle	26	Name plate		
12	Sleeve	27	Spacer		
13	Index pin	28	Screw nut		

Integrating with Custom System

The Motor, Cable, Plug, and Pinout are shown in **Figure 40**. Motor wiring is shown in the corresponding *Motor Wiring Chart* below.

- The cable plug is: AMP CPC series 211400-1
- The mating receptacle is: AMP CPC series 211398-1

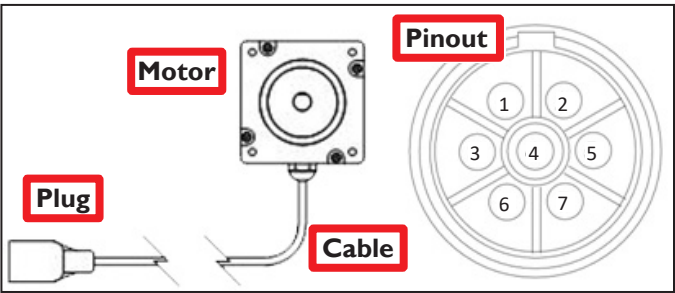


Figure 38

Motor Wiring Chart

Plug Pin	Cable	Motor Connection	Motor Function
1	White 1	Red	Phase A+
2	Black 1	White	Phase A-
3	NC	—	NC
4	Shield	Case	Case ground
5	NC	—	NC
6	White 2	Yellow	Phase B+
7	Black 2	Green	Phase B-