Ceramic inserts for high speed turning of cast iron
Ceramic grades for high speed turning of cast iron
New ceramic inserts for cast iron high speed machining

APPLICATION RANGE

**TZ120** (Al$_2$O$_3$-ZrO$_2$)
- Excellent wear resistance
- High speed continuous turning of cast iron without coolant

**LX21** (Al$_2$O$_3$-TiC)
- High hardness and moderate fracture toughness
- General turning of cast iron

**FX105** (Si$_3$N$_4$)
- Mechanical and thermal shock resistance
- Interrupted & rough machining

**New TZ120**
- TZ120 ceramic grade with high strength and excellent wear resistance by adding ZrO$_2$ to Al$_2$O$_3$ with high oxidation resistance
- Components are well dispersed to improve fracture resistance and boundary wear resistance
- Suitable for dry roughing and finishing of special cast iron (cylinder liner, etc.)
STANDARD CUTTING CONDITIONS

<table>
<thead>
<tr>
<th>ISO</th>
<th>Workpiece materials</th>
<th>Cutting mode</th>
<th>Coolant</th>
<th>Grades</th>
<th>Cutting speed Vc (sfm)</th>
<th>Feed f (ipr)</th>
<th>Depth of cut ap (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gray cast iron</td>
<td>Continuous</td>
<td>Dry</td>
<td>TZ120</td>
<td>1312 - 2789</td>
<td>0.004 - 0.012</td>
<td>0.020 - 0.079</td>
</tr>
<tr>
<td></td>
<td>Continuous, light interrupted</td>
<td>Dry</td>
<td>LX21</td>
<td>1312 - 2625</td>
<td>0.004 - 0.016</td>
<td>0.020 - 0.079</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Continuous, interrupted</td>
<td>Dry, Wet</td>
<td>FX105</td>
<td>984 - 1969</td>
<td>0.008 - 0.024</td>
<td>0.020 - 0.157</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Centrifugal cast iron</td>
<td>Continuous</td>
<td>Dry</td>
<td>TZ120</td>
<td>492 - 1312</td>
<td>0.004 - 0.012</td>
<td>0.020 - 0.079</td>
</tr>
</tbody>
</table>

- TZ120 is suitable for dry continuous turning

STANDARD EDGE PREPARATION

<table>
<thead>
<tr>
<th>Grades</th>
<th>TZ120</th>
<th>LX21</th>
<th>FX105</th>
</tr>
</thead>
<tbody>
<tr>
<td>T (inch)</td>
<td>0.0039</td>
<td>0.0039</td>
<td>0.0078</td>
</tr>
<tr>
<td>α</td>
<td>20°</td>
<td>30°</td>
<td>25°</td>
</tr>
</tbody>
</table>
### Insert NEGATIVE TYPE

#### CN

**Rhombic, 80° with hole**

<table>
<thead>
<tr>
<th>Chipbreaker Designation</th>
<th>Ceramic</th>
<th>Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inch</strong></td>
<td><strong>Metric</strong></td>
<td><strong>SZ</strong></td>
</tr>
<tr>
<td>CNMA 432</td>
<td>CNMA120408</td>
<td>●</td>
</tr>
<tr>
<td>CNMA 433</td>
<td>CNMA120412</td>
<td>●</td>
</tr>
<tr>
<td>CNMA 434</td>
<td>CNMA120416</td>
<td>●</td>
</tr>
<tr>
<td>CNGA 431</td>
<td>CNGA120404</td>
<td>● ●</td>
</tr>
<tr>
<td>CNGA 432</td>
<td>CNGA120408</td>
<td>● ●</td>
</tr>
<tr>
<td>CNGA 433</td>
<td>CNGA120412</td>
<td>● ●</td>
</tr>
<tr>
<td>CNGA 434</td>
<td>CNGA120416</td>
<td>●</td>
</tr>
</tbody>
</table>

#### CN

**Rhombic, 80° without hole**

<table>
<thead>
<tr>
<th>Chipbreaker Designation</th>
<th>Ceramic</th>
<th>Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inch</strong></td>
<td><strong>Metric</strong></td>
<td><strong>SZ</strong></td>
</tr>
<tr>
<td>CNGD 453</td>
<td>CNGD120712</td>
<td>●</td>
</tr>
<tr>
<td>CNGD 454</td>
<td>CNGD120716</td>
<td>●</td>
</tr>
<tr>
<td>CNGN 432</td>
<td>CNGN120408</td>
<td>●</td>
</tr>
<tr>
<td>CNGN 433</td>
<td>CNGN120412</td>
<td>●</td>
</tr>
<tr>
<td>CNGN 434</td>
<td>CNGN120416</td>
<td>●</td>
</tr>
<tr>
<td>CNGN 435</td>
<td>CNGN120420</td>
<td>●</td>
</tr>
<tr>
<td>CNGN 452</td>
<td>CNGN120708</td>
<td>●</td>
</tr>
<tr>
<td>CNGN 453</td>
<td>CNGN120712</td>
<td>●</td>
</tr>
<tr>
<td>CNGN 454</td>
<td>CNGN120716</td>
<td>●</td>
</tr>
<tr>
<td>CNGN 455</td>
<td>CNGN120720</td>
<td>●</td>
</tr>
</tbody>
</table>

- **SZ**: Continuous cutting
- **S**: Light interrupted cutting
- **D**: Heavy interrupted cutting

* with dimple

---

**Steel**

- **P**: Continuous cutting
- **M**: Light interrupted cutting
- **K**: Heavy interrupted cutting

**Stainless**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Cast iron**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Non-ferrous**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Superalloy**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Hard material**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Steel**

- **P**: Continuous cutting
- **M**: Light interrupted cutting
- **K**: Heavy interrupted cutting

**Stainless**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Cast iron**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Non-ferrous**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Superalloy**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Hard material**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

---

**Inch Metric**

- **Line up**: The tool is aligned correctly.
- **New**: The tool is new.

---

**Ceramic**

- **Line up**: The tool is aligned correctly.
- **New**: The tool is new.

---

**Dimension (inch)**

- **SZ**: Continuous cutting
- **S**: Light interrupted cutting
- **D**: Heavy interrupted cutting

---

**Steel**

- **P**: Continuous cutting
- **M**: Light interrupted cutting
- **K**: Heavy interrupted cutting

**Stainless**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Cast iron**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Non-ferrous**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Superalloy**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Hard material**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

---

**Rhombic, 80°**

- **Steel**
- **Stainless**
- **Cast iron**
- **Non-ferrous**
- **Superalloy**
- **Hard material**

---

**Application**

- **Finishing to medium cutting**
- **Finishing to medium cutting**

---

**Chipbreaker Designation**

- **Inch**
- **Metric**

---

**Ceramic**

- **Line up**: The tool is aligned correctly.
- **New**: The tool is new.

---

**Dimension (inch)**

- **SZ**: Continuous cutting
- **S**: Light interrupted cutting
- **D**: Heavy interrupted cutting

---

**Steel**

- **P**: Continuous cutting
- **M**: Light interrupted cutting
- **K**: Heavy interrupted cutting

**Stainless**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Cast iron**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Non-ferrous**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Superalloy**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

**Hard material**

- **N**: Continuous cutting
- **K**: Light interrupted cutting
- **S**: Heavy interrupted cutting

---

**Inch Metric**

- **Line up**: The tool is aligned correctly.
- **New**: The tool is new.
## ACCELERATED MACHINING

### Insert NEGATIVE TYPE

#### DN

**Rhombic, 55° with hole**

<table>
<thead>
<tr>
<th>Application</th>
<th>Chipbreaker</th>
<th>Designation</th>
<th>Ceramic</th>
<th>Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-</td>
<td>DNGA 431</td>
<td>DNGA150404</td>
<td>0.016 0.500 0.187 0.203</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>DNGA 432</td>
<td>DNGA150408</td>
<td>0.031 0.500 0.187 0.203</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>DNGA 433</td>
<td>DNGA150412</td>
<td>0.047 0.500 0.187 0.203</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>DNGA 434</td>
<td>DNGA150416</td>
<td>0.063 0.500 0.187 0.203</td>
</tr>
</tbody>
</table>

**Rhombic, 55° without hole**

<table>
<thead>
<tr>
<th>Application</th>
<th>Chipbreaker</th>
<th>Designation</th>
<th>Ceramic</th>
<th>Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-</td>
<td>DNGD 452</td>
<td>DNGD150708</td>
<td>0.031 0.500 0.313 -</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>DNGD 453</td>
<td>DNGD150712</td>
<td>0.047 0.500 0.313 -</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>DNGD 454</td>
<td>DNGD150716</td>
<td>0.063 0.500 0.313 -</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>DNGN 433</td>
<td>DNGN150412</td>
<td>0.047 0.500 0.187 -</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>DNGN 434</td>
<td>DNGN150416</td>
<td>0.063 0.500 0.187 -</td>
</tr>
</tbody>
</table>

- : Continuous cutting
  - : Light interrupted cutting
  + : Heavy interrupted cutting

---

**Application**

- Steel
- Stainless
- Cast iron
- Non-ferrous
- Superalloy
- Hard material

**Chipbreaker Designation**

- Continuous cutting
- Light interrupted cutting
- Heavy interrupted cutting

**Finishing to medium cutting**

- with dimple
- without hole
### Insert NEGATIVE TYPE

#### RN

<table>
<thead>
<tr>
<th>Application</th>
<th>Chipbreaker Designation</th>
<th>Ceramic</th>
<th>Dimension (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round, without hole</td>
<td>- RNGN 43 RNGN120400</td>
<td>●</td>
<td>- 0.500 0.187 -</td>
</tr>
<tr>
<td></td>
<td>RNGN 45 RNGN120700</td>
<td>●</td>
<td>- 0.500 0.187 -</td>
</tr>
</tbody>
</table>

#### SN

<table>
<thead>
<tr>
<th>Application</th>
<th>Chipbreaker Designation</th>
<th>Ceramic</th>
<th>Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square, 90° with hole</td>
<td>- SNMA 432 SNMA120408</td>
<td>●</td>
<td>0.031 0.500 0.187 0.203</td>
</tr>
<tr>
<td></td>
<td>SNMA 433 SNMA120412</td>
<td>●</td>
<td>0.047 0.500 0.187 0.203</td>
</tr>
<tr>
<td></td>
<td>SNGA 432 SNGA120408</td>
<td>●</td>
<td>0.031 0.500 0.187 0.203</td>
</tr>
<tr>
<td></td>
<td>SNGA 433 SNGA120412</td>
<td>●</td>
<td>0.047 0.500 0.187 0.203</td>
</tr>
<tr>
<td></td>
<td>SNGA 434 SNGA120416</td>
<td>●</td>
<td>0.063 0.500 0.187 0.203</td>
</tr>
</tbody>
</table>

* : Continuous cutting
● : Light interrupted cutting
* : Heavy interrupted cutting

<table>
<thead>
<tr>
<th>Steel</th>
<th>Stainless</th>
<th>Cast iron</th>
<th>Non-ferrous</th>
<th>Superalloy</th>
<th>Hard material</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>M</td>
<td>K</td>
<td>N</td>
<td>S</td>
<td>H</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application</th>
<th>Dimension (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round, without hole</td>
<td>0.500 0.187</td>
</tr>
<tr>
<td>Square, 90° with hole</td>
<td>0.031 0.500 0.187 0.203</td>
</tr>
</tbody>
</table>

Inch Metric

- Round, without hole
- Square, 90° with hole

- Line up

**TZ120**
# ACCELERATED MACHINING

## Insert

### NEGATIVE TYPE

### SN

<table>
<thead>
<tr>
<th>Application</th>
<th>Chipbreaker</th>
<th>Designation</th>
<th>Ceramic</th>
<th>Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>Metric</td>
<td>RE</td>
<td>IC</td>
<td>S</td>
</tr>
<tr>
<td>-</td>
<td>SNGD 453</td>
<td></td>
<td></td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>SNGD120712</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>* with dimple</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>SNGN 322</td>
<td></td>
<td></td>
<td>0.031</td>
</tr>
<tr>
<td></td>
<td>SNGN090308</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TN

<table>
<thead>
<tr>
<th>Application</th>
<th>Chipbreaker</th>
<th>Designation</th>
<th>Ceramic</th>
<th>Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>Metric</td>
<td>RE</td>
<td>IC</td>
<td>S</td>
</tr>
<tr>
<td>-</td>
<td>TNMA 332</td>
<td></td>
<td></td>
<td>0.031</td>
</tr>
<tr>
<td></td>
<td>TNMA160408</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>TNGA 331</td>
<td></td>
<td></td>
<td>0.016</td>
</tr>
<tr>
<td></td>
<td>TNGA160404</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Chipbreaker Details

**Steel (P)**

**Stainless (M)**

**Cast iron (K)**

**Non-ferrous (N)**

**Superalloy (S)**

**Hard material (H)**

**Application**

- Square, 90° without hole
- Triangular, 60° with hole

**Chipbreaker Designation**

- SNGD
- SNGN
- TNMA
- TNGA

**Ceramic**

- TZ120
- FX105
- Line up
- New
## Insert
### NEGATIVE TYPE

#### TN

**Triangular, 60° without hole**

<table>
<thead>
<tr>
<th>Application</th>
<th>Chipbreaker Designation</th>
<th>Ceramic</th>
<th>Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>Metric</td>
<td>RE</td>
<td>IC</td>
</tr>
<tr>
<td>-</td>
<td>TNGN 331 TNGN160404</td>
<td>✔️</td>
<td>0.016</td>
</tr>
<tr>
<td></td>
<td>TNGN 332 TNGN160408</td>
<td>✔️</td>
<td>0.031</td>
</tr>
<tr>
<td></td>
<td>TNGN 333 TNGN160412</td>
<td>✔️ ✔️</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>TNGN 334 TNGN160416</td>
<td>✔️</td>
<td>0.063</td>
</tr>
<tr>
<td></td>
<td>TNGN 335 TNGN160420</td>
<td>✔️</td>
<td>0.078</td>
</tr>
</tbody>
</table>

#### VN

**Rhombic, 35° without hole**

<table>
<thead>
<tr>
<th>Application</th>
<th>Chipbreaker Designation</th>
<th>Ceramic</th>
<th>Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>Metric</td>
<td>RE</td>
<td>IC</td>
</tr>
<tr>
<td>-</td>
<td>VNGD 353 VNGD160712</td>
<td>✔️</td>
<td>0.047</td>
</tr>
</tbody>
</table>

#### HN

**Hexagonal, 120° without hole**

<table>
<thead>
<tr>
<th>Application</th>
<th>Chipbreaker Designation</th>
<th>Ceramic</th>
<th>Dimension (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>Metric</td>
<td>RE</td>
<td>IC</td>
</tr>
<tr>
<td>-</td>
<td>HNGD 453 HNGD050712</td>
<td>✔️</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>HNGD 454 HNGD050716</td>
<td>✔️</td>
<td>0.063</td>
</tr>
</tbody>
</table>

- **P**: Steel
- **M**: Stainless
- **K**: Cast iron
- **N**: Non-ferrous
- **S**: Superalloy
- **H**: Hard material

**Inch Metric**

- **RE**: Line up
- **IC**: New
- **S**: Line up
- **D1**: New

**Application**

- Finishing to medium cutting: ✔️

**Chipbreaker Designation**

- **RE**: Line up
- **IC**: New

**Ceramic**

- **Dimension (inch)**
  - **IC**: Line up
  - **S**: New

**Material**

- **Steel**
- **Stainless**
- **Cast iron**
- **Non-ferrous**
- **Superalloy**
- **Hard material**

**Finishing to medium cutting**

- ✔️ with dimple

**Dimension (inch)**

- ✔️: Line up
- ✔️: New

**Triangular, 60° without hole**

- ✔️: Line up
- ✔️: New

**Rhombic, 35° without hole**

- ✔️ with dimple

**Hexagonal, 120° without hole**

- ✔️ with dimple

**Insert**

- ✔️: Continuous cutting
- ✔️: Light interrupted cutting
- ✔️: Medium interrupted cutting
### ACCERELATED MACHINING

#### PRACTICAL EXAMPLES

<table>
<thead>
<tr>
<th>Workpiece type</th>
<th>Cylinder liner</th>
<th>Roll</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toolholder</td>
<td>Special boring tool</td>
<td>ACLNL164-A</td>
</tr>
<tr>
<td>Insert</td>
<td>SNGN 454</td>
<td>CNGA 432</td>
</tr>
<tr>
<td>Grade</td>
<td>TZ120</td>
<td>LX21</td>
</tr>
<tr>
<td>Workpiece material</td>
<td>Centrifugal cast iron</td>
<td>Chilled cast iron (40HRC)</td>
</tr>
<tr>
<td>Cutting speed : ( V_c ) (sfm)</td>
<td>656</td>
<td>262</td>
</tr>
<tr>
<td>Feed : ( f ) (ipr)</td>
<td>0.0078</td>
<td>0.0078</td>
</tr>
<tr>
<td>Depth of cut : ( a_p ) (inch)</td>
<td>0.079</td>
<td>0.039</td>
</tr>
<tr>
<td>Machining</td>
<td>Boring</td>
<td>External</td>
</tr>
<tr>
<td>Coolant</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Results**

TZ120 is superior in wear resistance for centrifugal cast iron (such as cylinder liner) and extended tool life by 1.3x.

LX21 is superior in wear resistance for hardened cast iron roll turning providing improved tool life by 1.25x over conventional ceramic grade.

<table>
<thead>
<tr>
<th>Workpiece type</th>
<th>Disc brake rotor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toolholder</td>
<td>Special toolholder</td>
</tr>
<tr>
<td>Insert</td>
<td>SNMX 454</td>
</tr>
<tr>
<td>Grade</td>
<td>FX105</td>
</tr>
<tr>
<td>Workpiece material</td>
<td>Gray cast iron</td>
</tr>
<tr>
<td>Cutting speed : ( V_c ) (sfm)</td>
<td>1476</td>
</tr>
<tr>
<td>Feed : ( f ) (ipr)</td>
<td>0.020</td>
</tr>
<tr>
<td>Depth of cut : ( a_p ) (inch)</td>
<td>0.060</td>
</tr>
<tr>
<td>Machining</td>
<td>Face turning</td>
</tr>
<tr>
<td>Coolant</td>
<td>Wet</td>
</tr>
</tbody>
</table>

**Results**

FX105 decreases the occurrence of sudden breakage providing stable machining.