HARD TURNING

making hard turning less hard than it seems!

FEED the SPEED!
the second hardest material known to mankind
4 - What is Hard Turning?
6 - Tungaloy’s CBN
10 - Benefits of Coated CBN
11 - CBN Grades
12 - Edge Preparations
16 - Chip breakers
20 - Unique CBN Blanks
22 - Ceramic Grades
23 - Carbide Grades
25 - Selection Guide
26 - Field Test Reports
WHAT IS HARD TURNING?

Tungaloy has always been a pathfinder in hard turning applications, making hard turning less hard than it seems…

HARD TURNING commonly refers to turning operations of a part or bar stock harder than 50HRC on a lathe or turning center. In profiling hardened steel parts, grinding had long been the first-choice process for manufacturers to obtain the dimensions required on the workpiece. This was true until polycrystalline cubic boron nitride (PcBN) was introduced in late 1970s, which eventually impelled a shift from time- and energy-consuming grinding operations to hard turning operations.

Hard turning started to rapidly develop in the beginning of the 1990s as the availability of PcBN and ceramics increased, along with further advancement in physical vapor deposition (PVD) coating technologies and the capability of designing and building turning machines that are rigid, stable, and accurate enough to successfully finish hard turning. These advancements have made finish hard turning a viable alternative to grinding, as an accurate finishing operation.
Natural and synthetic diamonds are used for precision turning of non-ferrous metals. The hardest of all materials, however, cannot be used to machine steel because of its strong affinity for iron at high temperature.

**PcBN** solves this problem because of its hardness, which is approximately the same as diamond, and its thermal stability and inertness to iron at elevated temperatures. These unique properties make **PcBN** a perfect cutting tool material for machining hard, abrasive ferrous workpiece materials at higher cutting speeds.

**Ceramic** also have excellent wear resistance at high cutting parameters. Ceramic inserts are economically priced when compared with other insert grades and can be applied to high speed, continuous turning of hardened parts. Their low thermal shock resistance and fracture toughness, however, require blunt cutting edge geometry, which creates a stronger cutting force and lessens the surface finish potential. Tungaloy’s **LX11** is the ceramic grade most suitable for turning hardened steel.

Hard turning on low power machines poses challenges in terms of reliability and cost effectiveness. The **PVD-coated carbide grade** makes a great alternative in such machine setups. Tungaloy’s **AH8000 series** is not only efficient in turning heat-resistant superalloys but also proven to have superior performance in hard turning where high cutting parameters are not attainable. Its superior fracture toughness makes the grades excellent alternatives, over PcBN and ceramic grades, for efficient turning of hardened steel and tempered steel at low speed settings.

**Grade recommendations** for different applications

![Diagram showing tool materials for hard turning](image)
CBN inserts are generally used in a finishing process. A CBN insert grade with coarse abrasive grains will output a rough surface and may not be able to achieve the surface quality required. To achieve superior surface quality of Rz= 3.2 or better, always use a fine grain CBN insert.
Wear and fracture resistance in terms of CBN content

The lower the CBN content is, the more wear resistant the grade will be, and the higher the CBN content is, the more fracture resistant the grade will be when turning hardened steel.

Interrupted Cutting

Continuous Cutting

Cutting conditions
Cutting speed: Vc=180m/min (590 sfm)
Depth of cut: ap=0.1mm (.004")
Feed rate: f=0.1mm/rev (.004")
Coolant: Dry
Workpiece: SCM435 (60HRC)

Cutting conditions
Cutting speed: Vc=180m/min (590 sfm)
Depth of cut: ap=0.2mm (.008")
Feed rate: f=0.1mm/rev (.004")
Coolant: Dry
Workpiece: SCM415 (60HRC)

High CBN content
High fracture resistance

Low CBN content
High wear resistance
Typical parts

- Ring Gear
- Idler Gear
- Transmission Shaft
- CVJ
- Tool Holders
**Coolant effect - Continuous cutting**

![Graph showing flank wear width vs. tool life for continuous cutting.

Dry cutting improves tool life for continuous cutting operations.

**Coolant effect - Interrupted cutting**

![Bar graph showing tool life for interrupted cutting.

Dry cutting improves tool life for interrupted cutting operations.

**Use of coolant**

<table>
<thead>
<tr>
<th></th>
<th>Dry</th>
<th>Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous cutting</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Interrupted cutting</td>
<td>✓</td>
<td>✗</td>
</tr>
</tbody>
</table>
BENEFITS OF COATED CBN

Anti-oxidation wear
PVD coating protects CBN from interacting with oxygen.

Enhanced wear resistance
CBN has high thermal conductivity and plastic deformation resistance, preventing the coating from delaminating under extreme temperatures generated during hard turning process.

Coated Grades: BXA10, BXA20, BXA30, BXM10, BXM20, and BXC50

Cutting conditions
Vc= 180 m/min (590 sfm)
f= 0.1 mm/rev (.004”)
ap= 0.2 mm (.008”)
Coolant: Dry
Material: SCM415H (15CrMo4) D63 x 200 mm
Inserts: 2QP-CNGA120408 coated/uncoated
# CBN Grades

Tungaloy’s hard-turning CBN grades and their properties

<table>
<thead>
<tr>
<th>Grade</th>
<th>CBN grain size</th>
<th>CBN content</th>
<th>Binder type</th>
<th>Recommended cutting speed (Vc)</th>
<th>Application range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fine</td>
<td>Medium</td>
<td>Coarse</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>BXA10 TiCN/TiAIN-based multilayer</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>BXA20 TiAIN-based multilayer</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BXA30 TiAIN monolayer</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>BXM10 TiCN-based multilayer</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td></td>
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<td></td>
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<tr>
<td>BXM20 TiCN-based multilayer</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>BXC50 TiCNO</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BX310</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BX330</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BX360</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BX380</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

**CBN Grades**

- **BXA10**: TiCN/TiAIN-based multilayer
- **BXA20**: TiAIN-based multilayer
- **BXA30**: TiAIN monolayer
- **BXM10**: TiCN-based multilayer
- **BXM20**: TiCN-based multilayer
- **BXC50**: TiCNO
- **BX310**: -
- **BX330**: -
- **BX360**: -
- **BX380**: -

**Application range**

- Continuous
- Light Interrupted
- Heavy Interrupted

**CBN hardness**

- Fine
- Medium
- Coarse

**CBN content**

- Low
- Medium
- High

**Binder type**

- Ceramic
- Metal

**Cutting speed**

- m/min
- sfm

**Grade CBN grain size**

- CBN:
  - Fine
  - Medium
  - Coarse

**CBN content**

- Low
- Medium
- High

**Binder type**

- Ceramic
- Metal

**Recommended cutting speed (Vc)**

- m/min
- sfm

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**EDGE PREPARATIONS**

**Edge preparation - Designation**

<table>
<thead>
<tr>
<th>Negative land angle</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>W (mm)</td>
<td></td>
</tr>
<tr>
<td>0.05</td>
<td>LF</td>
</tr>
<tr>
<td>0.13</td>
<td>L</td>
</tr>
<tr>
<td>0.18</td>
<td>-</td>
</tr>
</tbody>
</table>

Five standard edge preparations are available for BXA10 and BXA20 inserts for hard turning.

**Edge preparation - Selection guide**

Based on the performance of the insert with standard edge preparation, the following solutions are recommended.
**Edge preparation - Continuous cutting**

The smaller the negative land angle is, the more wear resistant the cutting edge will be in continuous cuts.

**Cutting conditions**
- Cutting speed: $V_c = 100 \text{ m/min} \ (328 \text{ sfm})$
- Depth of cut: $a_p = 0.25 \text{ mm} \ (0.010")$
- Feed rate: $f = 0.1 \text{ mm/rev} \ (0.004")$
- Coolant: Dry
- Continuous cutting
- Workpiece: SCM415 (60HRC)
- Criteria: $V_B \text{max} = 0.15 \text{ mm}$

**Edge preparations**
- Width: 0.13 mm
- Angles: -15, -25, and -40°
- Honed to: R0.01~0.02 mm (R.0004”~.0008”)

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**Edge preparation - Interrupted cutting**

The larger the negative land angle is, the more fracture resistant the cutting edge will be in interrupted cuts.

**Cutting conditions**
- Cutting speed: $V_c = 100 \text{ m/min} \ (328 \text{ sfm})$
- Depth of cut: $a_p = 0.25 \text{ mm} \ (0.010")$
- Feed rate: $f = 0.15 \text{ mm/rev} \ (0.006")$
- Coolant: Dry
- Workpiece: SCM415 (60HRC)
- Criteria: Fracture

**Edge preparations**
- Width: 0.13 mm
- Honed to: R0.01~0.02 mm (R.0004”~.0008”)

---

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**Edge preparation - Cutting loads**

The -L and -LF edge preparations provide reduced cutting loads over the insert with standard edge preparation.

![Graph showing reduced cutting loads](chart)

*Insert: 2QP-CNGA120408*
*Workpiece material: SCM415 (60HRC)*
*Cutting speed: Vc = 100 m/min (328 sfm)*
*Feed: f = 0.3 mm/rev (.012”)*
*Depth of cut: ap = 0.2 mm (.008”)*
*Coolant: Dry*

**Edge preparation - Flank wear**

The -L and -LF edge preparations provide reduced flank wear over the insert with standard edge preparation.

![Graph showing reduced flank wear](chart)

*Insert: 2QP-CNGA120408*
*Workpiece material: SCM415 (60HRC)*
*Cutting speed: Vc = 130 m/min (426 sfm)*
*Feed: f = 0.15 mm/rev (.006”)*
*Depth of cut: ap = 0.2 mm (.008”)*
*Coolant: Wet*

**Edge preparation - Crater wear**

The -LC edge preparation provides reduced crater wear over the insert with standard edge preparation. As a result, insert fracture induced by crater wear is reduced.

*Insert: 2QP-CNGA120408*
*Workpiece material: SCM415 (60HRC)*
*Cutting speed: Vc = 200 m/min (656 sfm)*
*Feed: f = 0.1 mm/rev (.004”)*
*Depth of cut: ap = 0.2 mm (.008”)*
*Coolant: Dry*
Negative Inserts

Three standard types of chipbreakers are available for negative inserts:

HP: For standard finishing
HF: For removable carburized layer (at light DOC) of case-hardened steel
HM: For removable carburized layer (at great DOC) of case-hardened steel

Positive Inserts
HP - HardBreakers for finishing hardened steel

Innovative 3D chipbreaker for efficient chip control

- By separating the chipbreaker from the cutting edge, the cutting force imposed on the cutting edge during machining is significantly reduced, thus providing long tool life.

- The cutting edge preparation is designed to ensure easy cutting at low cutting forces, while maintaining close tolerances with no deviations.

- The HP style chipbreaker, combined with built-in wipers, yields excellent surface quality and good chip control.

Consistent and durable chip breaking

Chatter-free machining

Due to low cutting force, chatter stability is greatly improved.
**HF & HM - HardBreakers for removing carburized layer**

Two types of chipbreakers provide excellent chip control in a wide application range.

### HARDBREAKER HF

- Single-sided CBN insert provides high stability in heavy machining.
- Excellent chip control in small depth of cut due to the high functional nose.
- Delivers exceptional surface finishes.

### HF chipbreaker

<table>
<thead>
<tr>
<th>Feed: ( f ) (mm/rev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of cut: ( a_p ) (mm)</td>
</tr>
<tr>
<td>0.05</td>
</tr>
</tbody>
</table>

### HF chipbreaker imperial

<table>
<thead>
<tr>
<th>Feed: ( f ) (in/rev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of cut: ( a_p ) (inch)</td>
</tr>
<tr>
<td>0.02&quot;</td>
</tr>
</tbody>
</table>

### HARDBREAKER HM

- Single-sided CBN insert provides high stability in heavy machining.
- Provides ideal chip control in large depth of cut with the well-designed chipbreaker.
- Suitable for medium cutting or roughing.

### HM chipbreaker

<table>
<thead>
<tr>
<th>Feed: ( f ) (mm/rev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of cut: ( a_p ) (mm)</td>
</tr>
<tr>
<td>0.05</td>
</tr>
</tbody>
</table>

### HM chipbreaker imperial

<table>
<thead>
<tr>
<th>Feed: ( f ) (in/rev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of cut: ( a_p ) (inch)</td>
</tr>
<tr>
<td>0.02&quot;</td>
</tr>
</tbody>
</table>
FEED the SPEED - TUNGALOY ACCELERATED MACHINING
HARD TURNING SERIES

TAILORED TO YOUR NEEDS

Tungaloy is the market leader of CBN Blanks

Made by Tungaloy

Carefully-selected micron-sized cubic boron nitride powers are sintered with a ceramic or metallic binder under high-temperature, high-pressure (HTHP) environment of over 5 GPa (over 725,189 psi) at 1400°C - 1500°C (2552°F - 2730°F) in Tungaloy’s latest sintering equipment. The CBN blanks will then undergo strict quality screening before being fabricated into CBN inserts.

Tungaloy welcomes customers to collaborate with its Advanced Materials Team to develop customized CBN grades perfectly tailored to the customer’s specific hard turning needs. Tungaloy offers a high level of performance in the most challenging hard turning applications but can also bring these unique products to the customers in a short time span.
Wavy Joint

New brazing technology for increased machining efficiency - “WavyJoint”

For high depth of cut in hard turning up to 0.8 mm

Great performance for continuous to heavy interrupted cutting at low and medium speeds

Strong joint
The “wavy” contact surface enhances the brazing strength.

CBN Tip Size: 200% larger for improved wear resistance of the cutting edge

Brazing Area: 160% larger for enhanced brazing strength

WavyJoint

Vs.

Standard

double sided inserts
**Ceramic**

Ceramic cutting tools make a great alternative for efficient and economical hard turning generally due to its excellent wear resistance at high cutting speeds. However, ceramics suffer lack of fracture toughness and thermal shock resistance, and, as the result, any type of shocks or impact during machining must be avoided to prevent chipping or fracture.

**LX11** is Tungaloy’s oxide-based ceramic grade composed of aluminum oxide (Al₂O₃), or alumina, in a titanium nitride (TiN) coating. It is suited for hard turning in continuous to light-interrupted cuts, where surface finish requirements are moderate.

**LX21** is another alumina-based ceramic grade of Tungaloy with higher bend strength than **LX11** to enhance the grade’s fracture resistance. Designed with fracture toughness, **LX21** is best suited for interrupted cuts or large removal applications, such as hard turning of steel rolls.

### Ceramic Grades

<table>
<thead>
<tr>
<th>Grade</th>
<th>Ceramic grain size</th>
<th>Main component</th>
<th>Recommended cutting speed (Vc)</th>
<th>Application range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fine</td>
<td>Medium</td>
<td>Coarse</td>
<td>Al₂O₃-TiC</td>
</tr>
<tr>
<td><strong>LX11</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TiN monolayer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PVD COATED CARBIDE SERIES

Cost-effective solution for turning hardened steel

The AH8000 series

Tungaloy’s AH8000 series features a nano multi-layered PVD coating with high Al content. This provides the grades with multiple characteristics, including high hardness, good cutting edge integrity, and strong adhesion to the tough carbide substrate, all of which are vital for efficient turning of hardened steel. The AH8000 series is particularly suited for hard turning applications using moderate cutting speeds of up to 50 m/min and large depths of cut of 0.5 mm or greater.

The AH8000 Series

<table>
<thead>
<tr>
<th>Grade</th>
<th>Ceramic grain size</th>
<th>Main component</th>
<th>Recommended cutting speed (Vc)</th>
<th>Application range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fine</td>
<td>Medium</td>
<td>Coarse</td>
<td>WC-Co</td>
</tr>
<tr>
<td>AH8005</td>
<td>⬤</td>
<td>⬤</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AH8015</td>
<td>⬤</td>
<td></td>
<td>⬤</td>
<td></td>
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</tbody>
</table>
## Tungaloy’s recommended solutions for hard turning

### Get started!

<table>
<thead>
<tr>
<th>Is the workpiece hardened to 50 HRC or higher?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NO</strong></td>
</tr>
<tr>
<td><strong>YES</strong></td>
</tr>
</tbody>
</table>

#### Cutting Condition

- **Continuous**
  - PVD Grade
    - AH8000 Series

- **Light Interrupted**
  - X

- **Heavy Interrupted**
  - X

### First Recommendations

- **Bxa10**
  - Edge preparation - Standard
  - For reduce burr
  - For improved crater wear

- **Bxa20**
  - Edge preparation - Standard
  - For improved fracture resistance
  - For low cutting speed

- **Bxa20**
  - Wavy Joint
  - Edge preparation - H
  - Other Solutions

### More Solutions

- **Bxa10**
  - Edge preparation - LF
  - For improved crater wear

- **Bxa10**
  - Edge preparation - LC
  - For better surface finish

- **Bxa10**
  - With Hardbreaker HP
  - For an economical solution

- **Bxa30**
  - Edge preparation - Standard
  - For low cutting speed

- **Bx360**
  - Edge preparation - Standard
  - For an economical solution

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HARD TURNING SERIES - FIELD TEST REPORTS

FIELD TEST REPORTS

Industry: Automotive / CVT
Material: 18CrMo4 / SCM420 (HV720 - 850)
Toolholder: A32S-PDUNL15-D400
Insert: 2QP-DNGA150408
Grade: BXA10
Cutting conditions:
  - $V_c = 130$ m/min (426 sfm)
  - $f = 0.1$ mm/rev (.004 ipr)
  - $a_p = 0.15$ mm (.006")
  - Coolant = Wet
Application: Internal turning
Machine: CNC lathe

Tool life 1.7 times!

Industry: Automotive / Gear
Material: 18CrMo4 / SCM420 (62HRC)
Toolholder: ACLNL2525M12-A
Insert: 2QP-CNGA120408
Grade: BXA10
Cutting conditions:
  - $V_c = 100$ m/min (328 sfm)
  - $f = 0.05$ mm/rev (.002 ipr)
  - $a_p = 0.15$ mm (.006")
  - Coolant = Wet
Application: Face turning
Machine: CNC lathe

Tool life 1.9 times!
Industry: Automotive / Stator
Material: 18CrMo4 / SCM420 (62HRC)
Toolholder: ATGNR2525M16-A
Insert: 3QP-TNGA160408
Grade: BXA20
Cutting conditions:
\[ V_c = 168 \text{ m/min (551 sfm)} \]
\[ f = 0.08 \text{ mm/rev (.003 ipr)} \]
\[ a_p = 0.2 \text{ mm (.008")} \times 2 \text{ passes} \]
Coolant = Wet
Application: Face turning
Machine: CNC lathe

Industry: Automotive / Stator
Material: 18CrMo4 / SCM420 (62HRC)
Toolholder: ATGNR2525M16-A
Insert: 3QP-TNGA160408
Grade: BXA20
Cutting conditions:
\[ V_c = 168 \text{ m/min (551 sfm)} \]
\[ f = 0.08 \text{ mm/rev (.003 ipr)} \]
\[ a_p = 0.2 \text{ mm (.008")} \times 2 \text{ passes} \]
Coolant = Wet
Application: Face turning
Machine: CNC lathe

Industry: Automotive / Stator
Material: 18CrMo4 / SCM420 (62HRC)
Toolholder: ATGNR2525M16-A
Insert: 3QP-TNGA160408
Grade: BXA20
Cutting conditions:
\[ V_c = 168 \text{ m/min (551 sfm)} \]
\[ f = 0.08 \text{ mm/rev (.003 ipr)} \]
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Coolant = Wet
Application: Face turning
Machine: CNC lathe

Industry: Automotive / Stator
Material: 18CrMo4 / SCM420 (62HRC)
Toolholder: ATGNR2525M16-A
Insert: 3QP-TNGA160408
Grade: BXA20
Cutting conditions:
\[ V_c = 168 \text{ m/min (551 sfm)} \]
\[ f = 0.08 \text{ mm/rev (.003 ipr)} \]
\[ a_p = 0.2 \text{ mm (.008")} \times 2 \text{ passes} \]
Coolant = Wet
Application: Face turning
Machine: CNC lathe

Industry: General Engineering / Nut
Material: 20CrMo4 / SCM420H (58HRC)
Toolholder: ATGNR2525M16-A
Insert: 3QP-TNGA160408
Grade: BXA20
Cutting conditions:
\[ V_c = 200 \text{ m/min (656 sfm)} \]
\[ f = 0.08 \text{ mm/rev (.003 ipr)} \]
\[ a_p = 0.15 \text{ mm (.006")} \]
Coolant = Wet
Application: External turning
Machine: CNC lathe

Industry: General Engineering / Nut
Material: 20CrMo4 / SCM420H (58HRC)
Toolholder: ATGNR2525M16-A
Insert: 3QP-TNGA160408
Grade: BXA20
Cutting conditions:
\[ V_c = 200 \text{ m/min (656 sfm)} \]
\[ f = 0.08 \text{ mm/rev (.003 ipr)} \]
\[ a_p = 0.15 \text{ mm (.006")} \]
Coolant = Wet
Application: External turning
Machine: CNC lathe

Industry: Automotive / Input shaft
Material: 20Cr4 / SCr420 (63HRC)
Toolholder: E16R-SCLCR09-D180
Insert: 2QP-CCGW060204
Grade: BXA20
Cutting conditions:
\[ V_c = 120 \text{ m/min (394 sfm)} \]
\[ f = 0.1 \text{ mm/rev (.004 ipr)} \]
\[ a_p = 0.1 \text{ mm (.004")} \]
Coolant = Wet
Application: Internal turning
Machine: CNC lathe

Industry: Automotive / Input shaft
Material: 20Cr4 / SCr420 (63HRC)
Toolholder: E16R-SCLCR09-D180
Insert: 2QP-CCGW060204
Grade: BXA20
Cutting conditions:
\[ V_c = 120 \text{ m/min (394 sfm)} \]
\[ f = 0.1 \text{ mm/rev (.004 ipr)} \]
\[ a_p = 0.1 \text{ mm (.004")} \]
Coolant = Wet
Application: Internal turning
Machine: CNC lathe

Industry: Automotive / Input shaft
Material: 20Cr4 / SCr420 (63HRC)
Toolholder: E16R-SCLCR09-D180
Insert: 2QP-CCGW060204
Grade: BXA20
Cutting conditions:
\[ V_c = 120 \text{ m/min (394 sfm)} \]
\[ f = 0.1 \text{ mm/rev (.004 ipr)} \]
\[ a_p = 0.1 \text{ mm (.004")} \]
Coolant = Wet
Application: Internal turning
Machine: CNC lathe

Industry: Automotive / Input shaft
Material: 20Cr4 / SCr420 (63HRC)
Toolholder: E16R-SCLCR09-D180
Insert: 2QP-CCGW060204
Grade: BXA20
Cutting conditions:
\[ V_c = 120 \text{ m/min (394 sfm)} \]
\[ f = 0.1 \text{ mm/rev (.004 ipr)} \]
\[ a_p = 0.1 \text{ mm (.004")} \]
Coolant = Wet
Application: Internal turning
Machine: CNC lathe
**HARD TURNING SERIES - FIELD TEST REPORTS**

**Industry:** Automotive / Input shaft  
**Material:** SNCM420(H)(JIS) (58HRC)  
**Toolholder:** E20S-STUPR1103-D220  
**Insert:** 3QP-TPGW110308  
**Grade:** BXA20

**Cutting conditions:**  
- $V_c = 170$ m/min (558 sfm)  
- $f = 0.08$ mm/rev (.003 ipr)  
- $ap = 0.10$ mm (.004")  
- Coolant = Wet  

**Application:** Internal turning  
**Machine:** CNC lathe

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**Industry:** Automotive / Gear wheel  
**Material:** SCM420 (58HRC)  
**Toolholder:** ACLNL2525M12-H  
**Insert:** 4QS-CNGA120412-H  
**Grade:** BXA20

**Cutting conditions:**  
- $V_c = 100$ m/min (328 sfm)  
- $f = 0.15$ mm/rev (.006 ipr)  
- $ap = 1.0$ mm (.039")  
- Coolant = Wet  

**Application:** Internal turning  
**Machine:** CNC lathe

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**Industry:** Heavy Industries / Movable arm shaft  
**Material:** S45C (50HRC)  
**Toolholder:** ACLNR2020K12-A  
**Insert:** 4QS-CNGA120408-H  
**Grade:** BXA20

**Cutting conditions:**  
- $V_c = 180$ m/min (591 sfm)  
- $f = 0.10$ mm/rev (.04 ipr)  
- $ap = 0.5$ mm (.020")  
- Coolant = Dry  

**Application:** External turning (Finishing)  
**Machine:** NC lathe
Industry: Automotive / Gear part
Material: 20Cr4 / SCR420 (JIS) (60HRC)
Toolholder: D25T-DCLNR1204-32
Insert: 2QP-GNGA120408
Grade: BXA20
Cutting conditions:
\[ V_c = 120 \text{ m/min (394 sfm)} \]
\[ f = 0.10 \text{ mm/rev (.004 ipr)} \]
\[ a_p = 0.10 \text{ mm (.004")} \]
Coolant = Wet
Application: Internal turning
Machine: CNC lathe

Industry: Automotive / CVJ part
Material: SCR420(JIS) (60HRC)
Toolholder: ACLNR2525M12-A
Insert: 2QP-CNGM120408-HP
Grade: BXM10
Cutting conditions:
\[ V_c = 250 \text{ m/min (820 sfm)} \]
\[ f = 0.20 \text{ mm/rev (.08 ipr)} \]
\[ a_p = 0.20 \text{ mm (.08")} \]
Coolant = Wet
Application: Facing & external turning
Machine: CNC lathe

Industry: Automotive / Shaft
Material: SCM420(JIS) (59HRC)
Toolholder: SDJCR2525M11
Insert: 2QP-DCGT11T304-HP
Grade: BXM10
Cutting conditions:
\[ V_c = 120 \text{ m/min (394 sfm)} \]
\[ f = 0.05 \text{ mm/rev (.002 ipr)} \]
\[ a_p = 0.20 \text{ mm (.08")} \]
Coolant = Wet
Application: External turning
Machine: CNC lathe
HARD TURNING SERIES - FIELD TEST REPORTS

Industry: Automotive / Sprocket
Material: SCM415(JIS) (55HRC)
Toolholder: ACLNL2020K12-A
Insert: 2QP-CNGM120404WL-HP
Grade: BXA20
Cutting conditions:
\[ V_c = 120 \text{ m/min} \quad f = 0.05 \text{ mm/rev} \quad a_p = 0.10 \text{ mm} \]
Coolant = Wet
Application: External turning
Machine: CNC lathe

Industry: Die&Mold / Guide pin
Material: D2 tool steel (60 HRC)
Toolholder: ADJNR2525M15
Insert: DNGA432
Grade: LX11
Cutting conditions:
\[ V_c = 120 \text{ m/min} \quad f = 0.2 \text{ mm/rev} \quad a_p = 1.0 \text{ mm} \]
Coolant = Wet
Application: OD turning
Machine: CNC lathe

Industry: Automotive / Guide starter gear
Material: 16MnCr5 (58 HRC)
Toolholder: ACLNL2525M12-A
Insert: CNGA120408
Grade: LX11
Cutting conditions:
\[ V_c = 90 \text{ m/min} \quad f = 0.08 \text{ mm/rev} \quad a_p = 0.05 \text{ mm} \]
Coolant = Wet
Application: OD turning
Machine: CNC lathe

Double tool life!

Double tool life!

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Industry: **General Engineering** / Toggle pin  
Material: Tool steel (49 HRC)  
Toolholder: PCLNR3232  
Insert: CNMG190616-HRM  
Grade: AH8005  
**Cutting conditions:**  
\[ V_c = 66 \text{ m/min (216 sfm)} \]  
\[ f = 0.6 \text{ mm/rev (.023 ipr)} \]  
\[ a_p = 1.25 \text{ mm (.010")} \]  
Coolant = Dry  
Application: OD turning  
Machine: CNC lathe

Industry: **Die & Mold** / Pin for die set  
Material: SKH51 (HS6-5-2, M2) (63 HRC)  
Toolholder: PTGNR2525M16  
Insert: TNMG160408-HRF  
Grade: AH8005  
**Cutting conditions:**  
\[ V_c = 30 \text{ m/min (98.4 sfm)} \]  
\[ f = 0.1 \text{ mm/rev (.004 ipr)} \]  
\[ a_p = 1.0 \text{ mm (.040")} \]  
Coolant = Wet  
Application: OD turning  
Machine: CNC lathe

Industry: **Heavy Industries** / Roll  
Material: SKD11 (60 HRC)  
Toolholder: ACLNL2525M12-A  
Insert: RCMT1204M0-RS  
Grade: AH8005  
**Cutting conditions:**  
\[ V_c = 80 \text{ m/min (262 sfm)} \]  
\[ f = 0.2 \text{ mm/rev (.008 ipr)} \]  
\[ a_p = 2.0 \text{ mm (.08")} \]  
Coolant = Wet  
Application: Face turning, interrupted  
Machine: Vertical CNC lathe
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