NTK

INNOVATIVE THREAD WHIRLING

Single Pass

Double Lead Screw

Three Times Faster

Swiss Tooling Specialist

App for iOS
App for ANDROID
WATCH ON
NTKCUTTINGTOOLS.com
youtube.com/NTKCUTTINGTOOLS
Threading

Thread Whirling

Features

- NTK’s unique patented design technology makes precise and correct inserts possible the first time, **without any redesign or remanufacturing even if it is a multiple-lead thread**

- The sharper cutting edges produce a better surface finish and longer tool life than competitor’s inserts

Form Double-lead or Multiple-lead with Single Pass

<table>
<thead>
<tr>
<th></th>
<th>Double-lead threads</th>
<th>Triple-lead threads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work</td>
<td>Bone screw</td>
<td>Worm gear</td>
</tr>
<tr>
<td>Work material</td>
<td>Ti-6Al-4V ELI</td>
<td>brass</td>
</tr>
<tr>
<td>Work appearance</td>
<td><img src="image1.png" alt="Image of work appearance" /></td>
<td><img src="image2.png" alt="Image of work appearance" /></td>
</tr>
<tr>
<td>Insert appearance</td>
<td><img src="image3.png" alt="Image of insert appearance" /></td>
<td><img src="image4.png" alt="Image of insert appearance" /></td>
</tr>
<tr>
<td>Major Dia.</td>
<td>(0.157)&quot;(4.0\text{mm})</td>
<td>(0.278)&quot;(7.0\text{mm})</td>
</tr>
<tr>
<td>Minor Dia.</td>
<td>(0.094)&quot;(2.4\text{mm})</td>
<td>(0.185)&quot;(4.7\text{mm})</td>
</tr>
<tr>
<td>Lead [Pitch×No. of Lead]</td>
<td>(0.135)&quot;(3.42\text{mm}) ([0.067\times2(1.71\text{mm}×2)])</td>
<td>(0.193)&quot;(4.9\text{mm}) ([0.064\times3(1.63\text{mm}×3)])</td>
</tr>
</tbody>
</table>

- Can reduce cycle time by more than half
- NTK can achieve what other competitors cannot

Double-lead Bone Screw Process Example

1. 1st thread whirl at taper part
2. Rotate the bar 180° and whirl the 2nd thread on same part as 1
3. Thread whirl whole straight part
4. Thread whirl at very last part to get two-exits, after back of bar has been backed up a half lead (one pitch) and rotated 180°
Special Item Capability

- Even though almost all bone screw shapes are special, NTK thread whirling inserts can make the correct shape of thread the first time, without any redesign or remanufacturing.
- Inserts will be delivered in 5 weeks after the order is received.
- Within a 3 week time period, expedite delivery is available with an expedite fee.
- Basically NTK thread whirling inserts are ground with topping and coated.

Recommended Cutting Conditions

<table>
<thead>
<tr>
<th>Conditions</th>
<th>No. of teeth</th>
<th>Conditions</th>
<th>RPM</th>
<th>F</th>
<th>RPM</th>
<th>Feed Rate</th>
<th>Bar stock</th>
<th>Work Material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9</td>
<td>6</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ti-6Al-4V ELI / 316SS / Titanium</td>
</tr>
<tr>
<td>Main spindle</td>
<td>RPM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 - 40</td>
<td>10 - 25</td>
<td>7 - 15</td>
<td>Faster RPM reduces machining time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5400 - 14400</td>
<td>3600 - 9000</td>
<td>2500 - 5400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whirling cutter</td>
<td>RPM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1500 - 4000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed Rate</td>
<td>Same as thread-lead</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bar stock</td>
<td>φ</td>
<td>~φ.400&quot; *</td>
<td>~φ.200&quot; *</td>
<td>For cutter with φ12㎜ ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work Material</td>
<td></td>
<td>Ti-6Al-4V ELI / 316SS / Titanium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Formula for calculating thread whirling process time

\[ T \text{ (Seconds)} = \frac{60 \times \text{Thread length}}{\text{Main spindle rpm} \times \text{Feed rate (Thread lead)}} \]

Ex.) Double lead / 2" length / .100" lead (2×.050" pitch) / 30 rpm

\[ T \text{ (Seconds)} = \frac{60 \times 2}{30 \times .100"} = 40 \text{ Seconds} \]

Applicable Thread Geometry (Approximated)

- Lead: 1-3 leads
- Helix Angle: About 30° (Subject to machine and spindle specifications)
- Thread Height: About 0.98" (Lead)
- Pitch: About 0.248" (Lead)
- Bar Stock Diameter: About φ .394" (For cutters with 12mm ID)
- Depth of Cut: About .157" per side

The geometries shown above are approximated and could vary by actual applications.
## Thread Whirling System

### Type 1
- **Machine make**: CITIZEN
- **Model**: M32-VIII
- **Location**: Gang
- **Spindle make**: BTW-4000
- **Helix angle**: 0° - 15°
- **Thread whirling system**: TWC9C0746HP1
- **No. of tooth**: 9
- **φ D**: 12
- **P.C.D.**: φ 46
- **Mount adapter bolt**: M3

### Type 2
- **Quick-change Machine**
- **Make Model Location Spindle make Spindle model Helix angle NTk Thread Whirling system Stock No. of tooth φ D P.C.D. Mount adapter bolt**
- **CITIZEN**
  - **Model**: BTW-3000
  - **Helix angle**: 0° - 15°
  - **Thread whirling system**: TWC9C1037P2
  - **No. of tooth**: 9
  - **φ D**: 12
  - **P.C.D.**: φ 37
  - **Mount adapter bolt**: CS0310(M3)

### Type 3
- **Quick-change Machine**
- **Make Model Location Spindle make Spindle model Helix angle NTk Thread Whirling system Stock No. of tooth φ D P.C.D. Mount adapter bolt**
- **STAR**
  - **Model**: 54178
  - **Helix angle**: ±10°
  - **Thread whirling system**: TWC9S1640P2
  - **No. of tooth**: 9
  - **φ D**: 12
  - **P.C.D.**: φ 40
  - **Mount adapter bolt**: CS041485(M4)

### Notes
- For single-corner inserts only
- Provided with spindle
- (Provided with spindle)
- (Provided with spindle)
### Spare Insert Holder (Cartridge)

<table>
<thead>
<tr>
<th>Item number</th>
<th>No. of tooth</th>
<th>φDc (㎜)</th>
<th>Compatible cutters</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWC6HP2</td>
<td>6</td>
<td>12</td>
<td>For Type 2 and Type 3*</td>
</tr>
<tr>
<td>TWC9HP2</td>
<td>9</td>
<td>12</td>
<td>For Type 2 and Type 3*</td>
</tr>
<tr>
<td>TWC9HP2-D16</td>
<td>9</td>
<td>12</td>
<td>For Type 6</td>
</tr>
</tbody>
</table>

Note: Insert holder comes with insert screws and wrench. Insert holder mounting screw is not included. Cannot be used for TWC9TS20550P2, TWC9TO12050P2-D18 and TWC9HA22594P2.

### Spare Parts

<table>
<thead>
<tr>
<th>Item number</th>
<th>Description</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSI17-2.2×6.0</td>
<td>Insert Screw</td>
<td>For 4㎜ thick inserts</td>
</tr>
<tr>
<td>FSI24-2.2×7.9</td>
<td>Insert Screw</td>
<td>For 6.5㎜ thick inserts</td>
</tr>
<tr>
<td>T-07</td>
<td>Wrench</td>
<td></td>
</tr>
<tr>
<td>C50309-TW</td>
<td>Insert Holder Mounting Bolt</td>
<td></td>
</tr>
</tbody>
</table>

### NTK’s Unique Attachment System

NTK’s whirling insert holder can be attached and detached without removing mounting screws.

1. Loosen the Mounting Screws
2. Rotate the Insert Holder 10 degrees
3. Detach the Insert Holder without removing the Mounting Screws

● Stock  ○ 1-2 week delivery
**Threading**

**Basic Insert Grade**

**ZM3**

- ZM3 is our basic grade for NTK thread whirling
- ZM3 offers excellent surface finish
- NTK can make inserts with other coatings to meet customers demands

**NTK Experiences and Solutions Example**

For absolute flat on OD

- Two insert combination brings absolute flat on OD to meet the drawing

For tiny thread

- NTK’s Thread Whirling system can machine small diameter multi-lead screws to spec, with lower tool pressure, by using several types of specially designed and accurately ground inserts on the cutter.

**Standard Thread Whirling Inserts (two-sided) for ISO Style Threads**

(Note: Must use Thread whirling cutters with 12㎜ φDm dimension. See page U18-19 to find φDm for each cutter.)

<table>
<thead>
<tr>
<th>Item number</th>
<th>ISO Standard</th>
<th>(d_1)</th>
<th>(d_5)</th>
<th>(P)</th>
<th>(e)</th>
<th>(r_4)</th>
<th>(r_5)</th>
<th>(\alpha)</th>
<th>(\beta)</th>
<th>Supposition material Dia.</th>
<th>Coated Carbide</th>
<th>ZM3</th>
</tr>
</thead>
<tbody>
<tr>
<td>TW5835-HA1.5-D12</td>
<td>HA1.5</td>
<td>1.5(\pm_{0.15})</td>
<td>1.1(\pm_{0.1})</td>
<td>0.5</td>
<td>0.1</td>
<td>0.3</td>
<td>0.1</td>
<td>35°</td>
<td>3°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW5835-HA2.0-D12</td>
<td>HA2.0</td>
<td>2.0(\pm_{0.15})</td>
<td>1.3(\pm_{0.1})</td>
<td>0.6</td>
<td>0.1</td>
<td>0.4</td>
<td>0.1</td>
<td>35°</td>
<td>3°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW5835-HA2.7-D12</td>
<td>HA2.7</td>
<td>2.7(\pm_{0.15})</td>
<td>1.9(\pm_{0.15})</td>
<td>1</td>
<td>0.1</td>
<td>0.6</td>
<td>0.2</td>
<td>35°</td>
<td>3°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW5835-HA3.5-D12</td>
<td>HA3.5</td>
<td>3.5(\pm_{0.15})</td>
<td>2.4(\pm_{0.15})</td>
<td>1.25</td>
<td>0.1</td>
<td>0.8</td>
<td>0.2</td>
<td>35°</td>
<td>3°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW5835-HA4.0-D12</td>
<td>HA4.0</td>
<td>4.0(\pm_{0.15})</td>
<td>2.9(\pm_{0.15})</td>
<td>1.5</td>
<td>0.1</td>
<td>0.8</td>
<td>0.2</td>
<td>35°</td>
<td>3°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW5835-HA4.5-D12</td>
<td>HA4.5</td>
<td>4.5(\pm_{0.15})</td>
<td>3.0(\pm_{0.15})</td>
<td>1.75</td>
<td>0.1</td>
<td>1</td>
<td>0.3</td>
<td>35°</td>
<td>3°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW5835-HA5.0-D12</td>
<td>HA5.0</td>
<td>5.0(\pm_{0.15})</td>
<td>3.5(\pm_{0.15})</td>
<td>1.75</td>
<td>0.1</td>
<td>1</td>
<td>0.3</td>
<td>35°</td>
<td>3°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW5835-HB4.0-D12</td>
<td>HB4.0</td>
<td>4.0(\pm_{0.15})</td>
<td>1.9(\pm_{0.15})</td>
<td>1.75</td>
<td>0.1</td>
<td>0.8</td>
<td>0.3</td>
<td>25°</td>
<td>5°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW5835-HB6.5-D12</td>
<td>HB6.5</td>
<td>6.5(\pm_{0.15})</td>
<td>3.0(\pm_{0.15})</td>
<td>2.75</td>
<td>0.2</td>
<td>1.2</td>
<td>0.8</td>
<td>25°</td>
<td>5°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW9268-HC2.9-D12</td>
<td>HC2.9</td>
<td>2.79 to 2.9</td>
<td>2.03 to 2.18</td>
<td>1.06</td>
<td>0.1max</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW9268-HC3.5-D12</td>
<td>HC3.5</td>
<td>3.43 to 3.53</td>
<td>2.51 to 2.64</td>
<td>1.27</td>
<td>0.1max</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW9268-HC3.9-D12</td>
<td>HC3.9</td>
<td>3.78 to 3.91</td>
<td>2.77 to 2.92</td>
<td>1.27</td>
<td>0.1max</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW9268-HC4.2-D12</td>
<td>HC4.2</td>
<td>4.09 to 4.22</td>
<td>2.95 to 3.25</td>
<td>1.27</td>
<td>0.1max</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW9268-HD4.0-D12</td>
<td>HD4.0</td>
<td>4.0(\pm_{0.03})</td>
<td>2.92(\pm_{0.03})</td>
<td>1.59</td>
<td>0.1</td>
<td>—</td>
<td>—</td>
<td>45°</td>
<td>10°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>TW9268-HD4.5-D12</td>
<td>HD4.5</td>
<td>4.5(\pm_{0.03})</td>
<td>2.92(\pm_{0.03})</td>
<td>2.18</td>
<td>0.1</td>
<td>—</td>
<td>—</td>
<td>45°</td>
<td>10°</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

- Stock
- 1-2 week delivery
**Application Examples**

### Double-lead Bone Screw

**Work Material:** Ti-6Al-4v ELI

<table>
<thead>
<tr>
<th>Bar Stock Dia.</th>
<th>φ.375</th>
<th>Number of start</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Dia.</td>
<td>φ.157</td>
<td>Helix Angle</td>
<td>28.5°</td>
</tr>
<tr>
<td>Minor Dia.</td>
<td>φ.098</td>
<td>Hand of thread</td>
<td>Right</td>
</tr>
</tbody>
</table>

**Cutting condition**

<table>
<thead>
<tr>
<th>Main Spindle Speed (rpm)</th>
<th>15</th>
<th>Speed of whirling cutter (rpm)</th>
<th>3,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead = Feed (PR)</td>
<td>.217</td>
<td>Result</td>
<td>OK</td>
</tr>
</tbody>
</table>

**NTK Thread Whirling**

![Dramatically improved productivity]

**Competitor’s Thread Whirling**

Cannot complete with single pass. Requires feeding stock multiple times and two passes for threading each time.

NTK thread whirling succeeded in double lead screw machining when one of the major thread whirling suppliers has failed many times.

### Double-lead Bone Screw

**Work Material:** Ti-6Al-4v ELI

<table>
<thead>
<tr>
<th>Bar Stock Dia.</th>
<th>φ.250</th>
<th>Number of start</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Dia.</td>
<td>φ.118</td>
<td>Helix Angle</td>
<td>15.4°</td>
</tr>
<tr>
<td>Minor Dia.</td>
<td>φ.083</td>
<td>Hand of thread</td>
<td>Right</td>
</tr>
</tbody>
</table>

**Cutting condition**

<table>
<thead>
<tr>
<th>Main Spindle Speed (rpm)</th>
<th>11</th>
<th>Speed of whirling cutter (rpm)</th>
<th>2,200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead = Feed (PR)</td>
<td>.087</td>
<td>Result</td>
<td>OK</td>
</tr>
</tbody>
</table>

**NTK Thread Whirling**

![Dramatically improved productivity]

**Competitor’s Thread Whirling**

Cannot complete with single pass. Requires feeding stock multiple times and two passes for threading each time.

Customer was concerned with stock rigidity and long cycle time. NTK applied three geometry inserts to achieve single pass machining, in dramatically short time. The up-sharp cutting edges and low cutting pressure produced “excellent” surface finish.

### Single-lead Bone Screw

**Work Material:** Ti-6Al-4v ELI

<table>
<thead>
<tr>
<th>Bar Stock Dia.</th>
<th>φ.197</th>
<th>Number of start</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Dia.</td>
<td>φ.091</td>
<td>Helix Angle</td>
<td>5.3°</td>
</tr>
<tr>
<td>Minor Dia.</td>
<td>φ.067</td>
<td>Hand of thread</td>
<td>Right</td>
</tr>
</tbody>
</table>

**Cutting condition**

<table>
<thead>
<tr>
<th>Main Spindle Speed (rpm)</th>
<th>30</th>
<th>Speed of whirling cutter (rpm)</th>
<th>3,100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch = Feed (PR)</td>
<td>.023</td>
<td>Result</td>
<td>OK</td>
</tr>
</tbody>
</table>

**NTK Thread Whirling**

2200 pcs

This thread is up to 1.26” length with a small pitch. Cycle time could be increased with a single-point threading tool. NTK’s inserts, designed for lower tool pressure, ran 2,200 pcs/corner at 30 rpm of bar stock (F10,800). It only took 110 seconds to finish a 1.26” length thread.

### Double-lead Bone Screw

**Work Material:** Ti-6Al-4v ELI

<table>
<thead>
<tr>
<th>Bar Stock Dia.</th>
<th>φ.350</th>
<th>Number of start</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Dia.</td>
<td>φ.180</td>
<td>Helix Angle</td>
<td>23.0°</td>
</tr>
<tr>
<td>Minor Dia.</td>
<td>φ.120</td>
<td>Hand of thread</td>
<td>Right</td>
</tr>
</tbody>
</table>

**Cutting condition**

<table>
<thead>
<tr>
<th>Main Spindle Speed (rpm)</th>
<th>12</th>
<th>Speed of whirling cutter (rpm)</th>
<th>2,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead = Feed (PR)</td>
<td>.200</td>
<td>Result</td>
<td>OK</td>
</tr>
</tbody>
</table>

**NTK Thread Whirling**

![Dramatically improved productivity]

**Competitor’s Thread Whirling**

Cannot complete with single pass. Requires feeding stock multiple times and two passes for threading each time.

The customer could not get perfect double lead thread form in single pass from other manufacturers. NTK got perfect thread form with a single pass on first trial saving cycle time.

### Single-lead Bone Screw

**Work Material:** 316SS

<table>
<thead>
<tr>
<th>Bar Stock Dia.</th>
<th>φ.315</th>
<th>Number of start</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Dia.</td>
<td>φ.138</td>
<td>Helix Angle</td>
<td>7.5°</td>
</tr>
<tr>
<td>Minor Dia.</td>
<td>φ.098</td>
<td>Hand of thread</td>
<td>Right</td>
</tr>
</tbody>
</table>

**Cutting condition**

<table>
<thead>
<tr>
<th>Main Spindle Speed (rpm)</th>
<th>23</th>
<th>Speed of whirling cutter (rpm)</th>
<th>2,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch = Feed (PR)</td>
<td>.049</td>
<td>Result</td>
<td>OK</td>
</tr>
</tbody>
</table>

**NTK Thread Whirling**

2600 pcs

Competitor’s Thread Whirling

1000 pcs

Some thread whirling manufacturers offer 6-teeth or 12-teeth systems, too many teeth cause chip packing issues and more tool pressure. Fewer teeth means greater cycle time. NTK concluded that 9-teeth is the best configuration. Our customers can run 1.5 times faster and get longer tool life.

### Triple-lead Worm Gear

**Work Material:** Brass

<table>
<thead>
<tr>
<th>Bar Stock Dia.</th>
<th>φ.315</th>
<th>Number of start</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Dia.</td>
<td>φ.276</td>
<td>Helix Angle</td>
<td>14.6°</td>
</tr>
<tr>
<td>Minor Dia.</td>
<td>φ.185</td>
<td>Hand of thread</td>
<td>Left</td>
</tr>
</tbody>
</table>

**Cutting condition**

<table>
<thead>
<tr>
<th>Main Spindle Speed (rpm)</th>
<th>20</th>
<th>Speed of whirling cutter (rpm)</th>
<th>3,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead = Feed (PR)</td>
<td>.189</td>
<td>Result</td>
<td>OK</td>
</tr>
</tbody>
</table>

**NTK Thread Whirling**

2200 pcs

Multi-leading threads, common in the Worm Gear industry are made by a forming or cutting process. The large helix angle is difficult to machine with single-point threading. NTK now makes thread whirling inserts for multi-leading threads. Cycle time is reduced with a one pass process and thread form dimensions are stable with the low tool pressure.
Double lead Screw in single pass video is on YouTube

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