HIGH-FEED MILLING SOLUTIONS
HIGH-FEED MILLING

the Go-to Solution for Accelerated Machining
Tungaloy’s renowned solutions for High-Feed Milling (HFM) have been around for many years.

1990
Tungaloy’s insightfulness and devotion to HFM dates back to the late 1990s with the release of the MillFeed TXP series to meet the emerging needs for higher efficiency in face milling.

2010
Tungaloy introduces its DoFeed line in 2010 as the market starts to prefer more compact but faster machines. DoFeed revolutionized high-feed milling, offering large diameter cutters utilizing higher feed rates for incredible performance.

2016
MillQuad-Feed and DoTwist-Ball continue Tungaloy’s history of offering high efficiency products reflecting the core concept of Accelerated Machining.

www.tungaloyamerica.com
WHY HFM?

HFM is the go-to solution for Accelerated Machining!

In today’s hypercompetitive machining market, *cycle time plays a major role in productivity* and often determines the profitability of any given job.

Simply increasing the speed or revolutions per minute (RPM) may appear to decrease cycle time. A reduction in cycle time, however, is hampered by the time to change inserts as the increase in speed or RPM shortens tool life, which increases the tool cost in parallel.

**High-Feed Milling (HFM)** is the solution for this problem. The tool works at elevated feed rates with modest speed or RPM which reduces cycle time while extending tool life.

Thus, *HFM has transformed* many manufacturers’ ways of thinking about milling. These flexible and versatile tools offer much more than any other milling tool: dramatically reduced cycle time and cost, long tool life, and high quality of finished parts.

**Faster and more efficient machining**—long overhang, large components.

**HFM** specializes in long-reach applications such as deep hole and pocket machining. Combined with its capability of ramping, this feature allows the High Feed cutter to perform helical interpolation: the tool moves in a circular motion to X and Y axes while simultaneously moving downward on the Z axis.

**HFM** is the strongest and fastest in milling operations when machining large parts. Customers usually have to make an additional finishing pass, however, to clean up the rough surface generated. With the incorporation of wiper inserts, Tungaloy’s **HFM cutter** can deliver outstanding surface finish with no reduction in feed rate. As a result, the efficiency of the overall machining process is drastically improved.
**Simplifying the processes** for near net shape

HFM provides a high metal removal rate, despite its small depth of cut. As this makes workpiece materials closer to the desired shape in one operation, semi-finishing operations can often be eliminated, and the finishing process can be simplified.

This characteristic is ideal for 3D machining. Most 3D machining begins with a solid block of material. The material is gradually removed until the desired configuration is obtained. This method is called subtractive manufacturing, and is the opposite of additive manufacturing. An example of additive manufacturing would be 3D printing. While a 3D printer places thin layers upon layers, 3D machining removes thin layers of material in each pass. In both cases, thin layers help produce a shape close to the final structure.

**Versatility**

Versatility is another advantage of HFM. Tungaloy offers HFM inserts with very positive cutting edges, which easily shear the material without work hardening.

For example, DoFeed cutters can machine multiple hole diameters and produce counter bore and countersink in the same operation, with no need to change or purchase multiple tools. This versatility saves on both cost, and time.
First utilized in the Die and Mold industry, **High-Feed Milling** is a milling method that pairs shallow depth of cut (DOC) with high feed rate up to 0.08” per tooth to maximize the amount of metal being removed from a part, resulting in more parts being machined more quickly.

The **HFM** mechanism is based on the “chip thinning” effect. Chip thinning depends on the lead angle of a milling cutter. A cutter with a 90° lead angle has no benefit of chip thinning as 0.008” of feed per tooth only delivers the same 0.008” of chip thickness (Fig. 1). In the case of a cutter with a 45° lead angle, a 0.01” of feed per tooth creates a 0.007” of chip thickness (Fig. 2) which allows the feed to be increased, resulting in reduced cycle time. Fig. 3 shows the chip thinning effect of **DoFeed**, Tungaloy’s best selling **HFM** line, where a 0.05” of feed per tooth provides chip thickness of only 0.007”, and cycle time is typically decreased by 50% or more.

Low cutting force is also an advantage of **HFM**. The lead angle on a cutter decides the direction of the cutting force. A 90° cutter (Fig. 1) will produce cutting force that acts perpendicular to the spindle, putting incredible pressure on the tool. As for a 45° cutter (Fig. 2), cutting force acts against the spindle at a 45° angle. With **DoFeed**, cutting force is almost parallel, and directed back to the spindle due to its acute lead angle (Fig. 3), which means less pressure on the spindle.

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**Fig. 1**
- Chip thickness: 0.008”
- Feed per tooth: 0.008 ipt

**Fig. 2**
- Chip thickness: 0.007”
- Feed per tooth: 0.010 ipt

**Fig. 3**
- Chip thickness: 0.007”
- Feed per tooth: 0.050 ipt
GET STARTED!

What is inside?

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  - Power Generation
  - Aerospace
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MILESTONE PRODUCTS

Tungaloy has developed the widest range of High-Feed Milling tools and inserts, covering a spectrum of applications.

**Versatility** at its finest

- Perfect for **ramping, plunging, hole enlarging, slotting, drilling, and shoulder milling** in a wide range of industries.
- Smooth chip evacuation and minimal chattering.
- Easy machining on long overhang applications like large depth machining.
- Maximum feed rate: 0.059 ipt
- Tool diameters ø0.625" - ø6.000"

See pg. 22

**Unique twist on the insert to ensure stability for incredible productivity**

- 04 inserts to complement DoFeed’s 03 and 06 inserts ranges
- R4 round inserts are also mountable
- Maximum feed rate: 0.051 ipt
- Tool diameters ø1.000" - ø2.000"

See pg. 30
Simple but powerful for maximum performance and productivity

- Ideal for use with a high power spindle (40kW or more)
- Maximum feed rate: 0.079 ipt
- Tool diameters ø2.500" - ø6.000"

See pg. 36

Economical tool for rough operations

- Dovetail clamping prevents inserts from lifting up during heavy roughing operation.
- Maximum feed rate: 0.079 ipt
- Tool diameters ø2.000" - ø6.000"

See pg. 34

Indexable solid carbide head for high feed machining

- Highly accurate repeatability
- Drastically reduces tool changeover time
- Maximum feed rate: 0.040 ipt
- Tool diameters ø0.375" - ø0.750"

See pg. 18
Die and Mold machining primarily refers to the machining of complex 3D forms. Stamping, forming, forging dies, injection and blow molds are all examples of tooling that might have complex shapes precisely mirroring or matching the intended dimensions of a final, mass-produced part. HFM is an important topic for Die and Mold machining, because of the need to take light milling passes in order to obtain both the required geometry and surface finish.

DoFeed features a close-pitch design to increase the feed rate in profiling operations. See pg. 22

MillQuad-Feed is a solution for a high metal removal rate especially in face milling. See pg. 36

DoFeedQuad’s dovetail clamping system ensures stable machining. See pg. 34

DoTwist-Ball performs stable chip evacuation in pocketing operations. See pg. 30
The Power Generation industry is known for using components of complex structures made of stainless steel or heat-resistant alloys. To improve the performance in machining a complex structure, a cutter should be capable of delivering an elevated metal removal rate at a low depth of cut, and feature sharp cutting edges. With well balanced toughness and cutting edge sharpness, Tungaloy’s High-Feed mills assure stable machining in delicate operations.

The TungMeister series of indexable end mills are available in small diameters for machining narrow work areas.

DoFeed’s low cutting force prevents chattering even in a long overhang.

Many components in the aerospace industry are made of tough materials such as precipitation hardened stainless steel or titanium alloy. This quickly uses up common tools, making it difficult to balance tool life and machining performance. Tungaloy’s close-pitched High Feed mills will guarantee Accelerated Machining in aerospace manufacturing.

DoFeed can machine titanium alloy with high feed and speed because of the close pitch design.

MillQuad-Feed ensures reliability in heavy high-feed milling on unstable surfaces.
Tungaloy’s High-Feed MillLines are shown on this chart in relation to feed rate and depth of cut. Metal removal rates increase with spindle capacity.

In principle, the stronger the spindle power the machine is capable of, the higher the cutting parameters that can be used, such as a higher feed per tooth, larger cutter diameter, and/or denser tooth pitch. If the parameter is set too high, however, the cutting force will exceed the machine’s spindle capacity, causing sudden machine stoppage. To prevent such machine failures, calculate the theoretical cutting force prior to machining to ensure that the parameters to be used are within the safe level.

For easy calculation of theoretical cutting power, download “Dr. Carbide” here.
Recommended **Cutting Parameters**

Recommended cutting parameters for given materials in terms of cutting speed and feed per tooth.

<table>
<thead>
<tr>
<th>Density of Cutter</th>
<th>DoFeed 03</th>
<th>DoTwistBall 04</th>
<th>DoFeed 06</th>
<th>MillQuadFeed</th>
<th>DoFeedQuad</th>
<th>TungMeister</th>
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<td>0.020 - 0.051</td>
<td>0.020 - 0.059</td>
<td>0.039 - 0.079</td>
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<td>100 - 200</td>
<td>100 - 200</td>
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<tr>
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<td>fz</td>
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<tr>
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<td>0.004 - 0.012</td>
<td>0.004 - 0.012</td>
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</table>

**Tool and application choices**

- Facing
- Shoulder
- Slotting
- Slotted R
- Profiling
- Pocketing
- Ramping
- Interpolation
- Plunging

- TungMeister
- DoFeed 03
- DoTwistBall
- DoFeed 06
- DoFeedQuad
- MillQuadFeed
For maximum performance

$\phi Dc1$ and $\phi Dc$

Effective tool diameter $\phi Dc1$ is usually smaller than tool diameter $\phi Dc$.

Theoretical radius and programming

CAD/CAM systems will require a defined radius dimension in order to program for wall/shoulder machining. The parameters shown below are to be used for programming with DoFeed’s EXN06/TXN06 inserts. The “R” noted below is defined as the theoretical radius to be used for programming.

When programming, a theoretical radius (R) and the actual profile left uncut on the machined surface (t1) should be noted. Here R=0.12” is recommended for a EXN06/TXN06 insert. If a larger radius (e.g. R=0.16”) is programmed, an overcut (t2) of 0.01” may occur and the dimensional accuracy may be deviated from what is required.

Each value above is calculated theoretically at the maximum condition.
**Machining thin workpieces** with weak fixture

Workpieces in a thin, flat structure with weak fixture setting are prone to chatter. To minimize vibration, reduce thrust force by decreasing D.O.C. or feed rate. Another option is to use a cutter with a bigger approach angle for reduced thrust force.

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**Long overhang** and chattering

Due to the cutting force acting vertically up to the spindle, HFM is an ideal method in long reach applications to improve efficiency. However, if a tool length of 5xD or longer is used, the following cautions are advised to be taken:

- Use a coarse-pitched cutter: This will decrease the number of cutting edges in contact simultaneously on the workpiece. If additional stability is needed, use an ML chipbreaker (Use only as a supplemental method).

- Vibration may be minimized by optimizing cutting parameters (to 70% of the recommended parameters). Adjust the parameters in the following orders:
  1. Reduce the cutting speed ($V_c$)
  2. Reduce the DOC ($a_p$)
  3. Reduce the feed rate ($f_z$)

(Note: when using a $f_z=0.020$ ipt or lower, a reduction in feed rate may adversely increase vibration.)

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Note: If all the above measures are taken and chatter still exists, or production efficiency is not reaching an adequate level, use Tungaloy’s RoundSplit milling cutter.
**Milling unstable surfaces**

Milling unstable surfaces including scale removal is a troublesome operation. Insert damage is common in these operations, hindering unmanned machine operations. Many customers choose a high-feed cutter as a safe and productive machining solution. Due to surface unevenness, a high-feed cutter is forced to make unproductive "air cut" passes before the surfaces reaches a high enough quality for finishing operations to follow.

MillQuad-Feed is an extremely efficient milling solution for unstable surfaces, with its high-feed capability of 0.08" per tooth at 0.1" depth of cut. MillQuad-Feed ensures high stability and metal removal rates. DoTriple-Mill round inserts are another solution: one single set of inserts can be used for both highly efficient scale removal and follow-up high-feed milling.
HIGH-FEED MILLING

PRODUCT LINE-UP

A wide range of High-Feed Milling tools

VFX**-02...

TungMeister radius head for super high-feed milling

<table>
<thead>
<tr>
<th>Inch</th>
<th>AH725</th>
<th>z</th>
<th>Helix</th>
<th>øDc</th>
<th>ødf</th>
<th>Max. ap</th>
<th>r(t)</th>
<th>S</th>
<th>L</th>
<th>Wrench</th>
<th>Torque*</th>
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<td>0.080</td>
<td>SO8</td>
<td>0.590</td>
<td>KEYV-S08</td>
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<td>0.685</td>
<td>KEYV-S10</td>
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ap = Max. depth of cut, S = Connection screw size

(1) Corner radius for CAM programing
Note: For VFX head, taper neck shank or Tungsten shank should be recommended.
*Torque: Recommended torque (Nm) for clamping.
Packing quantity = 2 pcs.

STANDARD CUTTING CONDITIONS

High feed milling (VFX)

ISO Workpiece material Hardness Cutting speed Vc (ipt) ø0.375" Feed per tooth fz (ipt) Depth of cut ap (ipt) ø0.500" Feed per tooth fz (ipt) Depth of cut ap (ipt) ø0.750" Feed per tooth fz (ipt) Depth of cut ap (ipt) Width of cut ae (in)

P Low carbon steels 1045, 1055, etc. - 300 HB 330 - 660 0.012 - 0.028 0.020 0.016 - 0.031 0.020 0.024 - 0.040 0.040 0.6 x øDc
High carbon steels 4140, S120, etc. - 300 HB 260 - 590 0.008 - 0.024 0.020 0.012 - 0.028 0.020 0.020 - 0.035 0.040 0.6 x øDc
Prehardened steel PX5, NAK80, etc. 30 - 40 HRC 260 - 530 0.008 - 0.020 0.016 0.008 - 0.02 0.016 0.012 - 0.024 0.030 0.6 x øDc

M Stainless steels S30400, S31600, etc. - 200 HB 200 - 330 0.008 - 0.024 0.016 0.008 - 0.024 0.016 0.012 - 0.028 0.030 0.6 x øDc
Grey cast irons No.250B, No.300B, etc. 150 - 250 HB 330 - 720 0.012 - 0.028 0.020 0.016 - 0.031 0.030 0.024 - 0.040 0.040 0.6 x øDc
Ductile cast irons 60-40-18, etc. 150 - 250 HB 330 - 720 0.008 - 0.024 0.020 0.012 - 0.028 0.030 0.020 - 0.035 0.040 0.6 x øDc

S Titanium alloys Ti-6Al-4V, etc. - 130 - 260 0.008 - 0.020 0.016 0.008 - 0.020 0.016 0.008 - 0.024 0.020 0.25 x øDc
Heat-resistant alloys Inconel 718, etc. - 66 - 130 0.004 - 0.012 0.012 0.004 - 0.012 0.012 0.004 - 0.012 0.016 0.25 x øDc

H Hardened steel H13, etc. 40 - 50 HRC 130 - 260 0.008 - 0.016 0.012 0.008 - 0.016 0.012 0.012 - 0.020 0.016 0.45 x øDc
Hardened steel D2, etc. 50 - 60 HRC 66 - 200 0.004 - 0.008 0.008 0.004 - 0.008 0.008 0.004 - 0.012 0.012 0.25 x øDc
FEED the SPEED - TUNGALOY ACCELERATED MACHINING

**VSS...**

TungMeister, straight neck and cylindrical shank

<table>
<thead>
<tr>
<th>Inch</th>
<th>$\phi D_s$</th>
<th>$\phi d_1$</th>
<th>$L_1$</th>
<th>$L_2$</th>
<th>$L_3$</th>
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**VSSD**W...

TungMeister, straight neck and weldon shank

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<thead>
<tr>
<th>Metric</th>
<th>$\phi D_s$</th>
<th>$\phi d_1$</th>
<th>$L_1$</th>
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HIGH-FEED MILLING

VTS...

TungMeister, straight shank and taper neck

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<th>α°</th>
<th>øDs</th>
<th>ød1</th>
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VTSD**-W-A

TungMeister, straight shank and taper neck with coolant hole

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FEED the SPEED - TUNGALOY ACCELERATED MACHINING

VSSD**-W-A
TungMeister, straight shank and neck with coolant hole

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(TUnit : mm)

VAD**-M...
TungFlex conversion adaptor with TungMeister

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(Unit : mm)

WRENCH

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<th>Torque (N·m)</th>
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Note: Optional parts

CAUTIONARY POINTS IN USE

- The cutting heads specified by Tungaloy must be used. Avoid using alternate heads that are not Tungaloy products as this will damage the shank and can cause severe accident or injury.
- Before setting the head, clean the connection screw with an air blast or a wiping cloth to remove chips and other foreign matter that may remain.
- Do not apply the lubricant to the connection screw.
- Please use the supplied wrench. Tighten the head slowly until the face of the head contacts the shank. (Please refer to the picture shown on the right.) Do not re-tighten or over-tighten. Excessive tightening may cause the cutting head to break.
- Do not apply excessive force or hammer when tightening or exchanging the cutting heads.

www.tungaloyamerica.com 21
Super high-feed milling endmills with double sided inserts with 4 edges

Inch  Max. ap  øDc  z  øDc1  øD  ød  ℓt  b  a  κ°  lb  Air hole  Insert
EXN03R062U0062-02  0.039  0.625  2  0.369  0.625  4.000  1.250  2.750  15  0.440  ✓  LNMU03...
EXN03R062U0062-02L  0.039  0.625  2  0.369  0.625  6.000  2.000  4.000  15  0.440  ✓  LNMU03...
EXN03R068U0062-02  0.039  0.688  2  0.432  0.625  4.000  1.250  2.750  17  0.660  ✓  LNMU03...
EXN03R068U0062-02L  0.039  0.688  2  0.432  0.625  6.000  1.000  5.000  17  0.660  ✓  LNMU03...
EXN03R075U0075-02  0.039  0.750  2  0.494  0.750  5.000  2.000  3.000  17  0.660  ✓  LNMU03...
EXN03R075U0075-03  0.039  0.750  3  0.494  0.750  5.000  2.000  3.000  17  0.660  ✓  LNMU03...
EXN03R075U0075-03L  0.039  0.750  3  0.494  0.750  6.000  1.000  5.000  17  0.660  ✓  LNMU03...
EXN03R087U0075-02  0.039  0.875  2  0.619  0.750  5.000  2.000  3.000  17  0.880  ✓  LNMU03...
EXN03R087U0075-03  0.039  0.875  3  0.619  0.750  5.000  2.000  3.000  17  0.880  ✓  LNMU03...
EXN03R087U0075-03L  0.039  0.875  3  0.619  0.750  6.500  1.250  5.250  17  1.100  ✓  LNMU03...
EXN03R087U0075-06  0.039  0.875  6  0.619  0.750  6.000  3.000  3.000  17  1.100  ✓  LNMU03...
EXN03R090U0075-04  0.039  0.994  4  0.869  1.000  5.000  2.500  3.000  17  1.320  ✓  LNMU03...
EXN03R090U0075-04L  0.039  0.994  4  0.869  1.000  7.000  1.500  5.500  17  1.320  ✓  LNMU03...
EXN03R090U0075-05  0.039  0.994  5  0.869  1.000  5.500  2.500  3.000  17  1.320  ✓  LNMU03...
EXN03R090U0075-05L  0.039  0.994  5  0.869  1.000  8.000  3.000  3.000  17  1.320  ✓  LNMU03...
EXN03R090U0075-06  0.039  0.994  6  0.869  1.250  6.000  3.000  3.000  17  1.320  ✓  LNMU03...

Super high-feed milling cutters with double sided inserts with 4 edges

A.R. = +6°, R.R. = +12° – 13°
**FEED the SPEED - TUNGALOY ACCELERATED MACHINING**

**HXN03-M**
Super high-feed milling endmills (Dofeed) with TungFlex

![Image of HXN03-M milling endmill]

**Guide Dimensions**

A.R. = +6°, R.R. = +5° ~ +11°

A-A cross section

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<td>23</td>
<td>17</td>
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<tr>
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<td>21.5</td>
<td>57</td>
<td>35</td>
<td>10</td>
<td>17</td>
<td>23</td>
<td>17</td>
<td>M12</td>
<td>0.12</td>
<td>✓</td>
<td>LNMU03...</td>
</tr>
<tr>
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<td>30</td>
<td>4</td>
<td>23.5</td>
<td>63</td>
<td>40</td>
<td>12</td>
<td>22</td>
<td>28.8</td>
<td>17</td>
<td>M16</td>
<td>0.19</td>
<td>✓</td>
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</tr>
<tr>
<td>HXN03R030MM16-05</td>
<td>30</td>
<td>5</td>
<td>23.5</td>
<td>63</td>
<td>40</td>
<td>12</td>
<td>22</td>
<td>28.8</td>
<td>17</td>
<td>M16</td>
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<td>40</td>
<td>12</td>
<td>22</td>
<td>28.8</td>
<td>17</td>
<td>M16</td>
<td>0.2</td>
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<tr>
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<td>40</td>
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<td>M16</td>
<td>0.21</td>
<td>✓</td>
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</tbody>
</table>

(Uight : mm)

**SPARE PARTS**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Clamping screw</th>
<th>Lubricant</th>
<th>Wrench</th>
</tr>
</thead>
<tbody>
<tr>
<td>HXN03...</td>
<td>CSPB-2.5</td>
<td>M-1000</td>
<td>IP-4D</td>
</tr>
</tbody>
</table>

**INSERTS**

**LNMU03-MJ (for general use)**

![Image of LNMU03-MJ insert]

**LNMU03-ML (for low cutting force)**

![Image of LNMU03-ML insert]

**Classification of Materials**

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

<table>
<thead>
<tr>
<th>Designation</th>
<th>rc</th>
<th>Max. ap</th>
<th>Coated</th>
<th>A</th>
<th>B</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNMU0303ZER-MJ</td>
<td>0.047</td>
<td>0.039</td>
<td>AH130</td>
<td>0.126</td>
<td>0.236</td>
<td>0.169</td>
</tr>
<tr>
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<td>0.039</td>
<td>AH725</td>
<td>0.126</td>
<td>0.236</td>
<td>0.169</td>
</tr>
</tbody>
</table>

*: Standard item

**: First choice

**: Second choice
STANDARD CUTTING CONDITIONS TXN03/EXN03/HXN03

HIGH-FEED MILLING

CAUTIONARY POINTS IN USE

- The usage of standard and long shanks
  - When using a long shank, always lower the cutting conditions (Vc, fz, ap) to 70% of the maximum conditions for the standard shank.

CAM programming

- When programming for CAM, the tool should be considered as a round insert cutter. Usually, the corner radius should be set as R = 0.06°. If a larger radius is used, overcutting will occur. The following table shows the amount left as uncut (t1) and overcut (t2).

CAM programming

<table>
<thead>
<tr>
<th>Max. depth of cut</th>
<th>Corner radius r c</th>
<th>W (in)</th>
<th>Corner R when programming</th>
<th>Amount left as uncut</th>
<th>Amount left as overcut</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.039</td>
<td>0.047</td>
<td>0.118</td>
<td></td>
<td>0.039</td>
<td>0.024</td>
</tr>
<tr>
<td>0.060</td>
<td>0.047</td>
<td>0.118</td>
<td></td>
<td>0.060</td>
<td>0.020</td>
</tr>
<tr>
<td>0.079</td>
<td>0.047</td>
<td>0.118</td>
<td></td>
<td>0.079</td>
<td>0.010</td>
</tr>
<tr>
<td>0.098</td>
<td>0.047</td>
<td>0.118</td>
<td></td>
<td>0.098</td>
<td>0.006</td>
</tr>
</tbody>
</table>

Each value in the table is calculated theoretically at the maximum condition.

Always use an airgun to clear cavities and slots completely of chips and debris.

Tool overhang length must be as short as possible to avoid chatter. When the tool overhang length is long, decrease the number of revolutions and feed.
The above table shows the conditions for standard shank type cutters. When using long shank type cutters, the number of teeth may be different. In this case, the cutting conditions should be changed by referring to: “The usage of standard and long shanks” shown on the previous page.

Cutting conditions are generally limited by the spindle rigidity, machine power and the workpiece fixture stability. When setting the conditions, start from half of the values of the standard cutting conditions and then increase the value gradually while making sure the machine is running normally.

### Tool dia.: øDc (in), Number of revolutions: n (rpm), Feed speed: Vf (ipm), Max. depth of cut: ap = 0.039"

<table>
<thead>
<tr>
<th>ø0.750&quot;</th>
<th>ø0.875&quot;</th>
<th>ø1.000&quot;</th>
<th>ø1.125&quot;</th>
<th>ø1.250&quot;</th>
<th>ø1.500&quot;</th>
<th>ø2.000&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>Vf = 660 sfm, fz = 0.030 ipt</td>
<td>n</td>
<td>Vf = 660 sfm, fz = 0.030 ipt</td>
<td>n</td>
<td>Vf = 660 sfm, fz = 0.030 ipt</td>
<td>n</td>
</tr>
<tr>
<td>z = 2</td>
<td>202</td>
<td>303</td>
<td>2881</td>
<td>173</td>
<td>259</td>
<td>2021</td>
</tr>
<tr>
<td>z = 3</td>
<td>202</td>
<td>303</td>
<td>2881</td>
<td>173</td>
<td>259</td>
<td>2021</td>
</tr>
<tr>
<td>z = 4</td>
<td>168</td>
<td>252</td>
<td>2881</td>
<td>144</td>
<td>216</td>
<td>2521</td>
</tr>
<tr>
<td>z = 5</td>
<td>336</td>
<td>403</td>
<td>504</td>
<td>306</td>
<td>415</td>
<td>1036</td>
</tr>
</tbody>
</table>

The above table shows the conditions for standard shank type cutters. When using long shank type cutters, the number of teeth may be different. In this case, the cutting conditions should be changed by referring to: “The usage of standard and long shanks” shown on the previous page.

Cutting conditions are generally limited by the spindle rigidity, machine power and the workpiece fixture stability. When setting the conditions, start from half of the values of the standard cutting conditions and then increase the value gradually while making sure the machine is running normally.

### APPLICATION RANGE

- **Shoulder milling**
- **Slotting**
- **Ramping**
- **Small depth plunging**
- **Plunging**
- **Drilling (Helical feed)**
- **Enlarging hole**

<table>
<thead>
<tr>
<th>Inch</th>
<th>Tool dia. øDc</th>
<th>Max. depth of cut Max ap</th>
<th>Max. ramping angle B°</th>
<th>Max. plunging depth A</th>
<th>Max. cutting with in plunging W</th>
<th>Min.machinable hole diameter ød1</th>
<th>Max.machinable hole diameter ød2</th>
<th>Max. cutting with in enlarged hole ae</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENX03R062U0062...</td>
<td>0.625</td>
<td>0.039</td>
<td>2.1</td>
<td>0.012</td>
<td>0.138</td>
<td>0.866</td>
<td>1.181</td>
<td>0.492</td>
</tr>
<tr>
<td>ENX03R068U0062...</td>
<td>0.688</td>
<td>0.039</td>
<td>1.7</td>
<td>0.012</td>
<td>0.138</td>
<td>1.024</td>
<td>1.339</td>
<td>0.571</td>
</tr>
<tr>
<td>ENX03R075U0075...</td>
<td>0.750</td>
<td>0.039</td>
<td>1.4</td>
<td>0.012</td>
<td>0.138</td>
<td>1.181</td>
<td>1.496</td>
<td>0.650</td>
</tr>
<tr>
<td>ENX03R087U0075...</td>
<td>0.875</td>
<td>0.039</td>
<td>1.2</td>
<td>0.012</td>
<td>0.138</td>
<td>1.339</td>
<td>1.654</td>
<td>0.728</td>
</tr>
<tr>
<td>ENX03R100U0100...</td>
<td>1.000</td>
<td>0.039</td>
<td>1.0</td>
<td>0.012</td>
<td>0.138</td>
<td>1.575</td>
<td>1.890</td>
<td>0.846</td>
</tr>
<tr>
<td>ENX03R112U0100...</td>
<td>1.125</td>
<td>0.039</td>
<td>0.8</td>
<td>0.012</td>
<td>0.138</td>
<td>1.811</td>
<td>2.126</td>
<td>0.965</td>
</tr>
<tr>
<td>ENX03R125U0125...</td>
<td>1.250</td>
<td>0.039</td>
<td>0.7</td>
<td>0.012</td>
<td>0.138</td>
<td>2.126</td>
<td>2.441</td>
<td>1.122</td>
</tr>
<tr>
<td>TXN03R150U0125...</td>
<td>1.500</td>
<td>0.039</td>
<td>0.5</td>
<td>0.012</td>
<td>0.138</td>
<td>2.750</td>
<td>3.070</td>
<td>1.437</td>
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<tr>
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<td>0.039</td>
<td>0.4</td>
<td>0.012</td>
<td>0.138</td>
<td>3.540</td>
<td>3.858</td>
<td>1.830</td>
</tr>
</tbody>
</table>

- For øDc above 1.300", slot milling, ramping or contouring is not recommended as chips may be re-cut.
Super high-feed milling cutters with double sided inserts with 4 edges

A.R. = +10°, R.R. = +2° ~ +6°

<table>
<thead>
<tr>
<th>Inch</th>
<th>Max. ap</th>
<th>øDc</th>
<th>z</th>
<th>øDc1</th>
<th>øDb</th>
<th>Lt</th>
<th>ød</th>
<th>ℓ</th>
<th>a</th>
<th>b</th>
<th>lb</th>
<th>Air hole</th>
<th>Insert</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXN06R200U0075A04</td>
<td>0.059</td>
<td>2.000</td>
<td>4</td>
<td>1.513</td>
<td>1.850</td>
<td>1.969</td>
<td>0.750</td>
<td>0.750</td>
<td>0.315</td>
<td>0.197</td>
<td>0.970</td>
<td>✓</td>
<td>LN*U06...</td>
</tr>
<tr>
<td>TXN06R200U0075A05</td>
<td>0.059</td>
<td>2.000</td>
<td>5</td>
<td>1.513</td>
<td>1.850</td>
<td>1.969</td>
<td>0.750</td>
<td>0.750</td>
<td>0.315</td>
<td>0.197</td>
<td>0.990</td>
<td>✓</td>
<td>LN*U06...</td>
</tr>
<tr>
<td>TXN06R250U0075A04</td>
<td>0.059</td>
<td>2.500</td>
<td>4</td>
<td>2.012</td>
<td>2.323</td>
<td>1.969</td>
<td>0.750</td>
<td>0.750</td>
<td>0.315</td>
<td>0.197</td>
<td>1.740</td>
<td>✓</td>
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<tr>
<td>TXN06R250U0075A06</td>
<td>0.059</td>
<td>2.500</td>
<td>6</td>
<td>2.012</td>
<td>2.323</td>
<td>1.969</td>
<td>0.750</td>
<td>0.750</td>
<td>0.315</td>
<td>0.197</td>
<td>1.760</td>
<td>✓</td>
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<tr>
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<td>5</td>
<td>2.512</td>
<td>2.835</td>
<td>2.480</td>
<td>1.000</td>
<td>1.049</td>
<td>0.374</td>
<td>0.236</td>
<td>3.130</td>
<td>✓</td>
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<td>7</td>
<td>2.512</td>
<td>2.835</td>
<td>2.480</td>
<td>1.000</td>
<td>1.049</td>
<td>0.374</td>
<td>0.236</td>
<td>3.280</td>
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<td>6</td>
<td>3.512</td>
<td>3.819</td>
<td>2.480</td>
<td>1.500</td>
<td>1.610</td>
<td>0.626</td>
<td>0.394</td>
<td>4.850</td>
<td>✓</td>
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</tr>
<tr>
<td>TXN06R400U0150A10</td>
<td>0.059</td>
<td>4.000</td>
<td>10</td>
<td>3.512</td>
<td>1.500</td>
<td>2.480</td>
<td>1.500</td>
<td>1.610</td>
<td>0.626</td>
<td>0.394</td>
<td>4.850</td>
<td>✓</td>
<td>LN*U06...</td>
</tr>
<tr>
<td>TXN06R500U0150A08</td>
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<td>5.000</td>
<td>8</td>
<td>4.512</td>
<td>3.819</td>
<td>2.480</td>
<td>1.500</td>
<td>1.610</td>
<td>0.626</td>
<td>0.394</td>
<td>7.050</td>
<td>✓</td>
<td>LN*U06...</td>
</tr>
<tr>
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<td>0.059</td>
<td>5.000</td>
<td>12</td>
<td>4.512</td>
<td>1.500</td>
<td>2.480</td>
<td>1.500</td>
<td>1.610</td>
<td>0.626</td>
<td>0.394</td>
<td>7.280</td>
<td>✓</td>
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</tr>
<tr>
<td>TXN06R600U0200A10</td>
<td>0.059</td>
<td>6.000</td>
<td>10</td>
<td>5.512</td>
<td>4.331</td>
<td>2.480</td>
<td>2.000</td>
<td>1.496</td>
<td>0.748</td>
<td>0.433</td>
<td>9.480</td>
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<td>6.000</td>
<td>14</td>
<td>5.512</td>
<td>2.000</td>
<td>2.480</td>
<td>2.000</td>
<td>1.496</td>
<td>0.748</td>
<td>0.433</td>
<td>9.260</td>
<td>✓</td>
<td>LN*U06...</td>
</tr>
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SPARE PARTS

<table>
<thead>
<tr>
<th>Designation</th>
<th>Clamping screw</th>
<th>Grip</th>
<th>Lubricant</th>
<th>Torx bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXN06R200U - 500U</td>
<td>CSPB-5</td>
<td>H-TB2W</td>
<td>M-1000</td>
<td>BLDIP20/S7</td>
</tr>
<tr>
<td>TXN06R600U...</td>
<td>CSPB-5</td>
<td>H-TB2W</td>
<td>M-1000</td>
<td>BLDIP20/M7</td>
</tr>
</tbody>
</table>
**FEED the SPEED - TUNGALOY ACCELERATED MACHINING**

**EXN06**

Super high-feed milling endmills with double sided inserts with 4 edges

**Inserts**

LNMU06-MJ

LNGU06-W (2 cutting edges - Wiper)

**Spare Parts**

- Designation: CSPB-5
- Clamping screw: M-1000
- Lubricant: IP-20D

**Designation**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Max. ap</th>
<th>( \phi D_s )</th>
<th>( \phi D_{c1} )</th>
<th>Air hole</th>
<th>Insert</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXN06R125U0125W02</td>
<td>0.059</td>
<td>1.500</td>
<td>0.766</td>
<td>Z</td>
<td></td>
</tr>
<tr>
<td>EXN06R150U0125W03</td>
<td>0.059</td>
<td>1.500</td>
<td>1.008</td>
<td>Z</td>
<td></td>
</tr>
</tbody>
</table>

**Coated**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Max. ap</th>
<th>Coated</th>
<th>A</th>
<th>B</th>
<th>T</th>
<th>bs</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNMU06X5ZER-MJ</td>
<td>0.079</td>
<td>0.059</td>
<td>0.236</td>
<td>0.472</td>
<td>0.276</td>
<td>-</td>
</tr>
<tr>
<td>LNMU06X5ZER-ML</td>
<td>0.079</td>
<td>0.059</td>
<td>0.236</td>
<td>0.472</td>
<td>0.276</td>
<td>-</td>
</tr>
</tbody>
</table>

- Standard Item
- First choice
- Second choice

**Website:** www.tungaloyamerica.com
## CAUTIONARY POINTS IN USE

### The usage of standard and long shanks

When using a long shank, always lower the cutting conditions \( (V_c, f_z, ap) \) to 70% of the maximum conditions for the standard shank.

![Diagram showing depth of cut and feed per tooth for standard and long shanks.](Image)

**Depth of cut: ap (in)**

**Feed per tooth: \( f_z \) (ipt)**

**Standard shank:** \( V_c = 330 - 980 \) sfm

**Long shank:** \( V_c = 260 - 650 \) sfm

### CAM programming

When programming for CAM, the tool should be considered as a round insert cutter. Usually, the corner radius should be set as \( R = 0.12" \). If a larger radius is used, overcutting will occur. The following table shows the amount left as uncut \( (t_1) \) and overcut \( (t_2) \).

![Diagram showing corner radius and amount left as uncut and overcut.](Image)

<table>
<thead>
<tr>
<th>Max. depth of cut</th>
<th>Corner radius ( R )</th>
<th>W (in)</th>
<th>Corner R when programming</th>
<th>Amount left as uncut ( t_1 )</th>
<th>Amount left as overcut ( t_2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.059</td>
<td>0.079</td>
<td>0.236</td>
<td></td>
<td>0.079</td>
<td>0.040</td>
</tr>
<tr>
<td>0.18</td>
<td>0.11</td>
<td>0.236</td>
<td></td>
<td>0.118</td>
<td>0.030</td>
</tr>
<tr>
<td>0.157</td>
<td>0.157</td>
<td>0.236</td>
<td></td>
<td>0.157</td>
<td>0.021</td>
</tr>
</tbody>
</table>

Each value in the table is calculated theoretically at the maximum condition.
### APPLICATION RANGE

The above table shows the conditions for standard shank type cutters. When using long shank type cutters, the number of teeth may be different. In this case, the cutting conditions should be changed by referring to: "The usage of standard and long shanks" shown on the previous page.

Cutting conditions are generally limited by the spindle rigidity, machine power and the workpiece fixture stability. When setting the conditions, start from half of the values of the standard cutting conditions and then increase the value gradually while making sure the machine is running normally.

### Tool dia.: \( \Theta D_c \) (in), Number of revolutions: \( n \) (rpm), Feed speed: \( V_f \) (ipm), Max. depth of cut: \( ap = 0.059\)”, No. of inserts: \( z \)

<table>
<thead>
<tr>
<th>Inch</th>
<th>Tool dia.</th>
<th>( \Theta D_c )</th>
<th>( \Theta D_c )</th>
<th>( \Theta D_c )</th>
<th>( \Theta D_c )</th>
<th>( \Theta D_c )</th>
<th>( \Theta D_c )</th>
<th>( \Theta D_c )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n = 4 )</td>
<td>( V_f = 660 ) sfm, ( fz = 0.040 ) ipt</td>
<td>( n = 4 )</td>
<td>( V_f = 660 ) sfm, ( fz = 0.040 ) ipt</td>
<td>( n = 4 )</td>
<td>( V_f = 660 ) sfm, ( fz = 0.040 ) ipt</td>
<td>( n = 4 )</td>
<td>( V_f = 660 ) sfm, ( fz = 0.040 ) ipt</td>
</tr>
<tr>
<td></td>
<td>( n = 5 )</td>
<td>( V_f = 490 ) sfm, ( fz = 0.030 ) ipt</td>
<td>( n = 5 )</td>
<td>( V_f = 490 ) sfm, ( fz = 0.030 ) ipt</td>
<td>( n = 5 )</td>
<td>( V_f = 490 ) sfm, ( fz = 0.030 ) ipt</td>
<td>( n = 5 )</td>
<td>( V_f = 490 ) sfm, ( fz = 0.030 ) ipt</td>
</tr>
<tr>
<td></td>
<td>( n = 6 )</td>
<td>( V_f = 330 ) sfm, ( fz = 0.012 ) ipt</td>
<td>( n = 6 )</td>
<td>( V_f = 330 ) sfm, ( fz = 0.012 ) ipt</td>
<td>( n = 6 )</td>
<td>( V_f = 330 ) sfm, ( fz = 0.012 ) ipt</td>
<td>( n = 6 )</td>
<td>( V_f = 330 ) sfm, ( fz = 0.012 ) ipt</td>
</tr>
<tr>
<td></td>
<td>( n = 7 )</td>
<td>( V_f = 200 ) sfm, ( fz = 0.002 ) ipt</td>
<td>( n = 7 )</td>
<td>( V_f = 200 ) sfm, ( fz = 0.002 ) ipt</td>
<td>( n = 7 )</td>
<td>( V_f = 200 ) sfm, ( fz = 0.002 ) ipt</td>
<td>( n = 7 )</td>
<td>( V_f = 200 ) sfm, ( fz = 0.002 ) ipt</td>
</tr>
</tbody>
</table>

- For \( \Theta D_c \) above 4.000”, slot milling, ramping or contouring is not recommended as chips may be re-cut.

- For \( \Theta D_c \) above 4.000”, slot milling, ramping or contouring is not recommended as chips may be re-cut.
**HIGH-FEED MILLING**

**DOTWIST**

**TXLN**

Radius cutter with double sided inserts with 4 edges

A.R. = +3°, R.R. = -13°

<table>
<thead>
<tr>
<th>Inch</th>
<th>Max. ap</th>
<th>øDc</th>
<th>øDc1</th>
<th>øDb</th>
<th>Lf</th>
<th>ød</th>
<th>l</th>
<th>a</th>
<th>b</th>
<th>lb</th>
<th>Air hole</th>
<th>Insert</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXLN04U1.50B0.50R06</td>
<td>0.157</td>
<td>1.500</td>
<td>6</td>
<td>1.186</td>
<td>1.461</td>
<td>1.574</td>
<td>0.500</td>
<td>0.750</td>
<td>0.315</td>
<td>0.197</td>
<td>0.770</td>
<td>✓</td>
</tr>
<tr>
<td>TXLN04U2.00B0.75R07</td>
<td>0.157</td>
<td>2.000</td>
<td>7</td>
<td>1.680</td>
<td>1.693</td>
<td>1.969</td>
<td>0.750</td>
<td>0.750</td>
<td>0.315</td>
<td>0.197</td>
<td>0.990</td>
<td>✓</td>
</tr>
</tbody>
</table>

**SPARE PARTS**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Clamping screw</th>
<th>Mono block type</th>
<th>Grip</th>
<th>Lubricant</th>
<th>Torx bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXLN04U...</td>
<td>CSPD-3</td>
<td>SW6-SD</td>
<td>M-1000</td>
<td>BLD IP10/S7</td>
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</tr>
</tbody>
</table>

**DOTWIST**

**EXLN**

Radius cutter with double sided inserts with 4 edges

A.R. = +3°, R.R. = -12° ~ -14°

<table>
<thead>
<tr>
<th>Inch</th>
<th>Max. ap</th>
<th>øDc</th>
<th>øDc1</th>
<th>øDb</th>
<th>Lf</th>
<th>ød</th>
<th>l</th>
<th>a</th>
<th>b</th>
<th>lb</th>
<th>Air hole</th>
<th>Insert</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXLN04U1.00C1.00R03</td>
<td>0.157</td>
<td>1.000</td>
<td>3</td>
<td>0.685</td>
<td>1.000</td>
<td>3.000</td>
<td>2.500</td>
<td>5.500</td>
<td>1.000</td>
<td>✓</td>
<td>LNM04X0...</td>
<td></td>
</tr>
<tr>
<td>EXLN04U1.25C1.25R04</td>
<td>0.157</td>
<td>1.250</td>
<td>4</td>
<td>0.935</td>
<td>1.250</td>
<td>3.000</td>
<td>3.000</td>
<td>6.000</td>
<td>1.800</td>
<td>✓</td>
<td>LNM04X0...</td>
<td></td>
</tr>
<tr>
<td>EXLN04U1.25C1.25R05</td>
<td>0.157</td>
<td>1.250</td>
<td>5</td>
<td>0.935</td>
<td>1.250</td>
<td>3.000</td>
<td>3.000</td>
<td>6.000</td>
<td>1.800</td>
<td>✓</td>
<td>LNM04X0...</td>
<td></td>
</tr>
</tbody>
</table>

**SPARE PARTS**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Clamping screw</th>
<th>Mono block type</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXLN04U...</td>
<td>CSPD-3</td>
<td>IP-100</td>
</tr>
</tbody>
</table>
**FEED the SPEED - TUNGALOY ACCELERATED MACHINING**

**HXLN04-M**

Radius cutter with double sided inserts with 4 edges, Modular head with metric threaded connection

A.R. = +3°, R.R. = -12° ~ -14°

---

**Table: HXLN04M Specifications**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Max. ap</th>
<th>øDc</th>
<th>z</th>
<th>øDc1</th>
<th>L6</th>
<th>Lt</th>
<th>C</th>
<th>T</th>
<th>øD3</th>
<th>Ts</th>
<th>Kg</th>
<th>Air hole</th>
<th>Insert</th>
</tr>
</thead>
<tbody>
<tr>
<td>HXLN04M020M10R02</td>
<td>4</td>
<td>20</td>
<td>2</td>
<td>12</td>
<td>49</td>
<td>30</td>
<td>10</td>
<td>15</td>
<td>18</td>
<td>10</td>
<td>M10</td>
<td>0.07</td>
<td>LNX04...</td>
</tr>
<tr>
<td>HXLN04M025M12R03</td>
<td>4</td>
<td>25</td>
<td>3</td>
<td>17</td>
<td>57</td>
<td>35</td>
<td>10</td>
<td>17</td>
<td>21</td>
<td>12</td>
<td>M12</td>
<td>0.16</td>
<td>LNX04...</td>
</tr>
<tr>
<td>HXLN04M032M16R04</td>
<td>4</td>
<td>32</td>
<td>4</td>
<td>24</td>
<td>63</td>
<td>40</td>
<td>12</td>
<td>22</td>
<td>29</td>
<td>16</td>
<td>M16</td>
<td>0.2</td>
<td>LNX04...</td>
</tr>
</tbody>
</table>

**SPARE PARTS**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Clamping screw</th>
<th>Lubricant</th>
<th>Wrench</th>
</tr>
</thead>
<tbody>
<tr>
<td>HXLN04...</td>
<td>CSPD-3</td>
<td>M-1000 IP-10D</td>
<td></td>
</tr>
</tbody>
</table>

---

**Inserts**

**LNMX-HJ**

**LNMX-MJ (Radius insert)**

**LNMX-ML (Radius insert)**

---

**Designation**

<table>
<thead>
<tr>
<th>Designation</th>
<th>rc</th>
<th>Max. ap</th>
<th>Coated</th>
<th>A</th>
<th>B</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNMX0405R4-MJ</td>
<td>0.157</td>
<td>0.157</td>
<td>AH120 A</td>
<td>0.323</td>
<td>0.220</td>
<td></td>
</tr>
<tr>
<td>LNMX0405R4-ML</td>
<td>0.157</td>
<td>0.157</td>
<td>AH120 M</td>
<td>0.323</td>
<td>0.220</td>
<td></td>
</tr>
<tr>
<td>LNMX0405ZER-HJ</td>
<td>0.051</td>
<td>0.051</td>
<td>AH3135 B</td>
<td>0.169</td>
<td>0.323</td>
<td>0.197</td>
</tr>
</tbody>
</table>

- Standard item
- First choice
- Second choice

---

**Material Compatibility**

- P: Steel
- M: Stainless
- K: Cast iron
- N: Non-ferrous
- S: Superalloys
- H: Hard materials

**Material Chart**

- ★: First choice
- ★★: Second choice

---

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### STANDARD CUTTING CONDITIONS

#### For HJ type

<table>
<thead>
<tr>
<th>ISO</th>
<th>Workpiece material</th>
<th>Hardness</th>
<th>Priority</th>
<th>Grade</th>
<th>Chipbreaker</th>
<th>Cutting speed (Vc) (sfm)</th>
<th>Feed per tooth (fz) (ipt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Low carbon steels C15, C20, etc.</td>
<td>- 300 HB</td>
<td>First choice</td>
<td>AH3135 HJ</td>
<td>490 - 820</td>
<td>0.020 - 0.051</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 300 HB</td>
<td>Second choice</td>
<td>AH120 HJ</td>
<td>490 - 820</td>
<td>0.020 - 0.051</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carbon steels, Alloy steels 1055, etc.</td>
<td>- 300 HB</td>
<td>First choice</td>
<td>AH3135 HJ</td>
<td>490 - 820</td>
<td>0.020 - 0.051</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 300 HB</td>
<td>Second choice</td>
<td>AH120 HJ</td>
<td>490 - 820</td>
<td>0.020 - 0.051</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carbon steels, Alloy steels 1055, etc.</td>
<td>30 - 40 HRC</td>
<td>First choice</td>
<td>AH3135 HJ</td>
<td>330 - 660</td>
<td>0.012 - 0.028</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 - 40 HRC</td>
<td>Second choice</td>
<td>AH120 HJ</td>
<td>330 - 660</td>
<td>0.012 - 0.028</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Stainless steels S30400, etc</td>
<td>- 200 HB</td>
<td>First choice</td>
<td>AH3135 HJ</td>
<td>330 - 660</td>
<td>0.012 - 0.028</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 200 HB</td>
<td>First choice</td>
<td>AH3135 HJ</td>
<td>330 - 980</td>
<td>0.012 - 0.028</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Grey cast irons No.250B, No.300B, etc.</td>
<td>150 - 250 HB</td>
<td>First choice</td>
<td>AH120 HJ</td>
<td>490 - 820</td>
<td>0.020 - 0.051</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ductile cast irons 60-40-18, 80-50-06, etc.</td>
<td>150 - 250 HB</td>
<td>First choice</td>
<td>AH120 HJ</td>
<td>490 - 820</td>
<td>0.020 - 0.051</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Hardened steel</td>
<td>H13, etc</td>
<td>First choice</td>
<td>AH120 HJ</td>
<td>160 - 230</td>
<td>0.002 - 0.008</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D2, etc</td>
<td>First choice</td>
<td>AH120 HJ</td>
<td>160 - 230</td>
<td>0.002 - 0.008</td>
<td></td>
</tr>
</tbody>
</table>

Note: Recommended cutting conditions are just for reference in general machining.

#### For MJ, ML type

<table>
<thead>
<tr>
<th>ISO</th>
<th>Workpiece material</th>
<th>Hardness</th>
<th>Priority</th>
<th>Grade</th>
<th>Chipbreaker</th>
<th>Cutting speed (Vc) (sfm)</th>
<th>Feed per tooth (fz) (ipt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Low carbon steels 1015, etc.</td>
<td>- 300 HB</td>
<td>First choice</td>
<td>AH3135 MJ</td>
<td>490 - 820</td>
<td>0.008 - 0.024</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 300 HB</td>
<td>Second choice</td>
<td>AH3135 ML</td>
<td>490 - 820</td>
<td>0.008 - 0.024</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carbon steels, Alloy steels 1055, etc.</td>
<td>- 300 HB</td>
<td>First choice</td>
<td>AH3135 MJ</td>
<td>490 - 820</td>
<td>0.008 - 0.024</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 300 HB</td>
<td>Second choice</td>
<td>AH3135 ML</td>
<td>490 - 820</td>
<td>0.008 - 0.024</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prehardened steels NAK80, PX5, etc.</td>
<td>30 - 40 HRC</td>
<td>First choice</td>
<td>AH3135 MJ</td>
<td>330 - 660</td>
<td>0.006 - 0.016</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 - 40 HRC</td>
<td>Second choice</td>
<td>AH3135 ML</td>
<td>330 - 660</td>
<td>0.006 - 0.016</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Stainless steels S30400, etc</td>
<td>- 200 HB</td>
<td>First choice</td>
<td>AH3135 MJ</td>
<td>330 - 660</td>
<td>0.008 - 0.024</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 200 HB</td>
<td>Second choice</td>
<td>AH3135 ML</td>
<td>330 - 660</td>
<td>0.008 - 0.024</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Stainless steels S4200, etc</td>
<td>- 200 HB</td>
<td>First choice</td>
<td>AH3135 MJ</td>
<td>330 - 980</td>
<td>0.008 - 0.024</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 200 HB</td>
<td>Second choice</td>
<td>AH3135 ML</td>
<td>330 - 980</td>
<td>0.008 - 0.024</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Grey cast irons No.250B, No.300B, etc.</td>
<td>150 - 250 HB</td>
<td>First choice</td>
<td>AH120 MJ</td>
<td>490 - 820</td>
<td>0.008 - 0.024</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ductile cast irons 60-40-18, 80-50-06, etc.</td>
<td>150 - 250 HB</td>
<td>First choice</td>
<td>AH120 MJ</td>
<td>490 - 820</td>
<td>0.008 - 0.024</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Hardened steel</td>
<td>H13, etc</td>
<td>First choice</td>
<td>AH120 MJ</td>
<td>160 - 490</td>
<td>0.004 - 0.012</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D2, etc</td>
<td>First choice</td>
<td>AH120 ML</td>
<td>160 - 230</td>
<td>0.002 - 0.006</td>
<td></td>
</tr>
</tbody>
</table>
**APPLICATION RANGE**

For HJ type

<table>
<thead>
<tr>
<th>Inch</th>
<th>( \phi_Dc )</th>
<th>Max. depth of cut (in)</th>
<th>Max. ramping angle</th>
<th>Max. plunging (in)</th>
<th>Min. machining (in)</th>
<th>Max. machining (in)</th>
<th>Max. cutting width in enlarging (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXLN04U1.00C1.00R03</td>
<td>1.000</td>
<td>0.051</td>
<td>3</td>
<td>0.030</td>
<td>0.161</td>
<td>1.496</td>
<td>1.496</td>
</tr>
<tr>
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<td>1.250</td>
<td>0.051</td>
<td>2</td>
<td>0.030</td>
<td>0.161</td>
<td>2.008</td>
<td>2.008</td>
</tr>
<tr>
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<td>1.250</td>
<td>0.051</td>
<td>2</td>
<td>0.030</td>
<td>0.161</td>
<td>2.008</td>
<td>2.008</td>
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<td>0.161</td>
<td>1.063</td>
<td>1.063</td>
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<td>0.051</td>
<td>3</td>
<td>0.030</td>
<td>0.161</td>
<td>1.457</td>
<td>1.457</td>
</tr>
<tr>
<td>HXLN04M032M16R04</td>
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<td>0.051</td>
<td>2</td>
<td>0.030</td>
<td>0.161</td>
<td>2.008</td>
<td>2.008</td>
</tr>
</tbody>
</table>

For MJ, ML type

<table>
<thead>
<tr>
<th>Inch</th>
<th>( \phi_Dc )</th>
<th>Max. depth of cut (in)</th>
<th>Max. ramping angle</th>
<th>Max. plunging (in)</th>
<th>Min. machining (in)</th>
<th>Max. machining (in)</th>
<th>Max. cutting width in enlarging (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXLN04U1.00C1.00R03</td>
<td>1.000</td>
<td>0.157</td>
<td>3</td>
<td>0.031</td>
<td>0.157</td>
<td>1.535</td>
<td>1.929</td>
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<tr>
<td>EXLN04U1.25C1.25R04</td>
<td>1.250</td>
<td>0.157</td>
<td>1.9</td>
<td>0.031</td>
<td>0.157</td>
<td>2.047</td>
<td>2.402</td>
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<tr>
<td>EXLN04U1.25C1.25R05</td>
<td>1.250</td>
<td>0.157</td>
<td>1.9</td>
<td>0.031</td>
<td>0.157</td>
<td>2.047</td>
<td>2.402</td>
</tr>
<tr>
<td>HXLN04M020M10R02</td>
<td>0.787</td>
<td>0.157</td>
<td>4.7</td>
<td>0.031</td>
<td>0.157</td>
<td>1.102</td>
<td>1.496</td>
</tr>
<tr>
<td>HXLN04M025M12R03</td>
<td>0.984</td>
<td>0.157</td>
<td>3</td>
<td>0.031</td>
<td>0.157</td>
<td>1.496</td>
<td>1.890</td>
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<tr>
<td>HXLN04M032M16R04</td>
<td>1.260</td>
<td>0.157</td>
<td>2</td>
<td>0.031</td>
<td>0.157</td>
<td>2.047</td>
<td>2.441</td>
</tr>
</tbody>
</table>

**TOOL GEOMETRY ON PROGRAM**

<table>
<thead>
<tr>
<th>Max. depth of cut</th>
<th>W (in)</th>
<th>Programmed corner R (in)</th>
<th>Amount left uncut</th>
<th>Amount left overcut</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \phi_Dc ) max. ap (in)</td>
<td>0.051</td>
<td>R0.059</td>
<td>0.031</td>
<td>0</td>
</tr>
<tr>
<td>0.051</td>
<td>0.161</td>
<td>R0.079</td>
<td>0.026</td>
<td>0</td>
</tr>
<tr>
<td>0.051</td>
<td>0.161</td>
<td>R0.098</td>
<td>0.020</td>
<td>0.002</td>
</tr>
<tr>
<td>0.051</td>
<td>0.161</td>
<td>R0.118</td>
<td>0.014</td>
<td>0.008</td>
</tr>
</tbody>
</table>
HIGH-FEED MILLING

DO FEED QUAD

TXQ
High-feed cutter for face milling

![Image of TXQ cutter](image)

A.R. = +7°, R.R. = -8° ~ -4.5°

<table>
<thead>
<tr>
<th>Inch</th>
<th>Max. ap</th>
<th>øDc</th>
<th>z</th>
<th>øDc1</th>
<th>øDb</th>
<th>Lt</th>
<th>ød</th>
<th>ℓ</th>
<th>a</th>
<th>b</th>
<th>lb</th>
<th>Air hole</th>
<th>Insert</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXQ12R200U0075A03</td>
<td>0.079</td>
<td>2.000</td>
<td>3</td>
<td>1.362</td>
<td>1.850</td>
<td>1.969</td>
<td>0.750</td>
<td>0.750</td>
<td>0.315</td>
<td>0.197</td>
<td>1.120</td>
<td>✓</td>
<td>SQMU1206ZSR-MJ</td>
</tr>
<tr>
<td>TXQ12R200U0075A04</td>
<td>0.079</td>
<td>2.000</td>
<td>4</td>
<td>1.362</td>
<td>1.850</td>
<td>1.969</td>
<td>0.750</td>
<td>0.750</td>
<td>0.315</td>
<td>0.197</td>
<td>1.120</td>
<td>✓</td>
<td>SQMU1206ZSR-MJ</td>
</tr>
<tr>
<td>TXQ12R250U0075A04</td>
<td>0.079</td>
<td>2.500</td>
<td>4</td>
<td>1.862</td>
<td>2.323</td>
<td>1.969</td>
<td>0.750</td>
<td>0.750</td>
<td>0.315</td>
<td>0.197</td>
<td>1.760</td>
<td>✓</td>
<td>SQMU1206ZSR-MJ</td>
</tr>
<tr>
<td>TXQ12R300U0100A05</td>
<td>0.079</td>
<td>3.000</td>
<td>5</td>
<td>2.362</td>
<td>2.835</td>
<td>1.969</td>
<td>1.000</td>
<td>1.024</td>
<td>0.374</td>
<td>0.236</td>
<td>3.770</td>
<td>✓</td>
<td>SQMU1206ZSR-MJ</td>
</tr>
<tr>
<td>TXQ12R400U0150A06</td>
<td>0.079</td>
<td>4.000</td>
<td>6</td>
<td>3.362</td>
<td>3.780</td>
<td>1.969</td>
<td>1.500</td>
<td>1.457</td>
<td>0.626</td>
<td>0.394</td>
<td>5.710</td>
<td>✓</td>
<td>SQMU1206ZSR-MJ</td>
</tr>
<tr>
<td>TXQ12R500U0150A07</td>
<td>0.079</td>
<td>5.000</td>
<td>7</td>
<td>4.362</td>
<td>3.780</td>
<td>1.969</td>
<td>1.500</td>
<td>1.457</td>
<td>0.626</td>
<td>0.394</td>
<td>7.010</td>
<td>✓</td>
<td>SQMU1206ZSR-MJ</td>
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<tr>
<td>TXQ12R600U0200A08</td>
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<td>6.000</td>
<td>8</td>
<td>5.362</td>
<td>3.937</td>
<td>2.480</td>
<td>2.000</td>
<td>1.496</td>
<td>0.748</td>
<td>0.433</td>
<td>7.350</td>
<td>✓</td>
<td>SQMU1206ZSR-MJ</td>
</tr>
</tbody>
</table>

SPARE PARTS

<table>
<thead>
<tr>
<th>Designation</th>
<th>Clamping screw</th>
<th>Grip</th>
<th>Lubricant</th>
<th>Torx bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXQ12R**U...</td>
<td>CSPB-4</td>
<td>H-TBS</td>
<td>M-1000</td>
<td>BLDIP15/57</td>
</tr>
</tbody>
</table>

INSERTS

SQMU-MJ

![Image of SQMU-MJ insert](image)

<table>
<thead>
<tr>
<th>Designation</th>
<th>Max. ap</th>
<th>Coated</th>
<th>A</th>
<th>T</th>
<th>ød</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQMU1206ZSR-MJ</td>
<td>0.079 0.079</td>
<td>A120 AH130 T3125</td>
<td>0.461</td>
<td>0.236</td>
<td>0.461</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Steel</th>
<th>Stainless</th>
<th>Cast iron</th>
<th>Non-ferrous</th>
<th>Superalloys</th>
<th>Hard materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>✭</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
</tr>
</tbody>
</table>

★ : First choice
☆ : Second choice

● : Standard item
FEED the SPEED - TUNGALOY ACCELERATED MACHINING

STANDARD CUTTING CONDITIONS

<table>
<thead>
<tr>
<th>ISO</th>
<th>Workpiece material</th>
<th>Hardness</th>
<th>Priority</th>
<th>Grade</th>
<th>Cutting speed Vc (sfm)</th>
<th>Feed per tooth fz (ipt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>High carbon steels (1045, 1055 etc.)</td>
<td>~ 300HB</td>
<td>First choice</td>
<td>AH725</td>
<td>330 - 980</td>
<td>0.020 - 0.080</td>
</tr>
<tr>
<td></td>
<td>For wear resistance</td>
<td>T3130</td>
<td>330 - 980</td>
<td>0.020 - 0.080</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>For impact resistance</td>
<td>AH130</td>
<td>330 - 980</td>
<td>0.020 - 0.080</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>First choice</td>
<td>AH725</td>
<td>330 - 660</td>
<td>0.020 - 0.060</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>For wear resistance</td>
<td>T3130</td>
<td>330 - 660</td>
<td>0.020 - 0.060</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>For impact resistance</td>
<td>AH130</td>
<td>330 - 660</td>
<td>0.020 - 0.060</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prehardened steels (NAK80, PX5, etc.)</td>
<td>30 – 40HRC</td>
<td>-</td>
<td>AH725</td>
<td>330 - 660</td>
<td>0.020 - 0.040</td>
</tr>
<tr>
<td>M</td>
<td>Stainless steels (304, 316 etc.)</td>
<td>~ 200HB</td>
<td>-</td>
<td>AH130</td>
<td>330 - 500</td>
<td>0.012 - 0.030</td>
</tr>
<tr>
<td>K</td>
<td>Gray cast iron (No.25, No.30 etc.)</td>
<td>-</td>
<td>-</td>
<td>AH120</td>
<td>100 - 300</td>
<td>0.020 - 0.080</td>
</tr>
<tr>
<td>K</td>
<td>Ductile cast irons (60-40-18, 65-45-12 etc.)</td>
<td>-</td>
<td>-</td>
<td>AH120</td>
<td>260 - 660</td>
<td>0.020 - 0.080</td>
</tr>
<tr>
<td>S</td>
<td>Titanium alloy (Ti-6Al-4V etc.)</td>
<td>~ 40HRC</td>
<td>-</td>
<td>AH725</td>
<td>100 - 200</td>
<td>0.012 - 0.028</td>
</tr>
<tr>
<td>H</td>
<td>Hardened steels (H13 etc.)</td>
<td>40 – 50HRC</td>
<td>-</td>
<td>AH725</td>
<td>260 - 430</td>
<td>0.004 - 0.012</td>
</tr>
<tr>
<td></td>
<td>(D2 etc.)</td>
<td>50 – 60HRC</td>
<td>-</td>
<td>AH725</td>
<td>160 - 230</td>
<td>0.001 - 0.003</td>
</tr>
</tbody>
</table>

Tool dia.: ØDc (in), Number of revolutions: n (rpm), Feed speed: Vf (ipm), Max. depth of cut: ap = 0.079"

<table>
<thead>
<tr>
<th>Ø2.000</th>
<th>Ø2.500</th>
<th>Ø3.000</th>
<th>Ø4.000</th>
<th>Ø5.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>Vf</td>
<td>n</td>
<td>Vf</td>
<td>n</td>
</tr>
<tr>
<td>1,260</td>
<td>227</td>
<td>1,010</td>
<td>242</td>
<td>790</td>
</tr>
<tr>
<td>Vc = 660 sfm, fz = 0.060 ipt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>950</td>
<td>114</td>
<td>750</td>
<td>120</td>
<td>590</td>
</tr>
<tr>
<td>Vc = 500 sfm, fz = 0.040 ipt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>950</td>
<td>86</td>
<td>750</td>
<td>90</td>
<td>590</td>
</tr>
<tr>
<td>Vc = 490 sfm, fz = 0.030 ipt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>760</td>
<td>46</td>
<td>600</td>
<td>48</td>
<td>470</td>
</tr>
<tr>
<td>Vc = 400 sfm, fz = 0.020 ipt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,260</td>
<td>227</td>
<td>1,010</td>
<td>242</td>
<td>790</td>
</tr>
<tr>
<td>Vc = 660 sfm, fz = 0.060 ipt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>950</td>
<td>171</td>
<td>750</td>
<td>180</td>
<td>590</td>
</tr>
<tr>
<td>Vc = 500 sfm, fz = 0.060 ipt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>15</td>
<td>200</td>
<td>16</td>
<td>150</td>
</tr>
<tr>
<td>Vc = 130 sfm, fz = 0.020 ipt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>630</td>
<td>15</td>
<td>500</td>
<td>16</td>
<td>390</td>
</tr>
<tr>
<td>Vc = 330 sfm, fz = 0.008 ipt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>380</td>
<td>2</td>
<td>300</td>
<td>2</td>
<td>240</td>
</tr>
<tr>
<td>Vc = 200 sfm, fz = 0.002 ipt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Slot or pocket milling is not recommended since chip re-cutting can easily occur.
- Tool overhang length must be as short as possible to avoid chatter. When the tool overhang length is long, decrease the number of revolutions and feed.

Cutting conditions are generally limited by the spindle rigidity, machine power and the workpiece fixture stability. When setting the conditions, start from half of the values of the standard cutting conditions and then increase the value gradually while making sure the machine is running normally.

www.tungaloyamerica.com
Super high-feed milling cutter with large depth of cut; Bore type

### SPARE PARTS

<table>
<thead>
<tr>
<th>Designation</th>
<th>Clamping screw</th>
<th>Grip</th>
<th>Lubricant</th>
<th>Torx bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXSW15U2.50 - 4.00</td>
<td>TS50115i</td>
<td>H-TB2W</td>
<td>M-1000</td>
<td>BT20S</td>
</tr>
<tr>
<td>TXSW15U5.00, 6.00</td>
<td>TS50115i</td>
<td>H-TB2W</td>
<td>M-1000</td>
<td>BT20M</td>
</tr>
</tbody>
</table>

### INSERT SWMT-MJ

![Insert SWMT-MJ](image)

<table>
<thead>
<tr>
<th>Designation</th>
<th>Max. ap</th>
<th>Coated</th>
<th>A</th>
<th>φd</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWMT1506ZER-MJ</td>
<td>0.079</td>
<td>0.096</td>
<td>0.625</td>
<td>0.625</td>
<td>0.268</td>
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</tbody>
</table>

**Material Options:**

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

**Coating Options:**

- AH120
- AH3135
- AH3135

**Note:**
- : First choice
- : Second choice
- : Standard item
STANDARD CUTTING CONDITIONS

<table>
<thead>
<tr>
<th>ISO</th>
<th>Workpiece materials</th>
<th>Hardness</th>
<th>Priority</th>
<th>Grades</th>
<th>Chip-breaker</th>
<th>Cutting speed Vc (sfm)</th>
<th>Feed per tooth fz (ipt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Low carbon steel (1015, etc.)</td>
<td>- 300 HB</td>
<td>First choice</td>
<td>AH3135</td>
<td>MJ</td>
<td>330 - 1000</td>
<td>0.02 - 0.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 300 HB</td>
<td>Second choice</td>
<td>AH120</td>
<td>MJ</td>
<td>330 - 1000</td>
<td>0.02 - 0.08</td>
</tr>
<tr>
<td></td>
<td>Carbon steel and alloy steel (1015, 4140, etc.)</td>
<td>- 300 HB</td>
<td>First choice</td>
<td>AH3135</td>
<td>MJ</td>
<td>330 - 660</td>
<td>0.02 - 0.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 300 HB</td>
<td>Second choice</td>
<td>AH120</td>
<td>MJ</td>
<td>330 - 660</td>
<td>0.02 - 0.08</td>
</tr>
<tr>
<td></td>
<td>Prehardened steel (NAK80, PX5, etc.)</td>
<td>30 - 40 HRC</td>
<td>First choice</td>
<td>AH3135</td>
<td>MJ</td>
<td>330 - 660</td>
<td>0.02 - 0.06</td>
</tr>
<tr>
<td>M</td>
<td>Stainless steel (S30400, S31600, etc.)</td>
<td>- 200 HB</td>
<td>First choice</td>
<td>AH3135</td>
<td>MJ</td>
<td>330 - 500</td>
<td>0.012 - 0.04</td>
</tr>
<tr>
<td>K</td>
<td>Grey cast iron (No.250E, No.300B, etc.)</td>
<td>150 - 250 HB</td>
<td>First choice</td>
<td>AH120</td>
<td>MJ</td>
<td>330 - 1000</td>
<td>0.02 - 0.08</td>
</tr>
<tr>
<td></td>
<td>Ductile cast iron (60-40-18, 80-55-06, etc.)</td>
<td>150 - 250 HB</td>
<td>First choice</td>
<td>AH120</td>
<td>MJ</td>
<td>260 - 660</td>
<td>0.02 - 0.08</td>
</tr>
<tr>
<td>S</td>
<td>Titanium alloys (Ti-6Al-4V, etc.)</td>
<td>- 40 HRC</td>
<td>First choice</td>
<td>AH3135</td>
<td>MJ</td>
<td>100 - 200</td>
<td>0.012 - 0.028</td>
</tr>
<tr>
<td></td>
<td>Superalloys (Inconel718, etc.)</td>
<td>- 40 HRC</td>
<td>First choice</td>
<td>AH120</td>
<td>MJ</td>
<td>60 - 160</td>
<td>0.004 - 0.012</td>
</tr>
<tr>
<td>H</td>
<td>Hardened steel (H13, etc.)</td>
<td>40 - 50 HRC</td>
<td>First choice</td>
<td>AH3135</td>
<td>MJ</td>
<td>260 - 420</td>
<td>0.004 - 0.012</td>
</tr>
<tr>
<td></td>
<td>(D2, etc.)</td>
<td>50 - 60 HRC</td>
<td>First choice</td>
<td>AH120</td>
<td>MJ</td>
<td>160 - 230</td>
<td>0.001 - 0.003</td>
</tr>
</tbody>
</table>

APPLICATION RANGE

TOOL GEOMETRY ON PROGRAM
HIGH-FEED MILLING

FIELD TEST REPORTS

Success Stories

Industry: Die&Mold / Back block
Material: Prehardened steel HPM7 (HRC30)
Cutter: TXN06R080M31.7-08 (ø3.15", z=8)
Insert: LNMU06X5ZER-MJ
Grade: AH3035

Cutting conditions:
- $V_c = 377$ sfm
- $f_z = 0.028$ ipt
- $V_f = 101$ ipm
- $a_p = 0.043"$
- $a_e = 1.654"$

Process: Contour milling, Air blow
Machine: Vertical M/C, CAT50

Result:
AH3035 showed better chipping resistance than its competition, improving tool life by 50%.

Industry: Power Generation / Turbine blade
Material: Heat resistant cast steel
Cutter: EXN03R035M32.0-05 (ø1.38", z=5)
Insert: LNMU0303ZER-ML
Grade: AH725

Cutting conditions:
- $V_c = 230$ sfm
- $f_z = 0.020$ ipt
- $V_f = 73$ ipm
- $a_p = 0.020"$
- $a_e = 1.181"$

Process: Shoulder milling, Wet
Machine: Vertical M/C, CAT50

Result:
Cutting speed tripled, while super high feed milling offered 160% higher productivity.
Industry: Aerospace / Component
Material: Ti-6Al-4V (36HRC)
Cutter: TXN06R050M22.0E05 (ø1.97", z=5)
Insert: LNMU0303ZER-MJ
Grade: AH130
Cutting conditions:
- $V_c = 558$ sfm
- $f_z = 0.039$ ipt
- $V_f = 213$ ipm
- $a_p = 0.051^*$
- $a_e = 1.490^*$

Process: Plunging / Helical milling, Dry
Machine: Horizontal M/C, CAT50

Result:
DoFeed’s positive geometry reduced cutting force while improving metal removal rate.

---

Industry: Aerospace / Component
Material: Ti-6Al-4V
Cutter: EXN03R025M25.0-05 (ø0.98", z=5)
Insert: LNMU0303ZER-ML
Grade: AH130
Cutting conditions:
- $V_c = 164$ sfm
- $f_z = 0.028$ ipt
- $V_f = 88$ ipm
- $a_p = 0.020^*$
- $a_e = 0.984^*$

Process: Pocket milling, Wet
Machine: Vertical M/C, CAT40

Result:
Feed rate increased 730%, drastically improving metal removal rate by 330%.

---

Industry: Aerospace / End fitting
Material: Ti-6Al-4V
Cutter: EXN03R025M25.0-05 (ø0.98", z=5)
Insert: LNMU0303ZER-ML
Grade: AH130
Cutting conditions:
- $V_c = 131$ sfm
- $f_z = 0.028$ ipt
- $V_f = 71$ ipm
- $a_p = 0.031^*$
- $a_e = \text{variable}$

Process: Rough pocket milling, Wet
Machine: HMC Heller H5000

Result:
DoFeed prevented built up edge and coating peel-off, which significantly improved tool life.
Parts production rate was 250% more than the competitor, due to a sharp ML chipbreaker and tough AH130 grade.

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Industry: Heavy Industry / Body
Material: FCMP45-06
Cutter: TXN06R050M22.0E05 (ø1.97", z=5)
Insert: LNMU06X5ZER-MJ
Grade: AH130
Cutting conditions:
- $V_c = 558$ sfm
- $f_z = 0.039$ ipt
- $V_f = 213$ ipm
- $a_p = 0.051^*$
- $a_e = 1.490^*$

Process: Plunging / Helical milling, Dry
Machine: Horizontal M/C, CAT50

Result:
DoFeed’s positive geometry reduced cutting force while improving metal removal rate.
**HIGH-FEED MILLING**

**Industry:** Die&Mold / Automotive parts  
**Material:** DHA WORLD (X40CrMoV5-1) 44HRC  
**Cutter:** TXN06R080M31.7-08 (ø3.15", z=8)  
**Insert:** LNLU06X5ZER-MJ x7  
**Grade:** AH725  
**Cutting conditions:**
- $V_c = 495 \text{ sfm}$  
- $f_z = 0.004 \text{ ipt}$  
- $V_f = 21 \text{ ipm}$  
- $a_p = 0.004\"$  
- $a_e = 2.362\"$

**Process:** Face milling, Air blow  
**Machine:** Vertical M/C, CAT50  
**Result:**  
Dofeed wiper inserts improved metal removal rate and left a good surface roughness for mold face milling, eliminating the semi-finishing process.

**Industry:** Power Generation / Discharge casing  
**Material:** Duplex stainless steel  
**Cutter:** TXN06R200M47.6-12 (ø7.87", z=12)  
**Insert:** LNLU06X5ZER-MJ  
**Grade:** AH3035  
**Cutting conditions:**
- $V_c = 246 \text{ sfm}$  
- $f_z = 0.038 \text{ ipt}$  
- $V_f = 55 \text{ ipm}$  
- $a_p = 0.020\"$  
- $a_e = 6.299\"$

**Process:** Face milling: Interrupted, Dry  
**Machine:** Vertical M/C, CAT50  
**Result:**  
Due to its close-pitch structure, DoFeed improved output by 40% while using at a higher cutting speed. AH3035 improved tool life 150% due to its excellent thermal shock resistance.

**Industry:** Power Generation / Impeller wing  
**Material:** SRUD, SUS630  
**Roughing**  
**Cutter:** TXN06R080M31.7E08 (ø3.15", z=8)  
**Insert:** LNLU06X5ZER-MJ  
**Grade:** AH3035  
**Cutting conditions:**
- $V_c = 153 \text{ sfm}$  
- $f_z = 0.026 \text{ ipt}$  
- $V_f = 39 \text{ ipm}$  
- $a_p = 0.028\"$  
- $a_e =$ variable

**Semi-finishing**  
**Cutter:** TXN03R040M16.0E06 (ø1.57", z=6)  
**Insert:** LNLU0303ZER-MJ  
**Grade:** AH3035  
**Cutting conditions:**
- $V_c = 115 \text{ sfm}$  
- $f_z = 0.021 \text{ ipt}$  
- $V_f = 35 \text{ ipm}$  
- $a_p = 0.028\"$  
- $a_e =$ variable

**Process:** Pocketing, Wet  
**Machine:** Vertical M/C, CAT50  
**Result:**  
Both types of DoFeed inserts performed smooth machining in precipitation hardened stainless steel even during long overhang tooling due to their low cutting force. Insert tool life doubled compared to the competition.
Result:
MillQuad-Feed’s capability for a large depth of cut reduced the number of passes required, thus improving metal removal by 110%. Its robust cutting edge eliminated instability concerns in machining the extremely hard surface of a forging die.

Result:
MillQuad-Feed, with the wear resistant AH3135 grade allowed for increased cutting speed and double depth of cut without sacrificing tool life. As a result MillQuad-Feed improved material removal rate by 240%.

Result:
AH3135’s excellent combination of wear and fracture resistances assured stability and eliminated chipping and fracture during extreme machining, while also removing 136% more material than its competition.
HIGH-FEED MILLING

Result:
MillQuad-Feed's capability allowed for a 340% increase of metal removal rate over its competition.

Industry: Power Generation / Windmill housing
Material: Ductile cast iron 450 (GGG40)
Cutter: TXSW15J125B40.0R07 (ø4.92", z=7)
Insert: SWMT1506ZER-MJ
Grade: AH120

Cutting conditions:
\[ \begin{align*}
V_c &= 722 \text{ sfm} \\
f_z &= 0.051 \text{ ipt} \\
V_f &= 198 \text{ ipm} \\
ap &= 0.098" \\
a_e &= 4.921"
\end{align*} \]

Process: Face milling, Air blow
Machine: Horizontal M/C, CAT50

Result:
The total machining time was decreased by 25%, due to DoTwistBall’s excellent chip evacuation. Chip re-cutting was also eliminated, thus doubling tool life against the competition.

Industry: Power Generation / Planetary carrier
Material: Stainless steel X5CrNiNb 18-10
Cutter: EXLN04M32C32.0R05 (ø1.26", z=5)
Insert: LNMX0405ZER-HJ
Grade: AH3135

Cutting conditions:
\[ \begin{align*}
V_c &= 459 \text{ sfm} \\
f_z &= 0.028 \text{ ipt} \\
V_f &= 192 \text{ ipm} \\
ap &= 0.047" \\
a_e &= 1.260"
\end{align*} \]

Process: Deep 3D profiling, Air blow
Machine: Vertical M/C, CAT50

Result:
DoTwist-Ball extended tool life by 400% beyond its competition.

Industry: Die&Mold / Die
Material: DAC10 (48HRC)
Cutter: TXLN04M040B16.0R06 (ø1.57", z=6)
Insert: LNMX0405ZER-HJ
Grade: AH120

Cutting conditions:
\[ \begin{align*}
V_c &= 328 \text{ sfm} \\
f_z &= 0.017 \text{ ipt} \\
V_f &= 83 \text{ ipm} \\
ap &= 0.077" \\
a_e &= \text{variable}
\end{align*} \]

Process: Contouring, Air blow
Machine: Mitsubishi CAT50

Result:
DoTwist-Ball extended tool life by 400% beyond its competition.
**FEED the SPEED - TUNGALOY ACCELERATED MACHINING**

**DOFEEDQUAD**

**Industry:** Die&Mold / Die for Ceramic tile  
**Material:** Die steel (32-38 HRC)  
**Cutter:** TXQ12R063M22.0E04 (ø2.48", z=4)  
**Insert:** SQMU1206ZSR-MJ  
**Grade:** AH725  

**Cutting conditions:**  
- \( V_c = 394 \text{ sfm} \)  
- \( f_z = 0.031 \text{ ipt} \)  
- \( V_f = 201 \text{ ipm} \)  
- \( a_p = 0.024" \)  
- \( a_e = 0.500" \)  

**Process:** Slot milling, 1000 PSI  
**Machine:** Horizontal M/C  

**Result:**  
TungMeister’s VFX geometry improved workflow and ease of use due to its simple head changeability while still seated in the machine spindle.

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**Result:**  
DoFeedQuad was able to machine at double the feed rate of its competition due to its tough cutting edge. The AH130 grade also provided double the tool life due to its high thermal crack resistance.

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**Result:**  
Due to its 8 cornered insert, DoFeedQuad provided a 250% boost in productivity.

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**TUNGMEISTER**

**Industry:** General Engineering / Herringbone gear  
**Material:** SCM440 / 42CrMo4 (34HRC)  
**Shank:** VTSD12L110S06-W-A  
**Head:** VFX120L01.0R25-02S08 (ø0.47", z=2)  
**Grade:** AH725  

**Cutting conditions:**  
- \( V_c = 394 \text{ sfm} \)  
- \( f_z = 0.031 \text{ ipt} \)  
- \( V_f = 201 \text{ ipm} \)  
- \( a_p = 0.024" \)  
- \( a_e = 0.500" \)  

**Process:** Slot milling, 1000 PSI  
**Machine:** Horizontal M/C  

**Result:**  
TungMeister’s VFX geometry improved workflow and ease of use due to its simple head changeability while still seated in the machine spindle.

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**Industry:** Heavy Industry / Body and frame  
**Material:** Super-duplex stainless steel  
**Cutter:** TXQ12R080M27.0E05 (ø3.15", z=5)  
**Insert:** SQMU1206ZSR-MJ  
**Grade:** AH130  

**Cutting conditions:**  
- \( V_c = 262 \text{ sfm} \)  
- \( f_z = 0.024 \text{ ipt} \)  
- \( V_f = 38 \text{ ipm} \)  
- \( a_p = 0.031" \)  
- \( a_e = 2.756" \)  

**Process:** Face milling, Dry  
**Machine:** Multi-axis M/C  

**Result:**  
Due to its 8 cornered insert, DoFeedQuad provided a 250% boost in productivity.

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**Industry:** General Engineering / Herringbone gear  
**Material:** SCM440 / 42CrMo4 (34HRC)  
**Shank:** VTSD12L110S06-W-A  
**Head:** VFX120L01.0R25-02S08 (ø0.47", z=2)  
**Grade:** AH725  

**Cutting conditions:**  
- \( V_c = 394 \text{ sfm} \)  
- \( f_z = 0.031 \text{ ipt} \)  
- \( V_f = 201 \text{ ipm} \)  
- \( a_p = 0.024" \)  
- \( a_e = 0.500" \)  

**Process:** Slot milling, 1000 PSI  
**Machine:** Horizontal M/C  

**Result:**  
TungMeister’s VFX geometry improved workflow and ease of use due to its simple head changeability while still seated in the machine spindle.
OTHER PRODUCTS

Complementary Lines

**RNGU...MJ**

*Round insert* applicable for both high-feed and high depth of cut machining

- Double-sided round insert with **dovetail clamping system** enables productive and safe high-feed machining
- Maximum feed rate: 0.059 ipt (ap ≤ 0.039")
  - 0.031 ipt (ap ≤ 0.079")
- Tool diameters ø2.40" - ø6.73" mm

**HJ Chipbreaker**

*Low cutting* force with positive insert

- Large diameter cutters are suitable for high-feed face milling with large width of cut
- Maximum feed rate: 0.079 ipt
- Tool diameters ø2.65" - ø12.57"
FEED the SPEED - TUNGALOY ACCELERATED MACHINING

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