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Technical Document

CNC Tapping Guidelines

Product Identification: Tormach Reversing Tapping Head by Proconier (PN 32657), Modular Tension/Compression Tapping Head Kit (PN 31807), TTS-ER16 Tension/Compression Tapping Head (PN 32020), TTS-ER20 Tension/Compression Tapping Head (PN 32021)

Purpose: The purpose of this document is to provide an overview on the use of Tormach’s tapping head options for PCNC 1100 and PCNC 770 mills.

| PN | Item | Description |
|-------|--|---|
| 32657 | Tormach Reversing Tapping Head by Proconier | Industrial, high-duty cycle tapping head made exclusively for Tormach in the USA by Proconier Safety Chuck. Not compatible with Automatic Tool Changer (ATC). |
| 31807 | Modular Tension/Compression Tapping Head Kit | Modular system with quick change collets. Collets can be pre-loaded with taps for quick changeover with a single tension/compression tapping chuck. ATC compatible. |
| 32020 | TTS-ER16 Tension/Compression Tapping Head | Low profile tension/compression tap holders that use ER20 or ER16 collets. Dedicated to a single tap. ATC compatible. |
| 32021 | TTS-ER20 Tension/Compression Tapping Head | |

Proconier TruTAP™

Proconier TruTAP is a high-speed, auto-reversing tapping head (see **Figure 1**) for use in the following cases:

- A large number of tapped holes of the same size and pitch is required, or a PCNC 1100 or PCNC 770 mill is used as a dedicated CNC tapping station. Once installed, the Proconier TruTAP cycle time is reduced by up to 25 percent when compared to a tension/compression tapping head. Provides long life and repeatable performance.
- Small tapped holes (#0-#5, M2-M5). The clutch mechanism on an auto-reversing head minimizes tap stress, reducing the chance of small taps breaking during retraction when compared to a tension/compression tapping head.

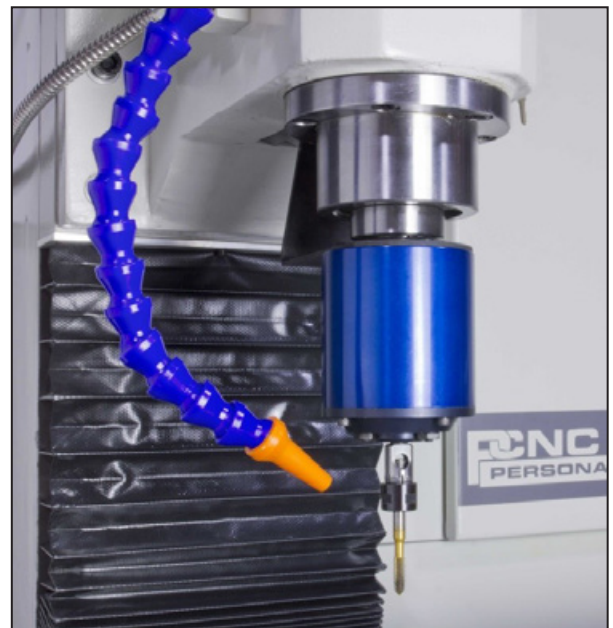


Figure 1

Operation

The Proconier TruTAP kit is shown in **Figure 2**.



Figure 2

1. Identify Torque Arm and Tapping Head (both included) as shown in **Figure 3**.
2. Using an M4 hex wrench, remove three screws on top of the Tapping Head (see **Figure 3**); set aside.
3. Place Torque Arm over 3/4" arbor on Tapping Head as shown in **Figure 3**; fasten securely with three screws removed in step 2.

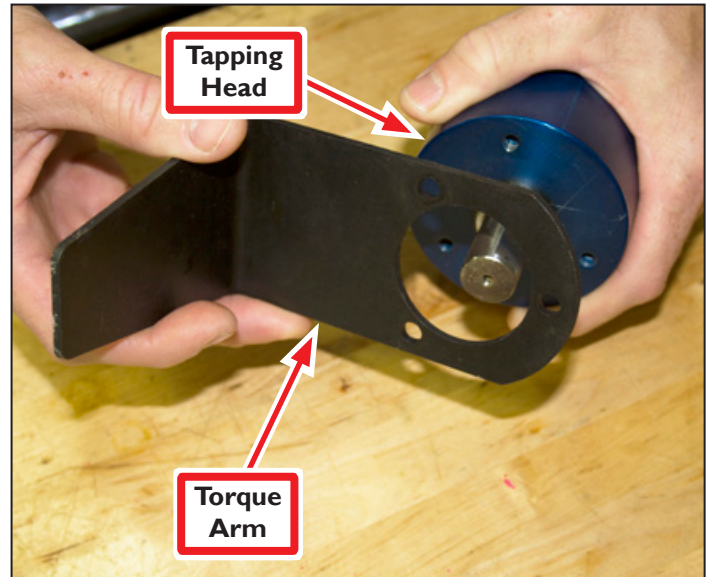


Figure 3

4. Using wrenches (included), remove Collet Retention Nut from Tapping Head as shown in **Figure 4**; set aside.
5. Select correct size Collet for Tap.
6. Loosely insert Tap into Collet; place into Tapered Receiver on the bottom of Tapping Head (see **Figure 4**).

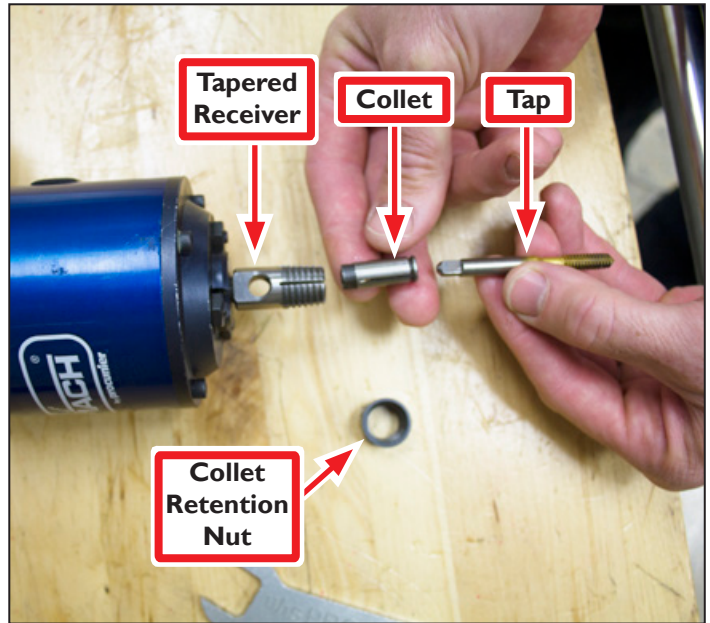


Figure 4

7. Slowly twist Collet until flats align with the flats on the inside of Tapered Receiver; at this point, Collet is fully seated in Tapered Receiver (see **Figure 5**).
8. Adjust final position of Tap.

NOTE: It is advised to completely insert the Tap so the Collet grips as firmly as possible along the entire length of the Collet.

9. Using wrenches, securely tighten Collet Retention Nut set aside in step 4.

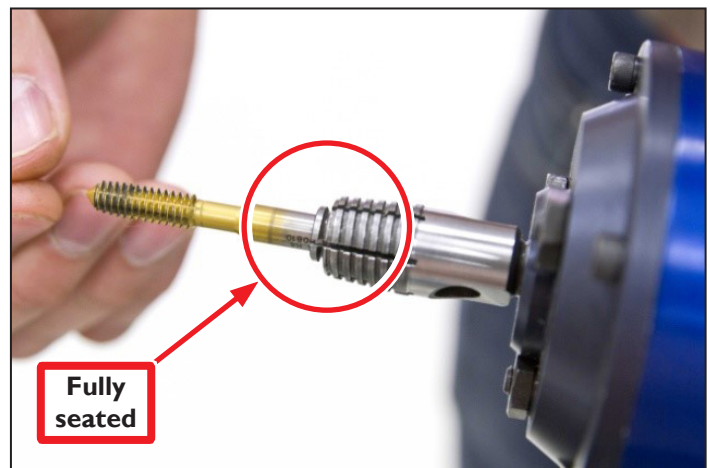


Figure 5

10. Install Tapping Head into spindle; position Torque Arm inside cavity on the underside of Head Casting (see **Figure 6**).

NOTE: For advanced operation information, disassembly instructions, and a complete parts list, refer to the Proconier TruTAP documentation included with product.

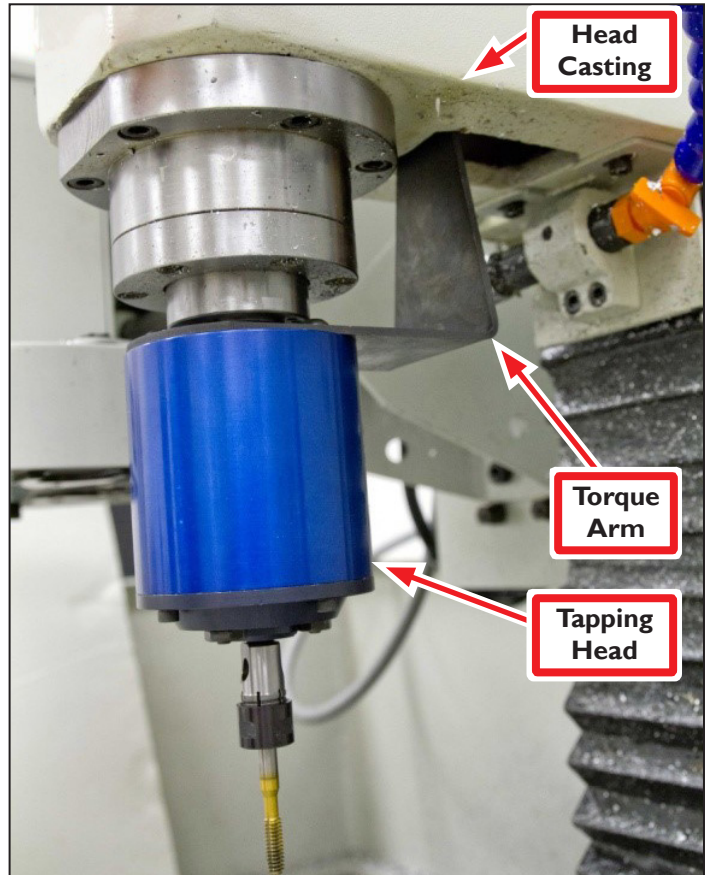


Figure 6

Programming Examples, Proconier TruTAP

Long-hand Code

This is the preferred method for programming for generic CNC operation.

Example:

```
(Tap: 1/4-20)
N10 G90 G80 G40 G54 G20 G17 G50 G94 G64
N20 M3 S1000
N30 G0 X2 Y2 Z.1
N40 G1 Z-.5 F50
N50 Z.1 F100
N60 G0 X3 Y2
N70 G1 Z-.5 F50
N80 Z.1 F100
N50 M30
```

```
(Safety block)
(Spindle on CW)
(Rapid to Above 1st Hole)
(Begin Tapping 1st Hole)
(Retract, 2x Feed)
(Rapid to Above 2nd Hole)
(Begin Tapping 2nd Hole)
(Retract, 2x Feed)
(Program End)
```


Tension/Compression Tapping

Tension/compression tapping heads are mechanically simple in operation as they rely on springs to provide axial float. The Modular Tension/Compression Tapping Head Kit (PN 31807) is shown in **Figure 7**.

The float allows the tap to maintain the correct position when it experiences moderate deviations in RPM from the actual programmed value. They are ideal for the following situations:

- Occasional tapping. Collets can be quickly changed; interchangeable collets accommodate a wide range of tap sizes and the tapping heads require minimal effort to maintain.
- Use with an ATC. Tension/compression tapping heads do not require the use of a stop collar, so they can be seamlessly integrated into an ATC.



Figure 7

IMPORTANT! Do not use tension/compression tapping heads with PCNC 1100 Series 1 mills unless the Spindle Drive Upgrade Kit (PN 31090) has been installed. For questions about compatibility with other brands, consult with machine manufacturer to ensure spindle acceleration and deceleration is appropriate.

TTS ER20 and TTS ER16 Tap Holders

ER20 and ER16 collets are self-extracting collets used for tap retention.

Operation

Before a tool can be installed, the Collet must be mounted in the Nut (see **Figure 8** and **Figure 9**):

1. Holding Collet at an angle (see **Figure 8**), tip Collet to snap into place in Nut as shown in **Figure 8**.
2. Insert assembly into collet holder. Tools are inserted into self-extracting Collet at location indicated in **Figure 9**.

IMPORTANT! If above steps are not followed, Collet/Nut may be damaged and holding capacity reduced.

NOTE: Collet nut is intentionally bored asymmetrical. This allows Collet to self extract as the Nut is loosened.

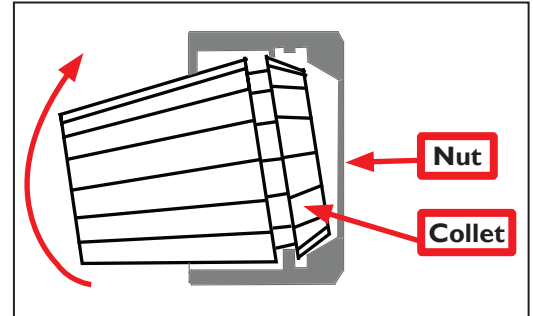


Figure 8

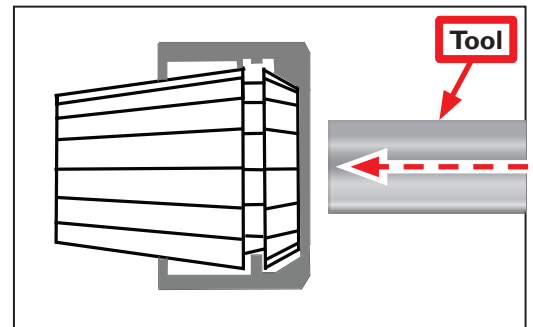


Figure 9

Modular Tension/Compression Tapping Head

The tension/compression tapping head set is a modular tool holding system consisting of a TTS tapping chuck and quick-change collets. The tapping range for the set is #0 - 1/2" (M1.6-M12). The total distance of float built into the tap is approximately 0.75".

Operation

1. Choose a collet (included) that most closely matches shank and square size of tap. The tap should seat firmly and securely in the collet. Consult the *Tension/Compression Tapping Collets* table for collet compatibility with taps. Each collet is marked in the following manner: hole diameter (mm) × square size (mm) as shown in **Figure 10**.

NOTE: The set is compatible with both metric and inch taps manufactured to the ANSI standard.



Figure 10

Tension/Compression Tapping Collets

| PN | Hole Diameter (mm) | Square Size (mm) | ANSI Inch Tap | ANSI Metric Tap |
|-------|--------------------|------------------|---------------|-----------------|
| 31164 | 3.58 | 2.79 | #0-#6 | M1.6-M3.5 |
| 31165 | 4.27 | 3.33 | #8, 5/32" | M4 |
| 31166 | 4.93 | 3.86 | #10, 3/16" | M4.5, M5 |
| 31167 | 5.59 | 4.19 | #12, 7/32" | — |
| 31168 | 6.48 | 4.85 | 1/4" | M6, M6.3 |
| 31169 | 8.08 | 6.05 | 5/16" | M7, M8 |
| 31170 | 9.68 | 7.26 | 3/8" | M10 |
| 31171 | 8.20 | 6.15 | 7/16" | M11 |
| 31172 | 9.32 | 6.99 | 1/2" | M12, M12.5 |

- Depress the locator sleeve and insert the tap into the Collet. When the locator sleeve is released, the tap will be held firmly in the Collet.
- Firmly press and twist the Collet against the Tapping Head until Teeth engage and the collar snaps into place (see **Figure 11**).
- To remove the tap, depress the locator sleeve and pull out the tool.
- To remove the collet, slide the sleeve collar against the body of the collet.



Figure 11

Slip Adjustment

Before using a collet for the first time, ensure that the slip adjustment is as tight as possible. If the tap becomes loose as it is fed into a hole, it can be driven into the back of the tapping head and damage the unit.

1. To tighten the slip adjustment, carefully remove the Spring Clip from the collet and use pin spanner wrench (included) to tighten or loosen the adjustable nut (see **Figure 12**).
2. Replace the Spring Clip to secure the nut in place, taking care to ensure that the one of the slots in the nut aligns with a hole in the collet body so the clip can be replaced.

NOTE: When tapping with very small taps, it can be advantageous to tune the slip compensation to allow the tap to slip if over-torqued. When used correctly, this may save the tap and preserve the integrity of the threads.

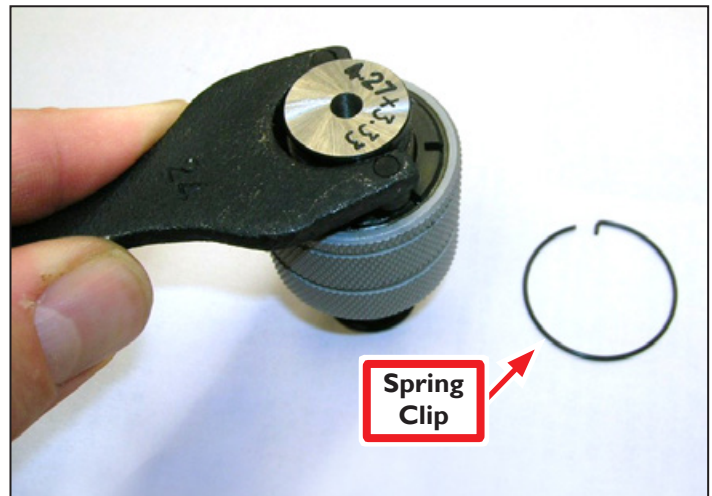


Figure 12

Programming Examples, Tension/Compression Tapping Head

Long-hand Code

This is the preferred method for general tapping.

(Tap: 1/4 20)

```
N10 G90 G80 G40 G54 G20 G17 G50 G94 G64
N20 M3 S400
N30 G0 X2 Y2 Z.1
N40 G1 Z-.5 F20
N50 M4 S400
N60 G4 P.5
N70 Z.1 F20
N80 M3 S400
N90 G4 P.5
N100 G0 X3 Y2
N110 G1 Z-.5 F20
N120 M4 S400
N130 G4 P.5
N140 Z.1 F20
N150 M30
```

```
(Safety block)
(Spindle on CW)
(Rapid to Above 1st Hole)
(Begin Tapping 1st Hole)
(Reverse Spindle Direction)
(Dwell, 0.5 Second)
(Retract)
(spindle on CW)
(Dwell, 0.5 Second)
(Rapid to Above 2nd Hole)
(Begin Tapping 2nd Hole)
(Reverse Spindle Direction)
(Dwell, 0.5 Second)
(Retract)
(Program End)
```




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G84 Tapping Cycle

G84 is designed for use with rigid tapping; however, it can also be used with success when utilizing a tension/compression head. A dwell time is automatically calculated when using.

```

(Tap: 1/4 20)
N10 G90 G80 G40 G54 G20 G17 G50 G94 G64      (Safety block)
N20 M3 S400                                  (Spindle on CW)
N30 G0 X2 Y2 Z.1                             (Rapid to Above 1st Hole)
N40 G84 Z-.5 R.1 F20                         (Tapping 1st Hole)
N50 X3 Y2                                     (Tapping 2nd Hole)
N60 M30                                       (Program End)

```

G84 in PathPilot™

Automatic dwell can be overridden by using a P word on the G84 line (e.g., G84 on P2) where the P value is the dwell in seconds.

General Tapping Tips

The following tips are applicable to all machine tapping applications.

Calculating Feed Rate

It is very important to use the correct feed rate. The feed rate for a specific tap is calculated as follows:

For Inch Taps: Feed Rate (IPM) = Spindle Speed (RPM)/Threads Per Inch (TPI)

- For Example, 1/4x20 tap programmed for 500 RPM will need to be feed at 25 IPM

For Metric Taps: Feed Rate (mm/min) = Spindle Speed (RPM) × Metric Pitch

- For Example, M5x0.8 tap programmed for 500 RPM will need to be fed at 400 mm/min

Verifying Spindle Speed

Confirm that the commanded spindle speed is at or near the actual spindle speed.

1. Mark the spindle with reflective tape.
2. Using a tachometer, aim at the mark with the spindle running and verify that the observed spindle RPMs match those commanded with the S word. A close match will provide the best tapping results, especially when tapping longer thread lengths.

IMPORTANT! A mismatch between the Spindle Range button and actual spindle belt position will result in the commanded speed being different from the indicated RPMs.

- Using a small flat-bladed screwdriver, turn the Trim Potentiometer Screw on the machine control board (see **Figure 13**) to adjust spindle speed.

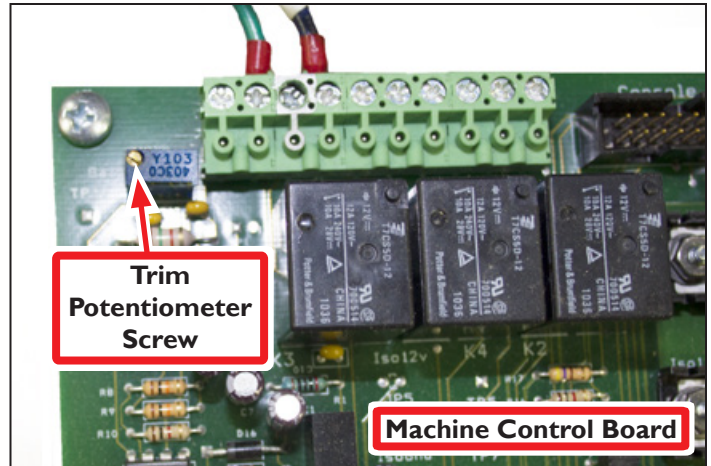


Figure 13

Tool Geometry

Always use high quality taps designed for CNC operation. A hand tap is more likely to break when used in a CNC application.

Tap manufacturers produce many styles of taps in different materials and geometries. Refer to tap suppliers' recommendations when choosing or using a tap. Tapping charts are available from many tap suppliers and are often freely available for download. Consult these as needed to aid with tap and drill selection.

Chip Clearance/Chip Evacuation

Make sure there is room for chip evacuation. This is especially important when bottom threading blind holes, threading deep holes, or both. Consider using a spiral tap for blind tapping.

Hard vs. Soft Materials

It can be much more difficult to tap hard materials. Use sharp tools and consult tap manufacturer's guidelines for recommended geometries.

Lubrication

It is important to keep the tap lubricated while it is cutting. Ensure that the tap receives plenty of cutting fluid. Dry tapping is generally not recommended; consult tap manufacturer's recommendations.



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Choosing Correct Drill

Consult a tap/drill chart to choose an appropriate sized drill for a tapped hole. It is sometimes advised to use a larger drill when tapping very small holes. This will reduce tap stress, but at the expense of the ultimate strength of the threaded connection illustrates how thread quality changes can change with different drilled hole diameters.

Drilled holes will generally have some amount of oversize resulting from the wandering of the drill tip during entry. The size and concentricity of a drilled hole prior to tapping will effect on the strength of a threaded connection. This can be reduced by using high quality precision drills, and by drilling twice; that is, drilling first with a slightly smaller pilot drill and then re-drilling with the correct sized hole to eliminate most oversize error associated with drill wandering.

| Tap Size | Drill Size | Decimal Drill Size (in.) | Theoretical Thread % | Probable Oversize (in.) | Probable Hole Size (in.) | Probable Thread % |
|----------|------------|--------------------------|----------------------|-------------------------|--------------------------|-------------------|
| 1/4 - 20 | 9 | .1960 | 83 | .0038 | .1998 | 77 |
| | 8 | .1990 | 79 | | .2028 | 73 |
| | 7 | .2010 | 75 | | .2048 | 70 |
| | 13/64 | .2031 | 72 | | .2069 | 66 |
| | 6 | .2040 | 71 | | .2078 | 65 |
| | 5 | .2055 | 69 | | .2093 | 63 |
| | 4 | .2090 | 63 | | .2128 | 57 |

Different drill combinations with the same tap will produce different threads.